



University of Novi Sad

**INSTITUTE
OF FOOD
TECHNOLOGY
IN NOVI SAD**

fech
congress
28-30. 10. 2014.

Novi Sad, Serbia

II International
Congress
Food Technology,
Quality and Safety



ABSTRACT BOOK

ISBN 978-86-7994-041-4

II INTERNATIONAL CONGRESS “FOOD TECHNOLOGY, QUALITY AND SAFETY”, NOVI SAD 2014, SERBIA

Publisher

University of Novi Sad
Institute of Food Technology
Bulevar cara Lazara 1.
21000 Novi Sad

Main editor

Dr Jovanka Lević

Editors

Dr Tea Brlek
Dr Milica Pojić

Abstract/Paper Review

All abstracts and papers are reviewed by International Scientific Committee and competent researchers

Technical editor

Bojana Kokić

Cover

Boris Bartula, BIS, Novi Sad, Serbia

Printed by

“Futura” – Novi Sad, Serbia

Number of copies

350 copies

Organization of Symposium:

- INSTITUTE OF FOOD TECHNOLOGY, University of Novi Sad, Serbia

Symposium is supported by:

- Ministry of Education, Science and Technological Development of the Republic of Serbia - Belgrade
- Provincial Secretariat for Science and Technological Development - Novi Sad
- Ministry of Agriculture and Environmental Protection of the Republic of Serbia - Belgrade
- Provincial Secretariat of Agriculture, Water Economy and Forestry - Novi Sad
- ISEKI Food association
- EFFoST – The European Federation of Food Science & Technology

INTERNATIONAL SCIENTIFIC COMMITTEE

Jovanka Lević, Institute of Food Technology, Chairman, University of Novi Sad

Viktor Nedović, Faculty of Agriculture, University of Belgrade, Serbia

Dietrich Knorr, Berlin University of Technology, Germany

Nastasia Belc, The National R&D Institute for Food Bioresources Bucharest, Romania

Paola Pittia, Dipartimento di Scienze degli Alimenti University of Teramo, Italy

Brian Mckenna, University College Dublin, Ireland

Marco dalla Rosa, Alma Mater Studiorum University of Bologna, Italy

Yrjö Roos, University College Cork, Ireland

Gerhard Schleining, Boku – University of Natural Resources and Life Sciences, Austria

Živko Nikolov, Department of Biological & Agricultural Engineering, Texas A&M University, USA

Jana Hajslova, Institute of Chemical Technology, Czech Republic

Francesco Capozzi, Faculty of Agriculture, University of Bologna, Italy

Bogdan Yegorov, Odessa National Academy of Food Technologies, Ukraine

Gustavo V. Barbosa- Cánovas, Washington State University, USA

Cristina Silva, Catholic University of Portugal, Portugal

Eleonore Winkelhausen, Faculty of Technology and Metallurgy, University of Skopje, Macedonia

Ewa Rambialkowska, Faculty of Human Nutrition and Consumer Science, Poland

Alan Kondjoyan, QuaPA, INRA, France
Huub Lelieveld, EFFoST, The Netherlands
Zala Jenko Pražnikar, Faculty of Health Sciences, University of Primorska, Slovenia
Peter Raspor, Faculty of Health Sciences, University of Primorska, Slovenia
Dolores O’Riordan, University College Dublin, Ireland
Radoslav Grujić, Faculty of Technology, University of East Sarajevo, BIH Republic of Srpska
Draženka Komes, Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Miomir Jovanović, Biotechnical Faculty, University of Montenegro, Montenegro
Željko Knez, Faculty of Chemistry and Chemical Engineering, University of Maribor, Slovenia
Mladen Brnčić, Department of Process Engineering, Faculty of Food Technology and Biotechnology, Croatia
Costas Biliaderis, Food Science and Technology, Aristotle University of Thessaloniki, Greece
Sonja Smole Možina, Biotechnical Faculty, University of Ljubljana, Slovenia
Božidar Žlender, University of Ljubljana, Department of Food Science and Technology, Slovenia
Klaus Hadwiger, Universitz of Hohenheim, Germany
Ana Belščak-Cvitanović, Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia
Tanja Petrović, Faculty of Agriculture, University of Belgrade, Serbia
Dragan Kovačević, University of Osijek, Faculty of Food Technology, Croatia
Andras Sebok, Campden BRI, Hungary
Harris Lazarides, Food Science and Technology, Aristotle University of Thessaloniki, Greece
Aleksandra Martinović, Food Safety at Biotechnical Faculty, University of Montenegro, Montenegro
Angel Angelov, Head of Center of Food Quality and Safety, University of Food Technologies, Bulgaria
Brian Gibson, Technical Research Centre of Finland VTT, Finland
Mirjana Pešić, Faculty of Agriculture, University of Belgrade, Serbia
Fani Mantzouridou, Aristotle University of Thessaloniki, Greece
Diego Moreno-Fernández, Food Science & Technology Department, University of Murcia, Spain
Mia Eeckhout, Department of Applied biosciences, Ghent University, Holland
Susanne Braun, Life Science Center, University Hohenheim, Germany
Vesna Tumbas, Faculty of Technology, University of Novi Sad, Serbia
Dragana Miladinović, Institut of Field and Vegetable Crops, Serbia
Vesna Matekalo-Sverak, Institute of Meat Hygiene and Technology, Serbia
Spasenija Milanović, Faculty of Technology, University of Novi Sad, Serbia
Branko Bugarski, Faculty of Technology and Metallurgy, University of Belgrade, Serbia
Milica Radosavljević, Maize Research Institute Zemun Polje, Serbia

Branka Pilić, Faculty of Technology, University of Novi Sad, Serbia

Marija Bodroža-Solarov, Institute of Food Technology, University of Novi Sad, Serbia

Đorđe Psodorov, Institute of Food Technology, University of Novi Sad, Serbia

Mladenka Pestorić, Institute of Food Technology, University of Novi Sad, Serbia

Milica Pojić, Institute of Food Technology, University of Novi Sad, Serbia

Olivera Šimurina, Institute of Food Technology, University of Novi Sad, Serbia

Pavle Jovanov, Institute of Food Technology, University of Novi Sad, Serbia

Marijana Sakač, Institute of Food Technology, University of Novi Sad, Serbia

Đorđe Okanović, Institute of Food Technology, University of Novi Sad, Serbia

Rada Jevtić-Mučibabić, Institute of Food Technology, University of Novi Sad, Serbia

Predrag Ikonić, Institute of Food Technology, University of Novi Sad, Serbia

Zvonko Nježić, Institute of Food Technology, University of Novi Sad, Serbia

Žarko Kevrešan, Institute of Food Technology, University of Novi Sad, Serbia

Aleksandra Mišan, Institute of Food Technology, University of Novi Sad, Serbia

Tanja Tasić, Institute of Food Technology, University of Novi Sad, Serbia

Tea Brlek, Institute of Food Technology, University of Novi Sad, Serbia

Anamarija Mandić, Institute of Food Technology, University of Novi Sad, Serbia

Miroslav Hadnađev, Institute of Food Technology, University of Novi Sad, Serbia

Tamara Dapčević Hadnađev, Institute of Food Technology, University of Novi Sad, Serbia

Bojana Filipčev, Institute of Food Technology, University of Novi Sad, Serbia

Dragan Živančev, Institute of Food Technology, University of Novi Sad, Serbia

Nebojša Ilić, Institute of Food Technology, University of Novi Sad, Serbia

Jelena Filipović, Institute of Food Technology, University of Novi Sad, Serbia

Aleksandra Torbica, Institute of Food Technology, University of Novi Sad, Serbia

HONORARY BOARD

Prof. dr Milica Petrović, dean, Faculty of Agriculture Zemun, University of Belgrade, Serbia

Prof. dr Milan Popović, dean, Faculty of Agriculture, University of Novi Sad, Serbia

Prof. dr Zoltan Zavargo, dean, Faculty of Technology, University of Novi Sad, Serbia

Prof. dr Bojana Obradović, dean, Technology and Metallurgy Faculty, University of Novi Sad, Serbia

Prof. dr Miroslav Ćirković, director, Scientific Veterinary Institute Novi Sad, Serbia

Prof. dr. Ćemal Dolićanin, rector, State University of Novi Pazar, Serbia

Dr Petar Kljaić, director, Institute of Pesticides and Environmental Protection, Belgrade, Serbia

Dr Vesna Matekalo-Sverak, Institute of Meat Hygiene and Technology, Novi Sad, Serbia

Dr Jegor Miladinović, Institute of Field and Vegetable Crops, Novi Sad, Serbia

Dr Jelena Begović, director, Institute of Molecular Genetics and Genetic Engineering, Belgrade, Serbia

Prof. dr Vladeta Stevović, dean, Faculty of Agronomy Čačak, University of Kragujevac, Serbia

Prof.dr Neda Mimica Dukić, dean, Faculty of Sciences, University of Novi Sad, Serbia

ORGANIZING BOARD OF SYMPOSIUM

President:

Dr Milica Pojić, University of Novi Sad, Institute of Food Technology, Serbia

Members:

Tea Brlek, Institute of Food Technology, University of Novi Sad, Serbia

Đorđe Okanović, Institute of Food Technology, University of Novi Sad, Serbia

Olivera Šimurina, Institute of Food Technology, University of Novi Sad, Serbia

Predrag Ikonić, Institute of Food Technology, University of Novi Sad, Serbia

Aleksandra Novaković, Institute of Food Technology, University of Novi Sad, Serbia

Dubravka Jambrec, Institute of Food Technology, University of Novi Sad, Serbia

Jelena Tomić, Institute of Food Technology, University of Novi Sad, Serbia

Nataša Nedeljković, Institute of Food Technology, University of Novi Sad, Serbia

Tamara Dapčević - Hadnađev, Institute of Food Technology, University of Novi Sad, Serbia

Miroslav Hadnađev, Institute of Food Technology, University of Novi Sad, Serbia

Bojana Šarić, Institute of Food Technology, University of Novi Sad, Serbia

Miona Belović, Institute of Food Technology, University of Novi Sad, Serbia

Jovana Đisalov, Institute of Food Technology, University of Novi Sad, Serbia

EXECUTIVE COMMITTEE

Dr Jovanka Lević, Institute of Food Technology, University of Novi Sad, Serbia

Prof. Dr Viktor Nedović, Faculty of Agriculture, University of Belgrade, Serbia

Dr Marija Bodroža-Solarov, Institute of Food Technology, University of Novi Sad, Serbia

Dr Milica Pojić, Institute of Food Technology, University of Novi Sad, Serbia

Dr Tea Brlek, Institute of Food Technology, University of Novi Sad, Serbia

MSc Bojana Kokić, Institute of Food Technology, University of Novi Sad, Serbia

CONTENT

FOOD SAFETY DILEMMA – WHAT IS DONE IN THE NAME OF CONSUMER? <i>Peter Raspor</i>	1
DEVELOPMENT OF THE "UNIVERSAL RECOVERY STRATEGY" FOR THE VALORIZATION OF HIGH ADDED-VALUE COMPOUNDS FROM FOOD BY-PRODUCTS AND WASTES <i>Charis Galanakis</i>	2
IMPACT OF PLANT AND ALGAL BIOTECHNOLOGY ON ENERGY, HEALTHCARE, AND FOOD SECTORS: A BIOPROCESSING PERSPECTIVE <i>Zivko Nikolov</i>	3
INTEREST OF THE MODELLING APPROACH TO PREDICT THE QUALITY OF PROCESSED FOODS - THE EXAMPLE OF SALTED MEAT PRODUCTS <i>Alain Kondjoyan, Pierre-Sylvain Mirade, Stéphane Portanguen, Jean-Dominique Daudin</i>	4
NUTRACEUTICALS: A NEW PARADIGM OF PRO ACTIVE MEDICINE <i>Antonello Santini</i>	5
COULD SUPERCRITICAL FLUIDS REPLACE CONVENTIONAL SOLVENTS IN FOOD INDUSTRY? <i>Željko Knez</i>	6
QUALITY OF MAIZE HYBRIDS AS A RAW MATERIAL IN FUNCTIONAL, ORGANIC AND TRADITIONAL FOOD PRODUCTION <i>Milica Radosavljević, Marija Milašinić-Šeremešić, Dušanka Terzić, Zorica Pajić, Goran Todorović, Valentina Semenčenko</i>	7
OSA STARCHES AS IMPROVERS IN GLUTEN-FREE BREAD FROM HEMP SEED MEAL <i>Tamara Dapčević Hadnađev, Miroslav Hadnađev, Milica Pojić</i>	8
AGARICUS SILVATICUS - PROMISING FUNCTIONAL FOOD <i>Anita Klaus, Maja Kozarski, Jovana Vunduk, Željko Žižak, Miomir Nikšić</i>	9
PORK MEAT AS A FUNCTIONAL FOOD <i>Eleftherios Bonos, Panagiota Florou-Paneri, Efterpi Christaki, Ilias Giannenas, Ioannis Skoufos, Anastasios Tsinas, Athina Tzora, Jian Peng</i>	10
OCCURRENCE OF LIPID OXIDATION PRODUCTS AND HETEROCYCLIC AMINES IN GRILLED <i>n</i>-3-ENRICHED CHICKEN PATTIES STORED UNDER OXYGEN RICH ATMOSPHERE <i>Božidar Žlender, Ana Penko, Mateja Lušnic Polak, Lea Demšar, Tomaž Polak</i>	11

THE INFLUENCE OF STARTER CULTURE TYPE ON RHEOLOGY AND TEXTURE OF FERMENTED MILK PRODUCTS <i>Katarina Kanurić, Vladimir Vukić, Dajana Hrnjez, Spasenija Milanović, Mirela Iličić, Eva Lončar</i>	12
TRADITIONAL DAIRY PRODUCTS: RICH AND DIVERSE MICROBIOTA WITH HEALTH-PROMOTING PROPERTIES <i>Nataša Golic, Amarela Terzić-Vidojević, Katarina Veljović, Maja Tolinački, Sanja Mihajlović, Jelena Lozo, Milan Kojić</i>	13
HYGIENIC EQUIPMENT DESIGN AND MEAT PROCESSING OPERATIONS <i>Zoran Petrović, Slavica Vesković-Moračanin, Danijela Vranić, Lazar Turubatović</i>	14
EFFECT OF HOT SMOKING ON PROCESSING YIELD AND MICROBIOLOGICAL SAFETY OF COMMON CARP <i>Miroslav Čirković, Dragana Ljubojević, Đorđe Okanović, Vesna Đorđević, Nikolina Novakov</i>	15
ELECTROSTATIC EXTRUSION – ENCAPSULATION TECHNIQUE FOR FUNCTIONAL FOOD PRODUCTS <i>Ana Kalušević, Steva Lević, Bojana Isailovic, Radovan Djordjevic, Mile Veljovic, Verica Djordjevic, Viktor Nedović, Branko Bugarski</i>	16
EXTRUSION PROCESS OPTIMIZATION OF CORN GRITS ON SINGLE SCREW LABORATORY EXTRUDER <i>Jovana Brkljača, Olivera Šimurina, Tea Brlek, Jelena Krulj, Jovana Đisalov, Bojana Kokić, Marija Bodroža Solarov</i>	17
ANTIBACTERIAL EFFECT OF SELECTED ESSENTIAL OILS AS CANDIDATES FOR DISINFECTANTS IN FOOD INDUSTRY <i>Anita Vidács, Antal Véha, Csaba Vágvölgyi, Judit Krisch</i>	18
LACTIC ACID FERMENTATION OF BREWER'S SPENT GRAIN HYDROLYSATE BY <i>LACTOBACILLUS FERMENTUM</i> AND <i>LACTOBACILLUS RHAMNOSUS</i> <i>Jelena Pejin, Ljiljana Mojović, Sunčica Kocić-Tanackov, Miloš Radosavljević, Aleksandra Djukić-Vuković</i>	19
SECRETION OF <i>BACILLUS</i> HYDROLYTIC ENZYMES USING FOOD-GRADE EXPRESSION SYSTEM <i>Montarop Yamabhai, Peenida Namvijitra, Suttipong Sak-Ubol, Dietmar Haltrich</i>	20
ZEOLITE AS A CARRIER FOR LACTIC ACID BACTERIA IN BIOREFINERY PROCESSES <i>Aleksandra Djukić-Vuković, Ljiljana Mojović, Jelena Pejin, Sunčica Kocić-Tanackov</i>	21
INFLUENCE OF <i>CORDYCEPS SINESIS</i> EXTRACT ON FERMENTATION PROCESS <i>Kristina Nešić, Saša Despotović, Milena Savić, Anita Klaus, Ida Leskošek-Čukalović, Viktor Nedović, Miomir Nikšić</i>	22

POTENTIAL OF INNOVATIVE »GREEN« STRATEGIES TO CONTROL <i>Campylobacter</i> CONTAMINATION AND INFECTION VIA FOOD CHAIN	23
<i>Sonja Smole Možina, Anja Klančnik, Jasna Kovač, Maja Šikić Pogačar</i>	
AN APPLICATION OF PORTABLE NIR INSTRUMENTS IN QUALITY CONTROL OF MILK	24
<i>Begoña de la Roza-Delgado, Ana Soldado, Amelia González Arrojo, Isabel Zafra</i>	
PROFICIENCY TESTING - AN IMPORTANT TOOL IN THE LABORATORIES' PERFORMANCE WITNESSING	25
<i>Lazar Turubatović, Snježana Pupavac, Tamara Gerić, Jasna Stevanović, Radoslav Turubatović</i>	
DEVELOPMENT OF HPLC-DAD METHOD FOR DETERMINATION OF THIAMETOXAM IN HONEY FROM AUTONOMOUS PROVINCE OF VOJVODINA	26
<i>Pavle Jovanov, Valéria Guzsvány, Marijana Sakač, Anamarija Mandić, Ivan Milovanović, Ljubiša Šarić, Jovana Kos</i>	
DETECTION OF HEPATITIS A VIRUS RNA IN SLICED HAM	27
<i>Branko Velebit, Dragoslava Radin</i>	
KINETIC PARAMETERS OF MEAT PROTEIN DENATURATION	28
<i>Sanja Ostojić, Lato Pezo, Darko Mičić, Danijela Šuput, Branislav Simonović, Ljubinko Lević</i>	
ORGANIC FOOD QUALITY AND IMPACT ON HUMAN HEALTH	29
<i>Ewa Rembiałkowska</i>	
NITROGEN AND CARBON ISOTOPIC SIGNATURE OF CHICORY (<i>Cichorium intybus</i> L.) AS AN INDICATOR OF ORGANIC PRODUCTION	30
<i>Lovro Sinkovič, Janez Hribar, Rajko Vidrih, Dragan Žnidarčič, Nives Ogrinc</i>	
TECHNOLOGICAL PROPERTIES OF SPELT ACCORDING TO DIFFERENT PRODUCTION SYSTEMS	31
<i>Silva Grobelnik Mlakar, Franc Bavec, Martina Bavec, Manfred Jakop, Martina Robačar, Jovana Brkljača, Marija Bodroža-Solarov</i>	
DESCRIPTIVE SENSORY ATTRIBUTES AND CONSUMER ACCEPTANCE OF CHERRY PIE FILLING	32
<i>Nikola Tomić, Marina Lazarević, Ilija Djekić, Nada Šmigić, Sanja Ljubisavljević, Andreja Rajković</i>	
ANALYSIS OF POTENTIAL CARCINOGENIC CONTAMINANTS IN GRAIN AND VEGETABLES WITH FOCUS ON HEAVY METALS	33
<i>Gabriel Mustatea, Nastasia Belc, Valentin Ionescu, Mariana Ionescu, Enuta Iorga</i>	
SENSORY PROPERTIES OF A NEW ACTIVE FOOD PACKAGING	34
<i>Giulia Bianchi, Anna Rizzolo, Carmela Anna Migliori, Tiziana M.P. Cattaneo</i>	

MODIFIED GUAR-XANTHAN MIXTURE IMPACT ON STARCH BASED EDIBLE FILM PROPERTIES	
<i>Danijela Šuput, Vera Lazić, Senka Popović, Nevena Hromiš, Lato Pezo</i>	35
MALONDIALDEHYDE AS THE MARKER OF LIPID PEROXIDATION OF RICE-BUCKWHEAT GLUTEN-FREE COOKIES DURING STORAGE	
<i>Pavle Jovanov, Nataša Nedeljković, Marijana Sakač, Aleksandra Mišan, Ivan Milovanović, Bojana Šarić, Dubravka Jambrec</i>	36
INFLUENCE OF STORAGE CONDITIONS ON SURVIVAL OF SELECTED BACTERIA IN BOTTLED MINERAL WATER	
<i>Marina Rajič, Dragoljub Cvetković, Aleksandra Velićanski, Siniša Markov</i>	38
INVESTIGATION OF BIOPOLYMER FILMS APPLICATION FOR PACKAGING IN MODIFIED ATMOSPHERE	
<i>Senka Popović, Vera Lazić, Danijela Šuput, Nevena Hromiš, Ljiljana Popović, Žužana Vaštag, Biljana Pejić</i>	39
BROCCOLI INGREDIENTS: INNOVATION FROM THE AGRIFOOD SCIENCE TO THE SPIN-OFF EXPERIENCE	
<i>Diego Moreno, Maria Carmen Martínez-Ballesta, Micaela Carvajal, Cristina García-Viguera</i>	40
WORLD WIDE SPREAD OF SALMONELLA ENTERICA SEROTYPES, HARBORING DIFFERENT MECHANISMS OF RESISTANCE	
<i>Maja Velhner, Gordana Kozoderović, Dubravka Milanov, Dalibor Todorović, Ljiljana Suvajdžić</i>	41
SUSTAINABLE DEVELOPMENT AS AN INNOVATIVE GUIDELINE IN MODERN AGRICULTURE	
<i>Vesna Weingerl</i>	42
FUNCTIONAL FOOD PRODUCTS IN THE EUROPEAN LEGISLATIVE FRAME	
<i>Nada Knežević, Suzana Rimac Brnčić</i>	43
FATTY ACID COMPOSITION OF WHITE MUSCLE OF TWO-YEAR OLD COMMON CARP REARED IN SEMI-INTENSIVE SYSTEM – PRELIMINARY RESULTS	
<i>Zorka Dulić, Dejana Trbović, Marko Stanković, Ivana Živić, Uroš Ljubobratović, Zoran Marković</i>	44
IMPACT OF FRYING ON CHEMICAL PARAMETERS OF SILVER CARP (<i>Hypophthalmichthys molitrix</i>) MEAT QUALITY	
<i>Vesna Đorđević, Danijela Vranić, Dejana Trbović, Vladimir Korićanac, Miroslav Ćirković, Dragana Ljubojević, Milan Milijašević</i>	45
INFLUENCE OF THE TECHNOLOGICAL PROCEDURE OF (HOT) SMOKING ON SILVER CARP MEAT QUALITY PARAMETERS (<i>Hypophthalmichthys molitrix</i>)	
<i>Vesna Đorđević, Danijela Vranić, Dejana Trbović, Radivoj Petronijević, Miroslav Ćirković, Dragana Ljubojević, Milan Milijašević</i>	46

THE GROWTH RATE DISPERSION OF SUCROSE CRYSTALS <i>Jasna Grbić, Rada Jevtić-Mučibabić, Tatjana Kuljanin, Bojana Filipčev, Olivera Šimurina, Jelena Krulj</i>	47
PHOSPHORUS CONTENTS IN THE LONGISSIMUS DORSI AND SEMIMEMBRANOSUS MUSCLES FOR FIVE PUREBRED PIGS FROM VOJVODINA (NORTHERN SERBIA) <i>Vladimir Tomović, Marija Jokanović, Tatjana Tasić, Predrag Ikonić, Snežana Škaljac, Branislav Šojić, Mila Tomović, Aleksandra Martinović, Sunčica Kocić-Tanackov, Nevena Hromiš</i>	48
THE INFLUENCE OF PARTIAL REPLACEMENT OF MECHANICALLY DEBONED CHICKEN MEAT WITH CHICKEN LIVER ON PROXIMATE COMPOSITION AND COLOUR OF COOKED SAUSAGES <i>Marija Jokanović, Vladimir Tomović, Mihajlo Jović, Branislav Šojić, Snežana Škaljac, Tatjana Tasić, Predrag Ikonić</i>	49
COMPARATIVE EFFECTS OF ESSENTIAL OILS AND ANTIMICROBIAL AGENTS ON THE GROWTH OF STAPHYLOCOCCUS AUREUS <i>Vesna Kalaba, Željka Marjanović Balaban</i>	50
COMPARISON OF TWO MICROBIOLOGICAL SWABBING METHODS IN SURFACE HYGIENE CONTROL <i>Dragica Đurđević-Milošević, Vesna Kalaba, Andrijana Kostić, Aleksandra Nikolić, Milka Stijepić, Jovana Glušac</i>	51
MINERAL CONTENT AND MICROBIOLOGICAL PROFILE AFTER OSMOTIC TREATMENT OF NETTLE LEAVES <i>Violeta Knežević, Vladimir Filipović, Biljana Lončar, Milica Nićetin, Lato Pezo, Jasmina Gubić, Dragana Plavšić</i>	52
A COMBINED EFFECT OF WATER AND NITROGEN AVAILABILITY ON WHEAT GRAIN PRODUCTION <i>Ankica Kondić-Špika, Ljiljana Brbaklić, Dragana Trkulja, Nikola Hristov, Milka Brdar, Imre Vass, Janos Pauk</i>	53
SUGAR BEET JUICE CLARIFICATION USING CALCIUM SULFATE, COPPER SULFATE AND ALUMINUM SULFATE <i>Tatjana Kuljanin, Biljana Lončar, Milica Nićetin, Violeta Knežević, Vladimir Filipović</i>	54
MICROBIOLOGICAL PROFILE OF FISH (<i>Carassius gibelio</i>) DEHYDRATED IN SUGAR BEET MOLASSES <i>Biljana Lončar, Vladimir Filipović, Milica Nićetin, Violeta Knežević, Lato Pezo, Dragana Plavšić, Ljubiša Šarić</i>	55
PHYSICO-CHEMICAL CHANGES DURING THE RIPENING OF SEMI-HARD EXPERIMENTAL CHEESE <i>Aleksandra Martinović, Ivana Zuber Bogdanović, Marija Vugdelić</i>	56
CRYOPROTECTIVE EFFECT OF OAT B – GLUCANS ON CHICKEN SURIMI <i>Krešimir Mastanjević, Dragan Kovačević</i>	57

LAB-SCALE OPTIMIZATION OF BEER FERMENTATION WITH IMMOBILIZED TOP-FERMENTING YEAST	58
<i>Vessela Naydenova, Vasil Iliev, Georgi Kostov</i>	
EVALUATION OF MASS TRANSFER KINETICS DURING OSMOTIC TREATMENT OF CELERY LEAVES	59
<i>Milica Nićetin, Lato Pezo, Biljana Lončar, Vladimir Filipović, Tatjana Kuljanin, Violeta Knežević, Danijela Šuput</i>	
EFFECT OF DOUGH MIXING ON SCAVENGING CAPACITY OF FREE AND BOUND PHENOLICS FROM MIXTURE OF WHEAT AND PORCINO (<i>Boletus edulis</i>) FLOUR	60
<i>Nada Nikolić, Jelena Stojanović, Miodrag Lazić, Ivana Karabegović, Saša Stojičević, Jasna Mastilović</i>	
EFFECT OF SUCROSE IMPREGNATION ON AIR-DRYING BEHAVIOUR OF APRICOT	61
<i>Ivan Pavkov, Ljiljana Babić, Mirko Babić, Milivoj Radojčin, Zoran Stamenković</i>	
MERCURY IN FISH AND FISH PRODUCTS	62
<i>Biljana Pečanac, Drago Nedić, Slobodan Dojčinović</i>	
FOAMING PROPERTIES OF CAPRINE MILK: WHETHER ARE IMPROVED BY HEATING?	63
<i>Mirjana Pešić, Mirosljub Barać, Slađana Stanojević, Aleksandar Kostić, Miroslav Vrvic</i>	
ANALYSIS OF THE IMPACT OF THE AMOUNT OF SPONTANEOUSLY FERMENTED SPELT DOUGH, BAKER'S YEAST AND ASCORBIC ACID ON SOME SPELT BREAD CHARACTERISTICS	64
<i>Olivera Šimurina, Bojana Filipčev, Marija Bodroža-Solarov, Jelena Kruļj, Đorđe Psodorov, Dragana Plavšić, Rada Jevtić–Mučibabić, Jasna Grbić, Dragana Šoronja Simović, Mladenka Pestorić, Dubravka Jambrec, Zvonko Nježić</i>	
MEAT QUALITY AND EFFECT OF DRYING CONDITIONS ON COLOR, TEXTURAL AND SENSORY ATTRIBUTES OF PETROVSKÁ KLOBÁSA	65
<i>Snežana Škaljac, Marija Jokanović, Natalija Džinić, Ljiljana Petrović, Vladimir Tomović, Tatjana Tasić, Predrag Ikonić, Branislav Šojić</i>	
PROTEOLYSIS OF LOW FAT SEMI HARD RECOMBINED CHEESES PRODUCED WITH CARBOXYPEPTIDASE PREPARATION	66
<i>Goran Trpković, Jelena Miocinović, Aleksandar Nedeljković, Mira Radovanović, Predrag Pudja</i>	
IMPROVEMENT OF THE FREEZING PROCESS OF SPINACH BY USING CRYOPROTECTANTS	67
<i>Mishela Temkov, Elena Velickova, Eleonora Winkelhausen</i>	

CHANGES IN THE NUMBER OF MICROORGANISMS DURING THE STORAGE OF THE NATURAL SPRING WATER <i>Siniša Markov, Dragoljub Cvetković, Olivera Pavlović, Ana Vidaković, Aleksandra Velićanski</i>	68
THE BIOTECHNOLOGICAL UTILIZATION OF WHEY <i>Filiz Yangılar, Pınar Oguzhan Yıldız</i>	69
TRENDS IN MASS TRANSFER OF MINERALS DURING OSMOTIC DEHYDRATATION OF PORK MEAT IN SUGAR BEET MOLASSES <i>Snežana Zlatanović, Olgica Kovačević, Sanja Ostojić, Lato Pezo, Danijela Šuput</i>	70
GC-MS ANALYSIS OF FATTY ACIDS AND NON-SAPONIFIABLE PART OF FLOUR OF DIFFERENT MAIZE HYBRIDS <i>Marijana Ačanski, Goran Bekavac, Đura Vujić, Kristian Pastor</i>	71
INFLUENCE OF <i>THYMUS VULGARIS</i> ON INITIAL CELL ATTACHMENT AND BIOFILM OF <i>Salmonella</i> Enteritidis <i>Ivana Čabarkapa, Marija Škrinjar, Jovanka Lević, Ljiljana Kostadinović, Bojana Kokić, Dragana Plavšić, Ana Varga</i>	72
DEAERATION METHOD FOR IMIDACLOPRID DETERMINATION ON GLASSY CARBON ELECTRODE <i>Ana Đurović, Zorica Stojanović, Nada Grahovac, Snežana Kravić, Zvonimir Suturović, Jaroslava Švarc-Gajić, Spasenija Milanović</i>	73
ELISA AND LC-MS/MS DETERMINATION OF AFLATOXIN M1 IN MILK SAMPLES <i>Jovana Kos, Jasna Mastilović, Elizabet Janić Hajnal, Pavle Jovanov, Bojana Šarić, Ivan Milovanović</i>	74
INACTIVATION KINETICS OF <i>E. COLI</i> IN CHICKEN SAMPLES USING SUPERCRITICAL CARBON DIOXIDE ASSISTED BY HIGH POWER ULTRASOUND <i>Rosa Castillo, Ingrid Paniagua, Carmen Ortuño, José Benedito</i>	75
INACTIVATION OF <i>E. coli</i> USING A CONTINUOUS FLOW ULTRASOUND-ASSISTED SUPERCRITICAL CO₂ SYSTEM <i>Ingrid Paniagua, Rosa Castillo, Carmen Ortuño, Miguel Ángel García, José Benedito</i>	76
ANALYTICAL AND SENSORY PROPERTIES OF SOME HEIRLOOM TOMATO CULTIVARS <i>Silva Grobelnik Mlakar, Franc Bavec, Martina Bavec, Manfred Jakop, Martina Robačar, Vesna Weingerl</i>	77
NEW SOURCES OF NATURAL ANTIFUNGAL AGENTS AND INHIBITORS OF MYCOTOXINS PRODUCTION <i>Verica Aleksić, Petar Knežević, Ljilja Torović, Ivana Beara, Dejan Orčić, Neda Mimica-Dukić</i>	78
ANTIOXIDANT AND ANTIFUNGAL PROPERTIES OF FRESH JUICES OF <i>BRASSICA</i> VEGETABLES <i>Svetlana Bošković, Marina Vujanić, Nataša Simin, Milana Rakić, Maja Karaman, Verica Aleksić, Neda Mimica-Dukić</i>	79

ANTHOCYANINS PROFILING BY HPLC-DAD-ESI/MSN AFTER BIOTIC ELICITOR TREATMENTS IN <i>BRASSICACEAE</i> SPROUTS <i>Nieves Baenas, Federico Ferreres, Cristina García-Viguera, Diego A. Moreno</i>	80
ANTIPROLIFERATIVE EFFECTS AND METABOLISM OF SULFORAPHANE AND GLUCORAPHANIN FROM BROCCOLI SPROUTS IN HUMAN COLON AND LIVER CANCER CELLS <i>Nieves Baenas, Jose Manuel Silván, Cristina García-Viguera, Diego A. Moreno, Sonia de Pascual-Teresa</i>	81
MODIFYING FATTY ACIDS PROFILE OF MEAT PRODUCTS BY ADDING INGREDIENTS BY VEGETAL ORIGIN <i>Balan Daniela, Gherghina Evelina, Israel-Roming Florentina, Luta Gabriela, Mihociu Tamara Elena</i>	82
LIPOSOME-IN-HYDROGEL SISTEMS FOR DELIVERY OF ANTIOXIDANTS <i>Bojana Balanč, Verica Djordjević, Smilja Marković, Kata Trifković, Ivana Kostić, Viktor Nedović, Branko Bugarski</i>	83
FRUIT WINES AS A SOURCE OF SOME OLIGOELEMENTS <i>Zorica Basic</i>	84
ANTIPROLIFERATIVE ACTIVITY OF LIPOPHILIC AND HYDROPHILIC TOMATO JUICE EXTRACTS IN HUMAN BREAST CANCER CELL LINE MCF-7 <i>Miona Belovic, Aleksandra Novaković, Milena Rašeta, Sonja Kaišarević, Maja Karaman, Nebojša Ilić</i>	85
FERMENTATIVE ACTIVITY AND VIABILITY OF IMMOBILIZED PROBIOTIC STARTER CULTURE ABY-6 IN WHEY BASED SUBSTRATES <i>Tanja Krunić, Nataša Obradović, Maja Bulatović, Maja Vukašinić Sekulić, Ljiljana Mojović, Marica Rakin</i>	86
INFLUENCE OF FRUIT JUICE ADDITION ON QUALITY OF FERMENTED WHEY-BASED BEVERAGE <i>Maja Bulatović, Tanja Krunić, Nataša Obradović, Maja Vukašinić-Sekulić, Danica Zarić, Marica Rakin</i>	87
NUTRITIVE VALUE OF CHIA SEEDS AND THEIR INCREASING USE AS A FUNCTIONAL FOOD <i>Mirjana Demin, Biljana Rabrenović, Jovanka Laličić-Petronjević</i>	88
ZINC CONTENT IN DIFFERENT TYPES OF MEAT FROM THE SERBIAN MARKET <i>Jasna Djinovic-Stojanovic, Dragica Nikolic, Srdjan Stefanovic, Sasa Jankovic</i>	89
PROTEIN AND OIL CONTENT OF DIFFERENT AGE SEEDS OF SOME HERB SPICES <i>Vladimir Filipović, Vladan Ugrenović, Vera Popović, Dragoja Radanović, Tatjana Marković, Đorđe Glamočlija, Rade Protić</i>	90

ANTIOXIDANT POTENTIAL OF FERMENTED DAIRY PRODUCTS DURING STORAGE	
<i>Dajana Hrnjez, Žužana Vaštag, Spasenija Milanović, Vladimir Vukić, Mirela Iličić, Katarina Kanurić, Ljiljana Popović</i>	91
PREDICTION OF STRUCTURE AND CATALYTIC RESIDUES OF B-GALACTOSIDASE FROM <i>STREPTOCOCCUS THERMOPHILLUS</i>	
<i>Vladimir Vukić, Dajana Hrnjez, Spasenija Milanović, Mirela Iličić, Katarina Kanurić, Edward Petri</i>	92
HEAVY METALS IN THE FOOD FROM EASTERN ROMANIA AREA	
<i>Carmen Hura</i>	93
CHEMOMETRIC ANALYSIS OF ANTIOXIDANT ACTIVITY OF LETTUCE	
<i>Milica Karadžić, Lidija Jevrić, Sanja Podunavac Kuzmanović, Strahinja Kovačević, Aleksandra Tepić, Zdravko Šumić, Žarko Ilin</i>	94
THE PRESENCE OF MOULDS IN HONEY BEE POLLEN COLLECTED IN SERBIA	
<i>Aleksandar Kostić, Tanja Petrović, Živoslav Tešić, Dušanka Milojković - Opsenica, Mirosljub Barać, Sladjana Stanojević, Nebojša Pantelić, Mirjana Pešić</i>	95
THE EFFECT OF SODIUM REDUCTION ON THE QUALITY AND SAFETY OF HOT DOGS	
<i>Vladimir Kurćubić, Slobodan Lilić, Danijela Vranić, Branko Velebit, Branka Borović, Đorđe Okanović</i>	96
POSSIBILITY OF USE OF POTASSIUM CHLORIDE IN THE FRESH SAUSAGES PRODUCTION	
<i>Slobodan Lilić, Vesna Matekalo-Sverak, Danijela Vranić, Dragica Karan, Mladen Rašeta, Jelena Jovanović, Mirjana Lukić</i>	97
SENSORY PROPERTIES AND SHELF LIFE OF SPREAD CREAM WITH SOYBEAN OIL	
<i>Ivana Lončarević, Biljana Pajin, Marijana Sakač, Jovana Petrović, Vladimir Tomović</i>	98
THE INFLUENCE OF SEX ON SLAUGHTER CHARACTERISTICS AND MEASURES OF CARCASS IN GOAT KIDS OF DOMESTIC BALKAN BREED	
<i>Nurgin Memiši, Vladan Bogdanović</i>	99
POSSIBILITIES OF RESISTANT STARCH APPLICATION IN SHORT DOUGH FORMULATION	
<i>Marija Milašinović-Šeremešić, Ljubica Dokić, Milica Radosavljević</i>	100
PROPERTIES OF BLENDS OF FLOUR AND RESISTANT STARCH ENRICHED INGREDIENTS FOR COOKIES PRODUCTION	
<i>Marija Milašinović-Šeremešić, Ljubica Dokić, Milica Radosavljević</i>	101
DEVELOPMENT OF A SPECIALIZED FOOD COMPOSITION DATASET FOR TOTAL VITAMIN D, 25(OH)D₃ AND D₃	
<i>Jelena Milešević, Lourdes Samaniego, Paul Finglas, Mairead Kiely</i>	102

THE ASSESSMENT OF THE SANITARY INDICATORS OF THE SPICY-AROMATIC RAW MATERIALS AND THEIR OIL MIXTURES <i>Bogdan Yegorov, Nadiia Mohylianska</i>	103
EFFECT OF KCl-PRIMING AND METHYL JASMONATE ON SECONDARY METABOLITES PRODUCTION IN TWO VARIETIES (WHITE AND RED) OF <i>BRASSICA OLERACEA</i> L. UNDER NaCl STRESS <i>Diego A. Moreno, Ismehen Hassini, Nieves Baenas, Micaela Carvajal, Maria Carmen Martínez Ballesta</i>	104
ANTIOXIDANT PROPERTIES OF ROSE HIP (<i>ROSA CANINA</i> L.) PRODUCTS <i>Dragana Paunović, Mile Veljović, Dušica Mirković, Tanja Petrović, Jasmina Rajić, Nataša Stošić, Branislav Zlatković</i>	105
THE INFLUENCE OF DEFFATED WHEAT GERM ADDITION ON PHYSICAL CHARACTERISTICS OF THE COOKIES DOUGH <i>Jovana Petrović, Aleksandar Fišteš, Biljana Pajin, Ljubica Dokić, Zita Šereš, Dragana Šoronja Simović, Dušan Rakić</i>	106
FORMULATION AND ANTIOXIDANT CAPACITY OF PLUM AND APPLE JUICES <i>Jasmina Rajić, Tanja Petrović, Predrag Vukosavljević, Dragana Paunović, Kristina Nešić, Viktor Nedović</i>	107
CUTANEOUS MAST CELL DEGRANULATION CAUSED BY PERORAL APPLICATION OF ACRYLAMIDE TO JUVENILE MALE RATS <i>Vesna Rajkovic, Milena Stosic, Renata Kovac, Ivana Koledin, Milica Matavulj</i>	108
MICRO AND NANOSTRUCTURE OF BUTTER WITH BLACKCURRANT CRYOPOWDER <i>Tamara Rashevskaya</i>	109
GLUCOSE AND INSULIN BLOOD SERUM ANALYSIS IN ADULT RATS AFTER SUBCHRONIC ACRYLAMIDE TREATMENT <i>Milena Stošić, Vesna Rajković, Renata Kovač, Ivana Koledin, Milica Matavulj</i>	110
PREPARATION, CHARACTERIZATION AND <i>IN VITRO</i> DRUG RELEASE STUDIES OF DIFFERENT CURCUMIN FORMULATIONS <i>Mojca Škerget, Tina Perko, Željko Knez</i>	111
SYNTHESIS OF γ-AMINOBUTYRIC ACID BY LACTIC ACID BACTERIA ISOLATED FROM BALKAN CHEESES <i>Maja Tolinacki, Sanja Mihajlovic, Svetlana Sokovic, Katarina Veljovic, Milica Nikolic, Amarela Terzic-Vidojevic, Milan Kojic</i>	112
MECHANICAL PROPERTIES OF CALCIUM-ALGINATE BEADS WITH IMMOBILIZED PROBIOTIC CELLS - INFLUENCE OF FERMENTATION PROCESS <i>Kata Trifković, Nataša Obradović, Marica Rakin, Marko Rakin, Verica Djordjević, Viktor Nedović, Branko Bugarski</i>	113

ANTIOXIDANT CHARACTERISTICS AND SCAVENGING ACTIVITY OF ORGANIC AND CONVENTIONAL SPELT <i>Boris Popović, Dubravka Štajner, Ružica Ždero-Pavlović, Marija Bodroža-Solarov, Vladan Ugrenović</i>	114
CANDIDATE PROBIOTIC LACTOBACILLUS PLANTARUM STRAIN APPLIED TO PRODUCE FERMENTED TOMATO JUICE <i>Darko Dimitrovski, Elena Velickova, Tomaz Langerholc, Eleonora Winkelhausen</i>	115
SOCIO-DEMOGRAPHIC AND LIFESTYLE CHARACTERISTICS AND ATTITUDES OF CONSUMERS IN VOJVODINA TO FUNCTIONAL FOOD <i>Nataša Vukelić, Jasmina Živković, Nikola Puvača</i>	116
THE EFFECTS OF PHENOLIC COMPOUNDS IN OLIVE OIL ON HUMAN HEALTH <i>Filiz Yangilar, Pınar Oğuzhan Yıldız</i>	117
SALMONELLA INFANTIS MAJOR INCREASE IN FOOD SAMPLES <i>Jelena Apić, Jelena Petrović, Jelena Babić, Miloš Kapetanov, Igor Stojanov</i>	118
AROMA QUALITY OF STRAWBERRIES: OVERVIEW OF THE POTENTIALITY OF GC-OLFACTOMETRY <i>Giulia Bianchi, Anna Rizzolo</i>	119
CONTRIBUTION OF MEAT INSPECTION AND ABATTOIR PROCESS HYGIENE TO BIOLOGICAL SAFETY ASSURANCE OF POULTRY CARCASSES <i>Biljana Božić, Bojan Blagojević</i>	120
MOLECULAR DETECTION OF ALTERNARIA SPP. ON ORGANIC SPELT WHEAT <i>Jovana Đisalov, Marija Bodroža-Solarov, Ferenc Bagi, Jelena Čulafić, Aleksandra Bočarov-Stančić, Tea Brlek, Jovana Brkljača</i>	121
AFLATOXINS IN CORN, CORN PRODUCTS AND MILK IN CROATIA IN 2012 AND 2013 <i>Slaven Zjalic, Vlasta Brlek, Ladislav Čosos, Iva Sabljak, Mirela Grubelic, Jelena Gavran, Marijana Matek Saric</i>	122
ISOFLAVONE CONTENT IN DIFFERENT MATURITY GROUPS OF SOYBEANS <i>Jelena Cvejić, Bojana Gaćeša, Mira Bursać, Vuk Đorđević, Jegor Miladinović</i>	123
EFFECT OF TIME, TEMPERATURE AND INOCULUM SIZE ON THE PENETRATION OF SALMONELLA ENTERITIDIS THROUGH EGG SHELL <i>Ivana Čabarkapa, Jovanka Lević, Bojana Kokić, Dragana Plavšić, Ana Varga, Ljiljana Suvajdžić</i>	124
RHEOLOGICAL METHODS TO CHARACTERIZE SPELTA FLOUR FOR PASTA MAKING <i>Jelena Filipović, Lato Pezo, Milenko Košutić, Rada Jevtić-Mučibabić</i>	125

TRENDS IN ASH AND MINERAL CONTENT OF MILK FROM DOMESTIC BALKAN DONKEY BREED THROUGHOUT LACTATION	126
<i>Jasmina Gubić, Tatjana Tasić, Ivan Milovanović, Jasmina Živković</i>	
EFFECTS OF GENOTYPE AND ENVIRONMENT ON THE FARINOGRAPH QUALITY INDICATORS OF WINTER WHEAT	127
<i>Nikola Hristov, Novica Mladenov, Ankica Kondić-Špika, Bojan Jocković</i>	
ORGANOCHLORINE AND ORGANOPHOSPHORUS PESTICIDE RESIDUES IN VEGETABLES IN EASTERN ROMANIA AREA	128
<i>Carmen Hura, Bogdan Hura</i>	
POSSIBILITIES OF VISUAL AND INSTRUMENTAL IDENTIFICATION OF WHEAT INFESTATION WITH FIELD FUNGI	129
<i>Elizabet Janić Hajnal, Miona Belović, Dragana Plavšić, Jasna Mastilović, Ferenc Bagi, Dragana Budakov, Jovana Kos</i>	
CONTENT OF FREE AMINO GROUPS IN WHEAT FLOUR AS INDICATOR OF WHEAT ENZYMATIC STATUS	130
<i>Elizabet Janić Hajnal, Jelena Tomić, Aleksandra Torbica</i>	
MOLASSES AS A SUPPLEMENT TO FOOD PRODUCTS	131
<i>Rada Jevtić-Mučibabić, Jasna Grbić, Bojana Filipčev, Ivan Milovanović, Olivera Šimurina, Jasmina Živković, Tatjana Kuljanin</i>	
CHEMOMETRIC ANALYSIS OF THE INFLUENCE OF PHENOLS, VULGAXANTHIN AND BETANINE CONTENTS ON ANTIOXIDATIVE ACTIVITY OF BEETROOT EXTRACT	132
<i>Strahinja Kovačević, Sanja Podunavac-Kuzmanović, Aleksandra Tepić, Lidija Jevrić, Žarko Ilin, Zdravko Šumić</i>	
RAPESEED (<i>Brassica napus</i> L.) SEED USED FOR CONSUMPTION AND INDUSTRIAL PROCESSING	133
<i>Ana Marjanović Jeromela, Radovan Marinković, Petar Mitrović, Željko Milovac, Sreten Terzić, Dragana Miladinović, Aleksandar Mikić</i>	
THE INFLUENCE OF WATER HYGIENE IN DAIRY INDUSTRY ON MICROBIOLOGICAL QUALITY OF BUTTER	135
<i>Nurgin Memiši, Slavica Vesković Moračanin, Marija Škrinjar</i>	
RADIOACTIVITY OF MILK IN THE TERRITORY OF VOJVODINA	136
<i>Željko Mihaljev, Milica Živkov-Baloš, Željko Ćupić, Sandra Jakšić, Brankica Kartalović, Dragana Ljubojević</i>	
OSMOTIC DEHYDRATION OF FISH (<i>CRASSUS GIBELIO</i>) IN DIFFERENT SOLUTIONS	137
<i>Dragana Plavšić, Jasmina Gubić, Ljubiša Šarić, Ana Varga, Milica Nićetin, Vladimir Filipović, Biljana Ćurčić</i>	
PRESENCE OF POTENTIALLY TOXIGENIC MOLDS IN CEREAL FLOURS	138
<i>Dragana Plavšić, Gordana Dimić, Đorđe Psodorov, Dragan Psodorov, Ljubiša Šarić, Anamarija Mandić, Dubravka Jambrec</i>	

THE WAYS OF PERFECTING THE MANAGEMENT OF THE MEAT PRODUCTION QUALITY	
<i>Bogdan Iegorov, Natalia Povarova, Predrag Ikonić</i>	139
DETERMINATION OF VIABLE BIOFILM CELLS IN MICROTITER PLATES	
<i>Anja Klančnik, Petra Podobnik, Sonja Smole Možina, Peter Raspor, Klemen Bohinc, Barbara Jeršek</i>	141
ANTIBIOFILM AND ANTI-QUORUM SENSING PROPERTIES OF <i>Evodia rutaecarpa</i> FRUIT EXTRACT AND ITS FRACTIONS ON <i>Campylobacter jejuni</i>	
<i>Katja Bezek, Marija Kurinčič, Balazs Mraz, Tina Cvetkovič, Anja Klančnik, Peter Raspor, Franz Bucar, Sonja Smole Možina</i>	142
MACRO- AND MICROELEMENTS HEALTH RISK ASSESSMENT FOR POPULATION VIA CONSUMPTION OF MUSSELS <i>MYTILUS GALLOPROVINCIALIS</i>	
<i>Mihajlo Jović, Antonije Onjia, Bojan Tanaskovski, Slavka Stanković</i>	143
DETERMINATION OF ACETAMIPRID RESIDUES IN PAPRIKA	
<i>Sanja Lazić, Dragana Šunjka, Irena Stojanović</i>	144
RESEARCHES CONCERNING THE USE OF ESSENTIAL OILS AS ANTIFUNGAL AGENTS IN PRESERVATION OF POSTHARVEST VEGETAL PRODUCTS	
<i>Alexandru Tomescu, Renata Maria Sumalan, Georgeta Pop, Ersilia Alexa, Isidora Radulov, Cristian Rus</i>	145
A GLASS OF MILK IN APRIL 2014	
<i>Ljilja Torović</i>	146
SURVEY ON PESTICIDE RESIDUES IN POTATOES ON GREEN MARKETS OF NOVI SAD	
<i>Ljilja Torović</i>	147
HACCP - A CONDITION FOR PRODUCING OF SAFE FOOD	
<i>Ana Varga, Dragana Plavšić, Jasmina Gubić, Ivana Čabarkapa, Ljubiša Šarić</i>	148
DETECTION OF TETRACYCLINE-RESISTANT LACTIC ACID BACTERIA IN "ZLATAR" CHEESE	
<i>Branko Velebit, Branka Borović, Slavica Vesković-Moračanin</i>	149
THE PRESENCE OF INDICATOR BACTERIA IN YEAST CREAM PRODUCTION	
<i>Nora Zaboš, Siniša Markov, Ana Vidaković, Dragoljub Cvetković, Aleksandra Velićanski</i>	150
VALIDATION OF AN ANALYTICAL METHOD FOR THE SIMULTANEOUS DETERMINATION OF FIVE SWEETENERS BY LC-MS/MS	
<i>Gorica Vuković, Marija Stanković, Jelena Vlajković, Marinela Tadić, Marina Mandić, Vesna Pantić-Palibrk</i>	151

ADVANTAGES AND SHORTCOMINGS OF LAB-ON-A-CHIP METHOD FOR INVESTIGATION OF HMW-GS OF WHEAT (<i>TRITICUM AESTIVUM</i>) CULTIVARS	
<i>Dragan Živančev, Aleksandra Torbica, Jasna Mastilović, Miona Belović, Žarko Kevrešan, Nikola Hristov</i>	152
QUALITY EVALUATION OF SPELT COMPOSITE BREADS PREPARED WITH VARIOUSLY PROCESSED AMARANTH SEED	
<i>Bojana Filipčev, Marija Bodroža-Solarov, Olivera Šimurina, Mladenka Pestorić, Dubravka Jambrec</i>	153
HOUSE FLORA IN PROCESSING UNITS DURING PRODUCTION PROCESS OF <i>PETROVSKÁ KLOBÁSA</i>	
<i>Vesna Janković, Ljiljana Petrović, Natalija Džinić, Brankica Lakićević, Snežana Škaljac, Branislav Šojić, Marija Jokanović</i>	154
<i>ENTEROBACTERIACEAE</i> SURVIVAL DURING FERMENTATION OF TRADITIONAL DRY FERMENTED SAUSAGE – <i>PETROVSKÁ KLOBASA</i>	
<i>Vesna Janković, Brankica Lakićević, Predrag Ikonić, Tatjana Tasić, Ljubiša Šarić, Branka Borović, Slavica Vesković, Dragica Karan</i>	155
SURVIVAL AND GENETIC CHARACTERIZATION OF <i>LISTERIA</i> SPP. DURING THE PRODUCTION OF <i>PETROVSKÁ SAUSAGE (PETROVSKÁ KLOBÁSA)</i>	
<i>Brankica Lakićević, Branka Borović, Vesna Janković, Branko Velebit, Slobodan Lilić, Predrag Ikonić</i>	156
ORGANIC PRODUCTION AS NATIONAL BRAND	
<i>Ružica Milovanović</i>	157
PRODUCTION OF BIOGENIC AMINES BY LACTIC ACID BACTERIA ISOLATED FROM “ZLATAR” CHEESE	
<i>Slavica Vesković Moračanin, Srđan Stefanović, Tatjana Radićević, Dragutin Đukić</i>	158
FUMONISINS IN FOOD: ORGANIC VERSUS CONVENTIONAL	
<i>Gorica Vuković, Vojislava Bursić, Mira Stavrović, Snežana Pavlović, Goran Aleksić, Slobodan Kuzmanović, Jelena Vlajković</i>	159
THE INFLUENCE OF DIFFERENT POSTHARVEST TREATMENTS ON THE SENSORY QUALITY OF TWO TOMATO VARIETIES AFTER STORAGE	
<i>Miona Belović, Žarko Kevrešan, Mladenka Pestorić, Jasna Mastilović, Milica Pojić, Aleksandra Novaković, Tanja Radusin, Elizabet Janić Hajnal, Biljana Cvetković, Nebojša Ilić</i>	160
REDUCTION OF SELECTED SPOILAGE BACTERIA BY <i>TRANS-2-HEXENAL</i>, LACTIC ACID AND HYDROGEN PEROXIDE ON MINIMALLY PROCESSED CABBAGE AND CARROTS	
<i>Vedran Gradvol, Nela Nedić Tiban, Hrvoje Pavlović</i>	161

CHARACTERIZATION AND POSSIBILITY OF APPLICATION OF SOME POLYMER PACKAGING MATERIALS FOR PACKAGING FERMENTED DAIRY PRODUCTS <i>Biljana Pejić, Spasenija Milanović, Vera Lazić, Senka Popović, Mirela Iličić</i>	162
CONVERSION OF HAZARDOUS PESTICIDE PACKAGING WASTE TO NON-HAZARDOUS BY TRIPLE RINSING TECHNIQUES <i>Milan Radusin, Tanja Radusin, Milan Martinov, Mirjana Vojinović-Miloradov, Miroslav Višković, Aleksandra Novaković</i>	163
INFLUENCE OF DIFFERENT PACKAGING SOLUTIONS ON TEXTURAL PROPERTIES OF TOMATO DURING CONTROLLED STORAGE CONDITIONS <i>Tanja Radusin, Marija Škrinjar, Ivana Čabarkapa, Žarko Kevrešan, Jasna Mastilović, Aleksandra Novaković, Elizabet Janić Hajnal</i>	164
THE INFLUENCE OF VACUUM PACKAGING AND STORAGE TIME ON LIPID OXIDATION IN TRADITIONAL SAUSAGE <i>Branislav Šojić, Ljiljana Petrović, Vladimir Tomović, Natalija Džinić, Snežana Kravić, Marija Jokanović, Predrag Ikonić, Tatjana Tasić, Snežana Škaljac</i>	165
INVESTIGATION OF THE EFFECT OF DIFFERENT ADDITIVES ON THE LEVEL AND DYNAMICS OF POLYETHYLENE FILM DEGRADATION <i>Vera Lazić, Danijela Šuput, Senka Popović, Nevena Hromiš</i>	166
FATTY ACID PROFILE AND SENSORY EVALUATION OF BACON <i>Jasna Djinović-Stojanović, Aleksandar Popović, Milan Ristic, Klaus Troeger, Danijela Vranic, Vesna Matekalo-Sverak, Aurelija Spiric</i>	167
GAS CHROMATOGRAPHIC CHARACTERIZATION OF KEY VOLATILE COMPONENTS IN SHEEP ADIPOSE TISSUE <i>Vladana Grabež, Milena Bjelanović, Vladimir Tomović, Aleksandra Martinović, Goran Vučić, Bjørg Egelanddal</i>	168
METHODOLOGY FOR NEW PRODUCT DEVELOPMENT ON THE EXAMPLE OF GEL WITH SPECIFIC PURPOSE <i>Slavica Grujić, Božana Odžaković, Božana Stanković</i>	169
SENSORY ANALYSIS AS A TOOL IN THE NEW FOOD PRODUCT DEVELOPMENT <i>Slavica Grujić, Božana Odžaković, Milana Ciganović</i>	170
COMPARISON OF TEXTURAL PROPERTIES OF DIFFERENT PASTA TYPES <i>Dubravka Jambrec, Mladenka Pestorić, Đorđe Psodorov, Marijana Sakač, Nataša Nedeljković, Bojana Šarić</i>	171
SENSORY PROPERTIES OF CEVAPCICI PRODUCED WITH VARIOUS CHLORIDE SALTS <i>Slobodan Lilić, Miloš Pavlović, Branka Borović, Mladen Rašeta, Ljiljana Spalević, Danka Maslić-Strižak, Ivana Branković</i>	172

SIGNIFICANCE OF SENSORY QUALITY OF MEAT PRODUCTS FOR CONSUMERS	
<i>Milan Ristić, Jasna Đinović-Stojanović, Nemanja Knezević, Marija Babić</i>	173
CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF BEVERAGES MADE FROM CAMEL, GOAT AND BOVINE WHEY USING KEFIR STARTER CULTURE	
<i>Farzaneh Abdolmaleki, Ali Hajibabaei</i>	174
INTERACTIONS OF INDIGENOUSLY LACTIC ACID BACTERIA ISOLATED FROM VEGETAL SOURCES WITH SPOILAGE FUNGI	
<i>Čalina Petruța Cornea, Oana-Alina Siciua, Florentina Israel-Roming, Radu Toma, Medana Zamfir</i>	175
FROM MEAT INDUSTRY WASTE TO POTENTIAL ACTIVE SUBSTANCES CARRIERS: ERYTHROCYTE GHOSTS FROM SLAUGHTERHOUSE BLOOD AS DEXAMETHASONE SODIUM PHOSPHATE CARRIERS	
<i>Ivana Kostić, Katarina Bukara, Vesna Ilić, Gavriilo Šekularac, Danijela Mišić, Viktor Nedović, Branko Bugarski</i>	176
STUDY ON THE APPLICATION OF THE CHITOSAN-ALGINATE CAPSULES AND ALGINATE-CHITOSAN-ALGINATE CAPSULES IN ETHANOL FERMENTATION	
<i>Vasil Iliev, Vessela Naydenova, Georgi Kostov</i>	178
THE INFLUENCE OF REDUCING SUGARS CONTENT ON LACTIC ACID FERMENTATION OF BREWER'S SPENT GRAIN HYDROLYSATE BY LACTOBACILLUS FERMENTUM AND LACTOBACILLUS RHAMNOSUS	
<i>Jelena Pejin, Ljiljana Mojović, Sunčica Kocić-Tanackov, Miloš Radosavljević, Aleksandra Djukić-Vuković</i>	179
ANTIBIOTIC RESISTANCE OF AUTOCHTHONOUS POTENTIAL PROBIOTIC BACTERIA	
<i>Milica Petrušić, Zorica Radulović, Ivana Zuber Bogdanović, Nemanja Mirković, Dušanka Paunović, Snežana Bulajić</i>	180
INFLUENCE OF FREEZE-DRYING ON VIABILITY AND BIOCHEMICAL PROPERTIES OF AUTOCHTHONOUS LACTIC ACID BACTERIA	
<i>Milica Petrušić, Zorica Radulović, Nemanja Mirković, Ivana Lazarević, Dušanka Paunović</i>	181
SELENIZED YEAST IN PRODUCTION OF SELENIUM ENRICHED PLEUROTUS OSTREATUS MUSHROOM WITH GOOD FLAVOUR	
<i>Milena Savić, Piotr Podsadni, Magdalena Bamburowicz-Klimkowska, Jadwiga Turlo, Viktor Nedović, Miomir Nikšić, Marzenna Klimaszewska, Mirosław Szutowski</i>	182

ANTIFUNGAL POTENTIAL OF EXTRACELLULAR METABOLITES PRODUCED BY <i>Streptomyces hygroscopicus</i> AGAINST <i>Colletotrichum gloeosporioides</i> <i>Ivana Tadijan, Jovana Grahovac, Jelena Dodić, Mila Grahovac, Stevan Maširević, Damjan Vučurović, Siniša Dodić</i>	183
CERAMIC MEMBRANE FILTRATION OF <i>Streptomyces</i> sp. FERMENTATION BROTH <i>Aleksandar Jokić, Jovana Grahovac, Ivana Tadijan, Jelena Dodić, Mila Grahovac</i>	185
TUMOR CELL GROWTH ACTIVITY OF BLACKBERRY (<i>RUBUS FRUTICOSUS</i> L.) POMACE EXTRACTS <i>Dragana Četojević-Simin, Gordana Četković, Vesna Tumbas Šaponjac, Jelena Vulić, Jasna Čanadanović-Brunet, Sonja Djilas</i>	186
RAPID DETERMINATION OF TOTAL POLAR MATERIALS IN USED DEEP-FRYING SUNFLOWER OILS FROM RESTAURANTS <i>Vladimir Koricanac, Danijela Vranic, Vesna Matekalo-Sverak, Vesna Djordjevic, Jasna Djinovic-Stojanovic, Slobodan Lilic, Zoran Petrovic</i>	187
INNOVATIVE PRACTICES IN THE TEACHING OF SUSTAINABLE DEVELOPMENT <i>Vesna Weingerl</i>	188
PASTING PROPERTIES AND FERMENTATION CAPACITY OF PURE OAT FLOUR AND WHEAT-OAT FLOUR MIXTURE <i>Slađana Rakita, Miroslav Hadnađev, Tamara Dapčević Hadnađev, Milica Pojić, Aleksandra Torbica</i>	189
ANN MODELLING OF SUSPENSIONS MICROFILTRATION OF BAKER'S YEAST USING MULTICHANNEL MEMBRANE <i>Aleksandar Jokić, Bojana Ikonić, Zoltan Zavargo</i>	190
ANTIFUNGAL ACTIVITIES OF SELECTED ESSENCIAL OILS <i>Julianna Török Jenei, Györgyi Horváth, Anita Vidács, Antal Véha, Judit Krisch</i>	191
THE EFFECTS OF ALUMINUM ON CALCIUM AND PHOSPHORUS CONTENT IN WHEAT <i>Andrea Szabó-Nagy, Antal Véha, Ernő Gyimes</i>	192
THE INFLUENCE OF FAT REPLACER ON INSTRUMENTAL PROPERTIES OF GLUTEN-FREE COOKIES <i>Marijana Sakač, Nataša Nedeljković, Dubravka Jambrec, Bojana Šarić, Mladenka Pestorić, Pavle Jovanov, Bojana Filipčev, Anamarija Mandić</i>	193
OSMOTIC DEHYDRATION OF CHICKEN MEAT IN SUGAR BEET MOLASSES <i>Vladimir Filipović, Biljana Lončar, Milica Nićetin, Violeta Knežević, Danijela Šuput, Tatjana Kuljanin</i>	194
VALUE CHAIN OF IMPORTANT COMMERCIAL SPICES OF NON-WOOD FOREST PRODUCTS WITHIN THE STATISTICAL REGION OF VOJVODINA <i>Milica Marčeta, Ljiljana Keča</i>	195

VALUE CHAIN ANALYSIS OF FOREST MUSHROOMS IN SERBIA <i>Ljiljana Keča, Milica Marčeta, Nenad Keča</i>	196
HYDROLYSIS OF LACTOSE IN THE PERMEATE OF MILK UNDER THE ACTION OF THE ENZYME GALACTOSIDASE <i>Dragana Ilić Udovičić, Spasenija Milanović, Mirela Iličić, Anamarija Mandić</i>	197
INFLUENCE OF GOJI BERRY, PUMPKIN POWDER AND ROSE PETAL EXTRACT ON THE QUALITY OF COOKED SAUSAGES WITH REDUCED NITRITE CONTENT <i>Dessislava Vlahova-Vangelova, Dessislav Balev, Stefan Dragoev, Boris Kapitanski, Kiril Mihalev, Toni Doncheva</i>	198
DEVELOPMENT OF NEW FUNCTIONAL COOKED SAUSAGES BY ADDITION OF ROSE PETAL EXTRACT <i>Dessislav Balev, Dessislava Vlahova-Vangelova, Stefan Dragoev, Kiril Mihalev, Toni Doncheva</i>	199
A PARTICULAR QUALITY ASPECT OF MILK FROM SMALL RUMINANTS <i>József Csanádi, Sára Bohata, Antal Véha, Ernő Gyimes</i>	200
LIPIDOMICS IN FOOD AND NUTRITION RESEARCH <i>Jana Hajslova, Milena Zachariasova, Vojtech Hrbek, Josep Rubert</i>	201
TRACEABILITY ACROSS FOOD CHAIN: LESSONS WE HAVE LEARNT <i>Jana Hajslova, Milena Zachariasova, Monika Tomaniova</i>	203
POTENTIAL USE OF NON-EQUILIBRIUM PLASMAS IN FOOD INDUSTRY <i>Zoran Petrović, Nevena Puač, Suzana Živković, Kosta Spasić, Gordana Malović</i>	204
GREEN TECHNOLOGIES IN THE VALORIZATION OF AGROFOOD WASTES IN THE FRAME OF THE BIOREFINERY CONCEPT <i>Ana Rita C. Morais, André M. da Costa Lopes, Rafał Bogel-Lukasik</i>	205
OPTIMIZATION OF WHEAT STARCH SUSPENSIONS MICROFILTRATION PROCESS <i>Bojana Ikonić, Aleksandar Jokić, Zoltan Zavargo, Zita Šereš</i>	206
FOOD SAFETY EVALUATION OF THE PASTEURISING-COOKING THERMAL PROCESSES <i>Ferenc Eszes, Gabriella Zsarnóczay, Ernő Gyimes, Antal Véha</i>	207

FOOD SAFETY DILEMMA – WHAT IS DONE IN THE NAME OF CONSUMER?

Peter Raspor*

University of Primorska, Faculty of Health Sciences,
Institute for Food, Nutrition and Health. Izola, Slovenia

*Corresponding author:

E-mail address: peter.raspor@fvz.upr.si

Safe Food and consumers protection is dominant concern of public domain, governmental and nongovernmental organizations, professional societies and trade organizations. EU food legislation is characterized by integral approach in food safety domain. EFSA was established as part of comprehensive policy for food safety improvement in EU. We try to assure high level of consumer's protection and revive consumers trust in European food supply systems. The main actor in this area among various European institutions is European Food Safety Authority. All activities of EFSA are based on excellence in science, independence, openness and transparency, and responsiveness and cooperation with all stakeholders in European Union. With competent professionals agency assures scientific advices, opinions of the highest scientific standards. They support or initiate its own activity, but it is still some room for improvements and strengthening the quality of its scientific work. Food safety standards are among the highest on the globe and consumer's oriented care is part of actual practice within food supply chain. Unfortunately a consumer consciousness is still undeveloped in their practical interest for safe food handling in the last part of food supply chain is missing in theory and in practice. We face evolution of terms like abundance, acceptability, accessibility, adoptability, affordability, allowability, availability, attractability to describe the quantity of food which is on disposal for humans, what brought some confusion to communication within food supply chain. Regarding food quality we started to move from food composition and safety to evidence based nutrition. This is an open challenge for governmental activities and education practices in current education system. They are many challenges for good practices to improve in daily practice.

Keywords: *food safety, food quality, regulation, EFSA, good practices, education, consumer*

DEVELOPMENT OF THE "UNIVERSAL RECOVERY STRATEGY" FOR THE VALORIZATION OF HIGH ADDED-VALUE COMPOUNDS FROM FOOD BY-PRODUCTS AND WASTES

Charis Galanakis*

R&I Department, Galanakis Laboratories, Skalidi 34, GR-73131 Chania, Greece

*Corresponding author:

E-mail address: cgalanakis@chemlab.gr

Food wastes are mixtures constituted of different phases, whereas their components can be divided in macro- and micro-molecular groups. In a third level of division, components can be further classified according to their structural characteristics and physicochemical properties. This simple consideration, moving from macroscopic to micromolecular level, allows the separation of target and non-target compounds gradually in different streams. Based on these principles, a holistic methodology (the so-called "5-Stages Universal Recovery Process") has been designed to ensure an optimized management of the available technologies and recapture several kinds of valuable compounds from any waste source. This methodology was further developed to a more general approach (the so-called "Universal Recovery Strategy") that includes all the relevant information in each case (i.e. wastes distribution, availability and production data, microstructure, etc) for the development of a particular application. Full details of the strategy will be launched in the forthcoming book entitled as "Food Waste Recovery: Processing Technologies and Techniques" (Elsevier, publication in 2015).

IMPACT OF PLANT AND ALGAL BIOTECHNOLOGY ON ENERGY, HEALTHCARE, AND FOOD SECTORS: A BIOPROCESSING PERSPECTIVE

Zivko Nikolov*

Biological and Agricultural Engineering, Texas A&M University, USA

*Corresponding author:

E-mail address: znikolov@tamu.edu

Biotechnology offers a toolbox for responding to society's challenges such as an ageing population, healthcare cost, resource efficiency, food security, climate change, energy shortages, and economic growth. The recent advances in synthetic biology and metabolic engineering have the potential to significantly change the landscape of biofuels and biotechnology-derived products. Examples include genetically engineered cells for production of less expensive therapeutic products, herbicide and drought resistant crops, transfer of whole metabolic pathways into safer and more economical systems for biofuel production. Development of advanced biological engineering tools is one aspect of biotechnology revolution; the other one is their judicious implementation. For example, processes with selected plants and microalgae are being developed to address anticipated shortage of transportation fuel, but their implementation has to follow an integrated assessment of key challenges, risk, and tradeoffs in relation to food security and water security and sustainable land-use. A good understanding of biotechnology advances, the science behind, and energy, water and food tradeoffs, is required to guide the choice of algal and/or plant systems for producing novel or less expensive bioproducts. This presentation will discuss drivers (government policies, markets, economy) and technology challenges facing the implementation of microalgae and plant-based technologies to address bioeconomy objectives: reducing greenhouse emissions, increasing food and energy security, and reducing healthcare cost.

Keywords: *genetic engineering, microalgae, transgenic plants, biofuels, bioproducts*

INTEREST OF THE MODELLING APPROACH TO PREDICT THE QUALITY OF PROCESSED FOODS - THE EXAMPLE OF SALTED MEAT PRODUCTS

Alain Kondjoyan*, Pierre-Sylvain Mirade, Stéphane Portanguen,
Jean-Dominique Daudin

INRA, QuaPA-Meat Product Quality Unit, Centre of Clermont-Ferrand/Theix,
63122 Saint-Genès-Champanelle, France

*Corresponding author:

E-mail address: alain.kondjoyan@inra.clermont.fr

Experimental results from literature on the evolution of food quality during meat treatments are very difficult to use in practice to improve food quality since they often correspond to a specific equipment and a few process conditions. This leads to contradictions between studies and makes difficult to transpose results from one case to another. Mathematical modelling which combines transfers phenomena to chemical reactions is appropriate to respond to this situation. This paper illustrates how this has been applied to predict the final quality of cooked meat and dry-cured ham. The approach presented in this paper can be generalized to other foods and other processes to find out the best scenarios to obtain a targeted quality by taking into account both initial food characteristics and types of industrial equipment.

Keywords: *model, transfer, reactions, quality, meat*

NUTRACEUTICALS: A NEW PARADIGM OF PRO ACTIVE MEDICINE

Antonello Santini*

Department of Pharmacy, University of Napoli "Federico II",
Via D. Montesano 49, 80131 Napoli, Italy

Corresponding author:

E-mail address: asantini@unina.it

Diet and lifestyle are essential to promote and maintain the condition of well-being, nicely- being and prevent disease. Food contains all the nutrients that allow the body to perform its functions, however a wrong approach to dietary habits can lead to the onset of pathological conditions. Metabolic syndrome, a worldwide epidemic disease, is mainly associated with the increased onset of health conditions and mortality connected to wrong lifestyle and dietary habit. This syndrome is characterized by cardio metabolic risk factors that include obesity, insulin resistance, hypertension, and dyslipidemia. Nutraceuticals can be a promising tool to prevent and support the cure of these pathologic conditions. The term refers to active substances extracted from plants, concentrated and administered in a pharmaceutical suitable form. The word "nutraceutical", coined in 1989 in Rome by Stephen De Felice, is a portmanteau of the words "nutrition" and "pharmaceutical" and the Merriam-Webster dictionary defines it "a food that provides benefits health in addition to its nutritional content". A nutraceutical is therefore a food (or part of a food) that produces health beneficial effects, including the disease prevention and/or treatment. The proper term of reference for these vegetal origin dietary supplements (as they are defined according to the current regulations) has been set by Ettore Novellino in 2012 by coining "beyond the diet, before drugs" since nutraceuticals combine beneficial healthy properties of food extracts with the healing properties of natural active compounds helping to prevent and also to cure diseases. A pro active medicine nutraceutical approach includes them in the daily diet and contributes to lower the risk connected to some lifestyle related diseases and also to reduce the cost for the National Health Systems, nowadays oriented to reduce the therapy costs and to promote correct information and diseases prevention.

Keywords: *nutraceuticals, medical food, integrators, metabolic syndrome, lifestyle*

COULD SUPERCRITICAL FLUIDS REPLACE CONVENTIONAL SOLVENTS IN FOOD INDUSTRY?

Željko Knez

University of Maribor, Faculty of Chemistry and Chemical Engineering
Smetanova 17, 2000 Maribor, Slovenia

Corresponding author:

E-mail address: zeljko.knez@quest.arnes.si

Is it realistic that supercritical fluids will replace conventional processes in food processing industries? From the current point of view, it is not realistic. But the main impetus for certain replacements of organic solvents is influenced by environmental impact and a need to design and produce the products with completely new specifications.

Extraction of substances from plant materials and their formulation in products with specific properties and their in "situ" formulation is at the moment one of the very promising applications of supercritical fluids.

Several industrial units are in operation also for extraction of spices for food industry and plant materials, like hop constituents, decaffeination of tea and coffee, separation of lecithin from oil. One of the most important advantages of use of supercritical fluids is selective extraction of components or fractionation of total extracts.

Applying supercritical fluids for particle formation may give powders and composites with special characteristics. Several processes for formation and design of solid particles using dense gases are studied intensively. The unique properties of SCFs can be used for impregnation of solid particles, for formation of solid powderous emulsions, particle coating, e.g. for formation of solids with unique properties for the use in different applications.

Sub- and supercritical fluids are a unique class of reaction media for chemical and biochemical reactions. Application of near - critical water for processing of biomass as an example of conversion of biomass into gas fuels such as hydrogen and methane will be presented.

Processes using sub- and supercritical fluids lead to sustainable manufacturing methods that are not only ecologically preferable but also gives the products with very special properties. But in some applications traditional processing processes will never be replaced by supercritical fluids as solvents

Keywords: *sub-critical, supercritical fluids, high pressure, extraction, particle formation, foaming, chemical and biochemical reactions*

QUALITY OF MAIZE HYBRIDS AS A RAW MATERIAL IN FUNCTIONAL, ORGANIC AND TRADITIONAL FOOD PRODUCTION

Milica Radosavljević, Marija Milašinović-Šeremešić, Dušanka Terzić,
Zorica Pajić, Goran Todorović, Valentina Semenčenko*

Maize Research Institute, Zemun Polje, Belgrade-Zemun, Serbia

*Corresponding author:

E-mail address: vsemencenko@yahoo.com

Maize, wheat and rice comprise 87% of all cereals production worldwide and provide 43% of all calories in food. In Serbia, maize has been traditionally cultivated as a number one field crop. In spite of a high nutritive value of its grain, its share in food production has been of minor significance. The growing importance of high-value food products has imposed a need for more intensive research within a field of the grain quality and utilisation. The achievements made by breeders have provided cultivation of maize hybrids with a wide range of kernel structures and compositions.

The objective of this study was to observe the grain quality of different maize hybrids developed at the Maize Research Institute as a raw material for use in maize-based food products.

The results showed that the starch, protein, oil, crude fibre and ash content ranged from 65.75 to 71.15%, 9.71 to 13.20%, 4.93 to 7.29%, 1.84 to 2.65% and 1.22 to 1.50%, respectively. The reducing sugars and sucrose contents ranged from 0.19 to 0.58% and from 2.28 to 3.72%, respectively. The NDF, ADF, ADL, hemicellulose and cellulose contents in the maize kernel varied from 10.10 to 24.42%, 2.13 to 5.08%, 0.20 to 0.89%, 5.02 to 21.24% and 1.87 to 4.19%, respectively. Diverse ratios of the contents of lignocellulose fibres affected the differences in digestibility of dry matter which varied between 85.26 and 93.14%. Physical properties of the studied ZP maize hybrids also widely ranged, similarly to the chemical composition. The amylose content in starches isolated from six ZP maize hybrids was characteristic for normal maize starches (24-26%).

All investigated maize hybrids had very different grain quality which could provide various possibilities of their utilization as a valuable raw material in functional, organic and traditional food production.

Keywords: *maize hybrids, grain quality, functional, organic and traditional food*

OSA STARCHES AS IMPROVERS IN GLUTEN-FREE BREAD FROM HEMP SEED MEAL

Tamara Dapčević Hadnađev*, Miroslav Hadnađev, Milica Pojić

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: tamara.dapcevic@fins.uns.ac.rs

By-products of vegetable, fruit and oilseed processing industry can be utilized for fortification of gluten-free products which, although being essential for people with celiac disease, usually lack important nutrients. However, their presence in gluten-free bakery formulations is often associated with negative technological quality of final product. According to recent studies, different hydrocolloids can be used as gluten mimetics. Due to the fact that feasibility of the most of them has already been investigated, the aim of this study was to test the role of starch sodium octenyl succinate (OSA starch) as gluten-free bread improver.

Therefore, in order to obtain both nutritionally and technologically improved gluten-free bread, a formulation in which up to 20% of rice flour was substituted with hemp seed meal (a by-product of cold pressed hemp seed oil processing) and up to 5% of single and dual modified OSA starches was developed. Obtained gluten-free mixture was tested for nutritional and rheological properties, as well as for quality attributes of gluten-free bread (specific volume, texture, crumb structure, sensory properties).

All samples with added hemp flour had much better nutritional quality than the one of solely rice flour in terms of higher protein, crude fibers, minerals, and essential fatty acids content. On the other hand, addition of OSA starch and pregelatinized OSA starch contributed to increased water absorption and viscosity of gluten-free batter in comparison to control sample. Moreover, gluten-free breads containing OSA starches have shown superior properties in term of specific volume and crumb texture. Developed gluten-free formulation was sensory acceptable, since addition of hemp flour contributed to pleasant nutty flavor.

Keywords: *hemp processing by-products, OSA starch, gluten-free bread*

AGARICUS SILVATICUS - PROMISING FUNCTIONAL FOOD

Anita Klaus^{1*}, Maja Kozarski¹, Jovana Vunduk¹, Željko Žižak², Miomir Nikšić¹

¹Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Belgrade, Serbia

²Institute of Oncology and Radiology of Serbia, Pasterova 14,
11000, Belgrade, Serbia

*Corresponding author:

E-mail address: aklaus@agrif.bg.ac.rs

Agaricus silvaticus Schaeffer is often found in groups in mixed woodland and under trees in parks. Recent investigations suggest highly efficient biological properties of this common, edible mushroom.

Objectives of this study were a) to determine the antibacterial ability of crude hot water extract (SV) and hot alkali extract (SNa) obtained from *A. silvaticus* against selected foodborne Gram-positive and Gram-negative pathogenic bacteria by microdilution assay; b) to evaluate their antioxidant ability by measuring DPPH free radical scavenging activity, inhibition of lipid peroxidation, reducing power and chelating ability; c) to determine their cytotoxic effect on malignant human breast cancer MDA-MB-453, cervical adenocarcinoma HeLa and myelogenous leukemia K562 cells. Antiproliferative activity of investigated compounds was assessed, measuring cell survival in standard, 72 h, by MTT test.

Gram-positive bacterial strains were more susceptible to the tested extracts than Gram-negative. SV possessed higher activity than SNa (MIC – 5-10 mg/mL and 0.3125-5 mg/mL). At 10 mg/mL, scavenging abilities of SV and SNa toward DPPH radicals increased to 76.8 and 74.8%, respectively. The antioxidant activities of SV and SNa reached the levels of 62.7 and 81.8% at 0.1 mg/mL. The reducing power of SV and SNa were 1.367 and 2.198 at 5 mg/mL. SV and SNa chelated 87.7 and 81.8% of ferrous ions at 5 mg/mL. Extracts derived from *A. silvaticus* displayed dose dependent antiproliferative action towards all investigated tumor cell lines, with IC₅₀ values ranging from 0.7 to 1.7 mg/mL. SNa extract showed the most cytotoxic effect (IC₅₀=0.7 mg/mL for HeLa cells).

The results of this study confirm the high biological potential of mushroom *A. silvaticus*. At a time of increasing resistance of microorganisms to conventional antibiotics, naturally-derived antimicrobial substances are very desirable. Due to its very pleasant taste and nutritional value, as well as the high content of antioxidant components it could be considered as functional food and might be able to contribute to the reduction of cancer risks.

Keywords: *Agaricus silvaticus*, antimicrobial, antioxidant, antiproliferative

PORK MEAT AS A FUNCTIONAL FOOD

Eleftherios Bonos¹, Panagiota Florou-Paneri^{1*}, Efterpi Christaki¹,
Ilias Giannenas¹, Ioannis Skoufos², Anastasios Tsinas²,
Athina Tzora², Jian Peng³

¹Laboratory of Nutrition, Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

²Department of Animal Production, Technological Institute of Epirus, 47100 Arta, Greece

³Laboratory of Animal Nutrition and Feed Science, Animal Nutrition and Feed Science Department, Huazhong Agricultural University, 430010 Wuhan, China

*Corresponding author:

E-mail address: ppaneri@vet.auth.gr

Several epidemiological studies have provided evidence that foods should no longer be considered only for their nutritive value, but also for their potential positive effects in preventing or protecting against serious chronic diseases, especially those associated with a Western lifestyle. These diseases include neoplastic, cardiovascular, or neurodegenerative ailments, cataracts, diabetes, metabolic syndromes, and inflammatory/degenerative processes associated with aging. The term "functional foods" can include simple foods, technologically treated food products and/or their active components that can be used to prepare fortified foods, or can be consumed separately from foods as supplements. It is possible that pig diets can be enriched with certain bioactive feed additives or raw materials such as aromatic plants, vitamins, trace elements, chelated substances, probiotics, prebiotics, plant and fish oils, microalgae and/or seaweeds, which have antioxidant, antimicrobial, immunomodulating or anti-inflammatory properties. Therefore, "functional" pork meat and meat products can be produced with enhanced beneficial properties. These new generation products may have a healthier composition and/or compounds that are highly sought by consumers that want or are obliged to follow a specific diet due to health reasons.

This work is part of the project 12CHN91, of the Bilateral R&D Cooperation between Greece and China 2012-2014, funded by the Hellenic GSRT.

Keywords: *pork meat, functional foods, bioactive ingredients, health benefits*

OCCURRENCE OF LIPID OXIDATION PRODUCTS AND HETEROCYCLIC AMINES IN GRILLED *n*-3-ENRICHED CHICKEN PATTIES STORED UNDER OXYGEN RICH ATMOSPHERE

Božidar Žlender*, Ana Penko, Mateja Lušnic Polak, Lea Demšar, Tomaž Polak

Department of Food Science and Technology, Biotechnical Faculty, University of Ljubljana, Jamnikarjeva 101, SI-1111 Ljubljana, Slovenia

*Corresponding author:

E-mail address: bozidar.zlender@bf.uni-lj.si

The oxidation processes on lipids (instrumentally measured colour values, TBARs, cholesterol oxides – COPs) and formation of heterocyclic amines (HAs) were studied in chicken patties enriched in *n*-3 fatty acids (whole flaxseed addition in the chicken feed), after 8 days of storage at 4 °C under different aerobic conditions (MAP–high CO₂, wrapping (air permeable), MAP–high O₂ and MAP–low O₂). HA precursors (creatine, creatinine, free amino acids) on raw patties before grilling, as well as COPs (7 α -hydroxycholesterol, 7 β -hydroxycholesterol, 20 α -hydroxycholesterol, 22-hydroxycholesterol, 25-hydroxycholesterol) and HAs (quinoxalines (MeIQx, 7,8DiMeQx, IQx) and PhIP) on homogenate of the upper and the lower surface slices of the grilled (two-plate grill, at 220 °C for 5 min) patties were determined by LC-MS; TBARs were determined on raw samples spectrophotometrically. For the raw chicken patties, *n*-3 enrichment (meat from chickens that had been fed ground whole flaxseed as an addition to their mixed cereal diet) increased the colour L* values and TBARs, while after the heat treatment, there were slightly higher (but not significant) content of COPs. Generally, higher contents of individual and total HAs were seen for the *n*-3-enriched groups (not significant), compared to the control patties (mixed cereal diet that contained no flaxseed). In comparison with the low O₂ (<0.5%) package-atmosphere condition, O₂ enrichment (80%) increased the instrumentally measured colour values, TBARs, as well as total and individual COPs. On the contrary we find, that content of total HAs was significantly lower in patties stored in packages with the highest O₂ (MAP–high O₂ and wrapping) than with the lowest O₂ concentration (MAP–low O₂, MAP–high CO₂).

Keywords: *chicken products, n-3 fatty acids, cholesterol oxides, TBARs, heterocyclic amines*

THE INFLUENCE OF STARTER CULTURE TYPE ON RHEOLOGY AND TEXTURE OF FERMENTED MILK PRODUCTS

Katarina Kanurić^{1*}, Vladimir Vukić², Dajana Hrnjez¹, Spasenija Milanović¹,
Mirela Iličić¹, Eva Lončar¹

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institut of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: stay@uns.ac.rs

Yoghurt and probiotic yoghurt have been proven as a healthy and nutritious food. The possibility of the application of kombucha as a non-conventional starter culture and its technological and nutritional aspects in dairy products has been described recently. The basic characteristics of yoghurt gel are the appropriate textural and rheological properties. The major structural changes during the milk fermentation are related to casein micelles, and they are due to the change of the pH value.

The aim of this study was to investigate the effect of the addition of three different starter cultures: yoghurt starter culture, probiotic starter culture and kombucha inoculum on fermentation time, rheological and textural properties of fermented milk products. During the fermentation process involving kombucha, yoghurt or probiotic starter culture, samples were taken at the pH values of 5.4, 5.1, 4.8 and 4.6.

The viscosity of the samples was measured at 5 °C using a viscometer HAAKE RheoStress 600HP (Karlsruhe, Germany) with a cone and-plate-sensor PP60Ti (gap 1 mm). Textural properties of produced samples were analyzed by Texture Analyser TA.HD.^{plus} (Stable Micro System, England).

The kombucha starter exhibited a similar influence on the casein networking pattern as the yoghurt and probiotic starter cultures. The applied starter cultures induced different gelation rates and final gel viscosity of the sample. The changes in the texture of all samples were obtained between the pH 5.4 and 5.1, which is in correlation with the analyzed rheological properties.

The rheology and texture of the samples produced by kombucha followed the same patterns as noticed for the probiotic and yoghurt samples.

Keywords: *yoghurt, kombucha, viscosity, textural properties*

TRADITIONAL DAIRY PRODUCTS: RICH AND DIVERSE MICROBIOTA WITH HEALTH-PROMOTING PROPERTIES

Nataša Golic^{1*}, Amarela Terzić-Vidojević¹, Katarina Veljović¹, Maja Tolinački¹,
Sanja Mihajlović¹, Jelena Lozo^{1,2}, Milan Kojić¹

¹Institute of Molecular Genetics and Genetic Engineering, University of Belgrade,
Vojvode Stepe 444a, P.O.Box 23, 11010 Belgrade, Serbia

²Faculty of Biology, University of Belgrade, Studentski trg 16, Belgrade, Serbia

*Corresponding author:

E-mail address: natasag@imgge.bg.ac.rs

Understanding the effect of beneficial microorganisms in maintaining the human health could shed new light on rare diseases such as inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), ulcerative colitis, colorectal cancer (CRC), diabetes etc. as well as lead to new therapeutic strategies for their treatment. Hence, we aim to study the health-promoting potential of natural isolates of lactic acid bacteria (LAB) originating from traditional dairy products manufactured in households in Western Balkan Countries (WBC). The ultimate goal is to identify the autochthonous LAB isolates with anticarcinogenic or immunomodulatory effect.

WBC is a distinct geographical area in Europe with the long tradition of manufacturing artisanal dairy products. Using molecular genetics methodology (rep-fingerprinting analysis, 16S rDNA sequencing) and detailed technological and probiotic characterisation of LAB isolates, including milk protein coagulation, proteinase and antimicrobial activity, exopolysaccharide production, production of aroma and taste precursors, as well as survival in simulated conditions of gastrointestinal tract, adhesion to epithelial intestinal cells (EIC), proliferation of gut associated lymphoid tissue (GALT) and peripheral blood mononuclear cells (PBMC), revealed the huge diversity of LAB strains in the artisanal dairy products of WBC.

Interestingly, our results showed that the autochthonous LAB isolates produce bioactive substances involved in immunomodulation, directly or indirectly reduce the level of cholesterol, triglycerides and blood sugar, or have hypoallergenic and immunosuppressive effect.

In conclusion, the characterisation of indigenous LAB strains in the artisanal cheeses, as well as characterisation of their probiotic and technological potentials makes possible formulation of defined functional starter cultures for novel dairy foods with geographical origin. In addition, such concept would lead to the characterisation of bioactive compounds suitable for the development of new therapeutics (nutraceuticals).

Keywords: *microbial diversity, artisanal dairy products, lactic acid bacteria, health-promoting properties*

HYGIENIC EQUIPMENT DESIGN AND MEAT PROCESSING OPERATIONS

Zoran Petrović^{1*}, Slavica Vesković-Moračanin¹, Danijela Vranić¹,
Lazar Turubatović²

¹Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

²Jaroslav Černi Institute for the Development of Water Resources, Jaroslava
Černog 80, 11226 Pinosava-Belgrade, Serbia

*Corresponding author:

E-mail address: zoran@inmesbgd.com

Hygienic design refers to those building design features that may be unique to a meat processing plant and are intended to reduce the risk of contamination by biological, physical and chemical hazards from meat processing operations. The task of hygienic design is to minimize risks of contamination and to make easier the challenges of cleaning and maintaining the plant and equipment. Poorly designed equipment might increase the risk of contamination of meat and meat products with micro-organisms and different stages of processing could demand different levels of hygienic design. The fundamental principle, however, is that the design of any piece of equipment must not allow any increase in the concentration of relevant contaminants.

The European Directive 2006/42/EC for machinery already sets up requirements for food processing equipment, which have to be obtained in all meat processing machines. Chapter 2.1. states that all machines have to be cleanable, drainable and all surfaces have to be smooth. These general statements are detailed in the following standards: The EN ISO 14159 "Safety of machinery - Hygiene requirements for the design of machinery" and the EN 1672-2 "Food processing machinery - Basic concepts - Part 2: Hygiene requirements". They also give the presumption of conformity for these machines build according to these standards, as they are listed under the machinery directive in the European journal, as harmonized standards.

Within Europe and the USA, a number of organisations exist to foster consensus in hygienic design and the use of these organisations' guidelines can have a quasi legal status. In 1989 an independent group, called the European Hygienic Equipment Design Group (EHEDG) was formed; it consists of approximately 100 members who are equipment manufacturers, food processors, research organisations, or government representatives from many countries including Serbia.

Keywords: *hygienic design, meat, processing, equipment*

EFFECT OF HOT SMOKING ON PROCESSING YIELD AND MICROBIOLOGICAL SAFETY OF COMMON CARP

Miroslav Ćirković^{1*}, Dragana Ljubojević¹, Đorđe Okanović², Vesna Đorđević³,
Nikolina Novakov⁴

¹Scientific Veterinary Institute "Novi Sad", Rumenački put 20,
21000 Novi Sad, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

³Institute of Meat Hygiene and Technology, Kačanskog 13,
11000 Belgrade, Serbia

⁴Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: miroslavcirkovic@yahoo.com

Fish processing industry is still underdeveloped in Republic of Serbia. Manufacturing of fish products and development of new fish products could increase offer of that food type and could contribute to better sale of fish, not only in traditional fish markets, but also in retail stores and supermarkets. Therefore, the main objective of this study was to describe the proper technological process of hot smoking of common carp as well as to determine the yield and microbiological safety of final product. Yield during smoking process was determined by using 21 fish, while microbiological tests were conducted according to the national legislation. Average yield of smoked common carp was 82.19 % based on weight of eviscerated and descaled fish or 47% based on weight of live fish. Yield of final product is of great technological and economical importance. Nutrition, age, weight, seasonal variation and physiological phase have great influence on yield and those factors that might affect analysis could be avoided, so fish were of the same weight class, origin and fed on the same diet. Microbiological analysis of hot smoked common carp showed the absence of pathogenic bacteria and confirmed that the obtained product is safe and suitable for human consumption. Appropriate technological process of manufacturing smoked carp provides high microbiological quality of final product. Obtained results could help to develop similar products from different fish species, which would complete the current offer of fish and fish products in the market.

Keywords: *common carp, hot-smoking, yield, microbiological safety, manufacturing*

ELECTROSTATIC EXTRUSION – ENCAPSULATION TECHNIQUE FOR FUNCTIONAL FOOD PRODUCTS

Ana Kalušević^{1*}, Steva Lević¹, Bojana Isailović², Radovan Djordjević¹,
Mile Veljović¹, Verica Djordjević², Viktor Nedović¹, Branko Bugarski²

¹Department of Chemical Engineering, Faculty of Technology and Metallurgy,
University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

²Department of Food Technology and Biochemistry, Faculty of Agriculture,
University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia

*Corresponding author:

E-mail address: ana.kalusevic@agrif.bg.ac.rs

For food products, especially functional products, stability of bioactives during processing and storage is crucial. Improved delivery of bioactives in organism is essential, as well. Encapsulation is a very useful tool for these demands.

There are a number of encapsulation techniques used to produce encapsulates for food products.

Electrostatic extrusion is one of technique that entraps bioactives with a carrier material and aims to preserve and to prevent undesirable interactions with food matrix. This technique is based on the using of electrostatic forces and dispersing solution of polymers and active components into galling bath.

Materials that form protective shells and barriers between the bioactives and its surroundings are food-grade and biodegradable.

This research gives a review of bioactives, carrier materials, and potential applications in food industry.

As active components extracts (e.g. *Pterospartum tridentatum*, β -caroten, grape polyphenols, black soybean coat), oils (e.g. grapeseed and *Ocimum basilicum* essential oil) and yeast cells (e.g. *Sacch.cerevisiae bayanus*) were used.

Carrier materials were natural polymers, mostly alginate and pectin with inulin as filler.

Those components were encapsulated by electrostatic extrusion producing different-sized encapsulates that could contribute to functionality of different foods such as numerous bakery products, sausages and other meat products, and beverages.

Keywords: *Encapsulation, bioactives, electrostatic extrusion, functional food products*

Acknowledgments: *These experiments are done under national project III 46010 funded by Ministry of Education, Science and Technological Development of Republic of Serbia and AREA project (Advancing Research in Agricultural and Food Sciences) funded by European Commission.*

EXTRUSION PROCESS OPTIMIZATION OF CORN GRITS ON SINGLE SCREW LABORATORY EXTRUDER

Jovana Brkljača*, Olivera Šimurina, Tea Brlek, Jelena Krulj,
Jovana Đisalov, Bojana Kokić, Marija Bodroža Solarov,

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jovana.brkljaca@fins.uns.ac.rs

The properties of corn grits extrudates were investigated as a result of different extrusion conditions including extrusion temperature, screw speed and moisture content. The experiment was conducted on the Brabender® single screw laboratory extruder. Box-Benhken design method was successfully used in this experiment and the selected process responses were expansion index (EI), water absorption index (WAI) and water solubility index (WSI). Statistical regression analysis and desirability function were applied in order to develop a predictive model, which revealed that moisture had the strongest influence on the parameters of investigation. The temperature had weak effect on the WSI and WAI, while a stronger influence was noticed on expansion index. The purpose of this study was to determine optimal operating extrusion conditions of corn grits for improvement of the process. Optimal levels of the tested parameters were determined by the desirability function approach. It was found that the optimal parameters are: screw speed: 175 r. p. m., moisture: 16% and temperature: 190°C.

Keywords: *extrusion, optimization, EI, WAI, WSI*

ANTIBACTERIAL EFFECT OF SELECTED ESSENTIAL OILS AS CANDIDATES FOR DISINFECTANTS IN FOOD INDUSTRY

Anita Vidács^{1*}, Antal Véha², Csaba Vágvolgyi¹, Judit Krisch²

¹Department of Microbiology, Faculty of Science and Informatics, University of Szeged, 6726, 52 Közép fasor, Szeged, Hungary

²Institute of Food Engineering, Faculty of Engineering, University of Szeged, 6724, 7 Mars tér, Szeged, Hungary

*Corresponding author:

E-mail address: anitavidacs@gmail.com

Disinfectants used in the food industry have to meet special requirements and therefore the number of usable chemicals is limited. Essential oils (EOs) are organic, natural components that can be a good source for disinfection. In our research minimal inhibitory concentrations (MICs) and minimal bactericidal concentrations (MBCs) of the EOs of thyme, clary sage, juniper, lemon, marjoram, cinnamon, and lemon were determined against *Bacillus cereus var. mycoides*, *Bacillus subtilis*, *Staphylococcus aureus*, MRSA, *Listeria monocytogenes*, *Pseudomonas putida* and *Escherichia coli*. MIC was determined by macro-dilution method and optical density, MBC by plating. Gram positive and Gram negative bacteria had different sensitivity to the EOs. Best results were achieved by cinnamon oil (0.4-3.2 mg/ml). Lemon EO had not effect at 100 mg/ml. In most cases MRSA had higher MBC values than the not-resistant *S. aureus* strain. It seems from our results that pathogens like *S. aureus* and *L. monocytogenes* were more susceptible to the investigated EOs, than spoilage bacteria. Most of the investigated EOs are promising candidates for the use in disinfectant solutions.

Keywords: *disinfection, essential oils, pathogens, spoilage bacteria, antibacterial*

LACTIC ACID FERMENTATION OF BREWER'S SPENT GRAIN HYDROLYSATE BY *LACTOBACILLUS FERMENTUM* AND *LACTOBACILLUS RHAMNOSUS*

Jelena Pejin^{1*}, Ljiljana Mojović², Sunčica Kocić-Tanackov¹,
Miloš Radosavljević¹, Aleksandra Djukić-Vuković²

¹Faculty of Technology, University of Novi Sad, Bulevar Cara Lazara 1,
21 000 Novi Sad, Serbia

²Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4,
11 000 Belgrade, Serbia

*Corresponding author:

E-mail address: jpejin@uns.ac.rs

Lactic acid is commonly used as a flavour and preservative in food, cosmetic and pharmaceutical industries. Brewer's spent grain (BSG) is the major by-product in beer production. It is produced in large quantities (20 kg per 100 L of produced beer) throughout the year at a low cost or no cost, and due to its high protein and carbohydrates content it can be used as a raw material in biotechnology. The use of BSG is still limited, being basically used as animal feed. In biotechnology BSG could be used as a substrate for cultivation of microorganisms.

In this study BSG was dried (at 40°C) and hydrolyzed using commercial α -amylase, glucoamylase, and cellulase. BSG hydrolysis was optimized. The produced hydrolysate was fermented by *Lactobacillus fermentum* PL-1 and *Lactobacillus rhamnosus* ATCC 7469 to lactic acid. During fermentation CaCO₃ or NaOH were used as neutralising agents.

The effect of different yeast extract content (0.5, 1.0, 2.0, 3.0, 4.0, and 5.0%) and reducing sugars content in hydrolysate on fermentation performance was investigated. Higher reducing sugars contents were obtained with addition of glucose.

Lactic acid bacteria cells viability was high in all fermentations. *L. rhamnosus* ATCC 7469 produced mostly L-(+)-lactic acid while *L. fermentum* PL-1 produced approximately 50% L-(+)-lactic acid and 50% D-(-)-lactic acid. Higher lactic acid yields were obtained in fermentations with *L. rhamnosus* ATCC 7469. Addition of neutralising agents increased lactic acid bacteria viability. Viability of *Lactobacillus fermentum* PL-1 and *L. rhamnosus* ATCC 7469 cells was significantly higher in fermentation with yeast extract addition than in fermentations without yeast extract addition. Calcium-carbonate and yeast extract addition increased lactic acid yield.

Keywords: *Lactic acid*, *Lactobacillus fermentum*, *Lactobacillus rhamnosus*, *brewer's spent grain*

SECRETION OF *BACILLUS* HYDROLYTIC ENZYMES USING FOOD-GRADE EXPRESSION SYSTEM

Montarop Yamabhai^{1*}, Peenida Namvijitra¹, Suttipong Sak-Ubol¹,
Dietmar Haltrich²

¹School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, Thailand

²Laboratory of Food Biotechnology, BOKU University of Natural Resources and Life Sciences, Vienna, Austria

*Corresponding author:

E-mail address: montarop@g.sut.ac.th

An ability of any expression system to secrete products into culture medium is highly attractive for large-scale biotechnological applications, because it facilitates harvesting and purification steps, reducing the overall production cost. Hydrolytic enzymes are one of the key factors for green and white biotechnology because they serve as efficient biocatalysts for the bioconversions of a wide variety of raw materials into value-added products. For food and medical application, food-grade gene expression system is necessary for commercial production of recombinant hydrolytic enzymes. One of the attractive expression hosts for food-grade system is Lactic acid because it is considered as safe and carry the "Generally Recognized As Safe" (GRAS) status.

In this report, genes encoding two *Bacillus* hydrolytic enzymes, i.e., chitosanase (Csn) [1] and beta-mannanase (ManB) [2], were sub-cloned into pSIP-based expression vector and over expressed in *Lactobacillus plantarum*. The genes could be efficiently expressed and secreted into culture supernatant. The secretion efficiency is varied from 50% to 90%, depending on the types of enzymes, culture condition and time of harvesting. Applications of secreted enzymes for the bioconversion of copra mannan and chitosan wastes into manno-oligosaccharides (MOS) and chito-oligosaccharides (COS), using secreted ManB and Csn, respectively, were demonstrated. These expression systems will be further optimized for large-scale productions of MOS and COS from agricultural wastes in the next step.

References

Keywords: food-grade, expression, secretion, *Lactobacillus plantarum*, enzyme

1. Pechsrichuang P, Yoohat K, Yamabhai M: Production of recombinant *Bacillus subtilis* chitosanase, suitable for biosynthesis of chitosan-oligosaccharides. *Bioresour Technol* 2013, 127:407-414.

2. Songsiriritthigul C, Buranabanyat B, Haltrich D, Yamabhai M: Efficient recombinant expression and secretion of a thermostable GH26 mannan endo-1,4-beta-mannosidase from *Bacillus licheniformis* in *Escherichia coli*. *Microb Cell Fact* 2010, 9:20

ZEOLITE AS A CARRIER FOR LACTIC ACID BACTERIA IN BIOREFINERY PROCESSES

Aleksandra Djukić-Vuković^{1*}, Ljiljana Mojović¹, Jelena Pejin²,
Sunčica Kocić-Tanackov²

¹Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4,
11000 Belgrade, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: adjukic@tmf.bg.ac.rs

Biorefinery is a concept based on utilization of wastes or by-products of different industries as substrates for biotechnological production of chemicals. Stillage as a by-product of bioethanol production on different feedstocks is high in proteins and could be a suitable substrate for the growth of fastidious *Lactobacillus rhamnosus* ATCC 7469 and lactic acid production. In order to increase the productivity of the process biomass of *L. rhamnosus* ATCC 7469 was immobilized onto zeolite, aluminosilicate material by adsorption. In the repeated batch fermentation with immobilized biomass overall obtained productivity was doubled in comparison to a free cell system, whilst average yield coefficient was 0.96 g g^{-1} . Due to the effective immobilization of *L. rhamnosus* ATCC 7469 onto the zeolite and further colonization of surface during the lactic acid fermentation on stillage, very high number of cells of over $10^{10} \text{ CFU g}^{-1}$ was attached to the surface of zeolite carrier after four subsequent recirculations. Simplicity of the method for immobilization of *L. rhamnosus* onto zeolite and high lactic acid productivity obtained in the process qualify zeolite as a new and suitable carrier for lactic acid bacteria in biorefinery processes.

Keywords: zeolite, lactic acid, stillage, immobilization, *Lactobacillus rhamnosus*

INFLUENCE OF *CORDYCEPS SINESIS* EXTRACT ON FERMENTATION PROCESS

Kristina Nešić, Saša Despotović*, Milena Savić, Anita Klaus,
Ida Leskošek-Čukalović, Viktor Nedović, Miomir Nikšić

University of Belgrade-Faculty of Agriculture, Belgrade, Serbia

*Corresponding author:

E-mail address: sdespot@agrif.bg.ac.rs

Cordyceps species are very valued in traditional Chinese medicine. Their extracts show significant therapeutic activities, as it is well known that these medical fungi have anti-oxidant, immunomodulatory, anti-inflammatory, anti-tumor and many more beneficial effects on human body. Extracts of *Cordyceps* sp. also increase strength and endurance and they are commonly used for the replenishment of health. They have influence on cell metabolism, but mechanisms of action in cells still remain unknown. The purpose of this article is to examine the influence of *Cordyceps* extract on growth of yeast's cells and fermentation process. Three different species of yeast were used as models to examine influence of *Cordyceps* extract on cells metabolism, especially CO₂ production. Two concentrations of water extract of *Cordyceps sinensis* were added to yeast cell suspensions. Yeast cells (*Saccharomyces cerevisiae*, *S. cerevisiae* K1 and *S. pastorianus* - as representatives of baker's, wine and brewer's yeasts), were cultivated in malt broth. Suspensions of cells were added to malt broth with sugar concentration equal to the industrial wort. Maximal and minimal concentrations of *Cordyceps* extract were added to malt broth and fermentation was performed in incubators for several days. After defined time of fermentation, samples were measured and decrement of their masses was evaluated. It was shown that maximal concentration of *Cordyceps* extract has greater effect on decrease in mass, than minimal concentration and also extracts have greater influence on brewer's and wine yeasts than on baker's yeast. This experiment opened a new field of research and further analysis need to be performed to examine possible influence of the *Cordyceps* extract on yeast fermentation in order to get shorter period of fermentation and more healthy product.

Keywords: *Cordyceps sinensis*, fermentation, extract, yeast

POTENTIAL OF INNOVATIVE »GREEN« STRATEGIES TO CONTROL *Campylobacter* CONTAMINATION AND INFECTION VIA FOOD CHAIN

Sonja Smole Možina^{1*}, Anja Klančnik¹, Jasna Kovač¹, Maja Šikić Pogačar^{1,2}

¹Department of Food Science and Technology, Biotechnical Faculty, University of Ljubljana, Ljubljana 1000, Slovenia

²Medical Faculty, University of Maribor, Maribor 2000, Slovenia

*Corresponding author:

E-mail address: sonja.smole@bf.uni-lj.si

Campylobacteriosis is a leading bacterial food-borne disease in developed world, including EU (EFSA, 2014), facing the increasing resistance of bacteria against antibiotics, other antimicrobials and constantly changing environments in industrial settings and food supply chain. Biofilms are additional resistant form in relation to planktonic cells. Thus, new antimicrobials are needed in medical and industrial applications. We have investigated phenolic compounds of different plant origin (e.g. fruits, herbs, spices and also agri-food by-products and wastes from olives, wine, hops and essential oil production). They present an economic burden and also environmental problem – but could also be a reasonable source of bioactive phytochemicals. Understanding the activity of pure compounds and potentially synergistic formulations of plant extracts as bacterial growth inhibitors, resistance modifiers, via efflux pump inhibition or other mechanisms of antimicrobial drug cell accumulation as well as their anti-adhesion and/or anti-biofilm activity is crucial for understanding bacterial resistance development of planktonic cells or biofilms – and a pre-step for successful application of new innovative methods and strategies against bacterial resistance. Using gene-specific knockout mutants with known and new efflux pump inhibitors we have identified CmeABC as the main drug efflux pump along with CmeDEF, other membrane proteins involved in efflux and other systems influencing resistance of planktonic *C. jejuni* cells to several antimicrobial agents. Even more complex resistance mechanisms are involved in reduced sensitivity of biofilm cells.

To facilitate the use of novel approaches, we examined their efficacy in several food models and conditions as well as with intestinal cell lines models. Plant materials as bioactive agents and their antimicrobial mechanisms will be discussed in terms of assuring food safety and combating infection without providing selection pressure for the emergence of antimicrobial resistance, without negative impact on food quality, intestinal host microbiota in humans/animals and well-being in general.

Keywords: food safety, mechanisms of antimicrobial activity, bacterial resistance, food-borne pathogens, *Campylobacter*

AN APPLICATION OF PORTABLE NIR INSTRUMENTS IN QUALITY CONTROL OF MILK

Begoña de la Roza-Delgado*, Ana Soldado, Amelia González Arrojo,
Isabel Zafra

Department of Nutrition, Grasslands and Forages. Regional Institute for
Research and Agro-Food Development (SERIDA), PO Box 13,
33300 Villaviciosa, Spain

*Corresponding author:

E-mail address: broza@serida.org

Milk provides essential nutrients of great nutritional relevance for humans, particularly during childhood and elderly age. It is an excellent source of protein, calcium, vitamins, minerals and other bioactive components that add value to milk and milk products. Its composition is not uniform and it is very important to know it in a real time.

This study seeks to get further scientific understanding of the potential of a novel, handheld NIRS instrument based on MEMS technology (Micro-Electrical Mechanical Systems) for its application in the analysis of milk samples as a fast, non-destructive and low-cost sensor for real time decision making in milk production at farm level. The aim of this work was to setup and to assess the near infrared spectroscopy instruments (MEMS-NIRS) that could be implemented for physico-chemical analysis of milk produced from individual dairy cows.

Milk samples were scanned in diffuse reflectance mode with a non-constant interval of around 8 nm over the NIR spectral range (1600–2400 nm) using a handheld MEMS Phazir 1624 (Polychromix Inc., Wilmington, MA, USA), with a window sampling area of 0.8x1 cm or a liquid adapter accessory employing a cuvette of 2 mm path length. The first step was the establishment of relevant specifications for the collection of high quality spectra of milk, including the evaluation of sampling to build large spectral libraries of milk from individual cows allowing their optimization to develop NIRS chemometric models for chemical characterization and labelling. The use of liquid adapter accessory for raw milk showed signal saturation in the absorption bands between 1900-2050 nm. The utilization of a 17 mm path length cuvette in static analysis mode, showed higher resolution spectra, similar to those obtained with at-lab NIRS instruments. Nevertheless, the performance results showed variability of replicated measurements related with scattering effects of milk samples.

Keywords: *NIR, hand held instrument, milk analysis*

PROFICIENCY TESTING - AN IMPORTANT TOOL IN THE LABORATORIES' PERFORMANCE WITNESSING

Lazar Turubatović^{1*}, Snježana Pupavac², Tamara Gerić³,
Jasna Stevanović⁴, Radoslav Turubatović⁵

¹Institute for Development of Water Resources "Jaroslav Černi",
Jaroslava Černog 80, 11000 Belgrade, Serbia

²EKO LAB, Padinska Skela, 11000 Belgrade, Serbia

³Institute of Meat Hygiene and Technology, Kaćanskog 13,
11000 Belgrade, Serbia

⁴Serbian Chamber of Commerce, Resavska 15, 11000 Belgrade, Serbia

⁵RT Consulting, Bože Baucala 48, 11000 Belgrade, Serbia

*Corresponding author:

E-mail address: lazarturubatovic@gmail.com

Laboratory testing of foods are the only real proof of safety and quality of the final product, but also the correctness of the applied processes. Accreditation is the only real attestation of the competence of laboratories to perform specific tests. Accreditation Body of Serbia (ATS), is the sole organization authorized to operate laboratory accreditation according to ISO/IEC 17025 standard in Serbia. The essence of accreditation is to determine the competency of the performance tests. The conformity assessment involves the competence assessment of the entire operations of the laboratories, including the competence of the personnel, the adequacy of equipment, the validity of the conformity assessment methodology and the validity of the conformity assessment results, proven by the participation in the interlaboratory comparison and/or proficiency testing programmes.

In the world there are providers that organize proficiency tests on clearly established rules (ISO/IEC 17043), specified way of determining the success of participation, expressed in qualitative numerical ranges. In Serbia, there are laboratories that organize mutual laboratory comparison, according to the internationally accepted procedures. The control of ATS should be carried out over accredited providers. There are no accredited providers in Serbia, but it is necessary to be under control of ATS all providers who organize comparative tests.

The participation in the international PT schemes is associated with a number of problems where unreasonably long the customs procedures affecting the time available for the completion of the tests and report results, is one of them. Especially the big problems are in importing samples containing dangerous substances. It is necessary that the state provide a faster progression of samples for proficiency testing. Another possible option to solve this problem is organized import of samples and their distribution to interested laboratories.

Keywords: *accreditation, laboratories, proficiency testing*

DEVELOPMENT OF HPLC-DAD METHOD FOR DETERMINATION OF THIAMETOXAM IN HONEY FROM AUTONOMOUS PROVINCE OF VOJVODINA

Pavle Jovanov^{1*}, Valéria Guzsvány², Marijana Sakač¹, Anamarija Mandić¹, Ivan Milovanović¹, Ljubiša Šarić¹, Jovana Kos¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Department of Chemistry, Biochemistry and Environmental Protection, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: pavle.jovanov@fins.uns.ac.rs

After the EU ban on the use of the neonicotinoids in flowering crops that honeybee might visit, there has been an increased interest on determination of the neonicotinoids residues in honeybee products such as honey. The objective of this study was to develop HPLC-DAD analytical method with QuEChERS sample preparation procedure for the analysis of neonicotinoid thiametoxam in honey samples. The liquid chromatographic conditions were optimized by Response surface methodology with *Box-Behnken* design and the global *Derringer's* desirability. The optimized method was validated to fulfill the requirements of SANCO/12495/2011 for the sample pretreatment procedure providing results for accuracy (R, 73.8-85.7%), repeatability (RSD, 4.87-9.45%) and within-laboratory reproducibility (RSD, 12.50-14.87%), limit of detection (LOD, 2.5 µg kg⁻¹) and quantification (LOQ, 7.5 µg kg⁻¹). Matrix effects were compensated by the use of matrix-matched calibration. For the first time, more than 50 sunflower honey samples collected from all 7 counties of Autonomous Province of Vojvodina were analysed discovering the presence of thiametoxam, therefore implicating the necessity of ongoing control of this type of food. All the residues were confirmed via LC-MS/MS.

Keywords: *Neonicotinoids, thiametoxam, QuEChERS, honey, HPLC-DAD*

DETECTION OF HEPATITIS A VIRUS RNA IN SLICED HAM

Branko Velebit^{1*}, Dragoslava Radin²

¹Institute of Meat Hygiene and Technology, Kacanskog 13,
11040 Belgrade, Serbia

²Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

*Corresponding author:

E-mail address: velebit@inmesbgd.com

Sliced dry meat products can be contaminated with hepatitis A virus (HAV) during slicing. This is due to deficient hygienic practices (dirty hands and fingernails and/or the inability to wash hands appropriately) since HAV infection is acquired primarily by the fecal-oral route by either person-to-person contact or ingestion of contaminated food or water. HAV infection dose in humans is 10-100 viral copies.

In this paper we evaluated HAV detection in artificially contaminated sliced ham using molecular approach. Sliced ham samples were gamma irradiated with 25 kGy Cobalt-60. Afterwards, these were contaminated with ten-fold dilution of respective aqueous solution of HAV (certified reference material at $4,8 \times 10^4$ viral copies per mL) and let stand until full absorption. Virus elution has been performed by PEG/NaCl precipitation whereas extraction of viral RNA was completed using Trizol/Chloroform method. Reverse transcription and one-step qPCR (RT-qPCR) were used to detect cDNA of HAV's RNA.

Repeatability studies demonstrated that average HAV recovery rate from contaminated ham was 46%. Furthermore, RT-qPCR despite being able to detect 100 copies of viral RNA "in vitro" was found to have a LOD_{50%} at 211 viral copies per gram while LOD_{95%} 554 viral copies per gram.

The results of this study show that the detection of HAV in meat products is challenging, and more efforts to improve elution methods are still needed to detect HAVs in meat products containing viruses in low copies.

Keywords: *hepatitis A, detection, ham*

KINETIC PARAMETERS OF MEAT PROTEIN DENATURATION

Sanja Ostojić^{1*}, Lato Pezo¹, Darko Mičić¹, Danijela Šuput²,
Branislav Simonović¹, Ljubinko Lević²

¹Institute of General and Physical Chemistry, University of Belgrade,
Studentski trg 12, 11000 Belgrade, Serbia

²Faculty of Technology, University of Novi Sad, Bul. cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: sostojic@iofh.bg.ac.rs

Differential Scanning Calorimetry (DSC) measurements carried out at different heating rates ($\beta = 0.5, 1, 1.5, 2, 3, 5$ and 10 C^o/min) were used for the kinetic analysis of the endothermic process assigned to the denaturation of pork meat proteins (*Longissimus dorsi*). Non isothermal kinetic model proposed for α keratin denaturation by Istrate et al., have been used.

DSC thermograms of raw pork muscle revealed the presence of three endothermic peaks corresponding to the thermal denaturation of myosin ($T_{max1} = 50^{\circ}\text{C}$) sarcoplasmic proteins ($T_{max2} = 58^{\circ}\text{C}$) and actin ($T_{max2} = 74^{\circ}\text{C}$). Denaturation enthalpies ΔH_1 , ΔH_2 and ΔH_3 corresponding to meat protein denaturation were estimated by measuring the area under the thermal transition curve. DSC scans have been performed on TA Instruments DSC Q1000, Differential Scanning Calorimeter (Delaware, USA), with TA Universal analysis 2000 software. The apparatus was calibrated with a high-purity indium standard. Meat samples of 11.0 ± 2 mg were weighed into hermetic aluminum pans and placed in the equipment's sample chamber. All experiments were performed under a nitrogen (99.999% purity) flow of 50 ml/min. Obtained kinetic parameters of meat proteins: myosin, sarcoplasmic protein and actin denaturation were in close agreement to literature data. Obtained dependence of the activation energy (E_a) on the conversion degree (α), determined by Friedman method, for all three meat proteins showed the decrease of the E_a , with α which corresponds to the kinetic scheme of an endothermic reversible reaction followed by an irreversible one also showed by Istrate et al. Obtained E_a were between 156.07 - 673.05 kJ/g (for myosin), 1.08-63.53 kJ/g (for sarcoplasmic proteins) and between 531.69-1166.41 kJ/g (for actin), for α between 0.1 and 0.9.

Keywords: DSC, kinetic, denaturation, protein, meat

Reference: Istrate, D., Popescu, C., Möller, M., *Macromol. Biosci.* 2009, 9, 805–812.

ORGANIC FOOD QUALITY AND IMPACT ON HUMAN HEALTH

Ewa Rembiałkowska*

Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences, Nowoursynowska 159 c, 02-787 Warszawa, Poland

*Corresponding author:

E-mail address: ewa_rembialkowska@sggw.pl

Organic food is characterized by high biological value, because it contains the right amount of nutrients with the lowest content of harmful substances. The most recent meta-analysis of different 343 investigations concerning the chemical composition of organic and conventional crops showed that the content of a number of key antioxidants in organic raw materials and based on these products is up to 60% higher than in conventionally grown plants.

The raw organically grown materials contain also significantly lower cadmium concentrations (on average by 48%); cadmium belongs to toxic heavy metals. The concentration of nitrogen compounds proved to be significantly lower in plants from organic farming than from the conventional one - the concentration of total nitrogen by 10% lower, nitrates by 30% and nitrites by 87%. Studies have also shown that the probability of detection of pesticide residues was four times higher in conventional crops than in organic ones.

Described quality aspects of the organic foods are a good basis to formulate a hypothesis that regular consumption of organic foods should positively affect the health of consumers. Preliminary results from the research on experimental animals suggest more favorable characteristics of fertility and survival rates of animals fed organic feed compared to those fed conventional one.

Studies in humans suggest that the regular consumption of milk and milk products from organic production by mothers of children up to the age of 2 was positively correlated with the lower incidence of atopic diseases among these children. Furthermore, preliminary studies on large groups of consumers indicate that persons eating regularly mostly organic products better evaluate their health status than persons eating conventional products.

Further studies on laboratory animals and on humans are necessary in order to strengthen the established facts and to understand the mechanisms.

Keywords: *organic food, less contaminants, more antioxidants, animal health, human health*

NITROGEN AND CARBON ISOTOPIC SIGNATURE OF CHICORY (*Cichorium intybus* L.) AS AN INDICATOR OF ORGANIC PRODUCTION

Lovro Sinkovič^{1*}, Janez Hribar¹, Rajko Vidrih¹, Dragan Žnidarčič², Nives Ogrinc³

¹Department of food science and technology, Biotechnical faculty, University of Ljubljana, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia

²Department of Agronomy, Biotechnical faculty, University of Ljubljana, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia

³Department of Environmental Sciences, "Jozef Stefan" Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

*Corresponding author:

E-mail address: lovro.sinkovic@gmail.com

Stable isotope analyses have been increasingly used in authenticity control of food production. Nitrogen signature ($\delta^{15}\text{N}$) can be effectively applied to differentiate between vegetables grown by organic and integrated production systems. For plant studies it is necessary to consider isotopic fractionation that occurs during photosynthesis. Carbon isotope composition enables us to understand photosynthetic pathways and its coordination with water use in ecological and physiological studies of C3 species (most plants of temperate and cold environments). Carbon signature $\delta^{13}\text{C}$ values of C3 plants vary between -24‰ and -34‰, whereas $\delta^{13}\text{C}$ values of C4 plants (tropical grasses, maize, sugar cane) vary between -6‰ and -19‰. Stable isotope composition of carbon and nitrogen in the chicory leaves was studied by isotope ratio mass spectrometer (IRMS). Five cultivars commonly produced in Slovenia ('Treviso', 'Verona', 'Anivip', 'Castelfranco', 'Monivip') were grown organically and conventionally in pots under controlled conditions in a glasshouse, with organic and/or mineral fertilizers administered to meet nitrogen requirements. The results obtained show statistically significant differences of $\delta^{15}\text{N}$ isotope signature between organically (10 to 16‰) and conventionally (4 to 10‰) grown chicory leaves. Organic fertilisers provoked an increase in $\delta^{15}\text{N}$ values compared to synthetic fertilisers, their combination or control samples. Differences among cultivars were small and not significant. Results of $\delta^{13}\text{C}$ isotope determinations were lower and varied from -28‰ to -32‰. Addition of organic fertilizers during growth show slightly higher and statistically significant values. The organically produced chicory leaves thus showed significantly higher ^{15}N ratio as compared to those grown with synthetic fertilisers. Fertilisation had no significant effect on carbon isotope ratios in measured chicory leaves tissue.

Keywords: *chicory, ecological production, isotope ratios $\delta^{15}\text{N}$, $\delta^{13}\text{C}$*

TECHNOLOGICAL PROPERTIES OF SPELT ACCORDING TO DIFFERENT PRODUCTION SYSTEMS

Silva Grobelnik Mlakar^{1*}, Franc Bavec¹, Martina Bavec¹, Manfred Jakop¹,
Martina Robačar¹, Jovana Brkljača², Marija Bodroža-Solarov²

¹Faculty of Agriculture and Life Sciences, University of Maribor, Pivola 10,
2311 Hoče, Slovenia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: silva.grobelnik@um.si

The object of present investigation was to analyze postharvest quality of spelt (*Triticum spelta* L.) cv. 'Ebners Rotkorn' harvested in June 2012 at the University Agricultural Centre of University of Maribor, Slovenia. Grain samples were taken from the long-term field trial established in 2007 to study the effects of different production systems: conventional (KON), integrated (INT), organic (ORG), biodynamic (BD) and control (K) on crop productivity and food quality. Samples were analyzed at the Institute for Food Technology in Novi Sad, Serbia with the purpose to evaluate the quality parameters of grain, flour and dough. The analyses were performed on classical (Brabender - farinograph, extensograph, amilograph and Chopin - alveograph) and Mixolab device (Chopin) - a new system which measures the torque associated with dough during mixing and heating. The results indicate that the production system significantly affected only 6 (absolute weight, the proportion of grains with the grain size of 2.0 mm, water absorption, time and torque in phase C2 and torque in phase C5) out of 48 analyzed parameters. The correlation analysis made between parameters assessed by Mixolab and classical devices showed statistically significant and strong to very strong correlations ($r > 0,50$ in $r > 0,75$) between parameters torque C1 and wet gluten; stability of the dough and parameters tenacity of resistance to extension (P), deformation energy (W) and wet gluten; between parameters torque in C2 with curve configuration ratio (P/L) and dough extensibility (L); water absorption is correlated with protein content, wet gluten, gluten in grains and sedimentation index. Discriminant analysis showed segregation between different production systems; however ORG and BD production systems do not provide poorer quality of spelt compared to KON and INT.

Keywords: *spelt, production system, quality, rheology, Mixolab*

DESCRIPTIVE SENSORY ATTRIBUTES AND CONSUMER ACCEPTANCE OF CHERRY PIE FILLING

Nikola Tomić*, Marina Lazarević**, Ilija Djekić, Nada Šmigić,
Sanja Ljubisavljević***, Andreja Rajković

University of Belgrade, Faculty of Agriculture, Department of Food Safety and
Quality Management, Nemanjina 6, 11080 Belgrade (Zemun), Serbia

*Corresponding author:

E-mail address: tsnikola@agrif.bg.ac.rs

**Undergraduate student

***Graduate student

The aim of this study was to investigate what sensory attributes, measured by a sensory panel, are important to consumer acceptance of cherry pie filling in pastry products. Six samples of cherry pie fillings commercially available on the Serbian market were evaluated by a descriptive sensory panel comprised of the University staff and students. Descriptive sensory analysis was carried out using a defined vocabulary of 14 attributes. For the purpose of acceptance testing 12 different samples of cherry filled pastry rolls were prepared in a local bakery using the 6 cherry pie fillings and 2 types of dough: fermented and puff pastry dough. Consumers rated the pastry samples on three 9-point hedonic scales and four 9-point just-about-right scales. Sensory descriptive data were subjected to generalized Procrustes analysis (GPA) resulting in consensus data matrix which was then subjected to principal component analysis (PCA). Extracted principal components were used as explanatory variables (predictors) in further linear multiple regression analysis against the acceptance (hedonic) values for the cherry pie filling. This technique is referred to as external preference mapping (PREFMAP). The regression coefficients obtained from the regression model were segmented using K-means cluster analysis. Pronounced sourness, cherry flavour, fruit firmness and adhesiveness of the cherry pie filling were the drivers of liking for more than 50% of tested consumers. None of the pastry samples did receive significant advantage in relation to others, considering overall acceptability. In general, all of the pastry samples were recognized as insufficiently sweet by consumers.

Keywords: *descriptive sensory analysis, consumer acceptance, external preference mapping, cherry pie filling*

ANALYSIS OF POTENTIAL CARCINOGENIC CONTAMINANTS IN GRAIN AND VEGETABLES WITH FOCUS ON HEAVY METALS

Gabriel Mustatea*, Nastasia Belc, Valentin Ionescu, Mariana Ionescu,
Enuta Iorga,

National R&D Institute for Food Bioresources, 6 Dinu Vintila Street, 021102,
Bucharest, Romania

*Corresponding author:

E-mail address: gabi.mustatea@bioresurse.ro

Heavy metals refer to metallic, high density elements that are toxic and poisonous at low concentrations. They enter into the body mainly through water and food and are absorbed faster than they can be discharged. That build-up effect is the reason why heavy metal exposure is so toxic and dangerous. Cancer results from the heavy metals attaching to a cell's DNA and causing mutations. The direct and indirect damage of DNA causes an increased risk of cancer. Several heavy metals such as arsenic, cadmium, chromium are known to be carcinogenic.

The aim of this paper is to determine the content of carcinogenic heavy metals in grains (wheat, oat and barley) and vegetables (tomatoes, green onion, spinach, cabbage, radishes, salad, green garlic) from a heavily industrialized area near Bucharest using atomic absorption spectrometry technique (AAS). To compare results the limits set by Commission Regulation (EC) no. 1881/2006, Codex Alimentarius, FDA and Regulations from China and Australia were used.

Keywords: *cancer, heavy metals, contaminants, AAS*

SENSORY PROPERTIES OF A NEW ACTIVE FOOD PACKAGING

Giulia Bianchi*, Anna Rizzolo, Carmela Anna Migliori, Tiziana M.P. Cattaneo

Consiglio per la Ricerca e la Sperimentazione in Agricoltura
Unità di ricerca per i processi dell'industria agroalimentare (CRA-IAA)
Via Venezian, 26 – 20133 Milano, Italy

*Corresponding author:

E-mail address: giulia.bianchi@entecra.it

In recent years the functions of food packaging have increased together with the consumers' expectations. In addition to containment, protection and facilitation of handling of foods, it has currently both a hedonistic function, basically related to the needs of marketing, and a communicative function, due to which it is often referred to as the "silent seller". Moreover, the packaging is no longer considered solely as a passive component, but it is considered to play an active role, interacting with the external environment and with the food inside, the latter being obtained by the release of active molecules that will provide protection against microbial spoilage and oxidation.

A demonstration project was carried out with the aim of discovering new application for the Italian propolis as ingredient for active food packaging. The products arising from this research convey the propolis active compounds, that are not directly embedded into the food and are dispensed over time due to the contact with the food moisture. Two addition methods were considered: surface spreading and incorporation.

Since many components of propolis have a low olfactory threshold, the sensory properties of packaging have to be checked in order to avoid the interference with food flavour. A gaschromatography-olfactometry (GC-O) analysis was carried out to characterise each type of packaging; the prevalence of odour notes such as "balsamic" and "floral" indicated the key role of terpenes in the odour profile of propolis, while other descriptors such as "chemical", "burnt" and "paper" could be referred to the packaging material. Triangle tests were carried out on cheese samples and processed meats to establish whether the developed packagings have an influence on the sensory quality of food. Results indicated that the taste and odour of packed food during a 30 days storage period at 4°C were influenced by the propolis addition method.

Keywords: *active packaging, propolis, gaschromatography-olfactometry, triangle test, sensory properties*

MODIFIED GUAR-XANTHAN MIXTURE IMPACT ON STARCH BASED EDIBLE FILM PROPERTIES

Danijela Šuput^{1*}, Vera Lazić¹, Senka Popović¹, Nevena Hromiš¹, Lato Pezo²

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of General and Physical Chemistry, University of Belgrade,
Studentski trg 12, 11000 Belgrade, Serbia

*Corresponding author

E-mail address: suput.danijela@gmail.com

The present paper examined the effects of modified guar-xanthan mixture on mechanical, barrier and structural characteristics of starch based edible films. Films were obtained from water solutions containing gelatinized modified corn starch, glycerol and modified guar-xanthan mixture in 3 different concentrations: 0.1%, 0.3% and 0.5%, by casting it on a Petri dish and evaporating at room temperature. The mechanical properties (thickness, tensile strength and elongation at break), barrier properties (water vapour permeability) and structural characteristics were examined. The obtained films had thickness in the range from 0.068 to 0.079 mm. Regarding the mechanical characteristics, the addition of modified guar-xanthan mixture improved film flexibility and enabled better film folding and handling. The mechanical properties of films with modified guar-xanthan mixture improved since tensile strength decreased from 0,049 N/15mm to 0,009 N/15mm and elongation at break increased from 5,80 to 6,90% for samples with lowest and highest modified guar-xanthan mixture addition, respectively. Regarding barrier properties, it was proved that the addition of modified guar-xanthan mixture negatively affected water vapour permeability. Water vapour permeability value increased from 205.84 g/m² 24h for sample with 0.1% guar-xanthan addition, over 214.33 g/m² 24h for sample with 0.3% guar-xanthan addition to 236.35 g/m² 24h for sample with 0.5% guar-xanthan addition. Structural properties were determined by analyzing FT-IR spectra obtained in the spectral range of 4000–500 cm⁻¹ with a 4.0 cm⁻¹ resolution. Results pointed the quantitative law dependence between the added amount of modified guar-xanthan mixture, described by equation: $y=0.385x+(-0.0295)$.

Keywords: *packaging, edible films, starch, guar-xantan, characteristics*

MALONDIALDEHYDE AS THE MARKER OF LIPID PEROXIDATION OF RICE-BUCKWHEAT GLUTEN-FREE COOKIES DURING STORAGE

Pavle Jovanov, Nataša Nedeljković, Marijana Sakač*, Aleksandra Mišan, Ivan Milovanović, Bojana Šarić, Dubravka Jambrec

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: marijana.sakac@fins.uns.ac.rs

Rice-buckwheat gluten-free cookies (20% RF/LB) were produced using light buckwheat flour (LBF) and rice flour (RF) (20:80) in gluten-free cookie formulation. Although cookies are known for their long shelf-life, 20% RF/LB possessed a high amount of vegetable fat (28% on flour weight basis) which made them susceptible to oxidative changes. The progress of lipid oxidation of 20% RF/LB was monitored by measuring malondialdehyde (MDA) content in unpacked and packed (polypropylene bags) cookies kept at elevated temperature ($40 \pm 1^\circ\text{C}$) during 9 months.

Malondialdehyde was collected after distillation of mixture consisted of cookies and water (adjusted to 1.5-1.8 with 2 M of HCl) and subsequently detected and quantified using liquid chromatograph (Agilent 1200 series), equipped with a DAD detector and an Eclipse XDB-C18, 1.8 μm , 4.6 \times 50 mm column (Agilent). The changes in MDA content are shown in Fig. 1.

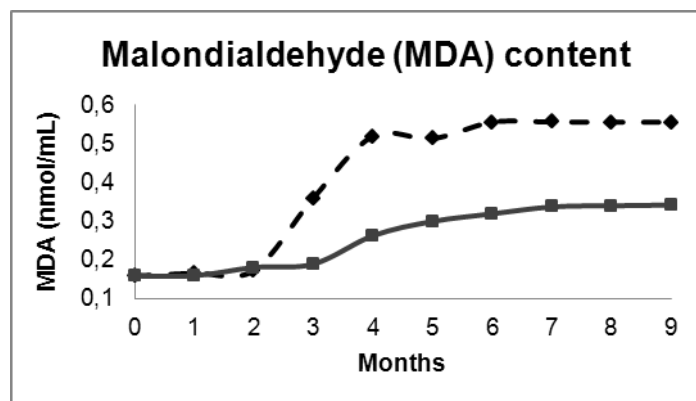


Fig. 1. Changes in malondialdehyde (MDA) content in packed (---) and unpacked (—) gluten-free cookies kept at elevated temperature ($40 \pm 1^\circ\text{C}$) during 9 months of storage

The obtained results indicated that MDA content can be used as the marker of lipid oxidation of gluten-free cookies kept at elevated temperature ($40 \pm 1^\circ\text{C}$) during storage, i.e. MDA values can be used for prediction their shelf-life. Monitoring of MDA values revealed the unpacked cookies kept at elevated temperature were acceptable until 3. months of storage while the packed cookies underwent the oxidative changes at the end of 4. months.

Keywords: *gluten-free cookies, lipid oxidation, MDA, shelf-life*

INFLUENCE OF STORAGE CONDITIONS ON SURVIVAL OF SELECTED BACTERIA IN BOTTLED MINERAL WATER

Marina Rajič*, Dragoljub Cvetković, Aleksandra Velićanski, Siniša Markov

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: rajich.marina@gmail.com

Bottled mineral water must not be treated before packaging, and in Serbia usually PET bottles are used. Current Regulations on water quality in Serbia prescribes that in 250 mL there must not be *Pseudomonas aeruginosa*, nor any faecal coliforms. Though, it is possible for water samples to contain a larger number of total count bacteria, if it is a result of natural growth of autochthonous bacteria during storage period. The aim of this paper was to determine the influence of different storage temperatures on viability of selected bacteria in bottled natural mineral water during storage period.

Out of several bacteria species which can be found, we have selected *Pseudomonas aeruginosa*, because of its crucial role in formations of biofilms, and some of bacteria indicators of faecal pollution: *Escherichia coli*, *Citrobacter freundii* and *Enterococcus faecalis*. All the strains were identified on Vitek 2 Compact System before the inoculation, as well as after the experiment. In order to determine the life range of these bacteria in original PET packages, 60 samples were artificially contaminated and another 60 were saved unopened as control batch. Half of each batch was stored in refrigerator and in dark, while other half was at room temperature exposed to sunlight, for 75 days. Growth of bacteria was monitored in regular time periods, using a membrane filtration method and selective media for each strain. Samples from control batch were checked for total count on 22 °C and 37 °C.

All the samples of bottled water were in compliance with microbiological regulations set out in the Regulations on the quality and other requirements for natural mineral water, natural spring water and table water. *Pseudomonas aeruginosa* was the most viable and resistant to different storage conditions, while other bacteria have decreased much rapidly when exposed to sunlight and room temperature.

Keywords: *water, microbiological control, contamination indicators, storage conditions*

INVESTIGATION OF BIOPOLYMER FILMS APPLICATION FOR PACKAGING IN MODIFIED ATMOSPHERE

Senka Popović^{1*}, Vera Lazić¹, Danijela Šuput¹, Nevena Hromiš¹,
Ljiljana Popović¹, Žužana Vaštag¹, Biljana Pejić²

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²"Imlek" AD. Padinska skela bb, Serbia

*Corresponding author:

E-mail address: madjarev@uns.ac.rs

Traditionally, a great quantity of plastic materials is used for packaging purposes. There is a growing pressure in fresh meat, fruits and vegetables, and minimally processed foods packaging sector to replace the petrochemical based packaging materials with a more environmentally friendly biodegradable ones. Biodegradable packaging materials produced from natural products may provide an alternative to the problem of disposing of synthetic plastic materials. The use of biodegradable polymers for packaging offers an alternative and partial solution to the problem of accumulation of solid waste composed by conventional inert polymers. The special interest is in biopolymers obtained from agro-industrial waste.

The improvement of the safety and quality of fresh and minimally processed foods is of major interest to both the consumer and the food industry. The MAP technology is widely used to extend shelf life of such type of food products by reducing moisture loss due to low O₂, high CO₂ and high RH within the package, resulting in lower respiration rate and retarded microbial growth.

In this paper, we investigate the possibility of biodegradable films, obtained from local agro-industry waste, to produce pouches and to maintain modified atmosphere in it. Examined physico-mechanical, barrier and structural characteristics showed that obtained films have satisfied properties to be used as packaging materials. Low gas permeability (648.76 ml/m²/day at 1 bar for CO₂, 27.42 ml/m²/day at 1 bar for O₂, 25.07 ml/m²/day at 1 bar for N₂, and 25.74 ml/m²/day at 1 bar for air) give them excellent potential as a material for modified atmosphere packaging. Pouches made from pumpkin oil cake/zein composite films possessed desired quality of heat-seal and maintained MAP for several weeks.

Keywords: *biopolymers, pumpkin oil cake, zein, characteristics, modified atmosphere packaging*

BROCCOLI INGREDIENTS: INNOVATION FROM THE AGRIFOOD SCIENCE TO THE SPIN-OFF EXPERIENCE

Diego A. Moreno*¹, Maria Carmen Martínez-Ballesta², Micaela Carvajal²,
Cristina García-Viguera¹

¹Food Science and Technology Dept. Phytochemistry lab. CEBAS-CSIC,
Campus Espinardo – 25, Espinardo, 30100 Murcia, Spain

²Plant Nutrition Dept. Research Group on Aquaporins. CEBAS-CSIC, Campus
Espinardo – 25, Espinardo, 30100 Murcia, Spain

*Corresponding author:

E-mail address: dmoreno@cebas.csic.es

Broccoli (*Brassica oleracea* var. *Italica*) appears to be one of the best inducers of mammalian detoxification enzymes (also known as phase II enzymes) associated with a reduced risk of suffering different chronic conditions and diseases including carcinogenic processes and cardiovascular pathologies. Additionally, it has been suggested as a health-promoting food for the digestive tract. Broccoli byproducts (harvest remains) are responsible of important environmental problems, since $\frac{3}{4}$ of the plant is discarded after harvest. This bioburden has only been used as animal feedstuff or as a source of glucosinolate standards. However, the boosted broccoli crop productions for the growing EU markets in the last few years makes unbearable to manage such amount of byproducts generated by this agri-food activity with a marked seasonality and strong economic relevance in the area. The integrated study "from farm to health" at CEBAS-CSIC (the Spanish Research Council Institute in Murcia), developing healthier foods enriched in bioactive phytochemicals, is uncovering new possibilities for the use of broccoli: edible fresh foods with added value of high-density in chemopreventive glucosinolates, biotechnological ingredients for cosmetics, patented ingredients for culinary and industrial dietetic food products, agricultural applications in green chemistry, etc. Therefore novel opportunities and strategies for economic activities in the EU arena were envisaged: The development of a spin-off company to offer a pipeline of scientifically based and certified products for commercialization – Aquaporins & Ingredients SL. Therefore, current developments on bioactive compounds from new sources in agricultural commodities open new opportunities in the convergence of food/pharma, with the transfer of technology from public R&D teams that could be incorporated in technologically based companies with a broad spectrum of possibilities in the global era of the food science for health.

Keywords: *Brassica*, *bioactive*, *glucosinolates*, *start-ups*, *ingredients*

WORLD WIDE SPREAD OF *SALMONELLA ENTERICA* SEROTYPES, HARBORING DIFFERENT MECHANISMS OF RESISTANCE

Maja Velhner^{1*}, Gordana Kozoderović², Dubravka Milanov¹,
Dalibor Todorović¹, Ljiljana Suvajdžić³

¹Scientific Veterinary Institute „Novi Sad“, Serbia

²Faculty of Education in Sombor, Department of Natural Sciences and
Mathematics, University of Novi Sad, Serbia

³Faculty of Medicine, Department of Pharmacy, University of Novi Sad, Serbia

*Corresponding author:

E-mail address: maja@niv.ns.ac.rs

Salmonellae are one of the most common foodborne pathogens. Intensive trades, traveling and therapeutic use of antibiotics pose significant risks for worldwide dissemination of multi-drug resistant Salmonella. In this work, we briefly described some biological and genetic features of clonally distributed *S. Typhimurium*, *S. Swarcengrund*, *S. Kentucky* and *S. Infantis*. The strains have developed various mechanisms of resistance and important genetic traits that enable their survival in the environment for years. *S. Typhimurium* var Copenhagen, *S. Typhimurium* DT12/193 and *S. Kentucky*, develop three to four-point mutations on topoisomerase genes. All of these isolates manifest clinical resistance to fluoroquinolones (MICs from 4-32 mg/L). *S. Enteritidis* and *S. Infantis* resistant to nalidixic acid and tetracycline are the most prevalent serotypes in Serbia. The resistance to quinolones in existing clones of *S. Infantis* is attributed to a single point mutation in *gyrA* gene (Ser83→Tyr). In several strains, the increase of MIC to CIP (2µg/ml) was observed as well as the second point mutation on *parC* gene (Ser80→Arg) (Velhner et al., Zoonoses and Public Health, 2013). The cautious use of antimicrobial agents is the most important way to prevent the development of bacterial resistance.

Keywords: *Salmonella*, resistance, fluoroquinolones, clonal spread

SUSTAINABLE DEVELOPMENT AS AN INNOVATIVE GUIDELINE IN MODERN AGRICULTURE

Vesna Weingerl*

Faculty of Agriculture and Life Sciences, University of Maribor, Pivola 10,
2311 Hoče, Slovenia

*Corresponding author:

E-mail address: vesna.weingerl@um.si

After years of competition in a conventionally insatiable agricultural running, we were finally aware that, we urgently need a new guideline in agriculture. Sustainable agriculture is an approach which is environmentally sound, economically worth doing, ethical and beneficial to society.

The present work represents innovative approach to contradictions and questions in order to review present food production system and thoughtful evaluate its future. Sustainable agriculture will be presented as a part of natural cycle. Local self-sufficiency and the importance of autochthonic seeds for human welfare were highlighted as a sustainable path. Recession is an unenviable crisis period. The time of global economic crisis it is the time, which we live at the local level. How can we deal with problems connected with this crisis and how should we survive in this period? The importance of cooperation and connection between people is highlighted as a basic tool for building sustainable agricultural society and to empower people. The good side of recession its incentive to do something, to change something, to connect, collaborate and help each other. We should try to see the world crisis as a natural disaster.

The connections between vegetarianism, spirituality and sustainable agriculture were clearly demonstrated. Modern agriculture urgently needs disciplines to transcend their traditional boundaries and move towards a requisitely holistic concept, able to integrate regarding socio-economic, ethical, and environmental questions. The main goal nowadays isn't the solutions to theoretical questions but the changes in the values of society and in the behaviour of the people, starting from the practitioners of the education process. Teaching and practicing of sustainable agriculture are the innovative guidelines in a modern agriculture.

Keywords: *sustainable development, agriculture, local self-sufficiency, empower*

FUNCTIONAL FOOD PRODUCTS IN THE EUROPEAN LEGISLATIVE FRAME

Nada Knežević^{1*}, Suzana Rimac Brnčić²

¹Podravka d.d., Food industry, A. Starčevića 32, 48000 Koprivnica, Croatia

²Faculty of Food Technology and Biotechnology, Pierottijeva 6,
10000 Zagreb, Croatia

*Corresponding author:

E-mail address: nada.knezevic@podravka.hr

A series of studies showed increased awareness of importance of healthy eating, which opened a range of possibilities for new types of products, called functional products or functional foods. The concept of functional foods is conceived in Japan thirty five years ago, and today food industry around the world bases its development on this segment.

Functional food products have a very high rate of growth. The trend of a healthy diet based on natural ingredients requires greater transparency and more information about these products and their impact on the health.

In order to place such foods on the market and to emphasize its impact on health, it is of great importance to comply with existing legislation. Many countries in the region still do not have regulations governing this area. Regulation (EC) No. 1924/2006 on nutrition and health claims made on foods (with amendments) and Directive 2009/39/EC on foodstuffs intended for particular nutritional uses, are of high importance for this group of products. Law on food with health claims and food enriched with nutrients (Official Gazette No. 39/13) and the Law for food with particular nutritional purposes (Official Gazette No. 39/13) are currently valid in Croatia.

These regulations include procedures for official notification and scientific studies that confirm the positive effect of these foods on human health. Furthermore, in order to successfully implement, monitor and supervise such food, it is necessary to have an updated Register of approved claims that can be placed on the food declaration. After a long time debate, the European Union managed to regulate the area of food with added values as well as the requirements when and under what conditions these foods can be marketed.

Keywords: *healthy eating, healthy food, functional food, health claims, legislation*

FATTY ACID COMPOSITION OF WHITE MUSCLE OF TWO-YEAR OLD COMMON CARP REARED IN SEMI-INTENSIVE SYSTEM – PRELIMINARY RESULTS

Zorka Dulić^{1*}, Dejana Trbović², Marko Stanković¹, Ivana Živić³,
Uroš Ljubobratović⁴, Zoran Marković¹

¹University of Belgrade, Faculty of Agriculture, Nemanjina 6,
11080 Belgrade, Serbia

²Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

³University of Belgrade, Faculty of Biology, Studentski trg 16,
11000 Belgrade, Serbia

⁴University of Belgrade, Institute for Multidisciplinary Research,
Kneza Višeslava 1, 11000 Belgrade, Serbia

*Corresponding author:

E-mail address: zorkad@agrif.bg.ac.rs

Fatty acid profile of common carp reared in semi-intensive system is influenced by two sources, natural food, mainly zooplankton and zoobenthos, available from the pond and supplemental feed. Zooplankton is a valuable food item for carp due to its high content of n-3 polyunsaturated fatty acids, especially eicosapentaenoic and docosahexaenoic acid. Additionally, it is observed that carp can metabolize n-3 highly unsaturated fatty acids from α linolenic acid. The aim of this study was to analyze the fatty acid content of two year old carp white muscle reared in semi-intensive system using pelleted feed. The experiment was carried out in three earthen ponds at fish farm "Despotovo" from June to October. Fish were fed daily with standard pelleted supplemental feed (25% protein, 7% fat). Fish and zooplankton samples for fatty acid analysis were collected monthly from ponds. The fish dorsal muscle had on average 31% of saturated fatty acids (SFA), while monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) were represented with 39% and 29%, respectively. The amount of n-3 and n-6 PUFA in fish muscle was 2% and 27%, respectively. Analysis of fatty acid composition of pelleted feed showed that it contained 16% SFA, 26% MUFA and 59% PUFA, higher content of n-3 and n-6 PUFA compared to fish meat, 4%, and 55% respectively. Zooplankton fatty acid composition was represented with 39% SFA, 29% MUFA, 32% PUFA, 24% n-3 PUFA and 9% n-6 PUFA. The highest difference between fish flesh, pelleted feed and zooplankton was observed in the content of n-3 and n-6 PUFA. It seems that two year old carp did not fully utilize the rich sources of n-3 HUFA coming from zooplankton. This was probably due to lower overall consumption of natural food, lower fatty acid turnover and selective storage in older carp.

Keywords: *fatty acids, common carp, semi-intensive system, zooplankton, pelleted feed*

IMPACT OF FRYING ON CHEMICAL PARAMETERS OF SILVER CARP (*Hypophthalmichthys molitrix*) MEAT QUALITY

Vesna Đorđević^{1*}, Danijela Vranić¹, Dejana Trbović¹, Vladimir Korićanac¹,
Miroslav Čirković², Dragana Ljubojević², Milan Milijašević²

¹Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

²Scientific veterinary Institute "Novi Sad"

*Corresponding author:

E-mail address: vesna@inmesbgd.com

The aim of this study was to determine and compare the chemical composition and fatty acid profile of silver carp fried fillets and of hot smoked fried fillets.

A total of six samples of fried carp fillets and of six samples of fried smoked carp fillets were examined. Fish was originating from the same pond.

Content of protein, fat, water and ash were determined by standard ISO methods, while the cholesterol determination was performed after direct saponification of sample by HPLC/PDA. Lipids were extracted from fish fillet by Dionex ASE 200. Determination of fatty acids as methyl esters was carried out by gas-liquid chromatography (GC/FID), on capillary HP-88 column.

The average content of protein, water and cholesterol in fillets of fried carp and hot smoked carp was not statistically significantly different ($p > 0.05$). The average ash content in the fillets of fried carp was statistically significantly lower than in fillets of hot smoked carp ($p < 0.05$), and the average fat content was higher in the fried fillets of hot smoked carp ($7.60 \pm 0.10\%$) compared to the fat content in fried carp fillets ($6.10 \pm 0.20\%$).

Fried carp contained more polyunsaturated fatty acids compared to fried smoked carp, which contained more saturated and monounsaturated fatty acids. The n-3/n-6 ratio was significantly lower in the fillets of fried carp than in smoked fillets of fried smoked carp (1.39).

Keywords: *frying, silver carp, chemical composition*

Acknowledgement: *This work was supported by the project TR-31011, funded by the Ministry of Education and Science of the Republic of Serbia.*

INFLUENCE OF THE TECHNOLOGICAL PROCEDURE OF (HOT) SMOKING ON SILVER CARP MEAT QUALITY PARAMETERS (*Hypophthalmichthys molitrix*)

Vesna Đorđević^{1*}, Danijela Vranić¹, Dejana Trbović¹, Radivoj Petronijević¹,
Miroslav Ćirković², Dragana Ljubojević², Milan Milijašević²

¹Institute of Meat Hygiene and Technology, Kačanskog 13,
11000 Belgrade, Serbia,

²Scientific veterinary Institute "Novi Sad"

*Corresponding author:

E-mail adress: vesna@inmesbgd.com

The objective of this study was to investigate whether the technological process of hot smoking of silver carp fillets affects the chemical composition of the fillets, and whether it changes their fatty acid profile. Six samples of silver carp were examined before and after the process of hot smoking.

Content of protein, fat, water and ash were determined by standard ISO methods, while the cholesterol determination was performed after direct saponification of sample by HPLC/PDA. Lipids were extracted from fish fillet by Dionex ASE 200. Determination of fatty acids as methyl esters was carried out by gas-liquid chromatography on capillary HP-88 column.

The average content of protein and fat was statistically significantly higher ($p < 0.05$), and water content significantly lower ($p < 0.05$) in the hot smoked carp fillets compared with the fillets of fresh carp. Hot smoked carp fillets had higher ($p < 0.05$) ash content ($2.88 \pm 0.03\%$) than fillets of fresh carp ($1.16 \pm 0.07\%$). The average cholesterol content was 108.21 ± 9.70 mg/100g, and was significantly higher ($p < 0.05$) compared with average cholesterol content of fresh carp fillets, 89.44 ± 2.76 mg/100 g.

Hot smoking of carp fillets caused no significant differences in the content of saturated and monounsaturated fatty acids. The content of polyunsaturated fatty acids and the n-3/n-6 ratio were higher in the hot smoked carp fillets (14.89% and 4.04) compared with the fillets of fresh carp (12.93% and 2.61). Hot smoked carp fillets can be considered of higher nutritional quality.

Keywords: silver carp, quality parameters

Acknowledgement: This work was supported by the project TR-31011, funded by the Ministry of Education and Science of the Republic of Serbia.

THE GROWTH RATE DISPERSION OF SUCROSE CRYSTALS

Jasna Grbić^{1*}, Rada Jevtić-Mučibabić¹, Tatjana Kuljanin², Bojana Filipčev¹,
Olivera Šimurina¹, Jelena Krulj¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jasna.grbic@fins.uns.ac.rs

Crystallization from solution is one of the oldest industrial separation process widely developed in chemical, pharmaceutical and food industries. It is carried out as a large scale batch or continuous operation in sugar cane and sugar beet industry. The aim of the crystallization process is to achieve the highest sugar quality and yield, the highest exhaustion of molasses, the lowest energy consumption together with the most effective use of equipment and time. Crystallization is an exothermic process, which consists of nucleation and crystal growth. In industrial sugar crystallization, nucleation is avoided by introducing crystalline centers by seed crystals produced in different ways.

In this study, the measurement of size distribution was applied for determination of sucrose crystal growth rate in model solutions in a batch cooling crystallizer. The sucrose crystal growth rate was estimated using the theory of molecular diffusion according to the two-step model.

Under the same conditions of supersaturation, temperature and hydrodynamics of solution, different crystals grew at different rates. This phenomenon was designated as growth rate dispersion. It was shown that the dependence of the crystal mass growth rate on the crystal size followed linear dependency. It was in accordance with the size-dependent growth model. During cooling crystallization maximum of mass distribution was shifted to higher values of crystal size and increased the distribution widths. Findings indicated that spread of sucrose crystal size distribution during cooling was a consequence of growth rate dispersion. The Rosin-Rammler-Sperling-Bennet model fitted the crystal size distribution data well. The achievement of a narrower size distribution in the final product is of great practical importance in industrial sugar crystallization.

Keywords: *sucrose crystal, cooling crystallization, size distribution, growth rate dispersion*

PHOSPHORUS CONTENTS IN THE LONGISSIMUS DORSI AND SEMIMEMBRANOSUS MUSCLES FOR FIVE PUREBRED PIGS FROM VOJVODINA (NORTHERN SERBIA)

Vladimir Tomović¹, Marija Jokanović^{1*}, Tatjana Tasić², Predrag Ikonić², Snežana Škaljac¹, Branislav Šojić¹, Mila Tomović³, Aleksandra Martinović⁴, Sunčica Kocić-Tanackov¹, Nevena Hromiš¹

¹University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²University of Novi Sad, Institute for Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

³Technical school "Pavle Savić", Šajkaška 34, 21000 Novi Sad, Serbia

⁴University of Donja Gorica, Faculty for Food Technology, Food Safety and Ecology, Donja Gorica, 81000 Podgorica, Montenegro

*Corresponding author:

E-mail address: marijaj@tf.uns.ac.rs

The content of phosphorus was investigated in *M. longissimus dorsi* and *M. semimembranosus* for five purebred pigs (Large White – LW, n = 8; Landrace – L, n = 7; Duroc – D, n = 6; Hampshire – H, n = 7; Pietrain – P, n = 7), produced in Vojvodina, northern Serbia. Phosphorus was determined by standard spectrophotometric method. The difference in the phosphorus content among the five purebred pigs was not significant in the analysed longissimus dorsi (P=0.775) and semimembranosus (P=0.108) muscles. Also, muscle had no significant effect on the phosphorus content (P=0.162). The order of the purebred pigs regarding phosphorus content in the longissimus dorsi muscle samples (in mg/100g) was: H (202–251, on average 227) > L (211–239, on average 223) > LW (201–238, on average 222) > D (207–236, on average 219) > P (204–239, on average 217). The average phosphorus content in all investigated longissimus dorsi muscle samples was 222 mg/100g. The order of the purebred pigs regarding phosphorus content in the semimembranosus muscle samples (in mg/100g) was: L (232–243, on average 238) > LW (202–248, on average 227) > H (211–236, on average 226) > D (212–243, on average 225) > P (204–239, on average 217). The average phosphorus content in all investigated semimembranosus muscle samples was 227 mg/100g. The Vojvodian pig meat showed similar phosphorus content compared with the values found in other countries.

These results are part of the project No 114-451-1016/2014, which is financially supported by the Provincial Secretariat for Science and Technological Development, Autonomous Province of Vojvodina, Republic of Serbia.

Keywords: pigs, *M. longissimus dorsi*, *M. semimembranosus*, phosphorus

THE INFLUENCE OF PARTIAL REPLACEMENT OF MECHANICALLY DEBONED CHICKEN MEAT WITH CHICKEN LIVER ON PROXIMATE COMPOSITION AND COLOUR OF COOKED SAUSAGES

Marija Jokanović^{1*}, Vladimir Tomović¹, Mihajlo Jović², Branislav Šojić¹, Snežana Škaljac¹, Tatjana Tasić³, Predrag Ikonić³

¹University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²"Agroživ" AD Žitište, Topolovački put b.b., 23210 Žitište, Serbia

³University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: marijaj@tf.uns.ac.rs

The effects of partial replacement of mechanically deboned chicken meat - MDCM with chicken liver on proximate composition (moisture, protein, total fat, total ash) and colour characteristics (CIE $L^*a^*b^*$) of cooked sausages were investigated. The control sausage was formulated with 60% of MDCM. In experimental cooked sausage samples three levels of chicken liver were incorporated 5, 10 and 15%, as partial replacement of MDCM. Regarding proximate composition, control was numerically ($P>0.05$) the highest in moisture content, lowest in protein content, and not different in fat content, comparing with experimental sausages. Different contents of liver addition did not significantly ($P>0.05$) affect protein content; moisture content was significantly ($P<0.05$) the lowest in sample with 5% of liver, fat content was significantly different ($P<0.05$) between samples with 5% and 10% of liver addition, and total ash content was significantly different ($P<0.05$) among all three experimental sausages. Regarding colour characteristics, control had significantly ($P<0.05$) the highest lightness (L^*), and lowest redness (a^*) and yellowness (b^*), comparing with experimental sausages. Different contents of liver addition did not significantly ($P>0.05$) affect lightness (L^*), while the significant ($P<0.05$) differences were noted for redness (a^*) among all three sausages, and for yellowness (b^*) between samples with 5 and 10% of liver.

Keywords: *cooked sausage, mechanically deboned chicken meat, liver, proximate composition, colour*

COMPARATIVE EFFECTS OF ESSENTIAL OILS AND ANTIMICROBIAL AGENTS ON THE GROWTH OF *STAPHYLOCOCCUS AUREUS*

Vesna Kalaba¹, Željka Marjanović Balaban²

¹JU Veterinary Institute of the Republic of Serbian "Dr Vaso Butožan" Banja
Luka, Bosnia and Herzegovina

²Faculty of Forestry, Banja Luka, Bosnia and Herzegovina

*Corresponding author:

E-mail address: vesna.kalaba@yahoo.com

In recent years, antimicrobial agents have become the most widely prescribed drugs worldwide.

Often and over-prescribing of antimicrobial agents is one of the main reasons for the development of resistant microorganisms. European Centre for Disease Control (ECDC) and the World Health Organization (WHO) launched a large-scale campaign aimed at raising awareness of antimicrobial substances and their rational use. This study investigated the antimicrobial activity of essential oils and reference antimicrobial agents on the growth of *Staphylococcus aureus*. The antimicrobial effect of the oil on the growth of *Staphylococcus aureus* was determined by disk diffusion method, and various concentrations of essential oils were prepared by dissolving them in alcohol 96% (1:1 and 2:1, v/v). Essential oils of cinnamon and thyme showed very good inhibitory effect on the growth of *Staphylococcus aureus*. The essential oil of cinnamon in combination with the alcohol in a 2:1 ratio showed the strongest inhibition on the growth of *Staphylococcus aureus*, even stronger than any of the tested antimicrobial agents.

Keywords: *antimicrobial substances, antimicrobial activity, essential oils*

COMPARISON OF TWO MICROBIOLOGICAL SWABBING METHODS IN SURFACE HYGIENE CONTROL

Dragica Đurđević-Milošević¹, Vesna Kalaba^{2*}, Andrijana Kostić¹, Aleksandra Nikolić¹, Milka Stijepić³, Jovana Glušac³

¹MP Lab, MP Bio d.o.o., Prokupačka 41, 11000 Belgrade, Serbia

²Veterinary Institute "Dr Vaso Butozoan", Branka Radičevića 18, 51000 Banja Luka, Bosnia and Herzegovina

³School of Applied Medical Science, Nikole Pasica 4a, 52000 Prijedor, Bosnia and Herzegovina

*Corresponding author:

E-mail address: vesna.kalaba@yahoo.com

The important part of food producing and processing is microbiological hygiene. Hygiene monitoring of process surface is necessary for assuring of food quality and protection of consumers.

The swab method is standardised surface sampling method. Otherwise, the total count of bacteria and total count of *Enterobacteriaceae* estimate the level of contamination risk during food processing.

In this study was performed artificial contamination of previously sterilized glass surface. For contamination was prepared suspension of *Escherichia coli* ATCC 25922 adjusted to 3.7 on McFarland scale. Prepared dilutions of suspension for contamination were sealed with TSA agar and results used for estimation of total count bacteria in 1ml of suspension. Each of 20 test surface with an artificially soiled area of 10x10 cm² was sampled with the swab and the solutions were sealed with plate count agar (PCA). Another 20 test surfaces with an artificially soiled area were swabbed and the solutions were sealed with violet red bile glucose agar (VRBGA).

Results show that recovery was less than 50% for the count of *Escherichia coli* on PCA as well as on VRBGA.

Keywords: surface, sampling method, swab, *Escherichia coli*

MINERAL CONTENT AND MICROBIOLOGICAL PROFILE AFTER OSMOTIC TREATMENT OF NETTLE LEAVES

Violeta Knežević^{1*}, Vladimir Filipović¹, Biljana Lončar¹, Milica Nićetin¹,
Lato Pezo², Jasmina Gubić³, Dragana Plavšić³

¹University of Novi Sad, Faculty of Technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

² Institute of General and Physical Chemistry, Studentski trg 12-16,
11000 Beograd, Serbia

³University of Novi Sad, Institute of Food Technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ovioleta@uns.ac.rs

The aim of this study was to investigate the effects of osmotic treatment performed in two different solutions, on mineral content and microbiological profile of nettle leaves. Drying process was conducted using low temperature regime to preserve original thermo-sensitive ingredients. Nettle leaves were dehydrated in order to lower the water activity and microbiological load.

Nettle leaves were dehydrated in sugar beet molasses (concentrated at 80%) and aqueous solution of sodium chloride and sucrose (sucrose in the quantity of 1.200 g/kg water, NaCl in the quantity of 350 g/kg water and distilled water - ASSS), at temperatures of 20°C, for 1 hour. Mineral content (Mg, Fe, Zn, Ca and K) was determined in fresh and dehydrated leaves.

The measured Mg content (expressed in relation to the dry mass) in fresh and osmotically treated leaves (in ASSS and molasses solution) were: 2.94%, 1.56% and 3.23%, respectively. Zn was found with the highest content: 23.20%, 15.01% and 27.32% (in fresh leaves, and treated in ASSS and molasses solution, respectively). Fe content was found with the lowest content in fresh leaves, and treated in ASSS and molasses solution: 1.42%, 0.98% and 1.53%. Ca was found with content of: 3.38%, 1.92% and 4.23%, while K content was: 5.83%, 3.02% and 7.51% (in fresh leaves, and treated in ASSS and molasses solution, respectively). The content of proteins in fresh leaves was 5.61% (expressed in relation to the dry mass).

Also, the change of the microbiological profile between the fresh and dehydrated nettle leaves was examined. It was noticed that the process of osmotic treatment does improve the initial microbiological profile of the nettle leaves due to increasing dry matter content and lowering aw value. Better results of the reduction of the observed microorganisms in nettle leaves were obtained in the process of osmotic treatment in molasses.

Keywords: *osmotic dehydration, nettle, sugar beet molasses, ternary solution*

A COMBINED EFFECT OF WATER AND NITROGEN AVAILABILITY ON WHEAT GRAIN PRODUCTION

Ankica Kondić-Špika*¹, Ljiljana Brbaklić¹, Dragana Trkulja¹, Nikola Hristov¹,
Milka Brdar¹, Imre Vass², Janos Pauk³

¹Institute of Field and Vegetable Crops, Novi Sad, Serbia

²Biological Research Center, Szeged, Hungary

³Cereal Research Non-Profit Company, Szeged, Hungary

*Corresponding author:

E-mail address: ankica.spika@nsseme.com

Limited water supply is one of the major abiotic stresses that affect agricultural productivity worldwide. Drought stress influences the normal physiology and growth of plants, which can be alleviated by better plant nutrition that activates physiological, biochemical and metabolic processes. Complex interactive effect of these two important environmental factors on seed production in wheat was the objective of the study.

The experiment was conducted with ten wheat (*Triticum aestivum* L.) cultivars in controlled greenhouse conditions. Grain production parameters (no. of spikelets and kernels per spike, seed production per plant) were analyzed in different growth conditions. Two levels of water (60% and 20% field capacity) and two levels of nitrogen supply (60 and 3-4 mg N/kg soil) were combined. For this experiment soils with defined nutrition levels were used. The water was provided by computer controlled protocols.

In all wheat genotypes water and N limitation reduced the seed production parameters. Water stress had stronger negative effect on no. of spikelets, while N limitation stronger inhibited no. of kernels per spike and seed production per plant. Combination of drought stress and N limitation enhanced the effect of these stress factors relative to their separate applications. However, in case of cv. Siete Cerros the N limitation under drought stressed conditions had only a small additional effect. Cultivar NS40S had the highest seed production in drought conditions with optimal N supply, while cv. NS Avangarda had the highest seed production in drought conditions with limited N supply. These cultivars could be potential parent lines in breeding programs for production under conditions when drought and N limitation are combined.

Keywords: *Triticum aestivum* L., drought, N limitation, seed production

SUGAR BEET JUICE CLARIFICATION USING CALCIUM SULFATE, COPPER SULFATE AND ALUMINUM SULFATE

Tatjana Kuljanin*, Biljana Lončar, Milica Nićetin, Violeta Knežević,
Vladimir Filipović

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: kuljanin@uns.ac.rs

In the sugar industry, chemical processing of raw sugar beet juice and molasses are important operations that include disposal of non-sucrose substances in order to obtain higher quality confectionery product- white sugar. Calcium ions (in the form of CaO) that are commonly used to eliminate these compounds from beet juice have a relatively low binding affinity and the quantities of used lime are very large (1 – 3 % w/w, calculated on the beet). In order to reduce the amount of waste materials, the possible application of alternative coagulants with divalent and trivalent cations, CaSO₄, CuSO₄ and Al₂(SO₄)₃ was studied. These compounds cause the process of charge neutralization beet juice macromolecules which creates conditions for coagulation and sedimentation. Mechanisms of macromolecule compounds discharge using a model of double electric layer are suggested. Model - pectin solutions (50 cm³ and 0.1 % wt.) were treated with different concentration of CaSO₄, CuSO₄ and Al₂(SO₄)₃ ranging of 50 – 450 mg/dm³. The pH of solutions were regulated at 7 (pH of solutions with Al₂(SO₄)₃ were regulated using equivalent amount Na₂CO₃). In order to monitor coagulation and sedimentation process of solution, a method of measuring the zeta potential of solution was used. Zeta potential was determined by electrophoretic method. Optimal amounts of applied coagulants were: 410 mg/dm³ (610 mg/g_{pectin}) for CaSO₄; 100 mg/dm³ (151,5 mg/g_{pectin}) for CuSO₄ and 110 mg/dm³ (162 mg/g_{pectin}) for Al₂(SO₄)₃. These values are significantly less than the average amount of CaO used in classical process of sugar beet juice clarification (about 9 g/g_{pectin}).

Keywords: *sugar beet juice, CaSO₄, CuSO₄, Al₂(SO₄)₃, zeta potential*

MICROBIOLOGICAL PROFILE OF FISH (*Carassius gibelio*) DEHYDRATED IN SUGAR BEET MOLASSES

Biljana Lončar^{1*}, Vladimir Filipović¹, Milica Nićetin¹, Violeta Knežević¹,
Lato Pezo², Dragana Plavšić³, Ljubiša Šarić³

¹University of Novi Sad, Faculty of Technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of General and Physical Chemistry, Studentskitrg 12-16,
11000 Beograd, Serbia

³University of Novi Sad, Institute of Food Technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

e-mail address: biljanacurcicc@gmail.com

Presence of fish in diet is very important for both human health and nutrition, but high water activity (*aw*) value and high moisture content of fish tissue make fish very perishable food. There are many processing methods to extend fish shelf life. Osmotic dehydration is a water removal process that involves the contact between food material and hypertonic medium. Sugar beet molasses has to be very useful osmotic medium. The objectives of the study were to evaluate the effects of two different processing temperatures on microbiological profile of fish (*Carassius gibelio*). Also, *aw* values, water loss and solid gain of the fresh and processed fish samples were determined and the microbiological profile between the fresh and dehydrated meat was compared. The process was carried out in laboratory jars under atmospheric pressure for 5 hours at 20 and 35°C. Sample to solution ratio was 1:5 (w/w) to neglect the changes of solution concentration during the water removal process. Agitation was repeated manually every 15 minutes. Osmotic dehydration in sugar beet molasses at both temperatures has proved to be efficient in reducing *aw* and moisture content of fish samples providing quality and safe fish semi product.

Keywords: *osmotic dehydration, fish, sugar beet molasses*

PHYSICO-CHEMICAL CHANGES DURING THE RIPENING OF SEMI-HARD EXPERIMENTAL CHEESE

Aleksandra Martinović*, Ivana Zuber Bogdanović, Marija Vugdelić

Faculty of Food Technology, Food Safety and Ecology,
University of Donja Gorica, Podgorica, Montenegro

*Corresponding author:

E-mail address: aleksandra.martinovic@udg.edu.me

Experimental semi-hard cheese variety has been analyzed to determine the general mechanisms during ripening process. By analyzing the sensory properties, gross chemical composition of the cheese as well as casein components, peptides, amino acids and volatile compounds, major cheese properties were determined at the end of the ripening. Primary proteolysis was monitored by capillary electrophoresis (CE), smaller peptides and free amino acid content by HPLC-MS, while the volatiles were determined using GC-MS. Results obtained for the UMB1 cheese were compared and discussed with the results obtained for different cheese varieties that could be found on the market. Capillary electrophoresis (CE) of the UMB1 cheese (Fig. 1) showed that there has been chymosin as well as plasmin activity, that has caused complete hydrolysis of α_{s1} -casein resulting in accumulation of α_{s1} -I-casein. The highest amount of amino acids was recorded for glutamic acid while the presence of GABA, AABA and trp was not detected by HPLC analysis. Recorded amount of total amino acids in UMB1 cheese after 12 months of its ripening implies the importance of metabolic activities of starter and nonstarter bacteria in this cheese and these findings are well connected to the results obtained for volatile compounds detected in UMB1 cheese.

Keywords: *semi-hard cheese, ripening, peptides, volatile compounds*

CRYOPROTECTIVE EFFECT OF OAT β – GLUCANS ON CHICKEN SURIMI

Krešimir Mastanjević, Dragan Kovačević*

Faculty of Food Technology, University of Josip Juraj Strossmayer in Osijek,
Kuhačeva 20 31 000 Osijek, Croatia

*Corresponding author:

E-mail address: dragan.kovacevic@ptfos.hr

Differential scanning calorimetry (DSC) was used to study cryoprotective effects of oats β – glucan on chicken surimi after frozen storage. Also influence of frozen storage on texture profile analysis (TPA), instrumental colour parameters and cooking loss of chicken surimi were investigated. Chicken surimi samples were prepared from broiler meat, mixed with oat β – glucans ($w = 0 - 6\%$), quickly frozen and stored for 30 days on -30 °C. Onset temperature of transition (T_o), peak thermal transition (T_p), and endset temperature of transition (T_e), and denaturation enthalpy (ΔH), was evaluated. Peak (T_p) thermal transition temperatures of chicken myosin showed shift to higher values with the increase of mass fraction of β – glucans. Denaturation enthalpies (ΔH) of chicken myofibrillar proteins showed increase with increase of mass fraction of oat β – glucans. Instrumental colour parameters (Lightness (L^*), redness (a^*), yellowness (b^*) and whiteness ($L^* - 3b^*$) of chicken surimi gels were significantly ($P < 0.05$) affected by addition of oat β – glucans. Hardness, gumminess and chewiness increased significantly ($P < 0.05$) and cooking loss decreased significantly ($P < 0.05$) by addition of oat β – glucans. Cohesiveness and springiness of chicken surimi gels were not significantly ($P > 0.05$) affected by addition of oat β – glucans. Increase in peak thermal transition (T_p), denaturation enthalpies (ΔH), some TPA and instrumental colour parameters indicates possible cryo-stabilisation of chicken myofibrillar proteins with addition of oat β – glucans.

Keywords: cryoprotection, chicken myofibrillar proteins, DSC, β – glucan texture (TPA), instrumental colour (L^* , a^* , b^*)

LAB-SCALE OPTIMIZATION OF BEER FERMENTATION WITH IMMOBILIZED TOP-FERMENTING YEAST

Vessela Naydenova*, Vasil Iliev, Georgi Kostov

Department "Technology of wine and brewing", University of Food Technologies,
26 Maritza boulevard, 4002, Plovdiv, Bulgaria

*Corresponding author:

E-mail address: vesi_nevelinova@abv.bg

The present work regards batch beer fermentation with immobilized top-fermenting yeast *Saccharomyces cerevisiae* Safbrew S-33. The yeast cells were encapsulated in alginate-chitosan microcapsules with a liquid core. The effects of main fermentation temperature (T_{MF}), immobilized cell mass (M_{IC}) and original wort extract (OE) on beer fermentation was investigated using Central Composite Design of type 2^3 with star arm and block structure. The basic beer characteristics, i.e. extract, ethanol, biomass concentration, pH and colour, as well as the concentration of aldehydes and vicinal diketones were measured. The results suggested that the process parameters represented a powerful tool in controlling the fermentation time. The differences observed in the main fermentation time and maturation time among the variants were due to the rate of carbonyl compounds production and reduction. The results were used for the development of two mathematical models for beer fermentation with immobilized cells. Subsequently, the optimized process parameters were used to produce beer in laboratory batch fermentation. The system productivity was also investigated and the data was used for the development of another mathematical model.

Keywords: *beer, top fermenting yeast, optimization, encapsulation*

EVALUATION OF MASS TRANSFER KINETICS DURING OSMOTIC TREATMENT OF CELERY LEAVES

Milica Nićetin¹, Lato Pezo², Biljana Lončar¹, Vladimir Filipović¹,
Tatjana Kuljanin¹, Violeta Knežević¹, Danijela Šuput¹

¹University of Novi Sad, Faculty of Technology, Bulevar Cara Lazara 1, 21000
Novi Sad, Serbia,

²University of Beograd, Institute of General and Physical Chemistry, Studentski
trg 12-16, 1100, Beograd, Serbia

*Corresponding author:

E-mail address: milican85@live.com

In order to analyze mass transfer kinetics during osmotic treatment, celery leaves (*Apium graveolens*) was dehydrated in two different osmotic solutions (sugar beet molasses and the mixed solution of sodium chloride and sucrose) under atmospheric pressure, at three different temperatures (20°C, 35°C and 50°C). The main objective was to examine the influence of osmotic agents, temperature and dehydration time on the mass transfer phenomena during osmotic treatment. Response Surface Methodology (RSM) was used for optimization of osmotic treatment of celery leaves in respect to temperature and type of osmotic solution. The significance of used hypertonic solutions, temperature and immersion time on the various kinetics parameters: water loss (WL), solid gain (SG) and dehydration efficiency index (DEI), were tested during the process, using Analysis of variance (ANOVA). According to results, optimum process parameters for osmotic treatment of celery leaves were: osmotic time of 5 hours, sugar beet molasses as osmotic solution and temperature of 50°C. The predicted responses for the optimum drying conditions in sugar beet molasses solution were: WL about 0.78 and SG about 0.16 g/g initial sample weight.

Keywords: *osmotic treatment, celery leaves, sugar beet molasses, mass transfer kinetics*

EFFECT OF DOUGH MIXING ON SCAVENGING CAPACITY OF FREE AND BOUND PHENOLICS FROM MIXTURE OF WHEAT AND PORCINO (*Boletus edulis*) FLOUR

Nada Nikolić¹, Jelena Stojanović¹, Miodrag Lazić¹,
Ivana Karabegović¹, Saša Stojičević¹, Jasna Mastilović²

¹University of Niš, Faculty of Technology, Leskovac, Bulevar oslobođenja 124,
16000 Leskovac, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: nadanikolic64@yahoo.com

The free phenolic compounds are mainly phenolic acids and the bound forms are linked by ester bonds to cell wall structural components such as cellulose, lignin and proteins. By bacterial hydrolysis in gastrointestinal tract from the bound forms free phenolics may be released. In this research the effect of dough mixing on scavenging capacity of free and bound phenolics from flour mixture made of wheat flour type 400 and mushroom *Boletus edulis* flour in ratio of 70:30, w/w, was investigated. A porcino mushroom from eko-region Piskupovo, Leskovac, Serbia, was used, and the flour was obtained after fresh mushrooms were dried at 35°C and milled. The scavenging capacity of 2,2 diphenyl-1-picrylhydrazyl radical (DPPH radical) was determined. The free phenolic compounds were extracted by methanol and the bound forms were alkali hydrolysed first and then extracted by mixture of diethyl ether and ethyl acetate (1:1, v/v). The obtained extract was evaporated and the dry residue dissolved in methanol. The IC₅₀ value was calculated by using Microsoft Excel ed50plus v1.0 software. The resulting IC₅₀ value of free and bound phenolics from flour mixture was 0.91 and 0.14 mg/ml, respectively, and after dough mixing, this value was 0.42 and 0.03 mg/ml, respectively. As the lower IC₅₀ value indicates higher scavenging capacity, the results show the bound phenolics had over six times higher DPPH scavenging capacity than that of free phenolics. The results showed that after dough mixing, the scavenging capacity of obtained extracts was significantly higher. This is probably due to hydration reactions of phenolic compounds which occurred when water during mixing was added. Then the phenolic compounds probably existed in a hydrate state which increased their extractability and scavenging capacity.

Keywords: *wheat, porcino, free, bound, phenolics*

Acknowledgement: *This work is supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under the project 172047.*

EFFECT OF SUCROSE IMPREGNATION ON AIR-DRYING BEHAVIOUR OF APRICOT

Ivan Pavkov*, Ljiljana Babić, Mirko Babić, Milivoj Radojčin, Zoran Stamenković

Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obardovića 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ivan.pavkov@polj.uns.ac.rs

In this study, osmotic dehydration and effect of sucrose impregnation on air-drying behavior of apricot halves were investigated.

As the research material, the mesocarp tissue of the apricot (*Prunus armeniaca* L) has been used in the shape of fruit halves. Apricot halves were dehydrated in sucrose solutions during three hours at varied concentrations (50 and 65%) and temperatures (50 and 60 °C). The sugar gain, water loss and relative volumetric shrinkage ratio were determined. The most significant water loss, sugar gain, and relative volumetric shrinkage ratio has been noted in the combination 60 °C and 65%, (-55 g/100g, 6.06 g/100g, 0.3449, successively). Samples not-treated and pre-treated in osmotic solutions during 23 hours were dried in a hot air dryer at varied air temperatures (40 and 60 °C) and flow rates (1 and 1,5 m/s). The monitoring of the effects of process parameters on the air drying kinetics of the apricot tissue has been done by the measurement of tissue: moisture, temperature and volumetric shrinkage.

The convective drying time is generally reduced with: increase in drying temperature and air velocity. The use of osmotic pretreatment resulted in longer drying times compared with not treated. Effective moisture diffusivity values (D_{eff}) for all the drying conditions varied from 5.27×10^{-8} to 2.07×10^{-6} m²/s and not treated samples had higher values than osmotic treated samples. Activation energy values for not treated samples were 37.41 KJ/mol and 61.79 KJ/mol for treated. During convective drying there was difference in material temperature and volumetric shrinkage, the lower material temperature and volumetric shrinkage was recorded with in pre-treated samples. Applying osmotic dehydration as a pre-treatment decreases the rate of convective drying due to forming of moisture adsorption bonds, solute, and dry matter in apricot flesh.

Keywords: *apricot, osmotic dehydration, air drying, drying kinetics*

MERCURY IN FISH AND FISH PRODUCTS

Biljana Pećanac, Drago Nedić, Slobodan Dojčinović

P.I. The veterinary institute of the Republic of Srpska "Dr Vaso Butozan" Banja Luka, 78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author:

E-mail address: biljanapecanac@hotmail.com

Mercury is a contaminant that belongs to the group of heavy metals. There is evidence that mercury has a toxic effect on human body. It enters human body by air and water. However, the main way to enter the living organism is food that is contaminated with mercury. One of the largest sources of mercury is fish meat, which is why the consumption of fish and fish products may pose a risk to human health. These findings have led to improved control of mercury content in these products. In order to protect consumers the regulations on the maximum allowable amount of mercury in food have been adopted. In order to determine the mercury content in fish and fish products placed on the market of the Serbian Republic of Bosnia and Herzegovina, the extensive research was conducted. Part of this research is presented in this paper.

Mercury was determined using spectrometric method by Advanced Mercury Analyser AMA - 254, and the measured concentrations are shown in mg/kg of fish. The study included 48 samples of fish and fish products. The largest amount of mercury was found in chunk canned tuna in vegetable oil (0,256 mg/kg) and a solid canned tuna (0.229 mg/ kg), while the lowest content was determined in the fresh trout meet and frozen pangasius (0,005 mg/kg). Slightly higher values than the minimum specified amounts were found in fresh carp (0,006 mg/kg) and picarel (0,008 mg/kg). When the obtained results are compared to the maximum contaminant level of this element, it can be concluded that the consumption of fish and fish products in a balanced diet, do not pose a risk to human health.

Keywords: *mercury, heavy metals, residues, fish and fish products*

FOAMING PROPERTIES OF CAPRINE MILK: WHETHER ARE IMPROVED BY HEATING?

Mirjana Pešić^{1*}, Mirosljub Barać¹, Slađana Stanojević¹, Aleksandar Kostić¹,
Miroslav Vrvic²

¹Faculty of Agriculture, Institute of Food Technology and Biochemistry,
University of Belgrade, Nemanjina 6, 11081 Zemun, POB 14, Serbia

²Faculty of Chemistry and Department of Chemistry IChTM, University of
Belgrade, Studentski trg 12-16, 11158 Belgrade, POB 51, Serbia

*Corresponding author:

E-mail address: mpesic@agrif.bg.ac.rs

Caprine milk shows a higher digestibility, lower allergenicity and better antioxidative activity than bovine milk and it was recognized as a source of valuable bioactive peptides which resulted in increased consumption of caprine milk and dairy products during last decade. Major caprine dairy products are cheeses, but whipped dairy products could be also very attractive for many consumers. Foaming properties of milk proteins are very important in whipped dairy products. But in contrast to the numerous literature corresponding to bovine milk, reports on foaming properties of caprine milk are very limited.

In the present study, foaming properties of untreated and thermally treated caprine skim milk at 90°C for 10 min at different pH values of milk (from 6.5 to 7.1) were investigated. Raw caprine skim milk formed very unstable foam with foam capacity of 76.3%. Heat treatment of caprine skim milk increased foam capacity for seven to ten times, depended on pH of milk, compared to value obtained for foam prepared with raw caprine skim milk. The foam stability significantly depended on the pH of milk. The best foam stability was obtained at pH 6.5 (638.8%), whereas the lowest value was obtained for foam prepared at pH 6.9 (43.8%).

The significant improvement of foaming properties of heat-treated caprine milk could be attributed to changes of caprine casein micelle surfaces due to whey protein/casein interactions during heating of milk. The obtained results indicated that thermally treated caprine skim milk could be used in formulation of whipped dairy products.

Keywords: *caprine milk, heat treatment, foaming properties*

Acknowledgements: *This work was supported by the Serbian Ministry of Education, Science and Technological Development. Grant No. III 46009 and III 43004.*

ANALYSIS OF THE IMPACT OF THE AMOUNT OF SPONTANEOUSLY FERMENTED SPELT DOUGH, BAKER'S YEAST AND ASCORBIC ACID ON SOME SPELT BREAD CHARACTERISTICS

Olivera Šimurina^{1*}, Bojana Filipčev¹, Marija Bodroža-Solarov¹, Jelena Krulj¹, Đorđe Psodorov¹, Dragana Plavšić¹, Rada Jevtić–Mučibabić¹, Jasna Grbić¹, Dragana Šoronja Simović², Mladenka Pestorić¹, Dubravka Jambrec¹, Zvonko Nježić¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: olivera.simurina@fins.uns.ac.rs

Sourdough has been used since ancient times and its ability to improve the quality and increase the shelf-life of bread has been widely described. In the present work, a specific type of bakery sourdough made from organically grown spelt wheat was applied. It is known that the addition of sourdough provides the possibility to reduce the amount of yeast. It has been found that ascorbic acid is an important ingredient in spelt breads. The study was aimed to determine the effects of the amount of spontaneously fermented spelt dough, baker's yeast and ascorbic acid on volume and textural properties of spelt bread. Spelt sourdough, baker's yeast and ascorbic acid levels were varied according to the Box–Behnken response surface design. The effect on bread volume and bread crumb texture (firmness and resilience) was investigated. Bread volume and bread resilience increased with addition of spelt sourdough in the range from 20% to 40% flour basis. On the other hand, in the given range, crumb firmness decreased. With the quadratic increase in the amount of sourdough there was a negative effect on the bread volume, positive on crumb firmness and insignificant effect on bread resilience. The amount of baker's yeast from 1% to 2% flour basis significantly increased crumb resilience. Ascorbic acid was added in a range from 100 to 200 mg/kg and was found to significantly increase crumb firmness, but insignificantly decrease bread volume and resilience. There was a significant interaction between the spelt sourdough and ascorbic acid level on bread firmness. It should be taken into account that this interaction leads to an increase in crumb firmness, which is unfavorable regarding the over-all quality of bread.

The optimization indicated that a formulation of spelt bread with 40% of the spelt sourdough, 2% of bakery yeast and 0.11 g/kg of ascorbic acid satisfied the specified criteria set forth in the optimization process.

Keywords: *spelt sourdough, spelt bread, Box–Behnken response surface design*

MEAT QUALITY AND EFFECT OF DRYING CONDITIONS ON COLOR, TEXTURAL AND SENSORY ATTRIBUTES OF *PETROVSKÁ KLOBÁSA*

Snežana Škaljac¹, Marija Jakanović¹, Natalija Džinić¹, Ljiljana Petrović¹,
Vladimir Tomović¹, Tatjana Tasić², Predrag Ikonić², Branislav Šojić^{1*}

¹University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: bsojic@gmail.com

In this study the colour, textural and sensory attributes of *Petrovska klobasa*, Serbian dry-fermented sausages with protected designation of origin at national level, dried in traditional and industrial conditions, were analysed at the end of drying process. *Petrovska klobasa* sausages, were made from meat and backfat of Landrace pigs (9-12 months old animals of live weight above 130 kg) with addition of spices (red hot paprika powder, raw garlic paste and caraway), salt and sugar. Sausages were produced in the household, manually stuffed in collagen casings (500 mm long and 55 mm in diameter) and divided in two batches: sample BT - drying process took place in the household, in naturally ventilated storeroom and sample BI - drying process took place in industrial chamber, under controlled conditions.

Quality of meat used for sausage processing was determined by criteria for pH, water holding capacity (WHC) and colour (CIE L^*) 24h *post mortem*. The colour measurements (CIE L^* , a^* , b^* , h, C^* , R, BI) of sausages were carried out on the fresh cut slices. TPA test was performed for evaluation of texture attributes of sausages. Sensory attributes of sausages (colour, texture and juiciness) were evaluated by a panel of 10 trained panellist using scale from 0 to 5 (0 – atypical, 5 - optimal).

According to analysed parameters and quality criteria pork used for sausage production was of red, firm and non-exudative (RFN) quality. At the end of drying process BT sausages had significantly ($P<0.05$) lower L^* , a^* , b^* , h, C^* and BI values, and significantly higher R value. Values for textural attributes of sausages (hardness, springiness, cohesiveness and chewiness) were significantly ($P<0.05$) higher for sausages BT. Also, scores for sensory evaluation of colour and texture were significantly ($P<0.05$) higher for BT sausages, comparing to BI sausages.

Keywords: *fermented sausage, meat quality, colour, texture, sensory quality*

PROTEOLYSIS OF LOW FAT SEMI HARD RECOMBINED CHEESES PRODUCED WITH CARBOXYPEPTIDASE PREPARATION

Goran Trpkovic, Jelena Miocinovic*, Aleksandar Nedeljkovic**,
Mira Radovanovic, Predrag Pudja

Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

**Grant holder of Ministry of Education, Science and Technological
Development, Republic of Serbia

*Corresponding author:

E-mail address: jmiocin@agrif.bg.ac.rs

In the past 20 years the popularity and commercialization of food that could be beneficial for human health significantly increased around the world. Dairy products, including cheeses, represent a good base for the development of new products with functional and dietetic properties. However, cheeses with reduced fat content, especially those within semi hard group, are often characterized with unacceptable sensory properties due to altered ripening.

The objective of this paper was to investigate the proteolysis during ripening of low fat semi hard recombined cheeses which were produced according to the developed production procedure by mixing milk protein powder, skim milk and cream. Cheese A was produced with commercial starter culture (LL 50 A and 100F, DSM, the Netherlands), rennet (Maxiren 600, DSM, the Netherlands), while cheese B was produced with same starter and rennet, but with addition of commercial carboxypeptidase preparation (Accelerazyme CPG, DSM, the Netherlands). The rate of proteolysis was analyzed by the water and 5% phosphotungstic acid soluble nitrogen fractions, as well as by SDS and UREA PAG electrophoresis. A significant difference on the proteolysis rate between cheeses was found. As expected, cheeses produced with enzyme added were characterized with the higher rate of proteolysis.

Sensory properties of cheeses were quite different, due to different proteolysis rate. However, both cheeses were characterized with a good flavour and acceptable texture properties and could be classified in the group of products with dietetic properties.

Keywords: *low fat cheese, carboxypeptidase, proteolysis, electrophoresis, sensory properties*

IMPROVEMENT OF THE FREEZING PROCESS OF SPINACH BY USING CRYOPROTECTANTS

Mishela Temkov, Elena Velickova*, Eleonora Winkelhausen

Department of Food Technology and Biotechnology, Faculty of Technology and Metallurgy, University of Ss. Cyril and Methodius, Ruder Boskovic 16, 1000 Skopje, R. Macedonia

*Corresponding author:

E-mail address: velickova@tmf.ukim.edu.mk

Industrial freezing of spinach is made in blast freezers, using rapid freezing, in forms of briquettes. Besides formation of small crystals, rapid freezing, can still deteriorate the quality of spinach and decrease its commercial value due to texture loss caused by re-crystallization and agglomeration of crystals during the thawing phase.

Cryoprotective treatment maintains the natural quality of food by inhibiting the growth of small crystals. In this study five cryoprotectants: glucose, trehalose, glycerol, mannitol and sodium tripolyphosphate were tested. They were introduced into the spinach tissue by means of vacuum infusion and ultrasound. Afterwards, samples were frozen in liquid nitrogen to simulate rapid freezing and stored at -18°C for a period of 30 days. The quality of the spinach leaves was evaluated in terms of drip loss, color, texture and sodium chloride content.

Cryocomponents reduced the drip loss during storage from 6 to 40% in all treated samples. In general, the combination of ultrasound and vacuum infusion ensured better cryoprotection for the spinach than using just vacuum infusion for incorporation of the cryoprotective substances in the tissue. In terms of texture, spinach leaves treated with cryoprotectants preserved their turgidity after freezing/thawing in comparison with the enervated control sample shown by the burst strength. There was a significant loss of elasticity of the samples shown by the decreased distance to burst. The results obtained from the evaluation of the color of stored samples (30 days at -18°C) after thawing demonstrated retention of the color in all samples treated with cryoprotectants compared to the 53% loss of the green color of the control sample.

Keywords: *spinach, vacuum infusion, ultrasound, cryopreservation*

CHANGES IN THE NUMBER OF MICROORGANISMS DURING THE STORAGE OF THE NATURAL SPRING WATER

Siniša Markov, Dragoljub Cvetković, Olivera Pavlović, Ana Vidaković*, Aleksandra Velićanski

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:
E-mail address: anav@uns.ac.rs

In many countries worldwide appears a lack of hygienic and quality drinking water, so the population more often use bottled water for justified or emotional reasons. With the advent of bottled water a new problem, that is not usually present in drinking water, has appeared. Namely, extremely high number of bacteria, that usually would not have a chance to grow in the drinking water, may occur in the bottles. Natural spring water is underground water intended for human use in its natural state, which is bottled at the source or in its immediate vicinity and that satisfies the quality requirements specified in the Regulations of the Republic of Serbia that is in accordance with European regulation. Clear and strict microbiological requirements are set for the water at source, as well as immediately after bottling. The same requirements are also applied to such products during storage and transport, except for the total number of microorganisms. For this parameter is allowed to multiply the number of microorganisms during the water marketing only if it is provided that this happens due to the normal increase in the number of species that the water contained in the source. The aim of this study was to examine during which time the increase in the number of microorganisms appears the specific natural spring water, as well as the impact of storage temperature. For this purpose, the membrane filtration was applied using the chromogenic and R2A culture media. All the samples fulfilled the essential requirements of microbiological quality. Increasing the number of microorganisms started in the second or third week of storage. In the coming weeks that increase gradually took form of the exponential growth curve. The rate of the growth appearance, as well as the growth intensity was depended of the storage temperature.

Keywords: *bottled water, natural spring water, storage temperature, number of microorganisms*

THE BIOTECHNOLOGICAL UTILIZATION OF WHEY

Filiz Yangılar*, Pınar Oguzhan Yıldız

Faculty of Engineering, University of Ardahan, 75000. Ardahan, Turkey

*Corresponding author:

E-mail address: f_yangilar@hotmail.com

Food processing industry operations need to comply with increasingly more stringent environmental regulations related to the disposal or utilisation of by-products and wastes. Whey is a by-product from the cheese production which is rich in lactose and whey proteins making this product to be considered as a source of valuable nutrient. Whey is well known for its nutritional and functional properties. Whey is a good candidate for its application in a great variety of products in food industry such as beverage powders, nutrition bars, soups, bakery, confectionery coatings and desserts. Unfortunately this highly valuable product cannot be used effectively in industry and most of this by-product is discharged to the sewage system. The carbohydrate reservoir of lactose (4–5%) in whey and the presence of other essential nutrients make it a good natural medium for the growth of microorganisms and a potential substrate for bioprocessing through microbial fermentation. Immobilised cell and enzyme technology has also been applied to whey bioconversion processes to improve the economics of such processes. Due to the high lactose content generated, its conversion to bio-ethanol has long been considered as a possible solution for whey biovalorization. Bioactive whey proteins and peptides are gradually finding more applications not only as food or feed products but also as functional compounds to be used in the pharmaceutical field. The alternative usage of whey which originated from dairy facilities and the immobilisation techniques that have been applied to produce valuable whey-based products will be described in this review.

Keywords: *whey, food technology, functional compounds*

TRENDS IN MASS TRANSFER OF MINERALS DURING OSMOTIC DEHYDRATION OF PORK MEAT IN SUGAR BEET MOLASSES

Snežana Zlatanović^{1*}, Olgica Kovačević¹, Sanja Ostojčić¹, Lato Pezo¹,
Danijela Šuput²

¹University of Belgrade, Institute of General and Physical Chemistry,
Studentski Trg 12, 11000 Belgrade, Serbia,

²University of Novi Sad, Faculty of Technology, Bulevar Cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: snezana.zlatanovic@gmail.com

Osmotic dehydration process is characterized by diffusion of water molecules from the treated material in the hypertonic medium, resulting in water content reduction, or drying of the treated material. At the same time there is a redistribution of the content of other ionic or molecular groups between the two materials. We have investigated the effects of the osmotic dehydration process, with the pork meat as the treated material, and molasses, containing approximately 20% water and 60% sugar, as the hypertonic medium. In addition to the transfer of water mass, we followed the mass transfer of major minerals in the molasses and meat. If the R denote the ratio of the concentration of cations in the pork meat after and before the osmotic dehydration treatment, then for different cations we get: $R_1(\text{Na})=5.52$, $R_1(\text{K})=3.95$, $R_1(\text{Ca})=14.1$ i $R_1(\text{Mg})=1.3$. Obviously, meat enrichment in cations is very different and depends on the type of cation. If the cations content in pork meat were calculated on a dry basis of OD meat, then the ratio R take values: $R_2(\text{Na})=2.67$, $R_2(\text{K})=1.92$, $R_2(\text{Ca})=6.85$ i $R_2(\text{Mg})=0.65$. This shows that the content of cations: Na, K, and in particular Ca, is significantly increased in osmotically dehydrated meat, compared to the values obtained in classical meat drying. It is also evident that the content of Mg is significantly lower than expected. Several factors may affect this diffusion of cations during the OD process. In our future work it will be of particular interest investigation of concentration factor, which depends on the mineral content, and the properties of cations in molasses and meat.

Keywords: *mass transfer, osmotic dehydration, pork meat, molasses*

GC-MS ANALYSIS OF FATTY ACIDS AND NON-SAPONIFIABLE PART OF FLOUR OF DIFFERENT MAIZE HYBRIDS

Marijana Ačanski^{1*}, Goran Bekavac², Đura Vujić³, Kristian Pastor¹

¹Faculty of Technology, University of Novi Sad, Bulevar Cara Lazara 1, Novi Sad, Serbia

²Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia

³Institute of Food technology, University of Novi Sad, Bulevar Cara Lazara 1, Novi Sad, Serbia

*Corresponding author:

E-mail address: macanski@tf.uns.ac.rs

The aim of this study is to determine liposoluble components in maize and obtain preliminary information on their variability in different types of maize hybrids. All the testing was conducted on a gas-chromatography system.

The recorded chromatograms clearly indicate three fields. The first field contains minor components on the chromatogram which are the same in its composition in all samples. The second field contains fatty acids, i.e. their methyl-esters. They make up about 90% of the integrated surface of the chromatogram. The third field is the most interesting, because it contains variable compounds suitable for comparison.

The purpose of the study was to identify oil components and to compare abundance of components in samples of oil from flour of maize hybrids. Cluster analysis was used for the comparison of the samples. This paper shows that it is possible to differentiate maize from other types of cereals and pseudocereals on the basis of lipid content using GC-MS chromatography and correlation analysis. The GC-MC analysis allows elimination of compounds (peaks) which do not have a biological origin or origin specific for analysed samples.

Keywords: *maize, GC-MS, liposoluble composition, cluster analysis*

INFLUENCE OF *THYMUS VULGARIS* ON INITIAL CELL ATTACHMENT AND BIOFILM OF *Salmonella* Enteritidis

Ivana Čabarkapa^{1*}, Marija Škrinjar², Jovanka Lević¹, Ljiljana Kostadinović¹,
Bojana Kokić¹, Dragana Plavšić¹, Ana Varga¹

¹University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

Corresponding author:

E-mail address: ivana.cabarkapa@fins.uns.ac.rs

Bacteria within a biofilm have a distinct phenotype from planktonic cells and generally show higher tolerance to antimicrobial agents, such as disinfectant treatments and antibiotics. Due to the increased tolerance against antimicrobial treatments, biofilms are hard to eradicate and they cause all kinds of problems in medical and industrial settings.

Therefore, the purpose of this study was to examine the influence of *Thymus vulgaris* essential oil on the initial adhesion and preformed biofilm of *Salmonella* Enteritidis. Results for antimicrobial activity of *Th. vulgaris* essential oil obtained using broth microdilution method against *S. Enteritidis* were identical for all tested isolates (MIC/MFC=0.156/0.3125 µL/mL). In order to understand the anti-biofilm action of essential oil (EO), its effect was tested on both the initial cell attachment by planktonic cells as well as on preformed biofilms. Obtained results indicated that the effect of *Th. vulgaris* essential oil on initial cell attachment of tested isolates SE4, SE5, SE7 and SE9 was in dosage dependent manner, although even at 0.5×MIC biomass attachment was reduced by 74.2%, 77.7%, 73.6% and 70.1%, respectively. Fairly high, but not complete inhibition of cell attachment was achieved using 1×MIC of this EO. Using 1×MIC, biomass attachment of tested isolates SE4, SE5, SE7 and SE9 was reduced for 91.4%, 90.2%, 90.6% and 88.4%, respectively. When the same EO was tested against a preformed biofilm, its inhibitory effect was reduced greatly.

Keywords: *Salmonella* Enteritidis, biofilm, thymus

DEAERATION METHOD FOR IMIDACLOPRID DETERMINATION ON GLASSY CARBON ELECTRODE

Ana Đurović^{1*}, Zorica Stojanović¹, Nada Grahovac², Snežana Kravić¹,
Zvonimir Suturović¹, Jaroslava Švarc-Gajić¹, Spasenija Milanović¹

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: djurovic.ana@tf.uns.ac.rs

In this work deaeration methods are investigated for chronopotentiometric determination of pesticide imidacloprid [1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine] on glassy carbon electrode. As a supporting electrolyte, a Britton-Robinson buffer is used. All investigations are carried out in model systems. Cathodic peak of imidacloprid could not be registered only in Britton-Robinson buffer, due to electrochemical reduction of dissolved oxygen. For this reason, it was necessary to investigate different deaeration methods for removing oxygen from the solution. Within this, deaerations by various reductants and by passing a nitrogen stream are compared. Investigated reductants are sodium sulfite, ascorbic acid, oxalic acid, potassium bromide, sodium bromide and sodium chloride. Combination of a certain reductant and nitrogen are compared as well. Addition of a saturated solution of sodium sulfite directly in the tested solution proved as the best deaeration method. This method provided fast deaeration step as it takes less than a minute for completely removing the oxygen. An optimal concentration of the solution of sodium sulfite is also investigated. Concentrations of sodium sulfite were tested in the range of 0.6 g/dm³ to 230 g/dm³. Considering the height of the analytical signal and its reproducibility, concentration of 8.8 g/dm³ showed as optimal. This method could be applied for the determination of imidacloprid in commercial formulations and some real samples.

Keywords: *imidacloprid, glassy carbon, deaeration method*

ELISA AND LC-MS/MS DETERMINATION OF AFLATOXIN M1 IN MILK SAMPLES

Jovana Kos*, Jasna Mastilović, Elizabet Janić Hajnal, Pavle Jovanov,
Bojana Šarić, Ivan Milovanović

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jovana.kos@fins.uns.ac.rs

Aflatoxin M1 (AFM1) is derivate of aflatoxin B1 (AFB1) which is formed in liver and excreted into the milk in the mammary gland of lactating animals that have been fed with AFB1 contaminated diet.

Considering that AFM1 was included in the first group by carcinogenicity and milk and its derivatives are consumed daily, there is a need for fast, sensitive, reliable and accurate analytical method for its determination.

The objective of this study was to compare performances of Enzyme Linked Immunosorbent Assay (ELISA) and liquid chromatography with triple quadrupole mass spectrometry (LC-MS/MS) methods for determination of AFM1 in naturally contaminated milk samples. For LC-MS/MS analysis, the samples were prepared using immunoaffinity columns while for ELISA milk samples were analyzed without sample preparation. Both methods were validated according to the European Union Regulative using certified reference material (CRM) as well as spiked blank milk samples. The obtained validation parameters indicate that ELISA and LC-MS/MS are suitable for determination of AFM1 in milk samples. Additionally, the validated methods were applied for analysis of ten naturally contaminated milk samples. Samples were selected with the aim to cover two different ranges of concentrations, around 0.05 and 0.50 µg/kg. Analysis showed that ELISA method did not give false positive results since presence of AFM1 determined using ELISA was confirmed with LC-MS/MS. Furthermore, ELISA gave slightly higher values of AFM1 in comparison to LC-MS/MS.

The statistical analysis of variance between methods and obtained correlation coefficients around and higher than 0.9 indicate that good correlation exists between the investigated methods.

Keywords: *aflatoxin M1, ELISA, LC-MS/MS, milk*

INACTIVATION KINETICS OF *E. COLI* IN CHICKEN SAMPLES USING SUPERCRITICAL CARBON DIOXIDE ASSISTED BY HIGH POWER ULTRASOUND

Rosa Castillo^{1,2}, Ingrid Paniagua^{2,3*}, Carmen Ortuño³, José Benedito³

¹Colegio de Postgraduados, Km. 88.5 Xalapa-Veracruz, Veracruz, México

²Unidad de Investigación y Desarrollo de Alimentos, Instituto Tecnológico de Veracruz, Calz. Miguel Ángel de Quevedo 2779, 91860, Veracruz, México

³Departamento de Tecnología de Alimentos, Análisis y Simulación de Procesos Alimentarios, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, España

*Corresponding author:

E-mail address: inpa1@posgrado.upv.es

Supercritical carbon dioxide (SC-CO₂) has been widely applied as no thermal inactivation technique in liquid media, however, in solid matrices, the bactericide effect is more difficult to achieve. The objective of the study was to evaluate the feasibility to use high power ultrasound (HPU) on the inactivation kinetics of *E.coli* using FSC-CO₂ in chicken samples at different temperature (36-46 °C, 350 bar) and pressure (150-350 bar, 46 °C). Cylinders of chicken breast (10 ± 2 g) were surface-inoculated with 100 µL of microorganism suspension to contain 10⁶ CFU of *E. coli* per g of product. Weibull model was used to describe the inactivation kinetics, using the process parameters as model variables. The temperature significantly (p<0.05) influence the inactivation level; using FSC-CO₂ only 1.2 log-cycles of *E. coli* was reduced at constant pressure (350 bar) and 36°C compared with the total inactivation (6.8 log-cycles) achieved at 51°C, after 30 min. The pressure did not significantly (p<0.05) influence the inactivation rate. When both FSC-CO₂ and HPU were used at pressure constant (350 bar), higher inactivation level and less time were needed to reach undetectable levels of *E. coli* in the samples. Using FSC-CO₂ + HPU at 51°C the total inactivation was achieved after 20 min compared with 30 min using FSC-CO₂ alone. This effect may be due agitation vigorous induced HPU, increase the inactivation mechanisms of FSC-CO₂ in samples. No lineal Weibull model properly fit the behaviour kinetics inactivation of *E. Coli* using FSC-CO₂ (R²=0.90, RMSE=0.30) and FSC-CO₂+HPU (R²=0.92, RMSE=0.28). The results demonstrated, the application of HPU during FSC-CO₂ process allows shorter times, compared with only FSC-CO₂. The FSC-CO₂+HPU can be considered a promising technique to microbiology stabilize chicken breast samples.

Keywords: *supercritical fluids, high power ultrasound, inactivation kinetics, E. coli, chicken samples*

INACTIVATION OF *E. coli* USING A CONTINUOUS FLOW ULTRASOUND-ASSISTED SUPERCRITICAL CO₂ SYSTEM

Ingrid Paniagua^{1,3*}, Rosa Castillo^{2,3}, Carmen Ortuño³, Miguel Ángel García¹, José Benedito³

¹Unidad de Investigación y Desarrollo de Alimentos, Instituto Tecnológico de Veracruz, Calz. Miguel Ángel de Quevedo 2779, 91860, Veracruz, México

²Colegio de Postgraduados, Km. 88.5 Xalapa-Veracruz, Veracruz, México

³Departamento de Tecnología de Alimentos, Análisis y Simulación de Procesos Alimentarios, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, España

*Corresponding author:

E-mail address: inpa1@posgrado.upv.es

Supercritical carbon dioxide (SC-CO₂) inactivation technology represents a promising non-thermal processing method, as it promotes minimum impact on the nutritional food properties. However, in some cases high pressures or temperatures and too long treatment times are required to guarantee the food's safety. In order to obtain the required lethality at shorter processing times, a combination of SC-CO₂ with high power ultrasound (HPU) has been studied. The results showed that the combination of both techniques in a batch system accelerated the death of *E. coli* compared with the use of only SC-CO₂. The objective of this work was to study the combined effect of SC-CO₂ and HPU on *E. coli* inoculated in commercial apple juice, approximately 10⁸ CFU and treated in a continuous system. The influence of the pressure, temperature and retention time on the inactivation process was evaluated. Experiments were performed at different temperatures (31, 36 and 41 °C), pressures (100-200 bar) and retention times (1.72, 2.58 and 5.44 min). The application of HPU significantly ($p < 0.05$) influenced the inactivation rate. Using SC-CO₂ (100 bar, 31 °C) for 2.58 min was required to achieve 3.29 log-cycles of reduction while using SC-CO₂+HPU (100 bar, 31 °C, 2.58 min), a reduction of 7.42 log-cycles was obtained. The inactivation rate of *E. coli* increased as pressure and retention time increased during the SC-CO₂ +HPU treatments, at 31 °C and 100 bar a reduction of 8 log-cycles was achieved at 5.44 min compared with only 4.4 log-cycles obtained at 1.79 min. No significant ($p < 0.05$) effect of temperature was found at the different process conditions. The results demonstrated the potential of the continuous SC-CO₂ +HPU inactivation technique, the use of mild process conditions could lead to an increase in the quality of the product treated under this technique.

Keywords: *supercritical carbon dioxide, high power ultrasound, inactivation E. coli*

ANALYTICAL AND SENSORY PROPERTIES OF SOME HEIRLOOM TOMATO CULTIVARS

Silva Grobelnik Mlakar, Franc Bavec, Martina Bavec, Manfred Jakop,
Martina Robačar, Vesna Weingerl*

Faculty of Agriculture and Life Sciences, University of Maribor, Pivola 10,
2311 Hoče, Slovenia

*Corresponding author:

E-mail address: vesna.weingerl@um.si

Tomato (*Lycopersicon esculentum* L.) is widely consumed vegetable represented by numerous cultivars and hybrids versatile in physical and sensory properties as well as in antioxidant concentration. The aim of present study was to evaluate some physical properties, antioxidants concentration and sensory attributes of one modern ('Optima F₁') and six heirloom tomato cultivars ('Rdeča češnja', 'White Beauty', 'Green Zebra', 'Hellfrucht', 'Yellow Submarine' and 'Zuckertraube'). Cultivars were organically produced at the University Agricultural Centre, Maribor, Slovenia. All the assessed fruit properties and the content of antioxidants were significantly influenced by the tomato cultivar. The colour of red-fruited cultivars ('Hellfrucht', 'Optima F₁', 'Rdeča češnja') were rated significantly higher than those bearing yellow fruits ('Yellow Submarine', 'Zuckertraube'), or creamy white ('White Beauty') and green fruits ('Green Zebra'). Cultivars 'Hellfrucht' and 'Green Zebra' received the highest score for overall impression. Red-fruited cultivars showed an expected high lycopene (374.5 - 238.7 mg/100 g DW) and β -carotene content (3.37 - 3.14 mg/100 g DW). The lutein concentration varied with the tomato cultivar from 1.20 mg/100 g DW in 'Optima F₁' to 1.13 mg/100 g DW in 'Zuckertraube'. 'Yellow Submarine' appeared to be the cultivar with the highest ascorbic acid content.

Keywords: *tomato, heirloom cultivars, lycopene, β -carotene, sensory properties*

NEW SOURCES OF NATURAL ANTIFUNGAL AGENTS AND INHIBITORS OF MYCOTOXINS PRODUCTION

Verica Aleksić^{1*}, Petar Knežević¹, Ljilja Torović², Ivana Beara³,
Dejan Orčić³, Neda Mimica-Dukić³

¹Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia

²Institute of Public Health of Vojvodina, Futoška 121, 21000 Novi Sad, Serbia

³Department of Chemistry, Biochemistry and Environmental Protection, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: verica.aleksic@dbe.uns.ac.rs

It is well-known that mycotoxins, a class of secondary metabolites produced by different fungal species, have an extremely broad range of effects in humans and animals: nephro-, neuro-, and cytotoxic, carcinogenic, mutagenic and immunosuppressive. Since the use of chemical fungicides is limited, particular attention is focused on alternative antifungal agents, mainly natural products with fungicidal activity. In this study, potential of several essential oils of organically grown, medicinal and aromatic plants from province Vojvodina (Serbia) to inhibit growth of mold (*Aspergillus flavus*) and its production of mycotoxin (aflatoxin B1) was examined. The *A. flavus* strain was isolated from infected corn grain and chemical composition of essential oils was evaluated by GC-MS analysis. The minimal inhibitory concentrations (MICs) of essential oils were determined by broth dilution method, and HPLC-UV method was developed for monitoring aflatoxin B1 production in extracts of *A. flavus* agar media. Summer savory (*Satureja hortensis*), marjoram (*Origanum majorana*) and thyme (*Thymus serpyllum*) showed notable fungicidal potential with MIC 2 µl/ml, while tarragon (*Artemisia dracunculus*), peppermint (*Mentha piperita*), hyssop (*Hyssopus officinalis*) and fennel (*Foeniculum vulgare*) were moderately active (MIC 4 µl/ml), with partial to complete inhibition of aflatoxin production. In both health and economic aspects of food protection, further studies are directed towards determination of composition/fungicidal activity correlation.

Keywords: mycotoxins, *Aspergillus flavus*, essential oils

Acknowledgments: Research was financed by Provincial Secretariat for Science and Technological Development, Autonomous Province of Vojvodina (Grant No.114-451-3973/2013-01).

ANTIOXIDANT AND ANTIFUNGAL PROPERTIES OF FRESH JUICES OF *BRASSICA* VEGETABLES

Svetlana Bošković¹, Marina Vujanić², Nataša Simin¹, Milana Rakić²,
Maja Karaman², Verica Aleksić^{2*}, Neda Mimica-Dukić¹

¹Department of Chemistry, Biochemistry and Environmental Protection,
Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3,
21000 Novi Sad, Serbia

²Department of Biology and Ecology, Faculty of Sciences, University of Novi
Sad, Trg Dositeja Obradovića 2, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: verica.aleksic@dbe.uns.ac.rs

Brassica vegetables are commonly consumed as healthy and inexpensive source of nutrients and other bioactive compounds all over the world. Fresh juices extracted from seven varieties of *Brassica* genus (broccoli, cauliflower, kohlrabi, cabbages – red, white, Savoy, Nappa), originated from different cropping systems (conventional-C, organic-O) were investigated on their antioxidant and antifungal potentials. Antioxidant activity was evaluated by ABTS (2,2-azino-di-(3-ethylbenzthiazoline-sulfonic acid) and DPPH (1,1-Diphenyl-2-picryl-hydrazyl radical) assays, expressed in trolox equivalents (mmol TE/mL). Total phenolic content (TP) was determined with Folin-Ciocalteu reagent, expressed in gallic acid equivalents (mg GAE/mL). Antifungal properties were screened against two strains of fungi: *Aspergillus sp.* and *Penicillium sp.*, using dilution method in microplates. The activity of tested juices was expressed as minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) in $\mu\text{L/mL}$.

Juice of red cabbage-O showed higher activity than other vegetables in ABTS assay reaching 17.0 mmol TE/mL, while juice of red cabbage-C expressed the highest value of 10.5 mmol TE/mL in DPPH assay. TP content ranged from 0.33 to 2.08 mg GAE/mL. The highest amount was obtained for juices of red cabbage-O and -C, 2.08 and 2.02 mg GAE /mL, respectively. Juices of broccoli-C and -O, cauliflower-C and kohlrabi-C showed antifungal activity against *Penicillium sp.* The most efficient was cauliflower-C juice reaching the same MIC and MFC values at 12.4 $\mu\text{L/mL}$. Juices of cauliflower-C, broccoli-C and kohlrabi-O were effective against *Aspergillus sp.* Cauliflower juice reached MIC and MFC at 24.7 $\mu\text{L/mL}$, while the other two exhibited MIC and MFC values only at the highest concentration applied (49.5 $\mu\text{L/mL}$).

Among all varieties analyzed, red cabbage-O and -C expressed the highest antioxidant activity, probably due to the high content of phenolic compounds. Cauliflower-C exhibited the highest antifungal activity against both strains investigated. The way of cropping had influence on antifungal activity, while antioxidant ability was not affected.

Keywords: *Brassica*, antioxidant, antifungal, *Aspergillus sp.*, *Penicillium sp.*

ANTHOCYANINS PROFILING BY HPLC-DAD-ESI/MSN AFTER BIOTIC ELICITOR TREATMENTS IN *BRASSICACEAE* SPROUTS

Nieves Baenas*, Federico Ferreres, Cristina García-Viguera, Diego A. Moreno

CEBAS-CSIC, Dept. of Food Science and Technology, Phytochemistry Lab.
Campus de Espinardo-25, E-30100, Murcia, Spain

*Corresponding autor:
E-mail address: nbaenas@cebas.csic.es

The anthocyanin profiles of three varieties of 8-day-old *Brassicaceae* sprouts, broccoli (*Brassica oleraceae*), "China rose" radish and "Rambo" red radish (*Raphanus sativus*) were studied using HPLC-DAD-ESI-MSⁿ and HPLC-DAD after biotic elicitor spray treatments with methyl jasmonate (25µM), jasmonic acid (150µM), salicylic acid (100µM), sucrose (176mM), glucose (277mM) and DL-methionine (5 mM). Ready-to-eat sprouts were treated during 5 days before harvest (day 3 to 7).

The most abundant type of anthocyanins was cyanidin and its derivatives, diglycosylated at C-3 and glycosylated at C-5, mainly acylated at 3 position (one or two cinnamoyl groups) and malonyl at hexose in 5 position, with qualitative and quantitative differences among varieties. All individual anthocyanins identified were increased by elicitor treatments, leading to the observed increase of total anthocyanin content (TAC). An increase of 40% of TAC was achieved after MeJA treatment in broccoli (17.51 mg · 100g F.W.), and by 50% in China rose radish (24.79 mg · 100g F.W.) and 30% Rambo red radish (241.77 mg · 100g F.W.) after glucose treatment.

The selection of ready-to-eat cruciferous sprouts rich in anthocyanins, as well as the appropriate elicitor treatment, is a candidate strategy to develop novel plant foods with beneficial nutritional and health properties.

Keywords: *Brassica*, *Raphanus*, anthocyanin, elicitors, sprouts

ANTIPROLIFERATIVE EFFECTS AND METABOLISM OF SULFORAPHANE AND GLUCORAPHANIN FROM BROCCOLI SPROUTS IN HUMAN COLON AND LIVER CANCER CELLS

Nieves Baenas^{2*}, Jose Manuel Silván¹, Cristina García-Viguera²,
Diego A. Moreno^{2*}, Sonia de Pascual-Teresa¹

¹Dept. of Nutrition and Metabolism, ICTAN-CSIC, c/Jose Antonio Novais 10,
28040, Madrid, Spain

²Phytochemistry Lab. Dept. of Food Science and Technology, CEBAS-CSIC,
P.O. Box 164, Espinardo, 30100, Murcia, Spain

*Corresponding author:

E-mail address: nbaenas@cebas.csic.es

Sulforaphane (SF), found in broccoli as its inactive precursor glucoraphanin (GRA), is considered to be responsible for the reduction of cancer risk that is associated with broccoli consumption. SF protects against the incidence and progression of cancer via several mechanisms including inhibiting phase I cytochrome P450 enzymes, inducer of phase II detoxification enzymes, inducing cell-cycle arrest and apoptosis and reducing inflammation.

The chemoprotective effect of a broccoli sprouts lyophilized powder and its bioactive compounds SF and GRA have been investigated on human colon cancer Caco-2 cells and human cancer liver HEP-G2 cells. The cytotoxicity of different concentrations of broccoli extract and the pure compounds were investigated in order to find the dose IC₅₀ of inhibition of proliferation.

Broccoli powder extract and sulforaphane showed a dose-dependent inhibition of the cell proliferation in both cell lines, while glucoraphanin inhibited on average less than 50%. The conversion of GRA to SF and subsequent ITC bioavailability is dependent on active myrosinase, not present in our culture medium. The extract of lyophilized broccoli sprouts showed the greatest potential for inhibiting cancer lines, reaching IC₅₀ dose concentrations around 2.5 µM in both cell lines. The bioactive compound SF showed the IC₅₀ around 40 µM in Caco-2 cells and 70 µM in HEP-G2 cells, therefore, isolated pure compounds may either lose their bioactivity or may not behave the same way as the compounds together in whole foods.

The absorption of sulforaphane metabolites (SFN, SFN-glutathione, SFN-cysteine, SFN-N-acetylcysteine) from broccoli sprouts was assessed by a selective UHPLC/MS/MS procedure, concentrations ranging 2 to 50 nmol/L were found within the cells depending on the type of analyte under study.

Keywords: *Brassica, metabolite, sulforaphane, cancer, cytotoxicity*

MODIFYING FATTY ACIDS PROFILE OF MEAT PRODUCTS BY ADDING INGREDIENTS BY VEGETAL ORIGIN

Balan Daniela^{1*}, Gherghina Evelina¹, Israel-Roming Florentina¹,
Luta Gabriela¹, Mihociu Tamara Elena²

¹Faculty of Biotechnology, University of Agronomic Sciences and Veterinary
Medicine/Centre for Applied Biochemistry and Biotechnology BIOTEHNOL,
59 Marasti Blvd., 11464 Bucharest, Romania

²National R&D Institute for Food Bioresources – IBA, 6 Dinu Vintila Street,
0201102 Bucharest, Romania

*Corresponding author:

E-mail address: balan.dana@gmail.com

The aim of the present study was to obtain healthier food by replacing part of the animal fat from meat products with plant oil. Another consequence of adding oils from vegetal sources is the increased protection against lipid oxidation, resulting more safety meat products

Both raw materials (pork leg meat, beef leg meat and pork backfat) and vegetal ingredients (walnuts oil and sea buckthorn oil) were analyzed for their total lipid content and fatty acid profile. Additional, for plant oils the content in α -tocopherol and carotene was also determined. Total lipid content was determined using Soxhlet method, fatty acids profile was achieved by GC-MS method, α -tocopherol content was analyzed using HPLC method and carotene content was determined by spectrophotometric method. Three samples were obtained using the same technology, type and quantity of ingredients (unless fat): one only with pork fat, one with pork fat and walnuts oil and one with pork fat and sea buckthorn oil. The determinations were performed when obtaining, after 12 days and after 21 days of storage in refrigeration conditions.

The ratio PUFAs/SFAs ranged between 0.5 and 1.68. Optimisation of the lipid profile was achieved when using sea buckthorn oil with a ratio PUFA/SFA of 0.96 maintained during the whole storage period.

Keywords: *walnuts oil, sea buckthorn oil, lipid oxidation, α -tocopherol, fatty acids profile*

LIPOSOME-IN-HYDROGEL SYSTEMS FOR DELIVERY OF ANTIOXIDANTS

Bojana Balanč^{1*}, Verica Djordjević¹, Smilja Marković³, Kata Trifković¹,
Ivana Kostić¹, Viktor Nedović², Branko Bugarski¹

¹Department of Chemical Engineering, Faculty of Technology and Metallurgy,
University of Belgrade, Serbia

²Department of Food Technology and Biochemistry, Faculty of Agriculture,
University of Belgrade, Serbia

³Centre for Fine Particles Processing and Nanotechnologies, Institute of
Technical Sciences of the Serbian Academy of Sciences and Arts, Belgrade,
Serbia

*Corresponding author:

E-mail address: bisailovic@tmf.bg.ac.rs

The encapsulation of natural antioxidants became interesting for food applications in last few years. Namely, natural antioxidants are sensitive compounds and by encapsulation it is possible to preserve their stability and activity. In this study complex systems such as liposomes-in-hydrogel microbeads are investigated for encapsulation of poorly soluble antioxidants. For better handling and long shelf life of the obtained microbeads, they were submitted to lyophilisation process.

Liposomes encapsulating poorly soluble antioxidant (resveratrol was used as a model compound) were prepared using proliposome method and then incorporated in calcium alginate microbeads using electrostatic extrusion technique. Apart from plain calcium alginate (1,5 wt.%), calcium alginate-sucrose (in weight ratio 1:0,3) was used as a matrix for liposomes with entrapped resveratrol (0,6 mg_{rsv}/g_{beads}). By applying high electrostatic field (6,3kV) it was possible to produce microbeads with the average diameter between 360 and 380 µm. The obtained microbeads were lyophilized and observed under SEM.

Encapsulation efficiency was about 90%, for liposome loaded microbeads and about 82% for the liposome loaded microbeads with sucrose. According to SEM microphotographs liposome loaded microbeads had spongy texture while those which had sucrose as filler appeared as rather smooth. After rehydration in water lyophilised liposome loaded microbeads swelled up to 57% and 89% of their original sizes (prior to lyophilisation) for plain alginate and alginate-sucrose, respectively.

To conclude, the addition of sucrose enabled the achievement of a smooth surface of the microbeads after lyophilisation and reduces shrinkage of the microbeads during this process. The liposome loaded microbeads with sucrose almost completely regained median size after rehydration and therefore they can be considered as suitable for further application

Keywords: *liposome, alginate, encapsulation, antioxidants, electrostatic extrusion*

FRUIT WINES AS A SOURCE OF SOME OLIGOELEMENTS

Zorica Basic*

Institute of hygiene, Military Medical Academy, Crnotravska 17,
11000 Beograd, Serbia

*Corresponding author:

E-mail address: basiczorica@yahoo.com

Fruit wines in Serbia have a reputation as a source of good health, immunity and blood count. They contain a low percentage of alcohol and are consumed as aperitifs. They are considered to contain hemoglobin precursors as well as oligoelements which are necessary for good health. Inductively coupled plasma-atomic emission spectrometry (ICP-AES) provides a rapid and precise means of monitoring elements simultaneously for minor- and trace- levels. The ICP-AES technique is widely regarded as the most versatile analytical technique in the chemistry laboratory.

Our aim-goal was to determine the content of oligoelements (iron, zinc, copper, chrome, manganese) in fruit wines, as well as in domestic red wines, using ICP-AES spectrometry, and to compare results obtained. We analyzed 4 types of fruit wines (blackberry, raspberry, cherry, apple) and red wine of various producers, a total of 30 samples. Samples were prepared by microwave sample digestion. Domestic fruit wines are a good source of oligoelements, as well as some grape wines from the market. The advantage can be given to fruit wines because of the lower ethanol content, making them suitable for the general population.

Keywords: *fruit wines, oligoelements, ICP-AES*

ANTIPROLIFERATIVE ACTIVITY OF LIPOPHILIC AND HYDROPHILIC TOMATO JUICE EXTRACTS IN HUMAN BREAST CANCER CELL LINE MCF-7

Miona Belovic^{1*}, Aleksandra Novaković¹, Milena Rašeta², Sonja Kaišarević³, Maja Karaman³, Nebojša Ilić¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Department of Chemistry, Biochemistry and Environmental Protection, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia

³Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: miona.belovic@fins.uns.ac.rs

Numerous epidemiological studies have suggested that a high consumption of tomatoes and tomato products containing lycopene can reduce risk of several types of cancer, most notably those of prostate, breast, and digestive tract. Therefore, high daily intake of tomato juice is recommended, especially for the people with increased risk of cancer. However, tomato juice contains other phytochemicals, predominantly phenolic compounds, which may also contribute to its anti-carcinogenic potential. In this context, the aim of our research was to investigate the antiproliferative activity of both lipophilic and hydrophilic tomato juice extracts on the estrogen-dependent breast cancer cell line MCF-7.

Tomato juice, prepared in a kitchen juicer, was lyophilized, grinded and extracted with hexane. After extraction, the residue was re-extracted with ethanol. Solvents from both extracts were removed by using vacuum evaporation unit. Dried extracts were used for the determination of the antiproliferative activity against breast cancer cell line (MCF-7) after 24 and 72 hours using MTT assay. Different concentrations of extracts were used to determine the concentration dependence and calculate the IC₅₀ values. Additionally, total phenolics (Folin-Ciocalteu assay) and total flavonoids were determined in ethanolic extract.

Antiproliferative activity of both extracts showed concentration dependant behaviour. Hexane tomato juice extracts expressed much higher antiproliferative activity after 24 hours than ethanolic extracts (IC₅₀=770.7 µg/ml and IC₁₅=158.53 µg/ml, respectively). However, after 72 hours of incubation, the difference between IC₅₀ values of hexane and ethanolic extracts was less prominent (798.00 µg/ml and 866.93 µg/ml, respectively). Higher antiproliferative activity of hexane extracts in the first 24 hours (acute phase) could be explained by the higher bioavailability of carotenoids compared to the phenolic compounds, presumably because of their lipophilicity.

Keywords: *tomato, extracts, antiproliferative activity, phenolic compounds*

FERMENTATIVE ACTIVITY AND VIABILITY OF IMMOBILIZED PROBIOTIC STARTER CULTURE ABY-6 IN WHEY BASED SUBSTRATES

Tanja Krunic¹, Nataša Obradović¹, Maja Bulatović^{2*}, Maja Vukašinić Sekulić², Ljiljana Mojović², Marica Rakin²

¹Innovation Centre of Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

²Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

*Corresponding author:

E-mail address: mbulatovic@tmf.bg.ac.rs

In the recent decade there has been an explosion of probiotic health-based products. After applications of probiotics in food such as milk and dairy products, new application of probiotics has been proposed: chocolate, bread, fermented vegetables. Unfortunately, many studies indicated that there is poor survival of probiotic bacteria in these products. The use of immobilized lactic acid bacteria of starter cultures in the conventional and especially nonconventional dairy products is one of the applications for next decade. Cell immobilization confers protection to sensitive probiotic lactic acid bacteria from oxygen, freezing and acidic conditions during manufacture and gastrointestinal transit. In dairy industry, immobilization has been applied to improve survival and delivery of bacterial cultures.

The aim of this paper was to study fermentative activity by free and immobilized probiotic ABY-6 culture in whey substrate enriched with milk. Viability of free and immobilized probiotic cells in simulated gastrointestinal conditions was evaluated. In order to improve probiotic character of immobilized cells, the influence of beads wall material composition (alginate, alginate beads with cells coated whey protein and chitosan –coated alginate beads) was examined. The beads were prepared using electrostatic extrusion technique. Alginate cell suspension was added dropwise by a syringe pump into a gelling solution. After 5.5h of fermentation, enumeration of viable cells was performed by determining the number of colony-forming units on MRS agar plates after incubation at 37 °C for 48 h using pour plate technique on MRS agar.

The results showed that immobilized cells beads have much better potential for survival in gastrointestinal conditions than free cells. Immobilization of probiotic cells in calcium alginate beads coated with chitosan resulted in better survival than both type of non-coated beads in simulated gastrointestinal conditions. These beads can be used to improve preservation of probiotic cells in fermented whey based beverage.

Keywords: *whey, probiotic, immobilization, alginate, chitosan*

INFLUENCE OF FRUIT JUICE ADDITION ON QUALITY OF FERMENTED WHEY-BASED BEVERAGE

Maja Bulatović^{1*}, Tanja Krunic², Nataša Obradović², Maja Vukašinić-Sekulić¹,
Danica Zarić³, Marica Rakin¹

¹Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4,
11000 Belgrade, Serbia

²Innovation center Faculty of Technology and Metallurgy, University of Belgrade,
Karnegijeva 4, 11000 Belgrade, Serbia

³IHS Techno Experts d.o.o. Research Development Center, Batajnički drum 23,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: mbulatovic@tmf.bg.ac.rs

The aim of this study was to evaluate the influence of fruit juice addition on the quality of fermented whey-based beverages that contain commercial ABY-6 starter culture. Milk (30%) and Cornelian cherry fruit juice (30%) were used for beverages formulation. Cornelian cherry fruit was used based on high antioxidant activity and specific texture that can improve overall quality of beverages. After 4h of whey fermentation followed by fruit juice addition, overall quality of beverages was evaluated by determining the viable cell count, pH value, titratable acidity, antioxidant activity and syneresis of produced beverages. Stability of beverages was monitored during 28 days of storage.

Based on the results fruit juice does not have statistically significant influence on viable cell count of probiotic bacteria. On the other hand, fruit significantly improves antioxidant activity and syneresis of beverages. Antioxidant activity reaches level of 88.6-94.5% in beverages formulated with fruit juice addition in contrast to the level of 36-36.7% without added fruit juice. Addition of fruit juice decreases syneresis of beverages for 9.5-11.9% after fermentation and for 9.5-25% after 28 days of storage. Titratable acidity and pH value of beverages were significantly affected by fruit juice addition but remain within recommended levels and stable during the whole storage period.

To formulate healthy beverage, supplementation of whey with 30% milk and 30% of Cornelian cherry fruit juice is advisable. Obtained fruity whey-based beverage has desirable quality attributes such as antioxidant activity of 97.0% and syneresis of 54.1%. Beverage contains 6.89 log (CFU mL⁻¹) probiotic bacteria, has a shelf life of at least 14 days and expresses quality that meets consumers' demands.

Keywords: *whey, ABY-6, fruit, syneresis, probiotics*

NUTRITIVE VALUE OF CHIA SEEDS AND THEIR INCREASING USE AS A FUNCTIONAL FOOD

Mirjana Demin*, Biljana Rabrenović, Jovanka Laličić-Petronijević

Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

*Corresponding author:

E-mail address: demin@agrif.bg.ac.rs

Chia (*Salvia hispanica* L.) is an annual plant of the Lamiaceae family. It was one of the main crops used by pre-Columbian societies in Central America, together with corn, beans and amaranth. Nowadays, chia was revived by a group of scientists and farmers due to its nutritional and functional characteristics. Chia contains high protein, dietary fibre and oil contents. The protein content is higher than that of other traditional crops such as wheat, corn, rice, oat, barley and amaranth. Also, chia seed contains the highest known percentage of α -linolenic fatty acid of any plant source. Content of dietary fibres in chia seeds are comparable to those in cereal and legume subproducts such as wheat, rice and oat bran, lupine, etc.

The application of new ingredients is a major challenge to the development of enriched food products. In this paper the basic chemical composition and nutritional value of chia seeds has been investigated. The obtained results indicated that the chia seeds could be a suitable source of dietary fibre and fat contents for the application in production of functional bakery and confectionery products.

Keywords: *chia seeds, dietary fibre, oil content, nutritive value*

ZINC CONTENT IN DIFFERENT TYPES OF MEAT FROM THE SERBIAN MARKET

Jasna Djinovic-Stojanovic*, Dragica Nikolic, Srdjan Stefanovic, Sasa Jankovic

Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: jasna@inmesbgd.com

Zinc is essential element and vital micronutrient necessary for more than 300 biochemical reactions in the body. Insufficient intake of zinc leads to several disorders, but an excessive zinc intake can cause adverse acute effects. The Recommended Dietary Allowances (RDA) for Zn is 11 mg/day for men and 8 mg/day for women over 19 years old.

The purpose of this study was to analyze and evaluate the levels of zinc in the beef, pork, turkey and chicken meat from the Serbian market. A total of 140 samples (29 samples of beef, 52 of pork, 29 of chicken and 30 of turkey) were collected from January 2014 to May 2014. The Zn analysis was performed using inductively-coupled plasma-mass spectrometry (ICP-MS) measuring ⁶⁶Zn isotope. In order to establish the differences between the zinc content in four types of meat, the obtained data were tested using one-way ANOVA and Tukey's test (95% confidence intervals).

The lowest and the highest established Zn levels were 3.93 mg kg⁻¹ in chicken and 59.50 mg kg⁻¹ in beef. The mean values for Zn content were 42.56±4.55 mg kg⁻¹, 30.51±5.88 mg kg⁻¹, 10.66±2.06 mg kg⁻¹ and 9.94±1.00 mg kg⁻¹ in beef, pork, turkey and chicken samples, respectively. Statistical analysis of the data showed significant differences between the zinc content in all types of meat except between the chicken and turkey meat.

According to the data of the World Health Organization (WHO) the daily intake of meat for adult Serbian population is 114.1 g of mammalian and 55.6 g of poultry species. Taking into account the results of this study, RDA for Zn, as well as WHO data for meat daily intake, it can be concluded that meat intake provides 35.2% of RDA for men and 48.4% of RDA for women in Serbian population.

Keywords: *zinc, beef, pork, chicken, turkey*

PROTEIN AND OIL CONTENT OF DIFFERENT AGE SEEDS OF SOME HERB SPICES

Vladimir Filipović^{1*}, Vladan Ugrenović², Vera Popović³, Dragoja Radanović¹,
Tatjana Marković¹, Đorđe Glamočlija⁴, Rade Protić⁵

¹Institute for Medicinal Plants Research "Dr Josif Pančić", Tadeuša Koščuška 1,
11000 Belgrade, Serbia

²Agricultural Expert Service Institute "Tamiš", Novoseljanski put 33,
26000 Pančevo, Serbia

³Institute of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

⁴Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

⁵University Business Academy, Faculty for Economy and Engineering
Management, Cvečarska 2, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: vfilipovic@mocbilja.rs

The objective of this study was to determine the effect of storage duration (from one to five years) on protein and oil content of the seeds of various herb spices. In the studied group, the seeds of the studied varieties and domesticated populations: dill (*Anethum graveolens* L.), fennel (*Foeniculum vulgare* Mill.), coriander (*Coriandrum sativum* L.) and caraway (*Carum carvi* L.). Laboratory studies have been performed in three replications in the course of 2014 according to accredited methods.

The storage duration had a great influence upon oil and protein content. The protein content of 18.33% was characteristic for two year old seed. But the seed with a duration period of five years had 16.66% on oil content. We came to a conclusion that the highest reduce in oil content was between second and third year of keeping (from 18.33% to 17.54%). Similar relations are obvious in oil content of keeping too.

On average, the highest protein content was recorded in the seeds of caraway (18.58%), which was by almost 2% higher than the lowest protein content in seeds of dill (16,62%). On average, the highest oil content was obtained with caraway (14.22%), whereas the lowest average of the oil content was recorded with dill seed (6.79%).

Keywords: oil and protein content, spice of medicinal plants, storage duration

ANTIOXIDANT POTENTIAL OF FERMENTED DAIRY PRODUCTS DURING STORAGE

Dajana Hrnjez*, Žužana Vaštag, Spasenija Milanović, Vladimir Vukić,
Mirela Iličić, Katarina Kanurić, Ljiljana Popović

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: dajana@tf.uns.ac.rs

Development of new functional products is essential to satisfy increasing consumers' requires in term of health benefits in dairy industry. It has been found that several bioactive peptide sequences are encrypted in milk proteins which have the potential to provide health benefits to consumers. Among many different bioactive peptides, the antioxidant and antihypertensive peptides are the most widely studied. The final dairy products could be enriched by vast amount of these peptides using different microorganisms in milk fermentation. Proteolysis of milk proteins contributes to yoghurt flavor and quality, via peptides and free amino acids as well as indirectly through their precursors.

Therefore, the aim of this research was to compare the antioxidant potential, i.e. DPPH (1,1-diphenyl-2-picrylhydrazyl) and ABTS (2,2'-azino-bis-(3-ethylbenzthiazoline-6-sulfonic acid) radical scavenger activities and sensory characteristics of fermented dairy products obtained by yoghurt, probiotic and kombucha starter culture during 21 days of storage.

The changes in DPPH activity differ among the samples, but the samples produced by kombucha have the highest DPPH antioxidative potential after production and 21 days of storage. All analyzed samples showed significant scavenging ability against ABTS.

These results also revealed no significant differences in sensory characteristics (appearance, flavour, taste) among kombucha, yoghurt and probiotic fermented dairy products.

Keywords: *fermented dairy products, antioxidative activity, sensory characteristics*

PREDICTION OF STRUCTURE AND CATALYTIC RESIDUES OF B-GALACTOSIDASE FROM *STREPTOCOCCUS* *THERMOPHILLUS*

Vladimir Vukić^{1*}, Dajana Hrnjez², Spasenija Milanović², Mirela Iličić²,
Katarina Kanurić², Edward Petri³

¹Institut of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

²Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 2,
21000 Novi Sad, Serbia

³Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

Corresponding author:

E-mail address: dajana@tf.uns.ac.rs

Streptococcus thermophilus is traditional starter culture for yoghurt production and the most used strain in dairy industry due to its optimal technological characteristics and health benefits. Property of its β -galactosidase to catalyze lactose makes it extremely important enzyme in fermented dairy technology.

As there are no data on *S. thermophilus*, β -galactosidase's 3D structure, the aim of this study was to make 3D model of β -galactosidase with its active site and to predict its catalytic residues.

BlastP search revealed its similar structure with *E. coli* β -galactosidase. As they are distant related species, it is evident horizontal gene transfer. Docking analysis revealed active sites position, residues involved in substrate binding and active residues. According to our model, putative catalytic residues are GLU458 and GLU546. These results were verified by sequence alignment with closely related β -galactosidases with known structure and active residues. Both catalytic residues are positioned close to lactose cleavage site and make hydrogen bonds with it. Substrate binding residues are also ASN98, ASP201 and HIS380.

Keywords: β -galactosidase, yoghurt, docking, catalytic residues

HEAVY METALS IN THE FOOD FROM EASTERN ROMANIA AREA

Carmen Hura*

INPH/ Centre Regional of Public Health, Iasi, Romania

*Corresponding author:

E-mail address: carmen_hura@yahoo.com

Exposure to heavy metals is an important problem of environmental toxicology. Most of these metals are toxic to humans, animals and plants. Anthropogenic activities are the major sources of heavy metals redistribution. Man, being at the top of the food chain, is at great risk of suffering from health hazards associated with toxic metals because of bioaccumulation. The aim of this study was the evaluation of the heavy metals contents in the food of the Eastern Romania area.

The study presents the results obtained in 2012-2013 period of some metals [Pb, Cd, Zn, Cu] in the food (meat, milk, vegetables, diets), in Eastern Romania area. Trace elements concentrations were analyzed by atomic absorption spectrophotometry (AAS) – Shimadzu 6300, graphite furnace and autosampler. In all analyzed samples these metals were found. Generally, a wide variation between individual samples was observed.

Meat: The mean metals levels in the meat products varied between 0.12 mg/kg Cd and 0.45 mg/kg Pb.

Dairy products: The results of the investigations showed a variation of heavy metals between 0.06 mg/kg Cd and 0.24 mg/kg Pb.

Vegetables: The mean metals levels in the vegetables varied between 0.03 mg/kg Cd and 0.26 mg/kg Pb.

Diets: The mean metals levels in the diets varied between 0.41 mg/kg Cd and 0.55 mg/kg Pb.

Determinations of these chemical contaminants in food are important in environmental monitoring for the prevention, control and reduction of pollution as well as for occupational health and epidemiological studies.

Keywords: *heavy metals, food, vegetables*

CHEMOMETRIC ANALYSIS OF ANTIOXIDANT ACTIVITY OF LETTUCE

Milica Karadžić^{1*}, Lidija Jevrić¹, Sanja Podunavac Kuzmanović¹,
Strahinja Kovačević¹, Aleksandra Tepić¹, Zdravko Šumić¹, Žarko Ilin²

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: mkaradzic@hotmail.com

Half maximum inhibitory concentration (IC_{50}) is a measure of the effectiveness of a compound to competitively inhibit a specific biological function. As a quantitative measure, it indicates how much of a particular substance is needed to inhibit a given biological process by half. The aim of this study was to establish models for half maximal inhibitory concentration of lettuce, using their biological properties (phenols, chlorophylls, total carotenoids, vitamin C). Antioxidant activity, expressed as IC_{50} , was determined in methanolic extracts of samples. Samples were extracted 24h in dark using methanol. In order to select biological properties that best describe the IC_{50} of the investigated lettuce, principal component analysis (PCA) was carried out by Statistica version 8 software. Hierarchical cluster analysis (HCA) was conducted in order to confirm the grouping already obtained by the PCA and multiple linear regression (MLR) was used for establishing the mathematical models. The complete regression and cluster analysis were carried out by NCSS 2007 and GESS 2006 software. The predictive ability of the established models was evaluated by standard statistical measures and *cross-validation* parameters. Given results should be treated as preliminary for the prediction of half maximum inhibitory concentration.

Keywords: *lettuce, multiple linear regression, hierarchical cluster analysis, principal component analysis*

THE PRESENCE OF MOULDS IN HONEY BEE POLLEN COLLECTED IN SERBIA

Aleksandar Kostić^{1*}, Tanja Petrović¹, Živoslav Tešić², Dušanka Milojković -
Opsenica², Miroљjub Barać¹, Sladjana Stanojević¹,
Nebojša Pantelić¹, Mirjana Pešić¹

¹Faculty of Agriculture, University of Belgrade, Institute of Food Technology and
Biochemistry, Nemanjina 6, 11080 Zemun, Belgrade, Serbia

²Faculty of Chemistry, University of Belgrade, Studentski Trg 12-16,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: akostic@agrif.bg.ac.rs

Name of the pollen, which is derived from the Latin name for the fine flour dust, was first used 1686th year by John Ray in his book "Historia plantarum". Bee pollen contains most of the nutrients necessary for human nutrition. It is rich in amino acids, proteins, minerals, carbohydrates, vitamins, fatty acids, polyphenols, enzymes, trace elements, etc. However, only in the case of unifloral pollen it can be claimed the continuity in the chemical composition. In addition to the chemical composition it is very important to determine the microbiological quality of pollen samples. Both, chemical composition and microbiological quality are considered as a prerequisite for the safe use of bee pollen as a supplement in human nutrition. Considering that bee pollen could be contaminated with microorganisms during the long way from the hive to the man as its consumer, proper harvesting practices, cleaning, drying process and storage should be of great importance. Due to rich nutrient content pollen represent a suitable substrate for the microbial growth where special risk are some moulds that secrete toxic products of their metabolism such as aflatoxins. In our study, presence of moulds in 20 samples of honey bee pollen collected from different regions of Serbia were investigated. The isolation of moulds was performed according to the standard mycological methods. The morphological characteristics of isolated colonies were identified based on macroscopic and microscopic characteristics to the genera level, except for the potent producers of aflatoxins, *Aspergillus flavus* which was determined to the species level. Among the investigated samples, eleven were contaminated by different moulds species. *Mucor* spp., *Penicillium* spp. and *Alternaria* spp. were found in three samples whereas *Rhizopus* spp. and *Aspergillus flavus* were determined in two samples. Among other moulds species, *Trichoderma* spp. and *Fusarium* spp. were isolated from two samples originated from different locality. The presence of potential toxigenic species (*Alternaria* spp., *Fusarium* spp., *Penicillium* spp. and *A. flavus*) in some of the samples indicated a high risk of occurrence of mycotoxins. The further investigation should be focused on their analysis.

Keywords: honey bee pollen, moulds, toxigenic mould species

THE EFFECT OF SODIUM REDUCTION ON THE QUALITY AND SAFETY OF HOT DOGS

Vladimir Kurćubić^{1*}, Slobodan Lilić², Danijela Vranić², Branko Velebit²,
Branka Borović², Đorđe Okanović³

¹Department of Food Technology, Faculty of Agronomy, University of Kragujevac, Cara Dušana 34, 32000 Čačak, Republic of Serbia

²Institute for Meat Hygiene and Technology, Kaćanskog 13, 11000 Belgrade, Republic of Serbia

³Institute of Food Technology, University of Novi Sad, Bulevar Cara Lazara 1, 21000 Novi Sad, Republic of Serbia

*Corresponding author:

E-mail address: vkurcubic@kg.ac.rs

The aim of this study is to evaluate the effects of replacing sodium nitrite salt with the finished mixture of sodium and potassium chloride for human consumption (Na-max 27 g/kg-min K 16 g/kg) at a rate of 25 %, 50 %, 75 % and 100 % on the physico-chemical quality and microbiological stability of the cooked sausages - hot dogs. Five different production batches (PB) were manufactured, each 10 kg in weight. The first PB (control) was prepared according to the manufacturer's original recipe. Experimental PB I was made by adding 50 g of mixed sodium-potassium salt (25 %) and 150 g nitrite salt into 10 kg of stuffing. PB II was prepared with 100 g of combined sodium-potassium salt (50 %) and 100 g nitrite salt, while PB III was made with 150 g of combined sodium-potassium salt (75 %) and 50 g nitrite salt. Hot-dogs of PB IV were made by adding 200 g (100 %) of combined sodium-potassium salt into 10 kg of stuffing.

The results obtained clearly indicate a continuous decrease of sodium content in samples originating from the control group to the experimental samples PB IV, in which the in which the nitrite salt was fully replaced with a mixture of potassium-sodium salt replaced with a mixture of potassium-sodium salt. Replacing sodium nitrite salt with the finished mixture of sodium and potassium chloride did not significantly affected examined physico-chemical quality (content of moisture, proteins, fat, ash, pH value and aw value) of experimentally prepared hot-dogs.

Tested samples originating from all experimental batches were microbiologically correct, according to the criteria prescribed in Serbian Regulations.

Keywords: *sodium nitrite salt, potassium chloride salt, physico-chemical quality, microbiological quality, hot dogs*

POSSIBILITY OF USE OF POTASSIUM CHLORIDE IN THE FRESH SAUSAGES PRODUCTION

Slobodan Lilić*, Vesna Matekalo-Sverak, Danijela Vranić, Dragica Karan, Mladen Rašeta, Jelena Jovanović, Mirjana Lukić

Institute of Meat Hygiene and Technology, Kačanskog 13,
11000 Beograd, Serbia

*Corresponding author:

E-mail address: slobo@inmesbgd.com

Excessive sodium intake is one of the major causes of human hypertension and because of that there is need to reduce salt content in meat products, especially sodium content. The most common substituent of sodium chloride in meat products is potassium chloride, but its use is limited due to bitter and metallic taste. The aim of this paper was to examine the possibility of use of potassium chloride as substituent of sodium chloride in the production of fresh sausages. Fresh sausages are popular as barbeque product in many restaurants as well as culinary product. Fresh sausages produced in this experiment contained various share of sodium and potassium chloride. Because of negative effect of potassium chloride on overall acceptability of meat products, produced sausages are sensory evaluated by ten assessors, previously trained for detection and recognition of various tastes (ISO 3972:2011) and odours (ISO 5496:2006). Sausages are evaluated after roasting by quantitative descriptive test, using scales with 5 or with 8 points, depending on sensory property, according to ISO 6658:2005. Colour of product is evaluated by scale with 5 points, while juiciness, softness, acceptability of taste and acceptability of smell by scale with 8 points. According to sensory evaluation, it can be concluded that replacement of sodium chloride by potassium chloride in the amount of 30% did not have the negative effects on the acceptability of taste in this kind of product.

Keywords: *fresh sausages, sodium, potassium chloride, sensory properties*

Acknowledgements: *This research was funded by grants TR 31083 from the Ministry of Education, Science and Technological Development, Republic of Serbia.*

SENSORY PROPERTIES AND SHELF LIFE OF SPREAD CREAM WITH SOYBEAN OIL

Ivana Lončarević^{1*}, Biljana Pajin¹, Marijana Sakač², Jovana Petrović¹,
Vladimir Tomović¹

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ivana.radujko@tf.uns.ac.rs

Spread cream is confectionery product based on powdered sugar, vegetable fat, cocoa powder, milk powder and other ingredients. Beside hydrogenated fats, cream product contains sunflower oil rich in essential fatty linoleic acid, but almost does not contain the essential α -linolenic acid. Soybean oil contains 85–88% unsaturated fatty acids of which up to 10% of α -linolenic acid. Oils rich in unsaturated fatty acids have beneficial nutritional attributes that make them desirable for incorporation into various foods, but, on the other hand, these oils might have lower oxidative stability.

This research examined sensory properties and shelf life of cocoa spread cream with partial and complete replacement of sunflower oil, which is exclusively used in Serbia in the production of cocoa spread cream, with soybean oil. Color on the surface of cocoa spread samples was monitoring by colorimetric method and sensory analyses 24h after cream production and every month in the period of six months of storage in the dark and room temperature. Oxidative stability was obtained applying gas chromatographic analyses of the formed aldehydes as secondary products of lipid oxidation.

The results showed that partial and complete replacement of sunflower oil with soybean oil doesn't have any influence on surface color and shelf life of cocoa spread cream. Soybean oil improved the taste of cocoa spread cream and had no influence on other sensory parameters.

Keywords: *spread cream, soybean oil, sensory properties, color, shelf life*

THE INFLUENCE OF SEX ON SLAUGHTER CHARACTERISTICS AND MEASURES OF CARCASS IN GOAT KIDS OF DOMESTIC BALKAN BREED

Nurgin Memiši^{1*}, Vladan Bogdanović²

¹AD Mlekara – Subotica, Tolminska 10, 24000 Subotica, Serbia

²Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11000 Belgrade, Serbia

*Corresponding author:

E-mail address: memisin@mlekara.rs

The paper presents the investigation of slaughter results, i.e. meat production results, and establishes relationships of traits of individual measures on the carcass and the halves in 96 goat kids of the domestic Balkan breed (with a sex ratio of 50:50).

Goat kids were slaughtered at the age of 90 days. Subsequent to slaughtering and primary carcass treatment, weight of warm carcass with head and offals was registered. After cooling period of 24 h, at the temperature of 0 to + 4°C, weight of cold carcass with head and offals was determined, as well as without head and offals. Following linear carcass measures (length and width of the carcass) were taken after cooling: Calcaneum – Ischium (pin bone), tail head – neck, Articulation genus – Articulation humeri, tail head – Atlas, width of both legs/thighs, breast width, scapula width and breast depth. After cutting of the carcasses into halves, the following measures were taken on the left half: Pubis – Talus ankle/joint, Pubis – I rib, Pubis – Atlas, Pubis – Articulatio genus.

Statistical analysis was performed using appropriate software procedures (Proc Means, Proc Corr, Proc REG) in the statistical software package SAS (SAS 9.1.3, 2007).

Higher values of dressing percentage/meat yield were determined for male goat kids, as well as linear measures on carcass and halves, compared to female goat kids. However, statistically significant differences at the level of $p < 0.05$ were determined in mass of cold and warm carcass with head and offals, as well as without offals, whereas statistically significant differences at the level of $p < 0.01$ were determined for certain values of carcass linear measures (breast width and scapula width) and measured lengths on carcass sides (Pubis – Talus ankle/joint).

Keywords: *goat kids, domestic Balkan breed, dressing percentage, slaughter results*

POSSIBILITIES OF RESISTANT STARCH APPLICATION IN SHORT DOUGH FORMULATION

Marija Milašinović-Šeremešić^{1*}, Ljubica Dokić², Milica Radosavljević¹

¹Maize Research Institute, Department of Food Technology and Biochemistry,
S. Bajića 1, 11185 Belgrade, Serbia

²Faculty of Technology, University of Novi Sad, Department of Food
Engineering, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: mmilasinovic@mrizp.rs

Resistant starch is the "sum of starch and starch degradation products not absorbed in the small intestines of healthy individuals". It is included in the definition of dietary fibre and can be applied in many food systems.

As short dough formulations have very low water content, any change of ingredients can lead to significant changes in properties of the dough and final products. The objective of this study was to observe functional properties of resistant starch (RS)-rich ingredients in short dough, that is, to evaluate the changes that take place in short dough when certain proportions of the flour are replaced by the RS-rich ingredients.

Rheological measurements were performed using Haake Rheo Stress 600. Micro-method Kieffer Extensibility Rig (Kieffer et al. 1981) was used to determine extensibility of dough. Dough hardness and stickiness were determined using the penetration test. All the analysis were done using the Texture Analyser TA. XT Plus.

Samples with the addition of the RS-rich ingredients had a less destructive structure and a greater ability for recovery. The dough extensibility significantly increased with the addition of the RS-rich ingredients. Significant decrease of dough hardness was found after adding water and greater concentrations (10 and 15%) of the RS3-rich ingredient and all concentrations (5, 10 and 15%) of the RS4-rich ingredient. The addition of the ingredients raised dough stickiness. Based on the results it can be concluded that besides gluten both types of the RS-rich ingredient bind a portion of water, which contributed to the increase of dough resistance with increasing its content. In that case, there is a need for modifications of the manufacturing process or the dough formula.

Keywords: *short dough, resistant starch, extensibility, hardness, stickiness*

PROPERTIES OF BLENDS OF FLOUR AND RESISTANT STARCH ENRICHED INGREDIENTS FOR COOKIES PRODUCTION

Marija Milašinović-Šeremešić^{1*}, Ljubica Dokić², Milica Radosavljević¹

¹Maize Research Institute, Department of Food Technology and Biochemistry,
S. Bajića 1, 11185 Belgrade, Serbia

²University of Novi Sad, Faculty of Technology, Department of Food
Engineering, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: mmilasinovic@mrizp.rs

The objective of this study was to determine some specific quality parameters of the blends of flour and resistant starch (RS) enriched ingredients as important criteria for evaluating the quality of flour and added ingredients due to formulate cookies with a high content of dietary fiber.

Seven blends were prepared. One without addition of the ingredients (control) and six in which RS enriched ingredients were added as partial replacement of the flour in following concentrations: 5%, 10% and 15% (calculated on flour weight used in control sample).

The analysis involved determination of alkaline water retention capacity (AWRC) and flour sedimentation (SV). The granulometric distribution was determined by sieving flour through laboratory sieves of different size holes (190, 150, 120, 105, 75, 55 and 37 μm) in a short time interval.

The RS3 enriched ingredient significantly affected the increase in the water-holding capacity while the RS4 enriched ingredient did not affect the quality parameter (with the exception of the highest dosage of the RS4). Major changes (decrease) in SV were found in samples with the RS4 enriched ingredient while the RS3 enriched ingredient did not affect the quality parameter (with the exception of the highest dosage of the RS3). Medium-sized particles of the flour are a good fit with the RS particles (40 μm), which affects the uniformity of the product structure.

Keywords: *flour, resistant starch, granulometric distribution, AWRC, flour sedimentation*

DEVELOPMENT OF A SPECIALIZED FOOD COMPOSITION DATASET FOR TOTAL VITAMIN D, 25(OH)D₃ AND D₃

Jelena Milešević^{1*}, Lourdes Samaniego¹, Paul Finglas¹, Mairead Kiely²

¹EuroFIR AISBL, Rue Washington, 40, Brussels, Belgium

²Vitamin D Research Group, University College Cork, Ireland

*Corresponding author:

E-mail address: jm@eurofir.org

Aim of the ODIN project is to develop a multi-component food-based strategy to increase the intake of vitamin D at the lower end of the distribution of intakes, which will reduce the prevalence of vitamin D deficiency with concomitant public health benefits. The objective of this study was to compile a food composition dataset of vitamin D to be used to generate estimates vitamin D exposure based on analytical vitamin D composition data compiled using EuroFIR standards. Vitamin D occurs in the diet naturally in the form of cholecalciferol (D₃) and ergocalciferol (D₂), and it can be consumed as a fortificant and in nutritional supplements. Naturally-occurring sources of vitamin D are limited (oily fish, meat, dairy, egg yolk and mushrooms), and many are not consumed on a regular basis. Depending on national legislation, some foods are fortified with vitamin D, including dairy & cereal products. The extended FoodExplorer™ tool was used to identify and select best available analytical data on vitamin D (total vitamin D, vitamin D₃, 25(OH)D₃) in major food groups (fish, meat, dairy, fats, eggs, mushrooms) including meta-data on documentation (e.g. method type and quality). Missing values were obtained from analytical literature and manufacturers' reports. The ODIN-EuroFIR vitamin D dataset has 981 vitamin D containing foods (658 vitamin D total values, 153 vitamin D₃ values, and 164 25(OH)D₃ values) from 8 European countries (UK, Denmark, Norway, Finland, Turkey, Sweden, France, and the Netherlands) and the US (from the USDA). All data were classified within three different food coding systems: Languag-EuroFIR, EFSA FoodEx2, and ODIN classifications. Ranges of vitamin D within food groups were identified and comparison between European and USDA data was conducted. This knowledge will be used for dietary modelling and identification of appropriate fortification and bio-fortification strategies for vitamin D.

Keywords: *Vitamin D, EuroFIR, USDA, food composition database*

Acknowledgements: *This research was carried out as part of the ODIN project [Food-based solutions for optimal vitamin D nutrition and health through the lifecycle] funded by the European Commission under the FP7 program [Grant Agreement no: 613977].*

THE ASSESSMENT OF THE SANITARY INDICATORS OF THE SPICY-AROMATIC RAW MATERIALS AND THEIR OIL MIXTURES

Bogdan Yegorov, Nadiia Mohylianska*

Odessa National Academy of Food Technologies, 65039, Odesa, Kanatna Str,
112, Ukraine

*Corresponding author:
E-mail address: mogilyanskaya@yandex.ru

The spicy-aromatic raw materials, which are used in food technologies, contain substances that show both as an antibiotic so an antioxidant activity.

The authors suggested carrying through the oil extraction of spices to accumulate their fat-soluble components in the unrefined sunflower salad oil.

In this work the sanitary quality indicators of the spicy-aromatic raw materials and their oil mixtures are explored. A black pepper (*Piper nigrum*), a coriander (*Coriandrum sativum*), a cardamoms (*Ellettaria cardamomum*), a garlic (*Allium sativum*), a fragrant basil (*Ocimum basilicum*), a capsicum (*Cápsicum ánnuum*), a bay leaf (*Láurus nóbilis*) have been investigated as the spicy-aromatic raw materials.

The initial semination by the microorganisms of the spicy-aromatic raw materials and the spicy-oil mixtures after the extraction is examined. It was very high in all selected spices except the garlic.

High semination of the spicy-aromatic raw materials has an influence on the initial semination of the spicy-oil mixtures. Therefore it was studied several ways to prepare spices before carrying in unrefined oil: washing raw material, followed by drying in natural air-cooling, convective drying at the temperature of +100 °C and processing of ultrahigh frequency waves.

The antibiotic effect of the mixture is expressed slightly when the concentration of the raw material was up to 1.5%. The number of the microbial cells after the extraction is close to the original value.

The stabilization of the microorganisms' growth and the suppression of their activity is observed with the increasing of the content of the spices in the source systems in the ready spicy-oil mixtures. This indicates that the fat-soluble components of the spicy- oil mixtures, which are moving from the spicy-aromatic raw materials, have the antibiotic action against the microorganisms, which are caught in the oil with the spices. The manifested antibiotic effect corresponds to the concentration of the spicy-aromatic raw materials in a mixture of 2% and more.

Keywords: *spicy-aromatic raw materials, spicy-oil mixtures, antibiotic activity*

EFFECT OF KCl-PRIMING AND METHYL JASMONATE ON SECONDARY METABOLITES PRODUCTION IN TWO VARIETIES (WHITE AND RED) OF *BRASSICA OLERACEA* L. UNDER NaCl STRESS

Diego A. Moreno^{1*}, Ismehen Hassini², Nieves Baenas¹, Micaela Carvajal³,
Maria Carmen Martínez Ballesta³

¹Food Science and Technology Dep, Centro de Edafología y Biología Aplicada del Segura CEBAS-CSIC, Campus de Espinardo 30100, Murcia, Spain

²Sciences Faculty of Bizerte, Zarzouna 7021, Tunisia

³Plant Nutrition department, Centro de Edafología y Biología Aplicada del Segura CEBAS-CSIC, Campus de Espinardo 30100, Murcia, Spain

*Corresponding author:

E-mail address: dmoreno@cebas.csic.es

Cruciferous plants represent an important source of health-promoting phytochemicals such as phenolic compounds and glucosinolates. These secondary metabolites are involved in plant defense and accumulate in response to environmental stress. Elicitors are signaling compounds that stimulate any of such defense responses affecting the profiles of secondary metabolites such as glucosinolates or phenolic compounds.

The fresh weight, as well as the content of glucosinolates, anthocyanins and phenolic compounds were determined in two different (red) and (white) *Brassica oleracea* L. sprouts. For that, control or 150 mM NaCl sprouts were treated with a methyl jasmonate (25 μ M MeJa) spraying solution until the sprouts were 10-days old.

Salt stress alone did not modify glucosinolates content in both cultivars, but in red cabbage enhanced chlorogenic and sinapic acid derivatives. Under non-saline conditions, in both cultivars, MeJa increased total glucosinolates content. However a genotypic response was observed in the total phenolic compounds, decreasing and maintaining in the red and white cultivars, respectively. The combination of MeJa and NaCl, significantly increased the total glucosinolate content in both cultivars. Anthocyanins levels were higher in red cultivar compared to the white cultivar. In the red cabbage, MeJa, decreased anthocyanins levels in control and NaCl-treated sprouts, whereas had no effect on anthocyanins content in the white cultivar.

In conclusion, MeJa improved nutritional quality of cabbage sprouts increasing glucosinolates content with higher concentration in NaCl-treated sprouts. However, the genotype must be considered when spraying sprouts with MeJa, since red cultivars were susceptible to phenolic compounds and anthocyanins reduction.

Keywords: *Brassica oleracea* L., glucosinolates, methyl jasmonate, phenolic compounds, salinity

ANTIOXIDANT PROPERTIES OF ROSE HIP (*ROSA CANINA* L.) PRODUCTS

Dragana Paunović*, Mile Veljović, Dušica Mirković, Tanja Petrović,
Jasmina Rajić, Nataša Stošić, Branislav Zlatković

Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Zemun,
Serbia

*Corresponding author:

E-mail address: draganap@agrif.bg.ac.rs

The fruits of rose hip (*Rosa canina* L.) are mainly used for the production of marmalade or in dried form for making tea. Rose hips are rich source of natural antioxidants such as ascorbic acid, carotenoids and phenolic compounds.

Therefore, the aim of our study was to estimate the influence of elevated temperatures used during the production of different rose hip products on their antioxidant capacity.

The total phenolic and flavonoids content as well as antioxidant activity were evaluated by three contemporary and compatible methods. The rose hip fruits were dried in laboratory dehydrator, whereas marmalade was produced by traditional method. The values obtained for the fresh fruits were used as a control.

In the dried fruits the losses of 31.84 %, 22.93 %, 20.69 %, on a dry basis for total flavonoids concentration, total phenolic content and antioxidant activity, respectively, has been obtained, in relation to the values of the fresh sample. During the production of marmalade the complete losses (100 %) of total flavonoids concentration and antioxidant activity have been performed, while 99.69 % losses on a dry basis were found for total phenolic compounds, calculated in relation with control fresh sample.

Based on these results, it could be concluded that long-term effect of elevated temperatures and aeration during the production of marmalade by traditional method have very significantly influenced the losses of its antioxidant properties.

Keywords: *dried rose hip, rose hip marmalade, antioxidant activity, phenolic compounds, flavonoids*

THE INFLUENCE OF DEFFATED WHEAT GERM ADDITION ON PHYSICAL CHARACTERISTICS OF THE COOKIES DOUGH

Jovana Petrović*, Aleksandar Fišteš, Biljana Pajin, Ljubica Dokić,
Zita Šereš, Dragana Šoronja Simović, Dušan Rakić

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jovana@tf.uns.ac.rs

Wheat germ is the by-product of flour milling process, and the most of the germ is mainly used in animal feed formulations. Nutritionally it is most valuable part of the grain and has great potential as a highly nutritious food supplement. However, the raw germ has very short shelf life and limited use due to a high risk of hydrolytic and oxidative rancidity. One of the possible ways to stabilize the wheat germ is to remove the oil fraction. Defatted wheat germ is a rich source of vitamin E, B vitamins, protein, dietary fiber and minerals. Compared to wheat flour it provides more than three times of proteins, up to 15 times more sugar and more than 6 times of minerals. Proteins of wheat germ are particularly rich in essential amino acids such as lysine, methionine and threonine which lack in the majority of the grains. Cookies are inexpensive and widely accepted food, and offer a valuable supplementation vehicle for nutritional improvement. Replacement of wheat flour with defatted wheat germ at different levels (5%, 10% and 15%), and at different particle sizes (<150 µm, 150-1000 µm, 800-2000 µm) along with the variation of the moisture content of the dough (20%, 22% i 24%) was investigated for its effect on physical characteristics of dough. Viscoelastic properties of dough were determined using rotational viscometer while dough hardness and extensibility were examined by texture analyser.

Keywords: *wheat germ, cookies, texture, viscoelastic properties*

FORMULATION AND ANTIOXIDANT CAPACITY OF PLUM AND APPLE JUICES

Jasmina Rajić*, Tanja Petrović, Predrag Vukosavljević, Dragana Paunović,
Kristina Nešić, Viktor Nedović

Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

*Corresponding author:

E-mail address: jasminadanilovic@yahoo.com

The plums and apples are more widely fruits grown in Serbia commonly used in the production of jams, marmalades, compotes, baby foods, dried fruits, brandy and fruit juices. These fruits are also important sources of natural antioxidants in a human diet.

The aim of this experiment was to determine the total phenolic content (TPC) and antioxidant capacity of clarified plum and apple juices as well as to formulate the optimum proportions of these juices. In addition, the sensory acceptance of formulated juices has been performed.

The juice samples were produced from concentrated fruit juices, diluting to the prescribed dry matter. Total phenolic content was determined using the Folin-Ciocalteu reagent whereas antioxidant capacity was established by two comparative methods (FRAP and DPPH).

Extremely high correlations between TPC and both methods used for determination of antioxidant capacity were observed, as well as between FRAP and DPPH test ($R^2 = 0.943$).

By sensory analysis the best evaluated juice sample showed significantly higher TPC and antioxidant capacity than apple juice, but significantly lower compared to plum juice. TPC in best sensory evaluated juice was 1162.79 ± 15.02 mg GAE/L, whereas FRAP and DPPH activities were 12043.57 ± 12.37 mmol Fe (II)/L and 3.07 ± 0.02 TE/mL, respectively.

The obtained results indicated that a highly acceptable product could be formulated by mixing plum and apple juices thus providing natural sources of phenols with high antioxidant capacity.

Keywords: *fruit juice, apple, plum, total phenols, antioxidant activity, sensory analysis*

CUTANEOUS MAST CELL DEGRANULATION CAUSED BY PERORAL APPLICATION OF ACRYLAMIDE TO JUVENILE MALE RATS

Vesna Rajkovic^{1*}, Milena Stosic², Renata Kovac¹, Ivana Koledin¹,
Milica Matavulj¹

¹Department of Biology and Ecology, Faculty of Sciences,
University of Novi Sad, Novi Sad, Serbia

²Department of Environmental Engineering and Occupational Safety and Health,
Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia

*Corresponding author:

E-mail address: vesna.rajkovic@dbe.uns.ac.rs

Acrylamide is present in various food commodities such as bread, coffee, potato chips, biscuits, cereals etc. Hence, the general population is exposed to one or combination of these food daily. Experimental studies have demonstrated a number of biological effects of acrylamide to date, including neurotoxicity, carcinogenicity and endocrine disruption. The present study was carried out on male Wistar rats aged 23 postnatal days at the beginning of the experiment. Acrylamide was administered *per os* in 25 mg/kg body weight dose 5 days a week, during three weeks. Following the termination of the experiment, skin specimens were processed for paraffin embedding and thereafter stained with Toluidine blue. The upper dermis was chosen for stereological analysis because it's the site of the most intense immune-immune and immune-nerve interactions during the effect of xenobiotics. Skin sections were analyzed using the M42 grid on 50 consecutive fields of vision per animal in order to determine the volume and numerical density of mast cells. The upper dermis of control rats demonstrated the presence of predominantly intact mast cells with characteristic cell morphology and intense metachromasia. Conversely, the altered cell morphology and prominently decreased metachromasia was found in acrylamide treated rats, which were the major findings in this study. Stereological analysis has revealed an increase in numerical density of total and degranulated mast cells, while the intact mast cells were decreased. Volume densities of mast cells showed no marked alterations between groups. All stereological parameters tested proved to be statistically insignificant. Despite of such results of the statistical analysis, the severe degranulation of a number of cutaneous mast cells seen in acrylamide treated group has an unequivocal biological importance in the light of interaction between mast cells and other cutaneous immune cells as well as interaction between mast cells and nerve endings in the skin.

Keywords: *acrylamide, skin, mast cells, degranulation, stereology*

Acknowledgement: *The work was supported by the Provincial Secretariat for Science and Technological Development of Vojvodina grant N^o 114-451-3599/2013-03, Ministry of Education, Science and Technological Development grant N^o III46001 and N^o 172050.*

MICRO AND NANOSTRUCTURE OF BUTTER WITH BLACKCURRANT CRYOPOWDER

Tamara Rashevskaya

National University of Food Technologies, Kiev, Ukraine

*Corresponding author:

E-mail address: rashevsk@nuft.edu.ua

Micro and nanostructure of butter with blackcurrant cryopowder were studied by scanning electron microscope method. Microstructure contains a lot of undestroyed fat globules. Bond strengthening between glyceride's core and membrane's crystalline layers of fat globule was revealed. This is because there are many components such as polysaccharides in blackcurrant cryopowder. They can interact with fat globule's membrane because of intermolecular interaction. The surface of fat globule contains a lot of water droplets $d \sim 5\div 10$ nm and quasi-one-dimensional linear chains of water droplets. A new mechanism of fat globule destruction was detected. It based on formation of nanoglobules inside fat globule and their discrete detachment. Repeated detachment causes collapse of fat globule that was fixed on a figure. The size of the nanostructure's elements of interglobular space (crystalline aggregates and nanoblocks) is smaller by 5-25 times than butter without additives. They are polyhedrous or round shaped with quasi-one-dimensional chains of nanoparticles of water phase on the boundary nanoelements surface. In the butter storage process (-18 °C) nanostructure self-organization there is Amorphous-crystalline layers are formed on the surfaces of fat globules, crystalline aggregates and nanoblocks because of intermolecular interaction between blackcurrant cryopowder polysaccharides and butter fat glycerides. There are formation of cellular structure, plate polyhedrous and pipe-shaped crystals $d \sim 10\div 20$ nm could be observed. Cryopowder addition expressed positive impact in butter improvement. To summarize it should noted that blackcurrant cryopowder has multifunctional properties in butter multicomponent nanocrystalline system.

Keywords: *butter, nanostructure, blackcurrant cryopowder*

GLUCOSE AND INSULIN BLOOD SERUM ANALYSIS IN ADULT RATS AFTER SUBCHRONIC ACRYLAMIDE TREATMENT

Milena Stošić^{1*}, Vesna Rajković², Renata Kovač², Ivana Koledin²,
Milica Matavulj²

¹Department of Environmental Engineering and Occupational Safety and Health,
Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia

²Department of Biology and Ecology, Faculty of Sciences,
University of Novi Sad, Novi Sad, Serbia

*Corresponding author:

E-mail address: milena.stosic@gmail.com

Acrylamide is a well known substance with adverse effects on the various organ systems in living organisms. In the last few years, acrylamide has been in the focus of interest due to its considerable presence in everyday, staple, foods. Acrylamide effects are associated with genomic and cytotoxic effects, mutagenic and cancerogenic effects, enzyme and hormone disruption. Due to different harmful effects on living systems, our present study was oriented towards the observation of the potential acrylamide effect on glucose and insulin levels in the Wistar rat serum. The study was carried out on adult male Wistar rats aged 65 postnatal days at the beginning of the experiment. Thirty male Wistar rats were divided into three groups, one control and two experimental groups, which were treated with 25 mg/kg or 50 mg/kg body weight (bw) of acrylamide respectively, from 65. until 84. postnatal day. Acrylamide was administered *per os*, during three weeks. Following the termination of the experiment, blood was taken from the body, after decapitation. Samples were centrifuged for 10 minutes at 1500 rpm and formed supernatant was frozen at -20°C. Serological analysis which refers to the amount of glucose in rat serum did not show any statistically significant difference between the control group and the groups treated with acrylamide in either concentration ($p > 0.05$). Serological analysis of the serum insulin level showed a statistically significant increase in the group treated with acrylamide in concentration of 25 mg/kg bw ($p < 0.05$) compared to the control. The control group and the group treated with acrylamide in concentration of 50 mg/kg bw, showed no statistically significant difference in serum insulin level ($p > 0.05$). This study is still in its early stage, and taking into account the proven effect of acrylamide on insulin levels, the study will further focus on changes at the histological and molecular levels.

Keywords: *acrylamide, glucose, insulin, blood serum*

Acknowledgement: *The work was supported by the Provincial Secretariat for Science and Technological Development of Vojvodina grant N° 114-451-3599/2013-03, Ministry of Education, Science and Technological Development grant N° III46001 and N° 172050.*

PREPARATION, CHARACTERIZATION AND *IN VITRO* DRUG RELEASE STUDIES OF DIFFERENT CURCUMIN FORMULATIONS

Mojca Škerget*, Tina Perko, Željko Knez

Faculty of Chemistry and Chemical Engineering, Laboratory for Separation
Processes and Product Design, University of Maribor, Smetanova 17,
2000 Maribor, Slovenia

*Corresponding author:

E-mail address: mojca.skerget@um.si

Curcumin is a multi-functional and pharmacologically safe natural agent. It is a hydrophobic polyphenol derived from turmeric, the rhizome of the herb *Curcuma longa*. It is a yellow pigment, widely used as a colouring agent and spice in many foods. Recently, curcumin has also been shown to display antioxidant, anti-cancer, antiviral, antiinfectious and antiinflammatory properties. It is practically insoluble in water at acidic and neutral pH. Although it is soluble in alkali, it undergoes rapid hydrolytic degradation at pH values above neutral. Its low water solubility limits further pharmacological exploitation and practical application of curcumin.

In the present study, the commercially available cellulose was used for curcumin encapsulation, which was performed by solvent displacement using simple dialysis methods. The encapsulation efficiency was 99.03 % and the loading capacity was 49.52 % for encapsulated curcumin. In the second step the curcumin-cellulose mixture was further formulated with various carriers (glycerol tristearate and polyethylene glycol - PEG) using supercritical fluid technology, namely Particles from Gas Saturated Solution technique (PGSSTM). The ratio between the components in the formulation curcumin : cellulose : carrier was 1 : 1 : 8. The PGSSTM formulation was carried out using supercritical carbon dioxide, which results in powderous product free of organic solvents. The efficiency of micronizations was 90 %. The best formulation results were obtained using PEG as carrier. This product was further used for studying the release of curcumin in simulated body fluids.

In vitro release studies were performed in 1.2 and 6.8 pH media to simulate the gastric fluid and intestinal conditions. The total curcumin released after 3 h from the curcumin-PEG formulation was 100 % of the initial amount incorporated in PEG.

Keywords: *curcumin, glycerol tristearate, PEG, cellulose, controlled release*

SYNTHESIS OF γ -AMINO BUTYRIC ACID BY LACTIC ACID BACTERIA ISOLATED FROM BALKAN CHEESES

Maja Tolinacki, Sanja Mihajlovic, Svetlana Sokovic, Katarina Veljovic,
Milica Nikolic, Amarela Terzic-Vidojevic, Milan Kojic

Laboratory for Molecular Microbiology (LMM), Institute of Molecular Genetics
and Genetic Engineering, University of Belgrade, Vojvode Stepe 444a,
11010 Belgrade, Serbia

*Corresponding author:

E-mail address: maja_tolinacki@imgge.bg.ac.rs

γ -aminobutyric acid (GABA) is synthesized from glutamate by the action of glutamic acid decarboxylase (GAD). It has several physiological functions in humans and animals, such as hypotensive, diuretic, and tranquilizing effects. We focused on the GABA production ability of lactic acid bacteria (LAB) autochthonous isolates in order to develop novel nutraceuticals and enhanced functional starter cultures for fermented dairy foods including cheeses and yogurts.

In silico analysis and a degenerate primer GAD typing method were used to screen the presence of a glutamate decarboxylase gene, *gadB* in the LMM collection of autochthonous LAB isolates. Thirty percent of LAB isolates that were positive on *gadB* were used for an *in vitro* test of survival under simulated gastrointestinal conditions. Two *Lactobacillus plantarum* strains from the LMM collection showing the best gastrointestinal survival, synthesized GABA under no stimulated conditions in MRS broth.

In conclusion, a selection of the most efficient GABA producing strains may contribute to the development of functional foods enriched in glutamic acid and GABA as a bioactive compound.

Keywords: GABA, lactic acid bacteria, glutamate decarboxylase

MECHANICAL PROPERTIES OF CALCIUM-ALGINATE BEADS WITH IMMOBILIZED PROBIOTIC CELLS - INFLUENCE OF FERMENTATION PROCESS

Kata Trifković^{1*}, Nataša Obradović², Marica Rakin¹, Marko Rakin¹,
Verica Djordjević¹, Viktor Nedović³, Branko Bugarski¹

¹Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4,
11120 Belgrade, Serbia

²Innovation Center of Faculty of Technology and Metallurgy, University of
Belgrade, Karnegijeva 4, 11120 Belgrade, Serbia

³Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Belgrade-Zemun, Serbia

*Corresponding author:

E-mail address: ktrifkovic@tmf.bg.ac.rs

Probiotics are the most common bioactive food component present in nowadays functional food market. Cell immobilization may enhance survival of cells and operating efficiency during fermentation and furthermore preserve probiotics in food and through the gastrointestinal tract. However, the process of cells encapsulation within Ca-alginate beads, as well as fermentation process, influences the mechanical properties of Ca-alginate matrix. The encapsulation of cells in Ca-alginate beads was performed by electrostatic extrusion technique. The mechanical properties (e.g. maximal forces required for reaching the default deformation and the Young's modulus) of beads before and after encapsulation of the cells and after fermentation were determined by testing the single bead submerged in water using the AG-*Xplus* Universal Testing Machine (Shimadzu, Japan). The encapsulation process influenced the Ca-alginate matrix in terms of increasing the maximal forces necessary for reaching the pre-set deformation percentage (from 0.254 ± 0.056 N to 0.339 ± 0.049 N). The same effect was observed for the beads with encapsulated probiotics after fermentation (0.428 ± 0.032 N). The explanation of the noticed trend could be: (1) the inclusion of the cells in the free space of the Ca-alginate matrix which led to the mechanical stabilization of the matrix and (2) additionally, the calcium ions from milk (added during fermentation) could have caused the further hardening of Ca-alginate beads. Furthermore, the decrease in the elasticity of examined beads after the cells encapsulation, followed by the additional decrease upon fermentation process was detected (Young's modulus were 0.069 ± 0.006 MPa; 0.073 ± 0.006 MPa and 0.077 ± 0.04 MPa, respectively). The process of cells encapsulation, as well as fermentation influences the Ca-alginate matrix, causing the improvement of the mechanical stability of beads encapsulating cells. Simultaneously, the Young's modulus increased, pointing out the predominantly plastic properties of the beads after encapsulation/fermentation process. The obtained results provide the valuable information that can be used in the development of functional food.

Keywords: *mechanical properties, Ca-alginate beads, encapsulated probiotic cells*

ANTIOXIDANT CHARACTERISTICS AND SCAVENGING ACTIVITY OF ORGANIC AND CONVENTIONAL SPELT

Boris Popović¹, Dubravka Štajner¹, Ružica Ždero-Pavlović¹,
Marija Bodroža-Solarov², Vladan Ugrenović^{3*}

¹Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

²Institute for Food Technology, University of Novi Sad, Bulevar Cara Lazara 1,
21000 Novi Sad, Serbia

³Institute "Tamiš", Novoseljanski put 33, 26000, Pančevo

*Corresponding author:

E-mail address: vladan.ugrenovic@gmail.com

This work is aimed to compare antioxidant properties and scavenging ability of conventionally and organic produced spelt. Moreover, antioxidant status of spelt was compared with wheat. Three spelt varieties were analyzed-Nirvana, Edners–Rotkom variety and Eco-10. Antioxidant enzymes, superoxide-dismutase and guaiacol-peroxidase, were determined as well as ferric reducing antioxidant power and DPPH-antiradical power. Total soluble proteins and total phenols were determined and also lipid peroxidation as a parameter of oxidative stress. It was observed that organically produced spelt was exposed to the higher level of oxidative stress than conventionally produced spelt, and also DPPH antiradical power was induced by conventional production. The best antioxidant properties, even better than wheat, showed organically produced genotype Edners–Rotkom with the highest phenol content, superoxide-dismutase activity, DPPH antiradical power and ferric reduced antioxidant power and consequently with the lowest lipid peroxidation intensity.

Keywords: *spelt, wheat, antioxidant, SOD, lipid peroxidation*

CANDIDATE PROBIOTIC *LACTOBACILLUS PLANTARUM* STRAIN APPLIED TO PRODUCE FERMENTED TOMATO JUICE

Darko Dimitrovski^{1*}, Elena Velickova¹, Tomaz Langerholc²,
Eleonora Winkelhausen¹

¹Department of Food Technology and Biotechnology, Faculty of Technology and Metallurgy, Ss Cyril and Methodius University, Rudjer Boskovic 16, 1000 Skopje, Macedonia

²Department of Microbiology, Biochemistry and Biotechnology, Faculty of Agriculture and Life Sciences, University of Maribor, Pivola 10, 2311 Hoce, Slovenia

*Corresponding author:

E-mail address: dardim@tmf.ukim.edu.mk

Lactobacillus plantarum PCS26 had been isolated from traditional Slovenian cheese. The data gathered from *in-vitro* tests on human intestinal cell lines indicate its probiotic effects. The suitability of this strain to ferment tomato juice and generate functional beverage with pleasant sensory properties was studied. The growth kinetic of the candidate probiotic was examined by measuring its viable count and pH change of inoculated tomato juice during fermentation. The sugars present in the juice and consumed by the bacterium as the main carbon source were also analyzed. Immobilization of *L. plantarum* PCS26 by entrapment in Ca alginate beads was used to improve the growth kinetics and the survivability during shelf life. Supplementation of the medium with whey, as protein enhancer, was studied as well.

L. plantarum PCS26 grew very well on the nutrients provided from the tomato juice reaching growth of 4.3 log cycles during 17 h with maximal viable count of 10⁹ cfu/ml and lag phase of just 2 h. Immobilized cells, on the other hand, grew 5.1 log cycles attaining 10¹¹ cfu/ml, remaining in the beads still after 28.8 h, keeping almost ideal immobilization efficiency (η) of 0.998. The pH in both cases decreased to 3.6. Addition of whey into the tomato juice did not improve the growth of *L. plantarum* PCS26 any further.

At the end, the sensory properties were assessed and the fermented tomato juice was found pleasant for consumption. Keeping in mind the increasing vegetarian and lactose intolerant population, commercialization of such probiotic beverages is much needed nowadays.

Keywords: *Lactobacillus plantarum*, tomato juice, candidate probiotic, beverage

SOCIO-DEMOGRAPHIC AND LIFESTYLE CHARACTERISTICS AND ATTITUDES OF CONSUMERS IN VOJVODINA TO FUNCTIONAL FOOD

Nataša Vukelić^{1*}, Jasmina Živković², Nikola Puvača¹

¹Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: vukelich@polj.uns.ac.rs

Functional food differs from conventional food in several ways. Within functional food, special components are directly connected with well-defined physiological effects and health benefits associated with a certain product. Known as a food for specific healthy consumption, this food includes functional ingredients which influence structure or function of the body.

A number of factors influence consumer attitudes toward foods and reshape food supply trends. These include age of the population, consumers' desire to enhance personal health, change in consumer awareness and expectations, advancing scientific evidence that diet can alter disease prevalence and progression, advances in food science and technology and changes in food regulations, etc. In order to determine consumers' socio-demographic and lifestyle characteristics as well as their attitudes towards buying functional food in Vojvodina, the research was conducted in cities such as Novi Sad, Subotica, Zrenjanin, Vršac, Ruma and Indjija. A survey involved 400 consumers who filled in questionnaires mainly in supermarkets offering functional food. The questionnaire included 3 groups of questions. The first group of questions focused on socio-demographic characteristics of respondents; the second group was designed to gather information about consumers' life style (health condition, type of health care, and type of nutrition), while the third group included questions about functional food, consumers' attitudes towards it, their awareness, needs for buying, etc. The survey results were analysed by program package software SPSS 19 using non-parametric tests and presented by certain descriptive statistics. Mann-Whitney U test and Kruskal-Wallis test showed that there were no significant differences in attitudes toward functional foods between different socio-demographic groups. Although 81% of the consumers claimed that they had no previous knowledge of the functional food terminology, after clarification of the terms used, 58% of respondents realised that they had already consumed functional food before. Considering the aforementioned, the lack of knowledge about functional food implies that it is very important to create effective marketing campaigns for such products.

Keywords: *functional food, consumers' attitudes, Vojvodina*

THE EFFECTS OF PHENOLIC COMPOUNDS IN OLIVE OIL ON HUMAN HEALTH

Filiz Yangılar*, Pınar Oğuzhan Yıldız

Ardahan University Engineering Faculty Food Engineering, Ardahan, Turkey

*Corresponding author:

E-mail address: f_yangilar@hotmail.com

Olive oil, the main source of fat in the Mediterranean diet, is a functional food which besides having a high level of monounsaturated fatty acid contains several minor components with biological properties. The most important of these compounds, which can also be called as bioactive compounds, are polyphenols, tocopherols, phospholipids, carotenoids, chlorophylls, sterols and squalen. These compounds are characteristic of Oleaceae plants and secoiridoids are the main compounds of the phenolic fraction such as oleuropein, hydroxytyrosol and tyrosol and especially for their role in human nutrition and their strong physiological effects on human health. Phenolic compounds in olive by-products may initiate biological reactions to affect cancer cells. These products contain an abundance of phenolic antioxidants including simple phenols (hydroxytyrosol, tyrosol), aldehydic secoiridoids, flavonoids and lignans (acetoxypinoresinol, pinoresinol). Since antioxidant properties of dietary phytochemicals have well-established roles in disease such as cancer. Beneficial effects of phenolic compounds due to their antioxidant activity and their effect on human health as a result of research developed in these areas for the last ten years will be mentioned in this review.

Keywords: *phenolic compounds, olive oil, health*

SALMONELLA INFANTIS MAJOR INCREASE IN FOOD SAMPLES

Jelena Apić*, Jelena Petrović, Jelena Babić, Miloš Kapetanov, Igor Stojanov

Scientific Veterinary Institute „Novi Sad“, Rumenački put 20,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jelena.a@niv.ns.ac.rs

The occurrence of zoonotic pathogens varies depending on the range of factors including the organism, geographical factors, farming and meat production practice. *Salmonella Infantis* infections in humans transmitted by food are increasingly observed around the world. The aim of this study is to show major increase of *Salmonella Infantis* among salmonella isolates in food control in Vojvodina region. These investigations, were conducted at different points in the production chain: pig and bovine carcass swab samples from abattoirs, neck skin samples from poultry abattoirs, meat samples from cutting plants, eggs and different food samples from retail. Totaly of 2252 samples, were examined, by standard ISO protocol. *Salmonella* species were isolated from 44 samples (1.95%), 17 of this isolates were *Salmonella Infatis* (38.64%). *Salmonella Infatis* was isolated at the slaughter mostly from poultry (11 isolates), pigs (6 isolates) and mechanically separated meat (1 isolate). According to Serbian official data *Salmonella Infantis* is the third most common serotype isolated from humans in Serbia, and infection is often associated with the consumption of poultry products. Presence of *Salmonella Infantis* at slaughter is related to fecal contamination and presence of Salmonella in live animals. This change of predominant *Salmonella* serovars in the poultry, vacated by vaccination against *S. Typhimurium* and *S. Enteritidis* and poor breeding conditions, may lead to an epidemic increase of *S. Infantis* in poultry meat.

Keywords: *Salmonella Infantis*, poultry, major increase

AROMA QUALITY OF STRAWBERRIES: OVERVIEW OF THE POTENTIALITY OF GC-OLFACTOMETRY

Giulia Bianchi*, Anna Rizzolo

Consiglio per la Ricerca e la Sperimentazione in Agricoltura
Unità di ricerca per i processi dell'industria agroalimentare (CRA-IAA)
Via Venezian, 26 – 20133 Milano, Italy

*Corresponding author:

E-mail address: giulia.bianchi@entecra.it

Strawberries (*Fragaria* spp.) are a source of phytochemicals with health promoting properties. The consumers' appreciation and further consumption of foods depend also upon good eating quality resulting from flavour, taste and aroma. Therefore, nowadays the improvement of flavour and aroma profile is taken into account in the breeding process using the genetic biodiversity of wild species in order to enhance the aroma characteristics of the new selections; therefore, the need of reliable tools to evaluate flavour and aroma is increasing. Strawberry aroma is composed of more than three-hundred compounds belonging to several chemical classes. The main components are esters, providing the «sweet-fruity» odour note, along with aldehydes, alcohols, furans and sulphur compounds; other volatiles, such as the monoterpene linalool, γ -dodecalactone and some sulphur compounds are the most important contributors to strawberry aroma, along with few impact compounds, such as furaneol and its methyl ether. The odour activity of each compound is related to its odour threshold, the lowest concentration able to generate an olfactory response.

A multidisciplinary approach that involves both chemical and sensory properties of volatile compounds is required in order to evaluate the aroma composition and the odour active compounds of foods. Gaschromatography-olfactometry (GC-O), allows the chromatographic separation of volatiles together with sensory evaluation, is an appropriate tool for this purpose.

This work aimed at reviewing and discussing the GC-O results on strawberries carried out at CRA-IAA over the last twenty years, focusing on the answers that this method can offer to the various issues arisen over time, such as the characterization of volatile composition using odour patterns, the control of aroma retention after technological processes such as osmodehydration, the evaluation of differences among cultivars, relating them to the expression profiles of flavour-related genes, by comparing the GC-O results with OAV (odour activity value) and E-nose odour patterns.

Keywords: *strawberry, gaschromatography-olfactometry, odour active compounds, hyphenated analysis method, sensory evaluation*

CONTRIBUTION OF MEAT INSPECTION AND ABATTOIR PROCESS HYGIENE TO BIOLOGICAL SAFETY ASSURANCE OF POULTRY CARCASSES

Biljana Bozić, Bojan Blagojević*

Department of Veterinary Medicine, Faculty of Agriculture, University of Novi
Sad, Trg D. Obradovica 8, 21000 Novi Sad, Serbia

*Corresponding author:
E-mail address: blagojevic.bojan@yahoo.com

The aim of the study was to compare performances of the current official meat inspection and abattoir process hygiene in ensuring biological safety of poultry carcasses through qualitative risk ranking of hazards associated with poultry that each of these risk management strategies can control at abattoir level. Available literature was used, and where no literature was available, international experts were consulted. The results indicate high risk of *Salmonella enterica* and thermophilic *Campylobacter* spp., and low risk of human pathogenic *Escherichia coli*, *Yersinia enterocolitica*, *Listeria monocytogenes*, *Clostridium* spp., *Toxoplasma gondii* and numerous other identified meat-borne biological hazards. Analysis of the current two main risk management strategies in poultry abattoirs indicated that abattoir process hygiene has a higher public health protection potential than official meat inspection. For many hazards, data gaps were identified; further studies and zoonoses monitoring should be addressed to fill those gaps so to have more accurate inputs for risk assessment and selection of appropriate risk management measures for those hazards.

Keywords: *poultry, biohazards, meat inspection, abattoir process hygiene*

MOLECULAR DETECTION OF *ALTERNARIA* SPP. ON ORGANIC SPELT WHEAT

Jovana Đisalov¹, Marija Bodroža-Solarov¹, Ferenc Bagi², Jelena Čulafić³, Aleksandra Bočarov-Stančić⁴, Tea Brlek¹, Jovana Brkljača^{1*}

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia

³Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21000 Novi Sad, Serbia

⁴Institute of Applied Sciences in Agriculture, Bulevar despota Stefana 68b, Belgrade, Serbia

*Corresponding author:

E-mail address: jovana.brkljaca@fins.uns.ac.rs

Molds of genus *Alternaria* are important contaminants of small grains and their products causing considerable losses to growers and food processing industry. Negative impact on quality and safety of food and feedstuffs is closely related with toxigenic potential of some *Alternaria* spp. There is a growing interest in spelt wheat as high quality grain suitable for organic production. Considering the importance of *Alternaria* spp. and increasing demand for spelt wheat products, aim of this study was to identify the most frequent *Alternaria* species on spelt kernels. Since detection based on morphological characterisation is laborious, time-consuming and might not detect molds on the species level with high certainty, molecular approach by PCR assays has been used. ITS sequence analysis indicated that *Alternaria tenuissima* was dominant species on spelt wheat kernels followed by *Alternaria infectoria*. Accurate identification of *Alternaria* spp. is a crucial phase in further detection of their toxic metabolites, thus PCR method may be applied to screening agricultural commodities for the presence of mycotoxin producers.

Keywords: *Alternaria* spp., spelt wheat, PCR

AFLATOXINS IN CORN, CORN PRODUCTS AND MILK IN CROATIA IN 2012 AND 2013

Slaven Zjalic¹, Vlasta Brlek^{2*}, Ladislav Čosos³, Iva Sabljak², Mirela Grubelic², Jelena Gavran², Marijana Matek Saric¹

¹University of Zadar, 23000 Zadar, Croatia

²Croatiakontrola doo, Karlovačka c. 4L, 10000 Zagreb, Croatia

³Hrvatska kontrola zračne plovidbe doo (Croatia Control Ltd.), P. O. B. 45, 10150 Zagreb - Airport, Croatia

*Corresponding author:

E-mail address: vbrlek@croatiakontrola.hr

Aflatoxins (AF), the secondary metabolites produced by fungi belonging to *Aspergillus* section Flavi, present a serious health hazard for human and animals. Their toxicity includes both genotoxic and cytotoxic effects. Aflatoxigenic species of *Aspergillus* can contaminate different food and feed stuff including cereal grains. Contamination of seeds and other feed components can occur both in pre and postharvest period. In Europe the contamination with aflatoxins were considered more a problem of imported food/feed stuff or bad storage conditions than contamination in field. For contamination in field environmental conditions rarely present in European countries are required: high temperature, over 35°C, and drought period in summer. But in last decades these conditions occurred several times in central and south-east Europe. In the spring of 2013 there was an outbreak of contamination of Croatian milk with AFM1. In Croatia the summer 2012 was drought and unusually hot, the mean temperatures in Jun and July were 3-4°C above the mean temperatures registered in last 10 years. The consequence was maize contamination by aflatoxigenic fungi in field. In our analysis about 20% of 124 samples of maize produced in 2012 in Croatian region of Slavonia and 28% of corn based cattle feed presented concentrations of AFB1 above the EU limits. The analysis of 1250 samples of milk produced in Croatia between February and March of 2013 showed that in 23% of examined samples concentration of AFM1 were above the EU limits. Our data confirms the validity of EU limits for AF concentration in feed for dairy animals. Moreover these results indicates that the outbreak of contamination of Croatian milk by AFM1 in 2013 was more due to the contamination of corn occurred in field than due the inadequate storage conditions.

Keywords: aflatoxin B1, Aflatoxin M1, feed, milk

ISOFLAVONE CONTENT IN DIFFERENT MATURITY GROUPS OF SOYBEANS

Jelena Cvejić^{1*}, Bojana Gaćeša¹, Mira Bursać¹, Vuk Đorđević²,
Jegor Miladinović²

¹Department of Pharmacy, Faculty of Medicine, Hajduk Veljkova 3,
21000 Novi Sad, Serbia

²Institute of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: cvejich@hotmail.com

Isoflavones are found in variety of plants, the most common being soybean and red clover. Depending on the critical photoperiod threshold, soybean varieties can be grouped into 13 maturity groups (MG) depending on the climate or latitude for which they are adapted. Maturity groups are designated as MG000, MG00, MG0, MG1 to MGX. The aim of this study was to determine and compare isoflavone content in 23 samples of soybeans of four different maturity groups: MG00 (5 genotypes), MG0 (4 genotypes), MG1 (7 genotypes), MGII (7 genotypes).

Whole soybean seeds were powdered, defatted by *n*-hexane and then extracted 2 hours in 25°C with methanol:water (8:2, v/v). Isoflavone content was determined by C₁₈ reversed phase high-performance liquid chromatography (HPLC/DAD).

Total isoflavone content in samples was in the range 0.69-6.30 mg/g of dried seed. Comparing average values of total isoflavone content between different maturity groups, it was found that the lowest average value was in MGII soybean seeds (1.04±0.34 mg/g), and the highest in MG0 soybean seeds (3.15±2.20 mg/g). Maturity groups 00 and 0 showed similar average values of total isoflavone content. Total daidzein content on average was the lowest in MGII soybean seeds (0.68±0.22 mg/g) and the highest in MG0 soybean seeds (2.31±1.93 mg/g). Total glycitein content on average was the lowest in MGII soybean seeds (0.21±0.09 mg/g), and the highest in MG00 soybean seeds (0.32±0.09 mg/g). Total genistein content on average was the lowest in MGII soybean seeds (0.15±0.13 mg/g) and the highest in MG0 soybean seeds (0.61±0.21 mg/g). The highest single values of total isoflavones, daidzein and genistein were determined in one MG0 soybean seed.

Differences were observed in isoflavone content between different maturity groups and genotypes. The lowest content was found in one soybean genotype of MGII and the highest in one soybean genotype of MG0.

Keywords: *isoflavones, soybean, maturity groups, HPLC*

EFFECT OF TIME, TEMPERATURE AND INOCULUM SIZE ON THE PENETRATION OF *SALMONELLA* ENTERITIDIS THROUGH EGG SHELL

Ivana Čabarkapa^{1*}, Jovanka Lević¹, Bojana Kokić¹, Dragana Plavšić¹, Ana Varga¹, Ljiljana Suvajdžić²

¹University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²University of Novi Sad, Faculty of Medicine, Department of Pharmacy, Hajduk Veljkova 3, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ivana.cabarkapa@fins.uns.ac.rs

In recent decades salmonellosis has been on the rise as a food related illness worldwide. *Salmonella* Enteritidis was responsible for 60% of all verified outbreaks due to *Salmonella* spp. *Salmonella* spp., in particular *S. Enteritidis*, is strongly associated with eggs and egg products. Eggs or products containing eggs have been the most common source for the transmission of *S. Enteritidis*. The present study was conducted in order to evaluate the effect of time, temperature and inoculum size on the penetration of *S. Enteritidis* through egg shell. Experimental treatments included 4 concentrations of inoculum (10^5 , 10^4 , 10^3 , 10^2 cfu/mL) and 3 temperatures of storage (4, 10 and 25°C). Presence or absence of *S. Enteritidis* was determined after 3, 7, 14 and 21 days. After 3 and 7 days from inoculation and storage at 4°C *Salmonella* was not detected in egg content and also at inner shell of treated egg samples. Further incubation at 4°C (14 and 21 days) led to detection of *Salmonella* but only at higher levels of inoculation.

In egg samples stored at 10°C after 3 and 7 days *Salmonella* was detected in egg content and inner shell only at higher levels of inoculation. At this temperature prolonged storage (14 and 21 days) resulted in detection of *Salmonella* at all levels of inoculations and increased number of positive samples especially at the higher levels of inoculation.

Storage temperature of 25°C resulted in *Salmonella* detection in egg content and inner shell at all levels of inoculation even after 3 days of storage. Prolonged storage led to greater number of positive samples.

In view of these findings, this study clearly demonstrates that *S. Enteritidis* can contaminate egg content by migration through the shell and associated membranes. *Salmonella* penetration is enhanced when eggs are inoculated with higher inoculum levels, storage on higher temperature and length of storage.

Keywords: *Salmonella* Enteritidis, eggs, egg shell

Acknowledgments: The research is financed by Projects No. III46012 financed by the Ministry of Education, Science and Technological Development, Republic of Serbia.

RHEOLOGICAL METHODS TO CHARACTERIZE SPELTA FLOUR FOR PASTA MAKING

Jelena Filipović^{1*}, Lato Pezo², Milenko Košutić¹, Rada Jevtić-Mučibabić¹

¹University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Institute of General and Physical Chemistry, University of Belgrade, Studentski Trg 12 - 16, 11000 Beograd, Serbia

*Corresponding author:

E-mail address: jelena.filipovic@fins.uns.ac.rs

Spelt wheat is suitable raw material on flour based product characterized by altered nutritional characteristics and health benefits compared to conventional wheat products. This paper investigates rheological methods for determining the quality of 5 different spelt samples of flour as a raw material for pasta making. Correlation between rheological methods for flour (Mixolab data and Farinogram of semolina) pasta quality is defined. Sample 1 has the lowest speed of protein network weakening due to warming -0.053 (Nm/min), the lowest warm paste stability (0,173 Nm/min) and retrogradation of starch (2.94 Nm) and the best score for semolina farinogram. These data are in direct correlation with quality of pasta (time of cooking 12 min and adhesiveness 10.25 gsec). Negative correlation between water absorption and farinogram of semolina, as well as between water absorption and adhesiveness was observed ($r=-0.98$, statistically significant at $p<0.01$), while positive correlation was noticed between water absorption and gluten strength ($r=-0.98$, $p<0.01$). Positive correlation between warm paste stability and farinogram of semolina ($r=0.98$, $p<0.01$), as well as negative correlation between warm paste stability and gluten strength was observed ($r=-0.97$, $p<0.01$). Retrogradation of starch and cooking time are negatively correlated ($r=-0.99$, $p<0.01$). Based on the rheological methods such as mixolab and farinogram data quality of pasta can be predicted.

Keywords: *mixolab data, farinogram of semolina, pasta quality*

TRENDS IN ASH AND MINERAL CONTENT OF MILK FROM DOMESTIC BALKAN DONKEY BREED THROUGHOUT LACTATION

Jasmina Gubić*, Tatjana Tasić, Ivan Milovanović, Jasmina Živković

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: jasmina.gubic@fins.uns.ac.rs

Ten female donkeys belonging to Domestic Balkan donkey autochthonous breed were controlled throughout a whole lactation period. Subjected animals were grown at Valjevac pasture of Special Nature Reserve "Zasavica". The milk samples were taken by hand milking of two glands at days 45, 60, 80, 100, 125, 150, 170 and 200 *postpartum*. From days 80 to 170 *postpartum*, the ash content increased from 0.38 to 0.76 g/100mL of milk ($P < 0.05$). In the same period, the content of the mineral elements also increased significantly ($P < 0.05$): Ca from 157 to 224 mg/100mL; Na from 34 to 36 mg/100mL; Zn from 0.38 to 0.57 mg/100mL. Similarly, the concentrations of P, K and Mg increased from 50 to 162 g/100mL, from 117 to 135 g/100mL and from 8 to 10 g/100mL, respectively, after 80, 125 and 170 days of lactation. Thus, the concentration of the investigated minerals was affected by the stage of lactation. The obtained results for the mineral content of the donkey milk characterized showed that it can be considered as nutritionally valuable and healthy food.

Keywords: *Balkan donkey milk, lactation stage, ash, mineral elements*

EFFECTS OF GENOTYPE AND ENVIRONMENT ON THE FARINOGRAPH QUALITY INDICATORS OF WINTER WHEAT

Nikola Hristov*, Novica Mladenov, Ankica Kondić-Špika, Bojan Jocković

Institute of Field and Vegetable Crops, M. Gorkog 30, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: nikola.hristov@nsseme.com

Technological quality of wheat, as well as most other properties, significantly respond to changes in environmental factors and depending on the variety, exhibit smaller or larger deviations from the expected values. Since over the past few decades, traditional manufacturing processes to obtain bread and biscuits, have become almost fully automated, it is extremely important to ensure the continuous quality of the grain for milling and baking industry. Rheological properties such as farinograph characteristics, have a great significance in the prediction of the formation, development, and baking of dough. The aim of this study was to analyze the genotype by environment interaction (GEI) and stability of wheat genotypes in different environmental conditions. Twenty divergent wheat genotypes with different high molecular glutenin subunits (HMW SG), were studied at five locations in three years. Two quality indicators were analyzed, Farinograph water absorption (FWA) and the dough development time (DDT). The average value of the FWA varied from 54.8 to 61.7%, while the value of the DDT varied from 1.7 to 6.3 min. Analysis of variance of the genotypes in 15 environments, showed that the effects of genotype, environment and GEI were highly significant for both analyzed traits. The genotypes with high FWA were more stable than the genotypes which had a high average value for DDT. Among groups of the genotypes with different HMW SG, no significant difference was found in mean values of the traits. Since the analyzed properties largely depend on the content and quality of proteins, which are highly influenced by genotype and environmental factors, it is necessary to make the correct choice of varieties and apply appropriate production technology in order to obtain high quality wheat products.

Keywords: *wheat, quality, farinograph, genotype, environment*

ORGANOCHLORINE AND ORGANOPHOSPHORUS PESTICIDE RESIDUES IN VEGETABLES IN EASTERN ROMANIA AREA

Carmen Hura, Bogdan Hura

INPH/ Centre Regional of Public Health, Iasi, Romania

*Corresponding author:

E-mail address: carmen_hura@yahoo.com

The presence of pesticide residues and metabolites in food, water and soil currently represents one of the major issues for environmental chemistry. Pesticides are, in fact, among the most important environmental pollutants because of their increasing use in agriculture. The presence of residues of such pesticides in food stuffs is of major concern for public health reasons.

The authors present the research results obtained in 2012 - 2013 period of some chemical pollutants with cancer risk (organochlorine and organophosphorus pesticides residues) in vegetables from Eastern Romania area.

In 2012 - 2013 period were analyzed the organochlorine and organophosphorus pesticide residues in 150 vegetables samples from Eastern Romania area.

The analysis of the organochlorine pesticides was performed by gas chromatography with an electron capture detector (EC) and the organophosphorus pesticides with a phosphorous nitrogen detector (NP) (Shimadzu A 2010 model), after the acetonitrile extraction of the pesticide residues from samples and the clean -up with SPE (we tested 55 pesticides).

The GC/ECD/NP analysis of pesticides in all samples searched showed that most of the detected and quantified residues were below the maximum residual limit for pesticide residues in vegetables products (Reg.CE396/2005).

The determinations of the chemical pollutants in vegetables are important in environmental monitoring for the prevention, control and reduction of pollution as well as for occupational health, legal decisions and epidemiological studies.

Keywords: *organochlorine, organophosphorus pesticides, vegetables*

POSSIBILITIES OF VISUAL AND INSTRUMENTAL IDENTIFICATION OF WHEAT INFESTATION WITH FIELD FUNGI

Elizabet Janić Hajnal^{1*}, Miona Belović¹, Dragana Plavšić¹, Jasna Mastilović¹, Ferenc Bagi², Dragana Budakov², Jovana Kos¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: elizabet.janich@fins.uns.ac.rs

Cereals are the primary source of human diet, wheat being the third most produced grain worldwide. Recent studies have shown that besides *Fusarium* spp., fungi of the genus *Alternaria* spp. became the dominant contaminants on wheat kernels. Besides pathogenicity and reduction of quality of kernels, several *Alternaria* spp. are known producers of toxic secondary metabolites *Alternaria* mycotoxins, which might be harmful for human and animal health. The aim of this work was to explore the possibility of determining the intensity of field fungi infestation by application of visual evaluation (using scale 1-6, where 1 represents the lightest sample) and instrumental analysis (using Minolta Chromameter CR-400) of wheat ears and kernels colour. Experiment was carried out on the wheat protected by fungicide and wheat inoculated by *Alternaria* spp., while non treated wheat was used as a control. Wheat ears used for the establishing of visual scale were measured instrumentally in order to explore the correlations between these two methods. Grouping of wheat ear samples by values of L* colour parameter (lightness) was in accordance with the established scale. L* values were also in the highest negative correlation (-0.97, $p < 0.001$) with the visual scale. Significant difference was observed between all three treatments using visual scale. Protected wheat samples were significantly different from other samples in terms of all measured colour parameters (L*, a*, b*, C*, hue angle, and dominant wavelength). Inoculated and control wheat samples were significantly different in terms of lightness, hue angle, and dominant wavelength. The colour of wheat kernels was only instrumentally measured. The kernels of inoculated wheat samples differed significantly from other samples in terms of L*, a*, b*, and C* parameters. Identification of field fungi in the all examined wheat samples showed that the dominant toxicogenic fungus was *Alternaria* spp., followed by *Fusarium* spp.

Keywords: colour, sensory evaluation, wheat ears, wheat kernels, field fungi

CONTENT OF FREE AMINO GROUPS IN WHEAT FLOUR AS INDICATOR OF WHEAT ENZYMATIC STATUS

Elizabet Janić Hajnal*, Jelena Tomić, Aleksandra Torbica

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: elizabet.janich@fins.uns.ac.rs

The quality of starch and protein fractions in wheat flour has the most dominant role in the formation of quality of wheat-based products. The level of protein quality as well as the end-use flour quality is determined by different chemical, physical and rheological methods. The aim of this study was to determine the biochemical status of maturated wheat flour originating from different localities in terms of the content of free amino groups as an indicator of the protein hydrolysis degree.

Samples of five wheat varieties were collected from six localities in northern Serbia in 2010/2011 production year. The content of free amino groups was determined after the wet gluten samples incubation for three hours at two different temperatures (30° and 37°C). The selected temperature of 30 °C is commonly used for processing of the dough in practise, while the temperature of 37 °C was chosen as the optimum temperature for present proteolytic enzyme activity.

The obtained results indicate significant differences in the content of free amino groups between the temperature treatments (at 30 and 37 °C) as well as the differences between varieties. The content of free amino groups increased with the increase in incubation temperature of gluten from 30 °C (0.110826 µg/mg) to 37 °C (0.132867 µg/mg) ($p < 0.05$). Significant difference was observed between wheat varieties in Subotica, Bačka Topola and Kikinda localities. The lowest average of free amino groups content was determined in Kikinda, while the highest content was determined in Sombor locality.

The further research should be carried out covering investigated wheat varieties from different production years.

Keywords: *wheat flour quality, free amino groups, proteolytic activity*

MOLASSES AS A SUPPLEMENT TO FOOD PRODUCTS

Rada Jevtić-Mučibabić^{1*}, Jasna Grbić¹, Bojana Filipčev¹, Ivan Milovanović¹,
Olivera Šimurina¹, Jasmina Živković¹, Tatjana Kuljanin²

¹University of Novi Sad, Institute of food technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

²University of Novi Sad, Faculty of Technology, Bul cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: rada.jevtic@fins.uns.ac.rs

Taking into consideration the global trends in food research oriented towards obtaining food with high nutritive and biological value, extensive study has been conducted to investigate the quality of molasses, a by-product of sugar industry, in order to estimate its suitability as an ingredient in food industry.

Although it is best to use sugar beet molasses in a traditional way, increasing demands after food products with enhanced nutritional value conjoined with specific composition of molasses has lead to the idea that sugar beet molasses is an ingredient with high potential to complete the array of useful ingredients for the production of functional and fortified food. Molasses is a concentrate of biogenic elements (potassium, calcium, magnesium, sodium) and many bioactive substances (proteins, betaine, glutamic acid, purine and pyrimidine bases, organic acids, melanoidines).

The results of the study showed that sugar beet molasses can be used as an ingredient in food industry offering new commercial possibilities from the aspect of consumers' health benefits.

Keywords: *sugar beet molasses application, bread, tea biscuits*

**CHEMOMETRIC ANALYSIS OF THE INFLUENCE OF
PHENOLS, VULGAXANTHIN AND BETANINE CONTENTS ON
ANTIOXIDATIVE ACTIVITY OF BEETROOT EXTRACT**

Strahinja Kovačević^{1*}, Sanja Podunavac-Kuzmanović¹, Aleksandra Tepić¹,
Lidija Jevrić¹, Žarko Ilin², Zdravko Šumić¹

¹University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²University of Novi Sad, Faculty of Agriculture, Trg Dositeja Obradovica 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: strahinjakovacevic@hotmail.com

The present study is based on chemometric analysis of the correlations between antioxidative activity of beetroot extracts and phenols, vulgaxanthin and betanine contents in the extracts. Preceding crops, such as cabbage, cauliflower, kohlrabi and broccoli, were grown on the same soil before beetroot. Regression analysis was carried out applying linear (LR) and multiple linear regression (MLR) approaches. The best LR and MLR correlations were established for extracts obtained from beetroot with cauliflower, kohlrabi and broccoli as preceding crops. The basic statistical measures and cross-validation parameters confirmed the prediction ability of the established models, which can be used for prediction of antioxidant activity of the obtained extracts. LR models indicate the increase of antioxidant activity with increase of phenols, vulgaxanthin and betanine contents in the beetroot extracts.

Keywords: *beetroot, antioxidant activity, chemometrics, regression analysis*

RAPESEED (*Brassica napus* L.) SEED USED FOR CONSUMPTION AND INDUSTRIAL PROCESSING

Ana Marjanović Jeromela*, Radovan Marinković, Petar Mitrović, Željko Milovac,
Sreten Terzić, Dragana Miladinović, Aleksandar Mikić

Institute of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ana.jeromela@nsseme.com

Utilization of rapeseed seed in diet and industry depends on its composition. Clear insight into seed components can help in precise definition of breeding directions and uses of individual rapeseed genotypes. Main breeding direction at the Institute of Field and Vegetable Crops in Novi Sad, Serbia is development of „00“ genotypes, i.e. without erucic acid and with low glucosinolates content. One of the basic goals in most rapeseed breeding programs is increased content of oleic acid and decreased content of linolenic acid. Industry development also demands creation of rapeseed genotypes with high content of erucic acid. Apart from alterations in fatty acids composition, rapeseed oil quality research also includes increased content of tocopherols, as oxidants. Improved isomeric composition, i.e. relative content of α , β , γ , δ forms, increases oxidative stability of oil as compared to the standard type. Rapeseed meal is used as an ingredient in feed mixes. Its use depends on protein quantity, amino-acid composition and anti-nutrients quantity and composition.

As a material for the study, 89 rapeseed lines differing in quality parameters were used. In order to analyze genetic variability of tocopherol content in the lines, a field experiment was conducted. Tocopherols are represented in rapeseed as: α tocopherol in content 106 - 524 ppm, γ tocopherol in content 211 - 525 ppm. No correlations between α - and γ - tocopherols or between tocopherol and oil content were detected. Among the most varieties and combinations that were used in our research, there were significant differences in the content of oleic acid (C 18:1). Of the analyzed cultivars, the highest value for this trait had variety Valeska (71.60%) and lowest Alligator (67.64%). In F1 hybrids, the highest value for this trait was found in combination Banačanka x Hurricane (72.41%). Sixteen rapeseed genotypes, grown at the two sites were analyzed in the study where sixteen types of amino acids were identified. Analysis showed significant effect of the site on protein and amino acid contents. There were significant differences among the genotypes in the basic amino acid content of seed. Several of the genotypes will be included in the breeding program: NS-L-129 (high protein content), NS-L-33, NS-L-128 and NS-L-74 (high lysine content), NS-L-128, NS-L-36 and NS-L 138 (high methionine content).

This study shows results of rapeseed breeding for the mentioned seed components, further improvements in nutritional composition and possibilities of

uses. Genotypes aimed for human consumption, genotypes for feed and for industrial processing have been treated separately.

Keywords: *oil, fatty acids, glucosinolates, proteins, meal*

THE INFLUENCE OF WATER HYGIENE IN DAIRY INDUSTRY ON MICROBIOLOGICAL QUALITY OF BUTTER

Nurigin Memiši^{1*}, Slavica Vesković Moračanin², Marija Škrinjar³

¹AD Mlekara – Subotica, Tolminska 10, 24000 Subotica, Serbia

²Institute for Meat Technology, Kačanskog 13, 11000 Belgrade, Serbia

³Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: memisin@mlekara.rs

This paper presents investigation results of the influence of water quality used in dairy industry on the quality and microbiological safety of butter. Determination of physico-chemical composition and microbiological status of water that is used in butter production was analysed along with the investigation of hygienic production conditions. The aim of this paper was to determine the water quality as well as its suitability in butter production from the hygienic and technological aspect in order to obtain safe products. Microbiological examinations were carried out and interpreted according to current legislation as well as with the elements of self-control prescribed in HACCP plans.

Based on investigation results, it can be concluded that microbiological safety and quality of water used in butter production (areas for cleaning, manufacturing and packaging of butter) meet the criteria set in current legislations. The results of microbiological investigations showed that measured count of aerobic mesophilic bacteria (<10 cfu/mL) was lower than prescribed limits. The presence of pathogenic bacteria was not determined in water samples analysed in this study.

Based on the data on microbiological safety of butter samples in certain phases of churning and production, it is evident that the microbiological quality of the butter produced was satisfactory. The presence of pathogenic bacteria was not found in the analyzed samples, which indicates that the product is safe and the hygiene of the production process is adequate.

During the production process, however, special attention has to be paid to microbiological safety and quality of raw materials, as well as to hygienic and sanitary conditions during the production process (washing and disinfection of equipment, temperature pasteurization regimes, etc.).

Keywords: *butter, chemical composition, water, microbiological quality*

RADIOACTIVITY OF MILK IN THE TERRITORY OF VOJVODINA

Željko Mihaljev^{1*}, Milica Živkov-Baloš¹, Željko Ćupić², Sandra Jakšić¹,
Brankica Kartalović¹, Dragana Ljubojević¹

¹Scientific Veterinary Institute „Novi Sad“, Rumenački put 20,
21000 Novi Sad, Serbia

²Research Institute for Reproduction, Artificial Insemination and Embryotransfer
"Temerin", Industrijska zona bb, 21235 Temerin, Serbia

*Corresponding author:

E-mail address: zeljko@niv.ns.ac.rs

Milk samples were collected during 2012/2013 from private dairy farms. Total beta-activity was determined in a mineral residue after dry burning using an anti-coincidence system omni guard, Tracerlab (USA), featuring basic activity of less than 1 imp/min. Activity level of ⁴⁰K in milk samples was determined according to measured total potassium levels, using the specific mass activity of potassium while the method of radiochemical solvent extraction has been used for determining radionuclide ⁹⁰Sr. Potassium and calcium contents in milk were determined by the method of emission spectrophotometry applying SpectrAA-10, Varian. Caesium and lanthanum were used as ion-suppressors for potassium and calcium, respectively. Results obtained in this research point out that the natural radionuclide ⁴⁰K was the predominant one in all investigated samples, and the presence of the produced radionuclides, such as ⁹⁰Sr was also confirmed in all samples. The activity level of radionuclides ⁹⁰Sr in milk was below 1 Bq dm⁻³ which is slightly lower than in previous few years.

Keywords: *milk, activity of Potassium-40, activity of Caesium-137, activity of Strontium-90*

OSMOTIC DEHYDRATION OF FISH (*CRASSUS GIBELIO*) IN DIFFERENT SOLUTIONS

Dragana Plavšić^{1*}, Jasmina Gubić¹, Ljubiša Šarić¹, Ana Varga¹, Milica Nićetin², Vladimir Filipović², Biljana Ćurčić²

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: dragana.plavsic@fins.uns.ac.rs

This research was conducted in order to examine changes in osmotic dehydrated fish (*Carassius gibelio*) by using hypertonic solutions. The change were followed in three different osmotic solutions sugar beet molasses (solution 3), the mixed solution of sodium chloride and sucrose (solution 1) and combination of these solutions in a 1:1 ratio (solution 2), under atmospheric pressure, at temperature of 50°C. The effects of osmotic dehydration on mineral composition, water activity and microbiological safety of fish, were investigated in order to determine the usefulness of this technique as pre-treatment for further treatment of fish. Osmotic dehydration of fish meat in sugar beet molasses (solution 3) lead to significant increase of Mg and Fe content, approximately 2 times. Influence of beet molasses on the chemical composition could be noticed. Amount of tracked minerals increased for Ca and Na, while amount of K not changed during dehydration in solution with sugar beet molasses. After five hours of immersion in all three solutions content of Hg in fish meat was reduced. Water activity of the fresh fish meat was 0.944 ± 0.007 , while the results obtained after the 5 hours of osmotic dehydration process varied from 0.863 ± 0.012 (solution 2) to 0.833 ± 0.009 (solution 3). The reduction of microbial populations in addition to reducing the water activity value was influenced by the temperature treatment, which amounted to 50°C. Bacterial count was reduced from $5 \log \text{CFU} \cdot \text{g}^{-1}$ to $3 \log \text{CFU} \cdot \text{g}^{-1}$ which is considered as microbiological limit for good fish meat quality.

Keywords: osmotic dehydration, fish, mineral and microbiological

PRESENCE OF POTENTIALLY TOXIGENIC MOLDS IN CEREAL FLOURS

Dragana Plavšić^{1*}, Gordana Dimić², Đorđe Psodorov¹, Dragan Psodorov³,
Ljubiša Šarić¹, Anamarija Mandić¹, Dubravka Jambrec¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

² Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

³College of Management and Business Communications, 21205 Sremski
Karlovc, Mitropolita Stratimirovića 110, Serbia

*Corresponding author:

E-mail address: dragana.plavsic@fins.uns.ac.rs

Concerning the agricultural products, grains present the most important staple food in the human diet. The most common cereals that are used for the processing are: wheat, rye, corn, rice, buckwheat etc. Presence of microorganisms is inevitable on the cereal grain surface and consequently in their products. Contamination is most frequently caused by molds which in turn could produce a numerous secondary metabolites. Mycotoxins are secondary metabolites of molds, which are toxic for humans and animals.

Aim of this work is to conduct a determination of molds that are present in buckwheat, corn and rice flour, as well as a frequency of genera, species and potentially toxigenic species.

All the samples were contaminated by molds. Mycopopulation of buckwheat, corn and rice flour consists of species from genera: *Absidia*, *Acremonium*, *Alternaria*, *Aspergillus*, *Cladosporium*, *Emericella*, *Eurotium*, *Mucor*, *Penicillium*, *Paecilomyces*, *Rhizopus*. Dominant species were: *Aspergillus flavus*, *Penicillium aurantiogriseum*, *P. expansum*, *Eurotium chevalieri*, *A. niger*. The most frequent species was *Aspergillus flavus*, which is a potential aflatoxin producer. Mycotoxicological examination of *A.flavus* didn't show the presence of aflatoxins.

Keywords: *cereal flours, fungal contamination, toxigenic molds*

THE WAYS OF PERFECTING THE MANAGEMENT OF THE MEAT PRODUCTION QUALITY

Bogdan Iegorov¹, Natalia Povarova¹, Predrag Ikonić²

¹Odessa National Academy of Food Technologies, Odessa, Ukraine

²Institute of Food Technology, University of Novi Sad, Bul. cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: bogdan_egoroff@list.ru (natashaonaxt1@rambler.ru)

Before the beginning of the 20th century, meat products quality assurance had required a number of control and ensuring measures, which would be lined up in a general process of an enterprise management. This implied a primary control of the raw materials, a process control well as different types of tests of the finished products.

In the 20th century the industrial methods of poultry- and live-stock keeping and raising were widely spread. The range of meat products has sharply increased. The modern technologies of meat raw material processing and meat production resulted in the increase of the components, used for their production. A number of technological process and variants of application of different processing conditions are available. All this led to the necessity of transfer of the separate uncoordinated measures concerning providing of the production quality to the system approach, the methods of the quality statistic control were laid. In 1960-s the quality statistic control spread beyond the production process limits and turned into the total quality control at the level of the firms-producers. The ideas of the complex quality control were born in the USA and Europe. Japan also began to use them actively and to perfect. As a result of using American, European and Japanese experience of quality control and account of still greater number of factors, influencing the quality of the finished products, management acquired complex, system character. Formation of the control system at all stages of food processing by the critical points of the production process, has found its reflection in the system of HACCP which is a combination of the organizational structure, documentation provision, production processes and resources, necessary for its realization. The new systems of quality assurance within the ISO standards and others have been developed and introduced. The made production has become more qualitative and safer. However, the existing systems of quality control and safety of meat products don't guarantee their authenticity and don't allow to correct the composition and to form the finished products with given prophylactic properties as well.

The bases of structure formation of the complex system of quality control of fodders, raw material and meat production have been offered in the paper. The creation of data bank about all the objects, stated in the production of fodders, meat raw material and meat production, taking into account the character of

interaction between them, as well as with the aim of correcting the ultimate properties of the finished products, has been proposed.

Keywords: *quality of meat products, the system of quality control*

DETERMINATION OF VIABLE BIOFILM CELLS IN MICROTITER PLATES

Anja Klančnik¹, Petra Podobnik¹, Sonja Smole Možina¹, Peter Raspor^{1,2*},
Klemen Bohinc³, Barbara Jeršek¹

¹Department of Food Science and Technology, Biotechnical Faculty,
University of Ljubljana, Ljubljana 1000, Slovenia

²Faculty of Health Sciences, University of Primorska, Polje 42,
6310 Izola, Slovenia

³Faculty of Health Sciences, University of Ljubljana, Zdravstvena 5,
1000 Ljubljana, Slovenia

*Corresponding author:

E-mail address: peter.raspor@fvz.upr.si

The ability of bacteria to attach to the food contact surface and form biofilm is one of the important hazards in production of safe food. Given the tremendous clinical importance of biofilms, it is somewhat surprising that there is no standard method for investigating the cells in bacterial biofilms. For bacteria, a common method is to quantitate the mass of biofilms by crystal violet or safranin staining, followed by extraction of bound dye with a solvent and measurement of absorption. Simple and rapid methods which provide information about viability are required for an effective control and operation of the biofilm systems. Tetrazolium salts have become some of the most widely used tools in cell biology for measuring the metabolic activity of microorganisms and depend on the reduction produces of dye in living cells, that can be used for quantitative redox assays. The goal was to optimize several spectrophotometric methods to broaden their applicability for biofilm quantification. We tested tetrazolium dyes MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide); XTT (2,3-bis-(2-methoxy-4-nitro-5-sulfophenyl)-2H-tetrazolium-5-carboxanilide); TTC (2,3,5-triphenyl-2H-tetrazolium chloride); and INT (2-(4-iodophenyl)-3-(4-nitrophenyl)-5-phenyl-2H-tetrazolium) as indicators of cell metabolism and their application in biofilm quantification. We included also a microdilution method based on bioluminescence measurement of ATP and fluorescence resazurin measurement which were previously found to be a useful, rapid technique for determining antibacterial efficiency. Assays were optimised and compared as quantitative methods of measuring bacterial viable cells on polystyrene surface.

Keywords: *biofilm, pathogenic bacteria, metabolic activity*

Acknowledgements: *The authors would like to thank ARRS and Iskra Pio d.o.o for financial support of the project L1-4067.*

ANTIBIOFILM AND ANTI-QUORUM SENSING PROPERTIES OF *Evodia rutaecarpa* FRUIT EXTRACT AND ITS FRACTIONS ON *Campylobacter jejuni*

Katja Bezek^{1,2}, Marija Kurinčič¹, Balazs Mraz¹, Tina Cvetkovič^{1,3}, Anja Klančnik¹,
Peter Raspor^{1,2}, Franz Bucar³, Sonja Smole Možina^{1*}

¹Department of Food Science and Technology, Biotechnical Faculty,
University of Ljubljana, Jamnikarjeva 101, Ljubljana 1000, Slovenia

²Faculty of Health Sciences, University of Primorska, Polje 42,
6310 Izola, Slovenia

³Institute of Pharmaceutical Sciences, Department of Pharmacognosy,
University of Graz, Universitätsplatz 4, A-8010 Graz, Austria

*Corresponding author:

E-mail address: sonja.smole@bf.uni-lj.si

Bacterial adherence to contact surfaces and sub-sequent biofilm formation confer increased antimicrobial resistance in medical and veterinary clinical settings as well as in the food chain. There is a need to introduce new anti-adhesive compounds to medical and industrial applications. Chemically characterized *Evodia rutaecarpa* fruit extract and its isolated fractions (quinolone A with different contents of evocarpine and related quinolone alkaloids fractions) containing mainly the indoloquinazoline alkaloids, evodiamine and rutaecarpine were tested for their potential antiadhesive and antibiofilm activity against *Campylobacter jejuni* NCTC 11168 (wild type; *cmeB* and *luxS* mutant). The effect of sub-inhibitory (0.25 MIC) concentrations was evaluated by the quantification of viable cells on the surface of stainless steel coupons (round, 12mm x 1,2 mm), after 1h, 24h, 48h and 72h incubation time in Müeller-Hinton broth (MHB). Since quorum sensing (QS) is known to be involved in bacterial biofilm formation, the effect of extracts addition was also observed through detection of autoinducer-2 (AI-2) signal molecule in *C. jejuni* conditional cell-free supernatant (CFS). *Vibrio harveyi* BB 170 was used as a reporter strain (Vilchez et al., 2007).

All preparations at least partially inhibited bacterial adhesion and biofilm formation on stain-less steel surface, with the most visible effect of quinolone A fractions on biofilm formation of all tested strains. Concerning the inhibition of QS signal synthesis, the quinolone A fractions were again the most efficient in *C. jejuni* WT and/or *cmeB* strain, followed by crude *Evodia* extract. Evodiamine and rutaecarpine fractions were less efficient in QS inhibition as well as in anti-biofilm activity. Although QS signaling and biofilm formation in *Campylobacter* should be further studied, we assume that they are interconnected. Plant preparations with anti-QS activity could be screened for further anti-microbial applications, including prevention against biofilms.

Keywords: *biofilm*, *QS*, *anti-biofilm activity*, *Campylobacter jejuni*, *Evodia rutaecarpa*

**MACRO- AND MICROELEMENTS HEALTH RISK
ASSESSMENT FOR POPULATION VIA CONSUMPTION OF
MUSSELS *MYTILUS GALLOPROVINCIALIS***

Mihajlo Jović¹, Antonije Onjia¹, Bojan Tanaskovski², Slavka Stanković^{2*}

¹Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522,
11001 Belgrade, Serbia

²Faculty of Technology and Metallurgy, Department of Analytical Chemistry,
University of Belgrade, 11000 Belgrade, Karnegijeva 4, Serbia

*Corresponding author:

E-mail address: slavka@tmf.bg.ac.rs

The aims of this study were to determine the levels of Fe, Zn, Mn, Sr, I, As, Cr, Ba, Cu, Ni, Sb, Sn, Cd, V, Co, Zr, Hg, K, Ca and Pb in the soft tissue of mussels *Mytilus galloprovincialis* sampled along the marine coast of Boka Kotorska Bay (Montenegro) in order to evaluate the public health risks associated with mussel consumption. Wild and farmed mussels were collected manually from seven different locations: Krasici, Kukuljina, Tivat, Opatovo, Sv. Stasija, Perast and Herceg Novi. Content of macro- and microelements were determined by energy dispersive X-ray fluorescence spectrometry (ED-XRF).

The impact of each element on consumer health was considered through the target hazard quotient (THQ) and the total hazard index (HI) developed by the United States Environmental Protection Agency (US EPA). A THQ < 1 signifies that the level of exposure is lower than the reference dose, which assumes that a daily exposure at this level is not likely to cause negative health effects during a lifetime in a human population. For the risk assessment of multiple elements contained in mussels, a HI was employed by summing all the calculated THQ values.

The number of eligible mussel meals per week for each element, in order to minimize potential adverse chronic health effects, was determined for each sampling location and also for wild and farmed mussels considering average element values.

Keywords: *Mytilus galloprovincialis*, macro- and microelements, health risk

DETERMINATION OF ACETAMIPRID RESIDUES IN PAPRIKA

Sanja Lazić, Dragana Šunjka*, Irena Stojanović

Faculty of Agriculture, University of Novi Sad, Trg Doditeja Obradovića 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: draganas@poli.uns.ac.rs

Paprika (*Capsicum annum*) is one of the most important vegetable crops. In order to control the spider mite pests, one of the major pests in paprika cultivation, acetamiprid insecticide can be applied. Since the presence of pesticide residues in fruits and vegetables can affect consumer health, the regulatory authorities have established maximum residues limits for most common vegetables and fruits. MRL for acetamiprid in paprika is 0.3 mg/kg.

Reversed-phase high-performance liquid chromatography (HPLC) techniques were developed to quantify acetamiprid in paprika. Insecticide determination and quantification were performed utilizing an Agilent Zorbax C₁₈ column (50 mm × 4.6 mm internal diameter, 1.8 μm particle size) with a mobile phase of acetonitrile/1.5% CH₃COOH (30/70) mixture in an isocratic elution at the flow rate of 1.0 ml/min. The column temperature was maintained at 25 °C and an aliquot of 2.5 μl was injected.

The accuracy and precision of the proposed method were evaluated to fulfill all the necessary requirements of SANCO/12495/2011. Recovery experiments were conducted by using the control samples to assess the analytical method proposed for acetamiprid residues. Prior to extraction, the series of the control samples were fortified with acetamiprid standard solution in acetonitrile at specified concentrations according to the MRL in paprika. The pesticide residue was extracted using extraction and clean-up kits for QuEChERS sample preparation and analysis were done by HPLC/DAD.

High value of the recoveries, ranging from 90-105%, was obtained for acetamiprid at fortified levels of 0.15, 0.30 and 0.45 mg/kg. The calibration curves were linear with correlation coefficients of 0.999. The limit of quantitation (LOQ) was 14 μg/kg. Precision, expressed in terms of repeatability, (RSDs) of the proposed method was 0.48%. The described method could be successfully applied to identify and quantify acetamiprid in paprika samples in routine laboratory analysis.

Keywords: acetamiprid, paprika, residue, validation, HPLC/DAD

RESEARCHES CONCERNING THE USE OF ESSENTIAL OILS AS ANTIFUNGAL AGENTS IN PRESERVATION OF POSTHARVEST VEGETAL PRODUCTS

Alexandru Tomescu*, Renata Maria Sumalan, Georgeta Pop, Ersilia Alexa,
Isidora Radulov, Cristian Rus

Banat's University of Agricultural Science and Veterinary Medicine "Regele
Mihai I al Romaniei", Calea Aradului 119, 300645 Timisoara, Romania

*Corresponding author:

E-mail address: alexotomescu48@gmail.com

In the last years essential oils from medicinal plants were used in the prevention of fungal grow in postharvest vegetal product as an alternative to the use of synthetic preparations.

In present paper we studied the effect of two essential oils: *Mentha piperita L* respectively *Salvia officinalis L* oils on growth of *Fusarium sp.* in lab condition on culture media. Also, it was tested the inhibitory potential of essential oils against deoxynivalenol (DON) production, a *Fusarium* mycotoxin developed in wheat grains. The antifungal biological assay objectives were to determine the minimum concentration of essential oils for mycelium growth (MCM) and to establish the concentration of fungicidal effect (CFE) for two essential oils. It was tested two different concentrations of essential oils (0.1 and 2%). As control it was used the treatment with thiophanat methyl a pesticide recommended against *Fusarium* development on wheat. The DON was analysed using enzyme-linked immunosorbent assay (ELISA).

The results show that in the case of *Mentha piperita L* the MCM was 0,5% and for *Salvia officinalis L* oil 1,5%, but the fungicidal effect (CFE) was lower relativ to thiophanat methyl treatment. The effect of essential oils against DON production reveals a slight inhibition on the mycotoxin development.

In conclusion, taking into account the antifungal effects, correlated with the absence of toxicity, the essential oils would be recommended as a natural preservative for stored food commodities.

Keywords: *Mentha piperita L.*, *Salvia officinalis L.*, *Fusarium sp.*, DON

A GLASS OF MILK IN APRIL 2014

Ljilja Torović^{1,2*}

¹Institute of Public Health of Vojvodina, Futoška 121, 21000 Novi Sad, Serbia

²Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ljilja.torovic@izizv.org.rs

Dairy cows consuming AFB1 contaminated feeds form in liver and excrete in their milk a hydroxylated metabolite of AFB1 known as aflatoxin M1 (AFM1). The maximum permitted level of AFM1 in milk in the EU (0.05µg/L; based on ALARA principle) is among the lowest in the world, while in the United States, for instance, this level is 10-fold higher. Milk and dairy products are main contributors to human exposure to AFM1.

Present investigation was carried out on six samples of pasteurized and UHT milk produced by five Serbian large scale dairy companies and purchased in supermarkets on 9th of April 2014, as available to the final consumers. Analysis was performed applying immunoaffinity column clean-up, liquid chromatography separation and fluorescence detection. Identity of AFM1 was confirmed using TFA derivatization. Proficiency Test showed excellent laboratory method performance (Fapas 04224; z score -0.2).

The results of the study revealed presence of AFM1 in all samples, but considerably lower level of AFM1 contamination in comparison with the values recorded in previous year, ranging from 0.003µg/L to 0.073µg/L. Serbia experienced multiple changes of regulated level of AFM1 in milk: 0.05µg/kg, valid until February 2013, was increased to 0.5µg/kg and then re-established in April 2014, but effective from July 2014. Therefore, all samples were in compliance with regulatory provisions. Calculated exposure to AFM1 from consumption of a glass (177.5g) of the most contaminated milk on a day was 0.22ng/kg bw for an adult (0.11ng/kg bw based on average contamination level). In case of children, intake of AFM1 could be significantly higher, driven by their diet based on milk and dairy products and a higher consumption relative to body weight.

Due to the opinion that intake of AFM1, even at low concentrations, pose a threat to human health, tolerable daily intake of AFM1 has not been established.

Keywords: *food safety, milk, aflatoxin M1, HPLC*

SURVEY ON PESTICIDE RESIDUES IN POTATOES ON GREEN MARKETS OF NOVI SAD

Ljilja Torović^{1,2*}

¹Institute of Public Health of Vojvodina, Futoška 121, 21000 Novi Sad, Serbia

²Faculty of Medicine, University of Novi Sad, Hajduk Veljkova 3, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ljilja.torovic@izjzv.org.rs

Food safety is an area of growing worldwide concern on account of its impact on human health, and question of pesticide residues is one of the most frequently asked among the consumers.

In this survey, pesticide residues have been monitored in potatoes commercially available on four largest green markets of Novi Sad in March 2014. In total, 62 samples of potatoes were collected. Presence of residues of fifty pesticides was investigated using GC-MS after QUEChERS extraction. Quantification was based on selected-ion-monitoring method, using potato-matched calibration to accommodate for matrix-induced chromatographic response. Method validation study included evaluation of LOQ, linearity, recovery and precision on spiked samples of organic potato.

Quantifiable chlorpyrifos residues were found in 19.4% of analysed samples, in concentration range from 0.017 to 0.112mg/kg. One quarter of positive samples exceeded the EU MRL established for the chlorpyrifos-potato combination (0.05mg/kg). Additionally, 3.2% of samples contained DDE residues in quantities below the respective MRL. Performance characteristics of analytical method were following: LOQ 0.01mg/kg, recovery 96 and 83%, RSD 5 and 4%, for chlorpyrifos and DDE, respectively. In recognizing that chlorpyrifos residues can pose health risk after acute exposure and that dietary consumption of potatoes is high, International Estimated Short-Term Intakes (IESTI) were calculated for children and adults. As official national data on unit weight of potato or data on a large portion were not available for Serbia, they were taken from the EFSA PRIMo model and combined with the highest residue concentration found in this survey and variability factor 7. Calculated IESTI values, expressed as percent of chlorpyrifos ARfD (0.10mg/kg bw), were 9.5 and 3.0% for children and adults, respectively.

Based on the survey results, potential short-term consumer risk was not identified for chlorpyrifos in potato, though the question of commercialized potatoes that were not in compliance with legal provisions remained.

Keywords: *food safety, potato, chlorpyrifos, GC-MS*

HACCP - A CONDITION FOR PRODUCING OF SAFE FOOD

Ana Varga*, Dragana Plavšić, Jasmina Gubić, Ivana Čabarkapa, Ljubiša Šarić

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ana.varga@fins.uns.ac.rs

The function of food in human life is multi-faceted. The food in the human organism is a source of protective and building material, a source of energy and also provides acting out of all biochemical processes. Nonetheless, food has an important social role, because good and balanced diet is one of the basic terms of socially acceptable behavior, high working ability and productivity of each individual. But only safe food can fulfill the above mentioned conditions. Therefore, the health safety of foodstuffs is something that is completely defined and also it is a condition to foodstuffs become a food. Very intense technological development process of production of foodstuffs requires strict control, which obliges compliance with certain standards including full review of "food chain". By this a high level of responsibility in the production and distribution of safe food is given for the producers and distributors of food. However even in the best production conditions we can not completely eliminate the risk of presence of pathogenic microorganisms. This article shows the results of the microbiological analysis of 826 samples of foodstuffs of animal origin and 590 samples of foods of plant origin. On these samples was performed 2754 microbiological analysis by the requests of ISO standards for certain types of microorganisms by accredited methods. The parameters of microbiological analysis in 86 analysis were satisfactory in accordance with the „Pravilnik o opštim i posebnim uslovima higijene hrane u bilo kojoj fazi proizvodnje, prerade i prometa“ (Sl. glasnik RS br. 72/10) while 100 results of microbiological analysis were unsatisfactory. These results of microbiological analysis indicate that the implementation of the HACCP system starting from the producing, packaging, storage and distribution of food greatly limits the presence of microbial contaminants. Because of this food safety is raised to a much higher level.

Keywords: *food safety, microbiological parameters, HACCP system*

DETECTION OF TETRACYCLINE-RESISTANT LACTIC ACID BACTERIA IN "ZLATAR" CHEESE

Branko Velebit*, Branka Borović, Slavica Vesković-Moračanin

Institute of Meat Hygiene and Technology, Kačanskog 13,
11040 Belgrade, Serbia

*Corresponding author:

E-mail address: velebit@inmesbgd.com

Artisanal products prepared from either raw meat and milk may act as carriers for antibiotic-resistant bacteria. This issue is currently of great concern in food safety. In this study, a collection of 96 lactic acid bacteria, mostly including genera *Lactobacillus* and *Enterococcus* was recovered from "Zlatar" cheese and was subjected to a polyphasic molecular study with the aim of detection of tetracycline resistance genes. Using 16S rRNA sequencing technique, lactic acid bacterial isolates were identified as *Lactobacillus plantarum*, *Lactobacillus sakei*, *Enterococcus faecalis*, *Enterococcus faecium*, and *Lactococcus lactis* subsp. *lactis*. Interestingly, a total of 5 *Lactococcus garvieae* strains known to be implicated in subclinical mastitis in cows were also identified which raised suspicion to plausible tetracycline resistance. Subsequently, all isolates were screened for presence of gene encoding ribosomal protection proteins (RPP) using conventional PCR. A total of five presumptive tetracycline-resistant strains (*L. plantarum*, *E. faecalis* and *L. garvieae*) were further tested on presence of tet(M) and tet(K) genes resulting in four tet(M) positive strains while one strain was neither tet(M) nor tet(K) positive. This molecular study indicates that taxonomically and genotypically diverse lactic acid bacteria from traditional cheese can be a host for tet genes.

Keywords: *lactic acid bacteria, tetracycline resistance, cheese*

THE PRESENCE OF INDICATOR BACTERIA IN YEAST CREAM PRODUCTION

Nora Zaboš, Siniša Markov, Ana Vidaković*, Dragoljub Cvetković,
Aleksandra Velićanski

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:
E-mail address: anav@uns.ac.rs

Yeast extract is the common name for different products obtained by processing biomass of yeast cells. These products are used in food as additives and aroma enhancers, in order to improve its organoleptic properties and nutritional value (amino acids, nucleotides, vitamins and minerals). In recent years, these products are used as a replacement for sodium-glutamate, because certain types of the products may contain a considerable amount of free glutamic acid. For products based on yeast extract the essential raw material is yeast cream, usually obtained by selected strains of *Saccharomyces cerevisiae*. The production process of yeast cream is similar to the production of yeast cell suspension in the baker's yeast technology. The uniqueness of this process is that it does not contain any stronger agent for inhibition or death of the contaminating microorganisms. Therefore, the microbiological process control is broad and continuous, and the results are important for deciding the purposes of yeast cream. In the three-year period (2010-2012), the presence of faecal pollution indicators - coliform bacteria and *E. coli* were observed in each phase of the process. The common microbiological methods were used, except using the fluorogenic culture media in order to obtain a valid result in the shortest time. The indicator bacteria were not detected in the samples from the laboratory culture to the second yeast generation. In fermented medium of the second yeast generation and its yeast cream, the presence of *E. coli* was sporadic, representing less than 5% of the analyzed samples on an annual basis. In the same samples the presence of coliform bacteria were detected in the range from 1/4 to 2/5 of the annual number of samples. Similar results were obtained for fermented media of propulsion bioprocess and final yeast creams.

Keywords: *yeast cream, coliform bacteria, E. coli, biomass production, microbiological process control*

VALIDATION OF AN ANALYTICAL METHOD FOR THE SIMULTANEOUS DETERMINATION OF FIVE SWEETENERS BY LC-MS/MS

Gorica Vuković*, Marija Stanković, Jelena Vlajković, Marinela Tadić,
Marina Mandić, Vesna Pantić-Palibrk

Institute of Public Health of Belgrade, Bulevar despota Stefana 54A,
11000 Belgrade, Serbia

*Corresponding author:
E-mail address: goricavukovic@yahoo.com

The aim of this work was to develop a liquid chromatography tandem mass spectrometry method (LC-MS/MS) for the simultaneous identification and quantification of five authorized sweeteners, Acesulfame-K (ACS-K), Aspartame (ASP), Cyclamate (CYC), Neohesperidin (NHDC) and Saccharin (SAC), in beverages and dietary supplements, in a single run.

The sample was extracted with water using ultrasonic bath for 3 minutes. Sample extract was filtrated and aliquot was centrifuged for 5 minutes at 12000 rpm. Supernatant was additionally diluted with mobile phase. Sweeteners were detected by triple quadrupole mass spectrometer (Agilent 6410B Triple Quad Mass Spectrometer, USA) in negative electrospray ionization using multiple reaction monitoring mode (MRM). The method was validated for accuracy, precision, linearity, and for limit of detection and quantification (LOD and LOQ). From the validation study, it was found that the method is specific, rapid, accurate, precise, and reproducible. Calibration curves were linear over the concentration range from 0.01 to 0.5 $\mu\text{g ml}^{-1}$ for ACS-K, CYC, NHDC and SAC, and from 0.001 to 0.05 $\mu\text{g ml}^{-1}$ for ASP. The limits of detection (LOD) values were less than 0.005 $\mu\text{g ml}^{-1}$, for each sweetener except for ASP (0.0002 $\mu\text{g ml}^{-1}$). A recovery study was performed by spiking samples at two concentration levels giving final concentrations of 0.01 and 0.25 $\mu\text{g ml}^{-1}$ on calibration curves. Results showed that the recoveries of the above five sweeteners were in the range of 90-105% with coefficients of variation less than 6% in case of beverages, and less than 12% for dietary supplements. The proposed method was suitable for routine analysis in control laboratories.

Keywords: *Artificial sweetener, LC-MS/MS, beverages, dietary supplements*

ADVANTAGES AND SHORTCOMINGS OF LAB-ON-A-CHIP METHOD FOR INVESTIGATION OF HMW-GS OF WHEAT (*TRITICUM AESTIVUM*) CULTIVARS

Dragan Živančev^{1*}, Aleksandra Torbića¹, Jasna Mastilović¹, Miona Belović¹,
Žarko Kevrešan¹, Nikola Hristov²

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of Field and Vegetable Crops, Maksima Gorkog 30,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: dragan.zivancev@fins.uns.ac.rs

High molecular weight glutenin subunits (HMW-GS) are one of the most influential factors on wheat (*Triticum aestivum*) dough strength and elasticity. Therefore, their fast and reliable determinations are important for wheat scientists. In this study, promising Lab-on-a-Chip (LoaC) technique for determinations three combination of HMW-GS (7+9 pair of subunits from Glu B1 locus, 5+10 pair of subunits from Glu D1 locus; 2* subunits from Glu A1 locus, 7+9 pair of subunits from Glu B1 locus, 5+10 pair of subunits from Glu D1 locus and 7+9 pair of subunits from Glu B1 locus, 2+12 pair of subunits from Glu D1 locus) of six wheat cultivars (Ljiljana, Dama, Pobeda, Bastijana, Simonida and Zvezdana) is examined. The advantages of this method are gained coefficients of variation for molecular weight of HMW-GS and their percentage in total sum of subunits, which is a relative measure of error because it weights the standard deviation for the size of the mean. However, the shortcomings were impossibility to obtain x HMW-GS from glu D1 locus in every analysis especially in the first five lanes of chip and problem to obtain regular electropherogram without decline of baseline and expansions of HMW-GS peak. Generally, LoaC technique is good for qualitative and quantitative determination of HMW-GS subunits.

Keywords: HMW-GS, LoaC, wheat cultivars

QUALITY EVALUATION OF SPELT COMPOSITE BREADS PREPARED WITH VARIOUSLY PROCESSED AMARANTH SEED

Bojana Filipčev*, Marija Bodroža-Solarov, Olivera Šimurina,
Mladenka Pestorić, Dubravka Jambrec

Institute of Food Technology, University of Novi Sad, Bul. cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: bojana.filipcev@fins.uns.ac.rs

In this work, the capacity of obtaining high quality amaranth-spelt composite organic breads by using variously treated amaranth seed was analyzed. Amaranth grain was 1) milled to obtain raw flour; 2) popped and milled to obtain flour from popped amaranth; 3) popped and steamed to obtain steamed whole popped amaranth grain. In addition, raw amaranth flour and flour from popped amaranth were additionally steamed to obtain steamed variants of these flours. When the most important quality indicators of bread were considered (volume yield, crumb texture and structure), raw and steamed amaranth flour were the most suitable ingredients to incorporate into bread formulations. Their incorporation positively affected most quality parameters: bread yield, volume and crumb hardness. The major disadvantage of steamed amaranth flour was the impairment of crumb elasticity and porosity. The next ingredient with regards to its suitability in breadmaking is steamed whole popped amaranth grain.

Keywords: *spelt, amaranth, composite bread, crumb, texture*

HOUSE FLORA IN PROCESSING UNITS DURING PRODUCTION PROCESS OF *PETROVSKÁ KLOBÁSA*

Vesna Janković^{1*}, Ljiljana Petrović², Natalija Džinić², Brankica Lakićević¹, Snežana Škaljac², Branislav Šojić², Marija Jokanović²

¹Institute of Meat Hygiene and Technology, Kaćanskog 13,
11000 Belgrade, Serbia

²Faculty of Technology Novi Sad, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: vessna@inmesbgd.com

Production of traditional dry-fermented sausages relies on natural contamination by environmental flora. This microbiota is usually referred to as "house flora". This contamination occurs during slaughtering and increases during manufacturing. This paper reviews the diversity of microbiota in small-scale processing units, during production process of the traditional fermented dry sausages - *Petrovska klobasa*. Test samples were collected in two village households in Bački Petrovac, where the preparation of *Petrovska klobasa* samples was performed in a traditional manner. Examination included total of 43 samples. Generally, before stuffing, *Listeria monocytogenes* and *Staphylococcus aureus* were detected in 6.97 and 9.30%, respectively, while *Escherichia coli* was enumerated in 18.60% of samples. Sausage samples at the end of the storage period (270. day) were safe with presence of bacteria populations from the working environment, such as: aerobic bacteria, *Micrococcaceae*, Lactic acid bacteria and *Enterococcus spp.* Examination of the hygienic status of the processing environment, equipment, raw materials and final product provides an overview of growth trends and the disappearance of bacterial populations.

Keywords: *Petrovska klobasa*, house flora, processing environment, growth trends

ENTEROBACTERIACEAE SURVIVAL DURING FERMENTATION OF TRADITIONAL DRY FERMENTED SAUSAGE - PETROVSKÁ KLOBÁSA

Vesna Janković^{1*}, Brankica Lakićević¹, Predrag Ikonić², Tatjana Tasić²,
Ljubiša Šarić², Branka Borović¹, Slavica Vesković¹, Dragica Karan¹

¹Institute of Meat Hygiene and Technology, Kaćanskog 13,
11000 Belgrade, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: vessna@inmesbgd.com

The *Petrovac sausage* (Petrovská klobása), is a traditional and autochthonous dry fermented pork meat product, which is a part of gastronomic heritage of Slovaks in Vojvodina. The *Petrovac sausage* (Petrovská klobása) is a product with a protected designation of its geographical origin. In order to achieve a recognizable product of standardized supreme quality which will be continually produced in the controlled conditions and sold on the domestic and world markets, the aim of this study was to determinate the mathematical model of *Enterobacteriaceae* presence and elimination during the production process of the *Petrovac sausage*. Isolation and identification of *Enterobacteriaceae* was done according to SRPS ISO 21528-2.

The presence of *Enterobacteriaceae* was detected in all groups, the elimination is fast and efficient, and is mainly implemented between 13 and 30 days. The function of eliminating is linear in all groups of sausages and the manner of packaging. Mathematical models for predicting a presence and elimination of *Enterobacteriaceae* during the production process of the *Petrovac sausage* present the helpful tool in optimizing existing and developing new process.

Keywords: *Petrovská klobása*, *Enterobacteriaceae*, *aw*, *pH*, *mathematical models*

SURVIVAL AND GENETIC CHARACTERIZATION OF *LISTERIA* SPP. DURING THE PRODUCTION OF PETROVSKÁ SAUSAGE (*PETROVSKÁ KLOBÁSA*)

Brankica Lakićević¹, Branka Borović¹, Vesna Janković¹, Branko Velebit¹,
Slobodan Lilić¹, Predrag Ikonić²

¹Institute of Meat Hygiene and Technology, Kačanskog 13,
11000 Belgrade, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: brankica@inmesbgd.com

Listeria monocytogenes is a psychrotrophic, gram-positive bacterium, that has become one of the biggest problems in the food industry because of its ability to grow at very low temperatures and to survive long periods of time under adverse environmental conditions. The aim of this study was conducted to determine survival of *Listeria* spp. during the preparation of *Petrovská klobása* and to characterize the isolates by amplification of the *hlyA* gene. Raw materials used for *Petrovská klobása* production (meat, spices and meat batter), environmental surfaces samples, pig carcass swabs and dry fermented sausages were examined on the presence of *Listeria* spp. Sampling of dry fermented sausages was carried out before stuffing (at day 0) and on 2nd, 6th, 9th, 15th, 30th, 60th, 90th, and 120th. The portions of 25 g were used for microbiological analyses.

Results obtained by standard microbiological and molecular methods showed that during the fermentation, drying, ripening and storage of *Petrovská klobása*, 17 out of 99 samples were positive for the presence of *Listeria* spp. Among them we detected a rare, hemolytic, atypical, non pathogenic *L. innocua* strain FSL J1-023. Also, this group of bacteria were present in sausages from 2nd, 6th, 9th and 15th days of production.

Genome sequences of a hemolytic, atypical, non pathogenic *L. innocua strain* FSL J1-023, is important in understanding the role of horizontal gene transfer and recombination in the evolution of pathogenicity in *Listeria*.

Keywords: *Petrovská klobása*, *Listeria* spp., *L. innocua*, *hlyA* gene, pathogenicity

ORGANIC PRODUCTION AS NATIONAL BRAND

Ružica Milovanović

Faculty of Economics, University of Kragujevac, Đure Pucara Starog 3,
34000 Kragujevac, Serbia

*Corresponding author:

E-mail address: milovanovic@kg.ac.rs

World market of organic products, food and beverage is of very fast growing kind. However, demand for these products in the market is much higher, than it is the offer. This trend creates significant opportunities for producers and exporters of less developed countries. Serbia has sufficient quality of agricultural land as well as and rich agroindustrial tradition, so it can be expected, that these benefits will be converted into export opportunities of well organized organic production. The concept of organic production combines economic and social aspects of agricultural production. Its goal is to enhance biological processes within production and to emphasise the preventive approach of controlling process and products. Since offer of organically produced food in the European market is less than demand, it would be significantly for Serbia to develop organic production and to forward derived organic products toward foreign markets. Also, this trend encourages new promotional campaigns with aim of greater sale of such products, that are being implemented by producers, as well as and by vendors. Techniques, which can be used, are unlimited application and are excellent way for producers and traders to display their creativity. It is very important that many countries, among them and our country, adopted policy of support of organic production, processing and placement products, which represents an additional motivation.

Keywords: *organic products, standards of quality, production management, ecological aspects, branding*

PRODUCTION OF BIOGENIC AMINES BY LACTIC ACID BACTERIA ISOLATED FROM "ZLATAR" CHEESE

Slavica Vesković Moračanin^{1*}, Srđan Stefanović¹, Tatjana Radičević¹,
Dragutin Đukić²

¹Institute of Meat Hygiene and Technology, Kačanskog 13,
11000 Belgrade, Serbia

²Faculty of Agronomy Čačak, University of Kragujevac, Cara Dušana 34,
32000 Čačak, Serbia

*Corresponding author:

E-mail address: slavica@inmesbgd.com

"Zlatar" cheese is one of the most significant representatives of national traditionally manufactured white cheeses in brine. The authenticity of cheeses from the mountain Zlatar comparing to other cheeses from the region, has been based on characteristic autochthonous microflora, dominantly of lactic acid bacteria (LAB), which are responsible for milk fermentation and ripening.

It is known that certain LAB, especially enterococci and lactobacilli, are particularly active in the production of biogenic amines (BA). Therefore, these microorganisms naturally present in raw materials, when introduced through the processing, or added as starter culture, can critically influence BA production during the manufacture of fermented milk products.

The aim of this study was to monitor production of seven biogenic amines (Cadaverine – CAD, Putrescine – PUT, Spermine – SPE, Spermidine – SPD, Histamine – HIS, Tyramine – TYR and Tryptamine – TRY) in selected 96 lactic acid bacteria (LAB) strains: *Lactobacillus*, *Enterococcus*, *Lactococcus* and *Leuconostoc*. The tested LAB were isolated from "Zlatar" cheese.

The decarboxylase activity of the microorganisms was studied in growth medium (MRS broth) after 24h cultivation. The ability of 96 LAB strains cultivated in MRS broth to produce biogenic amines was assessed using liquid chromatography tandem mass spectrometry (LC-MS/MS). Biogenic amines were measured after extraction with 5% trichloroacetic acid and SPE cleanup with Strata X cartridges. Measurements were performed in MRM mode by monitoring the presence of parent compound and one transition product per compound. Due to the difficulties in obtaining truly blank samples, quantification was performed by subtracting the amount of each amine found in blank (MRS broth) from their respective concentrations measured in samples. All strains showed very low ability to produce biogenic amines. The concentrations of all seven amines in each sample were below 250 µg/L confirming that analysed LAB strains do not pose health risk when used in food production in respect to biogenic amines formation.

Keywords: "Zlatar" cheese, lactic acid bacteria, biogenic amines, liquid chromatography tandem mass spectrometry

FUMONISINS IN FOOD: ORGANIC VERSUS CONVENTIONAL

Gorica Vuković^{1*}, Vojislava Bursić², Mira Stavrović³, Snežana Pavlović³,
Goran Aleksić³, Slobodan Kuzmanović³, Jelena Vlajković¹

¹Institute of Public Health, Bulevar despota Stefana 54A,
11000 Belgrade, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

³Institute for Plant Protection and Environment, Teodora Drajzera 9,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: goricavukovic@yahoo.com

The fumonisins are a group of mycotoxins produced primarily by *Fusarium verticillioides* and *Fusarium proliferatum*. There are at least 28 different forms of fumonisins, most designated as A, B, C, and P-series. Fumonisin B₁ is the most common and economically important form, followed by B₂ and B₃. The European Union regulated the maximum concentrations of fumonisins (as the sum of FB1 and FB2) from 200 to 2000 µg/kg in maize-based products and unprocessed maize. The health benefits of consuming organic compared to conventional food are unclear. The present study was carried out to obtain information on the presence of mycotoxins FB1 and FB2 in conventional and organic produced food.

The LC-MS/MS method was used for the detection of fumonisins in a one-step chromatographic run using an MS Agilent Triple Quad 6410B. The extraction was performed with acetonitrile/water. After the filtration the extract was cleaned-up using Fumoniprep®, R-Biopharm AG. The mobile phase was a mixture of methanol and water with 0.1% formic acid, flow 0.5 ml/min in gradient program starting from 90% water to 5% water for 15 min.

The limits of detection (LODs), defined as the lowest concentration that the analytical process can reliably differentiate from background levels, was estimated for those concentrations that provide a signal to noise ratio of 1:3. These values of the LODs are 0.25 µg/kg for the FB1 and 0.5 µg/kg for FB2. The limits of quantifications (LOQs) estimated as those concentrations of analytes which yield a signal-to-noise of at least 1:10, were 1.0 µg/kg for FB1 and 2.0 µg/kg for FB2.

The aim of this study was to compare the results of samples of cereals based baby food produced from organically grown cereals as well as commercially produced raw materials. The organic farming system produces food that is less likely to be contaminated with *Fusarium* species, although no significant difference in fumonisins was found between organic and conventional production.

Keywords: *fumonisin, LC-MS/MS, organic, conventional, food*

Acknowledgement: *The authors acknowledge the financial support of the Ministry of Education and Science, Republic of Serbia, Project Ref. TR31018.*

THE INFLUENCE OF DIFFERENT POSTHARVEST TREATMENTS ON THE SENSORY QUALITY OF TWO TOMATO VARIETIES AFTER STORAGE

Miona Belović*, Žarko Kevrešan, Mladenka Pestorić, Jasna Mastilović, Milica Pojić, Aleksandra Novaković, Tanja Radusin, Elizabet Janić Hajnal, Biljana Cvetković, Nebojša Ilić

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: miona.belovic@fins.uns.ac.rs

The aim of this research was to compare the influence of different postharvest treatments used for disinfection (H_2O_2), prevention of tissue softening ($CaCl_2$), and delay of the ripening process through inhibition of respiration (CO_2) applied solely and in combination to the tomatoes harvested at different ripening stages on the sensory quality after storage.

Two tomato varieties ("Zouk" and "Camry") were harvested in mature green and turning ripening stage. Fruits harvested at turning stage were washed with H_2O_2 , dipped in 1% $CaCl_2$ solution, kept under CO_2 for 24 hours or treated with all three treatments. Tomatoes harvested at mature green stage were treated with H_2O_2 and $CaCl_2$ or stored without treatment. All fruits were stored for 14 days in semi-controlled conditions (storage temperature ranged from 14.4 to 19.9°C and relative humidity ranged from 35% to 55%), while non-treated turning tomatoes, stored at room temperature, were used as a control. Descriptive sensory evaluation was performed by a trained panel after the storage period. Textural characteristics and colour were determined instrumentally before and after the storage.

All colour and texture parameters changed significantly compared to the results obtained before storage for both mature green and turning tomato samples. After 14 days of storage, the control samples had significantly lower lightness (L^*) values, while variety "Zouk" had significantly higher red colour intensity ($+a^*$) for all treatments. Samples of both varieties treated with CO_2 had higher hardness values in comparison with that of other samples. Regarding sensory evaluation, there were no significant differences between treatments in terms of taste after storage. Variety "Zouk" treated with CO_2 was evaluated with scores which were the closest to the standard values, which are defined as the middle value (5) on the intensity scale (1-9) for each attribute. The treatment with CO_2 was the most suitable for the preservation of tomato freshness.

Keywords: *tomato, postharvest treatment, sensory evaluation, colour, texture*

REDUCTION OF SELECTED SPOILAGE BACTERIA BY TRANS-2-HEXENAL, LACTIC ACID AND HYDROGEN PEROXIDE ON MINIMALLY PROCESSED CABBAGE AND CARROTS

Vedran Gradvol, Nela Nedić Tiban, Hrvoje Pavlović

Faculty of Food Technology, University of Josip Juraj Strossmayer,
Franje Kuhača 20, 31000 Osijek, Croatia

*Corresponding author:
E-mail address: vgradvol@ptfos.hr

This study was carried out in order to improve the microbiological safety and shelf-life of minimally processed cabbage and carrots at 16°C. Salad vegetables can be a source of opportunistic pathogens and spoilage bacteria – namely, *Aeromonas hydrophila*, *Aeromonas sobria* and *Pseudomonas syringae*. The inhibitory potential of *trans*-2-hexenal, lactic acid and hydrogen peroxide against the selected bacteria was assessed *in vitro* and *in situ* conditions using their respective minimum inhibitory concentration (MIC). Application of *trans*-2-hexenal and lactic acid caused a significant decrease ($p < 0.05$) of bacterial count in *in situ* conditions during 6 days of testing. Lactic acid and *trans*-2-hexenal showed the highest inhibitory potential for concentrations $\frac{3}{4}$ MIC - 2 MIC and 2 MIC, respectively, depending on the tested bacteria and substrate. Hydrogen peroxide showed the lowest inhibitory potential regardless of the testing conditions.

Keywords: *microbiological safety, spoilage bacteria, minimally processed vegetables, inhibitory potential*

CHARACTERIZATION AND POSSIBILITY OF APPLICATION OF SOME POLYMER PACKAGING MATERIALS FOR PACKAGING FERMENTED DAIRY PRODUCTS

Biljana Pejić^{1*}, Spasenija Milanović², Vera Lazić², Senka Popović², Mirela Iličić²

¹Imlek ad, Padinska skela bb, 11000 Beograd, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21 000 Novi Sad, Serbia

*Corresponding author:

E-mail address: biljana.pejic@imlek.rs

Packaging materials and packaging conditions are very important factors with great influence on the quality of fermented dairy products (FDP) during shelf life. Polymers have vast application in food industry according their's chemical inertness. Qualitative characteristics of packaging materials: tensile strenght, elongation at break and uniform thickness are important for adequate forming pakaging units during production and manipulation. Barrier characteristics – permeability of gasses, vapour and lights, have direct influence on quality of the FDP during the storage.

The aim of this work was to analyse physico-mechanical, barrier and structural properties of choosen polymer materials: polyethylen (PE), polyamid-polyethylen (PA/PE) and polypropylen (PP). It was also investigated, are those materials suitable for application in packaging FDP in modified atmosphere (MAP).

Physico-mechanical properties were determined by standard methods. Permeability of gases (O₂, CO₂, N₂) was measured using apparatus Lyssy GPM-200 gas chromatograph Gasukuro Kogyo GC320 and HP 3396 integrator. Permeability of air was calculated by computer. Structural properties were determined with IR-spectrophotometry according to FTIR on IR spectrophotometer NICOLET iS 10.

On the basis of the obtained results it can be concluded that polyamid-polyethylen coextruded foil can be used in MAP for packaging FDP thanks to vary good barrier properties. Polypropylen has better physico-mechanical properties then the other two materials so it could be used in different manipulative operations as a strong mechanical protection. According to it's properties it is best to combine polyethylen with the other polymer material in order to obtain properties of advanced characteristics of primary ones.

Keywords: *packaging materials, polymers, MAP, fermented dairy products*

CONVERSION OF HAZARDOUS PESTICIDE PACKAGING WASTE TO NON-HAZARDOUS BY TRIPLE RINSING TECHNIQUES

Milan Radusin¹, Tanja Radusin^{2*}, Milan Martinov³, Mirjana Vojinović-Miloradov³, Miroslav Višković³, Aleksandra Novaković²

¹Fund for Capital Investments of AP of Vojvodina, Bulevar Mihalja Pupina 25, 21000 Novi Sad, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

³Faculty of Technical Science, University of Novi Sad, Trg Dositeja Obradovića 6, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: tanja.radusin@fins.uns.ac.rs

Application of pesticides is a common operation in mass production of food, feed, fibre and feedstock in agriculture. Nowadays, it is not possible to achieve food security without application of pesticides. The principles of sustainable agriculture perform crop protection using possible minimum of chemicals.

However, the intensive use of pesticide generates a large amount of packaging waste, which, along with lack of users education ends up disposed on the fields, nature or municipal landfills. Hazardous waste represents one of the greatest dangers to the environment. Due to the lack of adequate waste treatment and sustainable waste management, the amount of waste that surrounds us is increasing and becomes threatening. As a result, contamination of soil and water with hazardous residual contents of discarded packaging occurs.

The aim of this research was to present the use of specially designed pesticide packaging containers and techniques of rinsing, as a simple method for converting hazardous to non-hazardous packaging waste. Rinsing of packaging should occur immediately after pesticide deployment into the sprayer mix tank because pesticide residual sets quickly and after that, it is almost impossible to remove them. In this research, three rinsing techniques will be presented: triple rinsing, pressure rinsing and integrated rinsing, as well as comparison between them. Based on experience and available data from developed EU countries, properly rinsed packaging does not exceed limit values for leftovers, legally defined, for non-hazardous classification of packaging which is 3 % for toxic and 0.1 % for very toxic active ingredients contained in pesticide. This simple technique gives great opportunity in developing successful waste management scheme, and different solutions concerning disposal and recycling.

Keywords: *pesticide, packaging, waste*

INFLUENCE OF DIFFERENT PACKAGING SOLUTIONS ON TEXTURAL PROPERTIES OF TOMATO DURING CONTROLLED STORAGE CONDITIONS

Tanja Radusin^{1*}, Marija Škrinjar², Ivana Čabarkapa¹, Žarko Kevrešan¹,
Jasna Mastilović¹, Aleksandra Novaković¹, Elizabet Janić Hajnal¹

¹Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: tanja.radusin@fins.uns.ac.rs

Packaging of fresh fruits and vegetables before its exposure at the market is becoming the common practice applied in order to increase shelf life of the products. Application of different packaging solutions for fresh tomato enables prolonging of its shelf life at the market from former several days up to 2-3 weeks. The aim of this research was to determine the influence of different packaging solutions based on conventional polymer packaging materials on postharvest shelf life of fresh tomato hybrid "Brooklyn", under commonly applied conditions at the market, regarding the changes of textural properties. Tomato fruits were packed in packaging units presenting packaging solutions and using packaging materials that are the most frequently used in tomato supply chain. Sealed packaging units were formed from polyethylene, cellophane and polystyrene tray covered with polypropylene stretch film. Comparatively perforated packaging units were made from polyethylene and cellophane. The main changes in textural properties (hardness, gumminess and resilience) were obtained during first week of storage regardless of packaging material and solution applied. During later storage periods, only slight changes of textural properties were exhibited with better preservation of hardness and gumminess in the case of tomato fruits packed in sealed packaging units. Texture parameters are strongly dependent on ripening process causing changes in the structure of cellulose, hemicelluloses and pectin that are the constituents of the fruit cell wall structure.

Keywords: *tomato, packaging, postharvest, shelf life*

THE INFLUENCE OF VACUUM PACKAGING AND STORAGE TIME ON LIPID OXIDATION IN TRADITIONAL SAUSAGE

Branislav Šojčić^{1*}, Ljiljana Petrović¹, Vladimir Tomović¹, Natalija Džinić¹,
Snežana Kravić¹, Marija Jokanović¹, Predrag Ikonić²,
Tatjana Tasić², Snežana Škaljac¹

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: bsojic@gmail.com

The effect of vacuum packaging on lipid oxidation of dry fermented sausage (*Petrovska klobasa*) was investigated. Fatty acid profile, malondialdehyde content and sensory analysis of odor and taste were determined after drying process and during seven months of storage. Sausages were produced in industrial conditions and subjected to smoking, drying and ripening processes during 60 days. After that time, sausages were divided in two groups. The first one consisted of unpacked sausages, while the sausages from the second group were vacuum packed. At the end of storage period, vacuum packed sausages showed better oxidative stability. Σ PUFA and PUFA/SFA in vacuum packed sausages were significantly higher than in unpacked sausages. Malondialdehyde content in vacuum packed sausages was 0.25 $\mu\text{g/g}$ and this content was significantly lower ($P < 0.05$) compared to unpacked sausage (0.73 $\mu\text{g/g}$). After 2 and 7 months of storage, sausages packed in vacuum had higher grades for sensory properties of odor and taste. Results suggest that vacuum packaging can be successful solution for protecting dry fermented sausages from lipid oxidation.

Keywords: *vacuum packaging, lipid oxidation, traditional sausage*

INVESTIGATION OF THE EFFECT OF DIFFERENT ADDITIVES ON THE LEVEL AND DYNAMICS OF POLYETHYLENE FILM DEGRADATION

Vera Lazić, Danijela Šuput*, Senka Popović, Nevena Hromiš

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author
E-mail address: suput.danijela@gmail.com

The utilization of non-renewable packaging materials that cause emissions during their production and application, accumulation and disposal is a serious threat to the environment. One of the directions of packaging materials ecological status improvement is the increased usage of biodegradable packaging materials. Polymer packaging materials could be natural biopolymers, which are biodegradable, or synthetic polymers that become biodegradable by addition of additives.

The aim of this study was to review the oxidative degradation and biodegradation mechanisms of synthetic polymers with additive addition. The methods for determination of the degree of decomposition and results of the decomposition level and dynamics in the chamber for accelerated aging of selected polyethylene films commonly used in the food industry are also presented. Polyethylene film samples of the same thickness with addition of various additives in same concentrations were selected for testing. Before and during artificial aging in the chamber for accelerated aging, physico-chemical and structural properties were investigated by determining tensile properties, melt flow rate and structural properties of the polymer.

The obtained results for all tested samples showed the decrease in tensile properties below 5% of the initial value, the increase in the carbonyl index value, as well as higher melt flow rate value after treating samples in the chamber for accelerated aging, indicating the biodegradability of the tested films. The influence of added additive type on the decomposition dynamics was proved. Moreover, the decomposition time, being in the range of 144-312 hours, were dependent on the type of additive used.

Keywords: *polymers, polyethylene, additive, oxo-biodegradation, properties*

FATTY ACID PROFILE AND SENSORY EVALUATION OF BACON

Jasna Djinovic-Stojanovic^{1*}, Aleksandar Popovic², Milan Ristic³, Klaus Troeger³,
Danijela Vranic¹, Vesna Matekalo-Sverak¹, Aurelija Spiric¹

¹Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

²Faculty of Chemistry, University of Belgrade, POB 158, 11001 Belgrade, Serbia

³Max Rubner-Institut (MRI), Federal Research Centre for Nutrition and Food,
Location Kulmbach, E.-C.-Baumann-Str. 20, 95326 Kulmbach, Germany

*Corresponding author:

E-mail address: jasna@inmesbgd.com

Smoked meat products present a significant part of the human diet in Serbia. They are important because of their good taste, high nutritional value, high level of production and large variety of products.

The aim of this study was to analyze and evaluate the fatty acid profile and sensory properties of the bacon with skin (B1) and of the bacon without skin (B2), which were smoked in traditional (TS) and industrial (IS) smokehouses. Sampling of both types of bacon has been performed before smoking, as well, and these samples were marked as raw material (RM). A total of 36 samples (TS: RM-6, B1-6, B2-6; IS: RM-6, B1-6, B2-6) were collected during the winter period on Zlatibor region. Fatty acids were analyzed, as fatty acid methyl esters, by Hewlett Packard (HP) gas chromatograph equipped with a flame ionisation detector (GC/FID). Sensory evaluation of smoked bacon was performed according to the DLG-5-points-scheme by professional staff of the Federal Research Centre for Nutrition and Food, Kulmbach, Germany.

Thirty-seven fatty acids (FA) were determined in the bacon and in the raw material. The content of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) in all analyzed samples was between 37.04% and 40.48%, 45.64% and 50.27% and between 12.38% and 15.62%, respectively. Statistical analysis of the data showed that there were not significant differences ($p < 0.05$) between the SFA content in the raw material and two types of bacon. Also, the MUFA and PUFA contents were not significantly different. It can be concluded that the type of smoking and the presence of the skin had not influence on FA content in bacon.

According to DLG-5-points-scheme bacon with skin from IS was evaluated with DLG award in Gold, while other samples were evaluated with DLG award in Silver.

Keywords: *fatty acids, sensory evaluation, smoked bacon*

GAS CHROMATOGRAPHIC CHARACTERIZATION OF KEY VOLATILE COMPONENTS IN SHEEP ADIPOSE TISSUE

Vladana Grabež^{1*}, Milena Bjelanović¹, Vladimir Tomović², Aleksandra Martinović³, Goran Vučić⁴, Bjørg Egelanddal¹

¹Department of Chemistry, Biotechnology, Food Science, Norwegian University of Life Sciences, P.O. Box 5003, N-1432 Aas, Norway

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

³Biotechnical Faculty, Mihaila Lalića 1, 81000 Podgorica, Montenegro

⁴Faculty of Technology, University of Banja Luka, Bulevar vojvode Petra Bojovića 1A, 78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author:

E-mail address: vladana.grabez@nmbu.no

Adipose tissues of three pasture fed sheep animals of 4 years and two different breeds: Norwegian White (n=14); two strains of Pramenka breed, Vlašička (n=15) and Pivska (n=15), were examined. The volatile compounds generated in 1 g liquid phase of adipose tissue were analysed by dynamic headspace-GC/MS. Samples were heated at 150 degrees in a headspace to obtain aroma volatiles in simulating oven-roasting conditions. The effects of pasture type and breed on volatile composition of sheep adipose tissue were presented in this study. Different sheep groups showed different volatile profiles. Ninety-seven volatile compounds were significant ($p < 0.001$) for three sheep groups. In agreement with analysed tissue, the larger groups formed by lipid oxidation were: 16 alkanes, 10 alkenes, 20 alcohols, 15 aldehydes, 5 ketones, 3 esters, and 6 acids. Lipid oxidation volatiles such as alkane, alkene, and alcohols were the most abundant in Pivska Pramenka (PP) adipose tissue, probably related to the lower antioxidant capacity and higher content of unsaturated fatty acids. Potential pasture-diet tracer caryophyllene was identified only in adipose tissue of Vlašička Pramenka (VP), while dimethyl sulfone was more abundant in VP than in other two groups. Fatty acid saturation and antioxidant capacity had important roles in volatile formation in NW retarded lipid oxidation.

Keywords: *sheep, adipose tissue, volatiles, headspace GC/MS*

METHODOLOGY FOR NEW PRODUCT DEVELOPMENT ON THE EXAMPLE OF GEL WITH SPECIFIC PURPOSE

Slavica Grujić*, Božana Odžaković, Božana Stanković

Faculty of Technology, University of Banja Luka, V.S. Stepanović 73,
78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author:

E-mail address: grujiclavica@yahoo.com

The aim of this research was to develop a gel of defined sensory and thermo-reversible properties, which would allow heating it in a pot to become liquid and use for making cake with biscuit dough and cream. After short cooling, it again takes gelled consistency and other properties.

Expected sensory properties of the gel are defined by descriptive method: gel is smooth with glossy surface; orange colour associated with ripe orange; sufficiently expressed aroma, pleasant and recognizable with other cake's ingredients (cream and biscuit), mild pungency reminds on fresh orange; taste moderately sweet and slightly sour; consistency moderately firm, harmonious with cream and biscuit consistency, pleasant during chewing.

Methodology of defining the new product's composition and quality parameters during development was described in this paper, on example of gel with orange juice. Sensory, physical and chemical properties of each gel sample were analyzed after production, and then recipe was modified for next product making, in order to achieve a defined quality.

Four gel samples were produced to define quantitative relationship between basic ingredients and to select orange aroma. The temperature of gel heating, before pouring in the cake was determined (~60°C), in order to form a solid gel during cooling.

Then, four samples of gel were produced and optimal concentration of pectin determined. The quality and stability of the gel in cake were analyzed applying descriptive analysis. Selected gel had a consistency compatible with the cake. The recipe for preparation of the product and quantity of the basic ingredients was defined (25% orange juice, 31.5% sugar, 42% water, 0.6% orange flavour), additives (0.7% pectin, 0.02% ascorbic acid, citric acid if necessary) and quality parameters of the gel (dry matter 35%, acidity 0.70%, pH 3.2, CIEL*a*b*), which will enable production of gel with defined sensory characteristics and quality.

Keywords: *gel for cakes, new product, sensory analysis*

SENSORY ANALYSIS AS A TOOL IN THE NEW FOOD PRODUCT DEVELOPMENT

Slavica Grujić*, Božana Odžaković, Milana Ciganović

Faculty of Technology, University of Banja Luka, V.S. Stepanović 73,
78000 Banja Luka, Bosnia and Herzegovina

*Corresponding author:

E-mail address: grujicstavica@yahoo.com

Jellied fruit products are interesting food category because of their sensory properties, favourable and biologically acceptable nutritional composition and content of certain ingredients that give them properties of functional food. The aim of this research was to develop a new food product, on a model of fruit topping, with quality harmonized with market needs and consumers' expectations. Fruit topping should have roughly chopped fruits, pleasant fruity aroma, refreshing sweet-sour taste, dark red colour, to be transparent with moderate density and viscosity, suitable for decorating ice cream and similar confectionery products.

A series of 6 model samples of fruit topping with wild berries (raspberry, blackberry, blueberry), sugar, water, food additives and aroma as ingredients, were produced in laboratory conditions. For quality control of topping, dry matter, total acids and pH were determined. Quantitative descriptive analysis of topping selected sensory properties were realised by consensus method, with five trained panellists. Sweet-sour taste acceptability of two products was evaluated by 58 consumers, and overall acceptability of final product was evaluated by 55 consumers, using the affective sensory test. The fruit topping was presented to each consumer with vanilla ice cream as a carrier.

Descriptive and affective sensory tests were used as a tool for development of the new products, with quality harmonized with consumers' expectations. After that, ingredients content, quality parameters of fruit topping as new product (dry matter 40%; total acidity 0.80%; pH 3.00) and processing parameters were defined. Prepared as finished product, it could be used for decorating the dessert just before serving and consumption, as is usual. Results of the research confirmed that an appropriate viscosity, sensory characteristics and acceptable quality of new product were achieved by the proper selection and modelling of quantitative relationship of ingredients and selected food additives during product development.

Keywords: *sensory analysis, new product, consumers*

COMPARISON OF TEXTURAL PROPERTIES OF DIFFERENT PASTA TYPES

Dubravka Jambrec*, Mladenka Pestorić, Đorđe Psodorov, Marijana Sakač,
Nataša Nedeljković, Bojana Šarić

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: dubravka.jambrec@fins.uns.ac.rs

Many studies have attempted to improve the nutritional and functional properties of pasta by substituting durum wheat semolina with flours of different cereals and pseudocereals, vegetables and seaweeds. In recent years, higher number of gluten free pasta formulations was observed. All those changes in traditional pasta formulation cause changes in textural properties which are considered being one of the most important quality properties of pasta.

The aims of this study were to compare textural properties of twelve dried pasta samples of different formulation and shape, by using two compression test probes (Mini Kramer cell and Ottawa cell), and to examine their ability to differentiate between pasta types.

A texture analyser TA.XTPlus, which was used to measure the texture of pasta samples, was equipped with a 50 kg load cell. Textural properties were measured from a force-distance graph where maximum force represented hardness and linear distance was considered as an indicator of brittleness. Six repeated measurements were taken for each type of pasta.

Results revealed that pasta shape did appear to affect pasta hardness when it was measured by Mini Kramer cell, while the differences due to formulation were not detected. Conversely, the Ottawa cell was able to detect differences in hardness and brittleness between formulations.

Keywords: *pasta, textural properties, hardness, brittleness*

SENSORY PROPERTIES OF CEVAPCICI PRODUCED WITH VARIOUS CHLORIDE SALTS

Slobodan Lilić^{1*}, Miloš Pavlović², Branka Borović¹, Mladen Rašeta¹,
Ljiljana Spalević³, Danka Maslić-Strižak³, Ivana Branković¹

¹Institute of Meat Hygiene and Technology, Kaćanskog 13,
11000 Belgrade, Serbia

²Faculty of Veterinary Medicine, Belgrade University, Bulevar oslobođenja 18,
11000 Belgrade, Serbia

³Institute of Veterinary Medicine of Serbia, Vojvode Toze 14,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: slobo@inmesbgd.com

Cevapcici is very popular barbeque product in Serbia, produced from pork, beef and lamb meat. As the other meat products, cevapcici are the important source of sodium originated from sodium chloride and often from sodium bicarbonate that is added commonly in this product. According to the recommendations of World Health Organization, daily intake of sodium should be reduced because of bad effects of excessive sodium intake on human health (cardiovascular diseases, essential hypertension). In the aim to reduce sodium content in products from minced meat, in this experiment were produced cevapcici with different combination of chloride salts: sodium chloride, potassium chloride and ammonium chloride. Control sample was contained only sodium chloride, while the experimental samples were produced with different proportion of sodium chloride, potassium chloride and ammonium chloride. These products are evaluated after roasting by quantitative descriptive test, using scales with 5 or with 8 points, depending on sensory property. Colour of product was evaluated by scale with 5 points, while juiciness, softness, taste, and odour was evaluated by scale with 8 points. Sensory evaluation was performed by ten trained assessors.

Keywords: cevapcici, sensory properties, sodium, chloride salts

SIGNIFICANCE OF SENSORY QUALITY OF MEAT PRODUCTS FOR CONSUMERS

Milan Ristić^{1*}, Jasna Đinović-Stojanović², Nemanja Knezević³, Marija Babić³

¹Max Rubner-Institut (MRI), Federal Research Centre for Nutrition and Food, Location Kulmbach, E.-C.-Baumann-Str. 20, 95326 Kulmbach, Germany

²Institute of Meat Hygiene and Technology, Kacanskog 13, 11000 Belgrade, Serbia

³Zlatiborac Company d.o.o., Mojkovacka 58, 11136 Belgrade, Serbia

*Corresponding author:

E-mail address: ristic.rc-kulmbach@t-online.de

For consumers sensory properties of meat and meat products are very important. For the perception of relish, a man is the most important "measuring instrument" as the decisive part of the examination is performed by his/her senses (eyes, smell, taste, sense of touch, sense of temperature and pain). With the purchase of food German consumers look for security and orient themselves by quality awards. For this purpose tests for sensory analysis according to the DLG-5-point-testing-scheme are at disposal (DIN EN 45011 and DIN EN ISO/IEC 17024). Here the following inspection features are evaluated: the external arrangement and state, appearance, color, composition, consistence, odor, and taste. 75% of consumers in Germany trust in products with DLG medals. For years the share of foreign products in DLG tests has been increasing (10-15%). In the many year lasting collaboration between the above-stated institutions, such as with the DLG tests, the products delivered from Serbia (smoked beef, pork sheep products as well as bacon, n=94) have reached above-average evaluations (in gold 70 % and silver 30 %). In a sensory test during the "Green Week" in Berlin the consumers were asked to identify the kind of meat (beef or pork) in meat products. Recognition of beef was 40% and detection of pork was 73%. The results showed that 95% of the beef and 88% of the pork products were rated as products of high quality. Under terms of a certain adaptation of production to the customers' expectations from here, the tested products would certainly represent an enriched offer of high-quality salt products of traditional kind, as e.g. smoked beef, pork and sheep raw ham are barely represented on the German meat product market.

Keywords: *sensory properties, traditional production, beef ham, pork ham, sheep ham*

CHEMICAL AND MICROBIOLOGICAL PROPERTIES OF BEVERAGES MADE FROM CAMEL, GOAT AND BOVINE WHEY USING KEFIR STARTER CULTURE

Farzaneh Abdolmaleki^{1*}, Ali Hajibabaei²

¹Department of Food Science and Technology, Faculty of Industrial and Mechanical Engineering, Islamic Azad University, Qazvin Branch, Iran

²Department of Food Science and Technology, Science and Research Branch, Islamic Azad University, Yazd, Iran

*Corresponding author:

E-mail address: fa.abdolmaleki@qiau.ac.ir

Kefir is a traditional fermented milk beverage with a sharp acidic and slight yeasty flavor from the Caucasus Mountains in central Asia. In this study kefir starter culture were used for production of beverage. Some chemical parameters (Carbohydrate, Ethanol, Dry matter, Fat, Free amino acid and pH) and microbiological changes (Lactic acid bacteria and yeasts) were determined during 24h of fermentation and then after 2, 7, 14, 21, and 28 days of storage at 4 °C. Three different substrates (camel, bovine and goat whey) were used as fermentation media by kefir starter culture. The incubation time (24h) and temperature (25 °C) inoculation rate (5%) and mixing rate (90 rpm) were the same for the all products. The changes in beverage properties manufactured by three substrates were more or less similar. During weeks 0-4 storage, population of Lactobacilli and lactococci decreased although population of yeast increased. It was noted that, during the fermentation carbohydrate content (w/w) and pH decreased markedly, but dry matter and fat content of the beverages were not significantly different from dry matter and fat content of the substrates. At the end of 4 weeks of storage, carbohydrate content (w/w), ethanol and pH change significantly in three substrates. Although, the results confirm that the changes in properties of camel whey during fermentation are more than goat and bovine whey.

Keywords: *camel whey, kefir starter culture, goat whey, fermented*

INTERACTIONS OF INDIGENOUSLY LACTIC ACID BACTERIA ISOLATED FROM VEGETAL SOURCES WITH SPOILAGE FUNGI

Călina Petruța Cornea^{1,2*}, Oana-Alina Siciua³, Florentina Israel-Roming^{1,2},
Radu Toma², Medana Zamfir⁴

¹Center of Applied Biochemistry and Biotechnology, BIOTEHNOL,
59 Mărăști Blvd, 011464 Bucharest, Romania

²University of Agronomic Sciences and Veterinary Medicine – Bucharest,
Faculty of Biotechnologies, 59 Mărăști Blvd, 011464 Bucharest, Romania

³Research and Development Institute for Plant Protection, 8 Ion Ionescu de la
Brad Blvd., 013813 Bucharest, Romania

⁴Institute of Biology, Romanian Academy, 296 Splaiul Independentei,
060031 Bucharest, Romania

*Corresponding author:

E-mail address: pccornea@yahoo.com

Significant losses in food industry are due to spoilage fungi that contaminate all kinds of raw materials, including legumes, fruits, cereals or meats. Fungal contamination can induce several undesirable effects, including mycotoxin production, off-flavours, rotting, discolouration etc. Lactic acid bacteria, generally accepted as GRAS („Generally Regarded As Safe”) organisms has large impact in food industry, not only for their fermentation abilities but also for protective action against spoilage microbes. For this reason, the aim of our study was the examination of the inhibitory action of some strains of *Lactobacillus* spp. Isolated from Romanian traditional foods against fungi like *Botrytis cinerea*, *Alternaria* spp., *Aspergillus* spp., *Monilinia fructigena*, *Rhizoctonia solani* and *Penicillium* spp. that contaminate fruits and legumes. Eight broad-spectrum LAB were selected by double layer techniques and their protective antifungal action was evaluated in a *in vitro* fruit model, using tomato, apricot and peach homogenate as culture substrate. Organic acid production was evaluated by HPLC method and revealed a good correlation with antifungal action of some LAB. Two out of the LAB tested proved high protective effects against at least *Botrytis cinerea*, *Alternaria* spp. and *Monilinia fructigena*, important plant pathogen involved in fruits and legumes alteration. Moreover, the selected LAB were able to inhibit some *Aspergillus* spp. (*A.niger*, *A.flavus*) proved as mycotoxigenic strains. In conclusion, the results demonstrate the functionality of these antifungal isolates as bio-protectants that could reduce the level of contamination with spoilage fungi.

Keywords: LAB, spoilage fungi, *in vitro* fruit model

Acknowledgments: This work was supported by Romanian Project 105/2012 Acronym PLANTLAB.

**FROM MEAT INDUSTRY WASTE TO POTENTIAL ACTIVE
SUBSTANCES CARRIERS: ERYTHROCYTE GHOSTS FROM
SLAUGHTERHOUSE BLOOD AS DEXAMETHASONE SODIUM
PHOSPHATE CARRIERS**

Ivana Kostić¹, Katarina Bukara¹, Vesna Ilić², Gavriilo Šekularac³,
Danijela Mišić⁴, Viktor Nedović⁵, Branko Bugarski¹

¹Department of Chemical Engineering, Faculty of Technology and Metallurgy,
University of Belgrade, Karnegijeva 4, 11120 Belgrade, Serbia

²Institute for Medical Research, University of Belgrade, Dr Subotića 4, POB 39,
11129 Belgrade 102, Serbia

³Department of Electrochemistry, Institute of Chemistry, Technology and
Metallurgy, University of Belgrade, Njegoševa 12, 11001 Belgrade, Serbia

⁴Institute for Biological Research "Siniša Stanković", University of Belgrade,
Bulevar despota Stefana 142, 11060 Belgrade, Serbia

⁵Department of Food Technology and Biochemistry, Faculty of Agriculture,
University of Belgrade, Nemanjina 6, 11080 Belgrade-Zemun, Serbia

*Corresponding author:

E-mail address: ikostic@tmf.bg.ac.rs

Erythrocyte membranes i.e. ghosts from slaughterhouse blood could be an innovative added-value product of meat industry and have strong potential to be used for delivery of active substances. This study describes preparation of ghosts from bovine and porcine slaughterhouse blood and their preliminary loading with dexamethasone-sodium phosphate (Dex), as a drug model. Erythrocyte ghosts were isolated and loaded by the optimized process of gradual hypotonic hemolysis, adding Dex at the concentration of 0.04 g/L at room temperature. After resealing, the loaded ghosts were washed 3 times with isotonic PBS to separate them from free, un-encapsulated Dex. An UHPLC/HESI-MS/MS method was developed to quantify the Dex concentrations in samples of loaded ghosts. Fourier transform infrared spectroscopy was used to verify the chemical interaction between Dex and the structural components of the ghosts.

Encapsulation of Dex was ~twenty times more efficient in porcine ghost compared to bovine ghosts, where loaded amount of Dex was 11.9 ± 2.8 ng/mL and 269.0 ± 50.9 ng/mL for bovine and porcine ghosts, respectively. The major peaks of Dex were seen at 854, 925, 1045 and 1453 cm^{-1} , which were masked/broadened due to interaction with structural components of both types of erythrocyte ghosts. Absorption band at 3429 cm^{-1} in the case of porcine ghosts shifted to wave number at 3408 cm^{-1} , suggesting an increase in hydrogen bonding. In the case of Dex-loaded bovine ghosts, the shifting of absorption band at 3429 cm^{-1} was less pronounced, to wave number at 3422 cm^{-1} .

The level of similarity with pure Dex fingerprint region was much more expressed for the Dex-loaded porcine erythrocyte ghosts compared to bovine

ones, confirming the data obtained by UHPLC/-HESI-MS/MS analysis. Future studies will be focused on improvement of loading efficiency for both types of ghosts and their in-vitro and in-vivo characterization.

Keywords: *slaughterhouse blood; gradual hemolysis, erythrocyte ghosts, drug carriers, dexamethasone, mass spectrometry, FTIR*

STUDY ON THE APPLICATION OF THE CHITOSAN-ALGINATE CAPSULES AND ALGINATE-CHITOSAN-ALGINATE CAPSULES IN ETHANOL FERMENTATION

Vasil Iliev, Vessela Naydenova*, Georgi Kostov

Department "Technology of wine and brewing", University of Food Technologies,
26 Maritza boulevard, 4002, Plovdiv, Bulgaria

*Corresponding author:
E-mail address: vesi_nevelinova@abv.bg

In this study the possibilities of the yeast immobilization in chitosan - alginate and alginate - chitosan – alginate capsules and their application in ethanol fermentation were investigated. All the capsules had a liquid core and they were prepared from 3 % Ca- alginate beads. It was found that the increase in the coating time had a negative effect on the ethanol yield. Simultaneously, the additional coating with alginate with low concentrations led to the formation of a membrane which was the main reason for the increase in the mechanical stability of the capsules. The results were used to determine proper combination of the coating time and the alginate and chitosan concentrations for the formation of mechanically stable capsules.

Keywords: *encapsulation, ethanol fermentation, mechanical stability*

THE INFLUENCE OF REDUCING SUGARS CONTENT ON LACTIC ACID FERMENTATION OF BREWER'S SPENT GRAIN HYDROLYSATE BY *LACTOBACILLUS FERMENTUM* AND *LACTOBACILLUS RHAMNOSUS*

Jelena Pejin^{1*}, Ljiljana Mojović², Sunčica Kocić-Tanackov¹,
Miloš Radosavljević¹, Aleksandra Djukić-Vuković²

¹Faculty of Technology, University of Novi Sad, Bulevar Cara Lazara 1,
21000 Novi Sad, Serbia

²Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4,
11000 Belgrade, Serbia

*Corresponding author:
E-mail address: jpejin@uns.ac.rs

Lactic acid is commonly used as a flavour and preservative in food, cosmetic and pharmaceutical industries. Brewer's spent grain (BSG) is the major by-product in beer production. It is produced in large quantities (20 kg per 100 L of produced beer) throughout the year at a low cost or no cost, and due to its high protein and carbohydrates content it can be used as a raw material in biotechnology. The use of BSG is still limited, being basically used as animal feed. In biotechnology BSG could be used as a substrate for cultivation of microorganisms. In this study BSG was dried (at 40°C) and hydrolyzed using commercial α -amylase, glucoamylase, and cellulase. The produced hydrolysate (containing approximately 2.8% glucose) was fermented by *Lactobacillus fermentum* PL-1 and *Lactobacillus rhamnosus* ATCC 7469 to lactic acid. The effect of different reducing sugars content (2.8, 4.0, 6.6, 8.5, 11.0, and 13.0%) in hydrolysate on fermentation performance was investigated. Hydrolysate contained 2.8% of reducing sugars. Higher reducing sugars contents were obtained with the addition of glucose. CaCO₃ (2%) and yeast extract (2%) were added to hydrolysate before fermentation.

Lactic acid bacteria cells viability was high in all fermentations. *L. rhamnosus* ATCC 7469 produced mostly L-(+)-lactic acid while *L. fermentum* PL-1 produced approximately 50% L-(+)-lactic acid and 50% D-(-)-lactic acid. Higher lactic acid yields were obtained in fermentations with *L. rhamnosus* ATCC 7469. The highest lactic acid yield (98.76%) was obtained in fermentation with 4.0% of reducing sugars. With further increase in reducing sugars content lactic acid yield decreased and was 79.02% in fermentation with 13.0% of reducing sugars. Much lower lactic acid yield was obtained with *L. fermentum* PL-1. The highest lactic acid yield was in fermentation of hydrolysate with 13.0% of reducing sugars (52.63%).

Keywords: lactic acid, *Lactobacillus fermentum*, *Lactobacillus rhamnosus*, brewer's spent grain

ANTIBIOTIC RESISTANCE OF AUTOCHTHONOUS POTENTIAL PROBIOTIC BACTERIA

Milica Petrušić¹, Zorica Radulović¹, Ivana Zuber Bogdanović²,
Nemanja Mirković¹, Dušanka Paunović¹, Snežana Bulajić³

¹University of Belgrade, Faculty of Agriculture, Department for Food Microbiology, Nemanjina 6, 11080 Belgrade, Serbia

²Accreditation body of Montenegro, Department for Certification Bodies, George Washington 51, 81110 Podgorica, Montenegro

³University of Belgrade, Faculty of Veterinary Medicine, Department for Food Hygiene and Sanitary Control, Bulevar Oslobođenja 18, 11000 Belgrade, Serbia

*Corresponding author:

E-mail address: petrusicm@agrif.bg.ac.rs

Traditional cheeses represent great source for isolation and selection of lactic acid bacteria and potential application as starter cultures or potential probiotic bacteria. Nowadays, probiotic criteria (ability to survive gastrointestinal tract, antimicrobial activity, antibiotic resistance) and clinical trials, became very important for selection of autochthonous potential probiotic lactic acid bacteria. Some potential probiotic strains may carry transmissible plasmid-encoded antibiotic resistance genes. The transmission of antibiotic resistance genes to potentially pathogens bacteria or unrelated pathogens in gastrointestinal tract is a major health concern related with application of probiotic bacteria. The aim of this work was to evaluate the antibiotic resistance of 85 autochthonous potential probiotic strains isolated from traditional Serbian cheeses. Antibiotic resistance was determined for ampicillin, vankomycin, oxacillin, neomycin, chloramphenicol, gentamycin, tetracycline, erythromycin, kanamycin, penicillin, streptomycin using disk diffusion test and E-test. All the strains showed resistance to kanamycin, while most of the LAB strains showed resistance to streptomycin (94%) and vancomycin (82%). Slightly less number of strains showed resistance to gentamicin (65%), neomycin (56%) and oxacillin (53%). All strains showed sensitivity to penicillin, while several strains showed resistance to ampicillin, erythromycin, tetracycline and chloramphenicol. Strains showed minimal inhibitory concentration (MIC) for streptomycin $\geq 24 \mu\text{g mL}^{-1}$, gentamicin $\geq 48 \mu\text{g mL}^{-1}$, oxacillin $\geq 1.5 \mu\text{g mL}^{-1}$, tetracycline $\geq 3 \mu\text{g mL}^{-1}$ and erythromycin $\geq 1 \mu\text{g mL}^{-1}$. The results obtained in this study indicate that resistance of autochthonous potential probiotic lactic acid bacteria isolated from traditional Serbian cheeses to antibiotics, is very important feature in characterisation and selection of strains for application as potential probiotic bacteria in production of functional food.

Keywords: *antibiotic resistance, autochthonous potential probiotic bacteria, traditional cheeses, lactic acid bacteria*

INFLUENCE OF FREEZE-DRYING ON VIABILITY AND BIOCHEMICAL PROPERTIES OF AUTOCHTHONOUS LACTIC ACID BACTERIA

Milica Petrušić*, Zorica Radulović, Nemanja Mirković, Ivana Lazarević, Dušanka Paunović

Faculty of Agriculture, University of Belgrade, Nemanjina 6,
11080 Zemun, Serbia

*Corresponding author:

E-mail address: petrusicm@agrif.bg.ac.rs

The majority of autochthonous microflora of traditional dairy products represent lactic acid bacteria (LAB) and their variety is a result of the great number by different strains. The industrial use of LAB as starter cultures and/or probiotic bacteria for food industry depends on the concentration and preservation technologies, which are required to guarantee long-term delivery of stable cultures in terms of viability and functional activity. Freeze-drying has been extensively used for the preservation and long-term storage of LAB.

The aim of this study was to examine the influence of freeze-drying on autochthonous lactic acid bacteria *Lactobacillus plantarum* 564, *Lactobacillus paracasei* 08, *Lactococcus lactis* 563, *Lactococcus lactis* 565 (Department for Food Microbiology, Faculty of Agriculture, University of Belgrade). These LAB strains were isolated from Serbian traditional cheeses and selected based on their biochemical characteristics. Their ability to tolerate freeze-drying process was examined with determination of viability and acidification activity. Four different mediums were used for freeze-drying, 10% reconstituted skim milk (RSM), 10% RSM+1% glycerol, 10% RSM+1.5% gelatin and 10% RSM+1% glycerol+1.5% gelatin. Strains were freeze-dried in ALPHA 1-4 freeze-dryer (Martin Christ, Osterad am Harz, Germany).

Before freeze-drying, count of examined strains was around 10^9 cfug⁻¹. Cell number of all autochthonous strains after freeze-drying remained at the same level. The acidification activity of freeze-dried *Lc. lactis* 563 and *Lc. lactis* 565 strains stayed unchanged after freeze-drying. Nevertheless, *Lb. plantarum* 564 and *Lb. paracasei* 08 showed reduced acidification activity after freeze-drying in all mediums.

The results indicate that freezing mediums and freeze-drying conditions are suitable for *Lc. lactis* 563 and *Lc. lactis* 565 strains. However, freeze-dried *Lb. plantarum* 564 and *Lb. paracasei* 08 showed unsatisfactory biochemical properties. Therefore, alternative freezing medium and methods are essential to afford protection and unchanged biochemical properties for these autochthonous strains.

Keywords: autochthonous lactic acid bacteria, freeze-drying, acidification activity, viability

SELENIZED YEAST IN PRODUCTION OF SELENIUM ENRICHED *PLEUROTUS OSTREATUS* MUSHROOM WITH GOOD FLAVOUR

Milena Savić¹, Piotr Podsadni², Magdalena Bamburowicz-Klimkowska³,
Jadwiga Turlo², Viktor Nedović¹, Miomir Nikšić¹, Marzenna Klimaszewska²,
Miroslaw Szutowski³

¹Department of Food and Industrial Microbiology, Faculty of Agriculture,
University of Belgrade, Serbia

²Department of Drug Technology and Pharmaceutical Biotechnology, Medical
University of Warsaw, Warsaw, Poland

³Department of Toxicology, Faculty of Pharmacy, Medical University of Warsaw,
Warsaw, Poland

*Corresponding author:

E-mail address: milenas@agrif.bg.ac.rs

The aim of this study was to investigate the potential influence of selenized yeast (Sel Plex, Alltech Inc., Lexington, USA) on chemical composition and flavour of solid state grown mushroom *Pleurotus ostreatus*. Amino acid composition that influence the flavour of selenium-enriched *P.ostreatus* P80 (137.84 ppm of selenium in d.w.) and non-enriched cultivated strains with particular emphasis on selenomethionine was determined by HPLC method, after the complete hydrolysis. The volatile flavour compounds of mushroom cultures were analyzed by GC-MS using Headspace sampler. In mushrooms with high selenium content, selenium in the form of L-selenomethionine was present. High selenium concentration in fruit body did not change significantly amino acid composition of mushrooms. The major amino acids of fruit body sample were glutamic acid, alanine, aspartic acid and tryptophan. In the fruit body of *P.ostreatus* P80 control, 30 volatile compounds were detected and in selenium enriched sample 25. Compounds that were detected in control sample, but not in enriched fruit body are 2-amino-N-ethylpropanamide; 2-methylpropyl pentan-2-yl sulfite; 2,3-pentanedione; heptan-2-one; pentan-1-ol; 2-methyldihydrofuran-3(2H)-one; 1-hydroxyacetone; 3-hydroxy-2-butanone; 2,5-dimethylpyrazine; 2,6- dimethylpyrazine; benzaldehyde. Compounds that were detected in enriched *P.ostreatus* P80, but not in control are acetone; ethylacetate; 2-propanol; acetonitrile; 2-methylbenzaldehyde and 2-hydroxyethylmethacrylate. Selenized yeast presents good selenium source for selenium enriched mushroom production with good flavour, probably safety for consumption.

Keywords: *aminoacids, flavour, Pleurotus ostreatus, selenomethionine, selenized yeast*

**ANTIFUNGAL POTENTIAL OF EXTRACELLULAR
METABOLITES PRODUCED BY *Streptomyces hygroscopicus*
AGAINST *Colletotrichum gloeosporioides***

Ivana Tadijan^{1*}, Jovana Grahovac¹, Jelena Dodić¹, Mila Grahovac²,
Stevan Maširević², Damjan Vučurović¹, Siniša Dodić¹

¹Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
Novi Sad, Serbia

*Corresponding author:

E-mail address: tadi@uns.ac.rs

Colletotrichum is one of the most common and important genera of plant-pathogenic fungi. During storage, transport and selling, pathogenic fungi of the genus *Colletotrichum* cause bitter rot of apples. This investigation studied the potential of *Streptomyces hygroscopicus* as a biocontrol agent against *Colletotrichum gloeosporioides* obtained from apple fruit samples expressing rot symptoms. The test microorganism was identified according to pathogenic, morphological and ecological characteristics, and the identification of *Colletotrichum* isolate was confirmed by polymerase chain reaction (PCR). Production of antifungal metabolites by *S. hygroscopicus* was carried out in 3-litre bench-scale bioreactor (Biostat® Aplus, Sartorius AG, Germany) during 7 days. Fermentation was carried out at 27 °C with aeration rate of 0.5 vvm and agitation rate of 200 rpm. The aim of this work was to examine the kinetics of batch biofungicide production in medium containing glucose as a carbon source and defining the optimal fermentation time under specified conditions. *In vitro* antifungal activity of the produced metabolites against *Colletotrichum gloeosporioides* grown on potato dextrose agar was determined every 24 h using wells technique. The antifungal activity of cell-free culture filtrate and filtrate treated with high temperature and proteinase K was tested. However, the filtrate treated with high temperature didn't show any antifungal activity suggesting that active components are thermo unstable. On the other hand, there was no significant difference between the antifungal activities of cell-free culture filtrate and filtrate treated with proteinase K suggesting that active components are extracellular metabolites with non-protein nature. Obtained results showed that maximal antifungal activity was achieved after 5 days of *S. hygroscopicus* cultivation under defined conditions (inhibition zone diameter 45 mm). For further optimization of cultivation time techno-economic analyses of process should be included.

Keywords: *Colletotrichum gloeosporioides*, *Streptomyces hygroscopicus*, biocontrol, biofungicides

Acknowledgement: *The study is result of the investigations conducted within the Project „Development and scale-up of a biotechnological process for production of apple storage pathogens antagonists“ (114-451-5041/2013) funded by Provincial Secretariat for Science and Technological Development of Autonomous Province of Vojvodina, Republic of Serbia.*

CERAMIC MEBRANE FILTRATON OF *Streptomyces* sp. FERMENTATION BROTH

Aleksandar Jokić¹, Jovana Grahovac¹, Ivana Tadijan^{1*}, Jelena Dodić¹,
Mila Grahovac²

¹Faculty Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 8,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: tadi@uns.ac.rs

Fermentation processes are increasingly involved in the production of high value bioproducts including agents for biological control of plant diseases. During storage, transport and marketing of apple fruits pathogenic fungi of the genus *Colletotrichum* causes significant losses. *Streptomyces* sp. fermentation broth has significant antifungal potential against the isolate of *Colletotrichum acutatum*, obtained from rotten apple fruits. However, from the perspective of commercial application antifungal components contained in the fermentation broth must be concentrated. Therefore, cross-flow ceramic membrane filtration in concentration mode of *Streptomyces* sp. fermentation broth has been studied. For the study three single channel ceramic membranes were selected, i.e. 800 nm, 200 nm and 1 kDa. Under the same predetermined filtration conditions, the membrane permeation rate decreased with time for all selected membranes. The highest flux was achieved when 200 nm membrane was used, while the lowest values of flux were obtained in the case of filtration with 1 kDa molecular cut-off membrane, 63 L/m²h and 12 L/m²h, respectively. This decrease could be explained by deposition and interaction of material onto/with the membrane resulting in the concentration of permeable products which is more pronounced in the case of 1 kDa cut-off membrane. *In vitro* antifungal activity of permeate and retentate of the fermentation broth was determined using wells technique. It has been found that significantly higher concentration of active components in the retentate was achieved when 1 kDa cut-off membrane was applied (35.3±0.6 mm) in comparison with 200 nm (28.7±1.2 mm) and 800 nm (24.8±0.3 mm) membranes. Based on these results, considering the rate of the filtration process, microfiltration with 200 nm membrane is the best choice.

Keywords: membrane filtration, fermentation broth, *Streptomyces* sp.

Acknowledgement: The study is result of the investigations conducted within the Project „Development and scale-up of a biotechnological process for production of apple storage pathogens antagonists“ (114-451-5041/2013) funded by Provincial Secretariat for Science and Technological Development of Autonomous Province of Vojvodina, Republic of Serbia.

TUMOR CELL GROWTH ACTIVITY OF BLACKBERRY (*RUBUS FRUTICOSUS* L.) POMACE EXTRACTS

Dragana Četojević-Simin^{1*}, Gordana Četković², Vesna Tumbas Šaponjac²,
Jelena Vulić², Jasna Čanadanović-Brunet², Sonja Djilas²

¹Faculty of Medicine, Oncology Institute of Vojvodina, University of Novi Sad,
Dr Goldmana 4, 21204 Sremska Kamenica, Serbia

²Faculty of Technology, University of Novi Sad, Bul. Cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: ddaaggeerr@gmail.com

Blackberries possess a wide range of nutritional compounds as well as non-nutritive phytochemicals which have been shown to reduce the incidence of cancer and other degenerative diseases. The manufacturing of products derived from blackberry generates high volumes of wastes which represent an environmental problem. Over the last years considerable emphasis has been put on the recovery, recycling and upgrading of wastes that can be transformed into several different products like bio-fuels, multifunctional food ingredients, nutrients, food flavours, feed etc. Taking into account substantial potential of blackberry processing by-products, pomace extracts from two blackberry cultivars 'Čačanska bestrna' (BC) and 'Thornfree' (BT) were investigated for their polyphenol content and tumor cell growth activity. Total polyphenolic (75.50 and 88.28 mg GAE/g), flavonoid (39.88 and 45.50 mg RE/g) and anthocyanin (6.81 and 12.61 mg CyGE/g) contents were determined in BC and BT pomace extracts, respectively. The most pronounced cell growth inhibition effect was obtained in breast adenocarcinoma cell line reaching EC₅₀ values of 52.5 and 64.7 µg/ml for BC and BT pomace extract, respectively. BT pomace extract also demonstrated highly favorable non-tumor/tumor cell growth ratios and potently increased apoptosis/necrosis ratio in breast adenocarcinoma cells. The results indicate significant polyphenolic content, antiproliferative and proapoptotic activity of blackberry pomace and favor its use as functional food ingredient.

Keywords: *blackberry pomace, polyphenols, antitumor activity, apoptosis*

RAPID DETERMINATION OF TOTAL POLAR MATERIALS IN USED DEEP-FRYING SUNFLOWER OILS FROM RESTAURANTS

Vladimir Koricanac*, Danijela Vranic, Vesna Matekalo-Sverak, Vesna Djordjevic, Jasna Djinovic-Stojanovic, Slobodan Lilic, Zoran Petrovic

Institute of Meat Hygiene and Technology, Kacanskog 13,
11000 Belgrade, Serbia

*Corresponding author:

E-mail address: vladimir@inmesbgd.com

Deep-frying is frequently used technique for food preparation. The quality of cooking oil is very important and directly determines the quality of deep fried food. Thermal treatment of oils, during food preparation, results in oxidative and hydrolytic reactions; chemical and physical changes take place leading to the formation of undesirable secondary products. The majority of the non-volatile byproducts are categorized as total polar materials (TPM). Amount of TPM is one of the indicators of oil degradation level, and its quality, which were examined. The aim of this study was measurement of TPM content (%) in samples of used deep-frying oils from restaurants.

According to the Working Group of Food Chemistry Experts – ALS (German Federal Health Gazette 2/91) cooking oils with TPM>24,00% is considered to be waste. Sunflower oils (25 samples), used for deep-frying of various foods, were collected from restaurants. TPM amount in oils samples were measured by hand-held device TESTO 270 (Testo, Germany) which works on capacitive basis (measuring changes in dielectric constant). This equipment determines the total amount of polar materials, in %, reliable and simple.

Range of TPM amount in sunflower oils samples from restaurants were 10,00% - 38,50%, with $TPM_{avg}=20,78\%$. In eight samples (32% of examined samples) TPM amount were higher than allowed limit in many EU countries (TPM>24,00%) and in five samples (20%) amount of TPM were in range 20,00% - 24,00%, close to the limit of rejection. Only nine samples (36%) were in range 14,00% - 22,00% TPM, which is considered as optimal range for frying. Obtained results showed the need for permanent and frequent control of total polar materials content in deep-frying oils.

Keywords: *total polar materials, sunflower oil, deep-frying*

Acknowledgements: *This work is part of the project no. 74011-137/2012.*

INNOVATIVE PRACTICES IN THE TEACHING OF SUSTAINABLE DEVELOPMENT

Vesna Weingerl

Faculty of Agriculture and Life Sciences, University of Maribor, Pivola 10,
2311 Hoče, Slovenia

*Corresponding author:

E-mail address: vesna.weingerl@um.si

The main goal nowadays isn't the solutions to theoretical questions but the changes in the values of society and in the behaviour of the people, starting from the practitioners of the education process. Sustainable development (SD) needs disciplines to transcend their traditional boundaries and move towards a requisitely holistic concept, able to integrate regarding socio-economic, ethical, and environmental questions.

Presented paper is connected with the framework of the ISLE Erasmus project (Innovation in the teaching of the Sustainable Development of Life Sciences in Europe), which included 38 partners from 32 European countries representing Higher Education Institutions (HEIs), Research Institutes, and Enterprises that focus on life sciences. The project's objective was to implement the concept of SD within Higher Education. The main activities of the project were to bring together stakeholders from Europe who had already introduced the concept of SD into their curricula and wished to transfer their knowledge to the other partners of the network or wished to introduce the concept of SD into the curricula of their institutions; to acquire new knowledge on Education for SD (ESD) and develop the necessary tools for knowledge transfer, to increase awareness in European HEIs of the urgency of ESD, and to provide the instruments for facilitating and supporting ESD.

HEIs from amongst all educational structures have an enormous impact on knowledge discovery and transfer, as well as the promotion of SD within the society and business world. Sustainability is not an individual property but is a property of an entire web of relationships. HEIs are the environment that has the chance to build the requisitely holistic point of view, and therefore the basis for SD, which is nowadays a necessity, not a fashion.

Keywords: *teaching, sustainable development, life sciences, higher education*

PASTING PROPERTIES AND FERMENTATION CAPACITY OF PURE OAT FLOUR AND WHEAT-OAT FLOUR MIXTURE

Slađana Rakita, Miroslav Hadnađev, Tamara Dapčević Hadnađev*,
Milica Pojić, Aleksandra Torbica

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: tamara.dapcevic@fins.uns.ac.rs

Oat (*Avena sativa*) is suitable for human consumption since it contains valuable nutrients such as proteins, unsaturated fatty acids, vitamins, minerals and phytochemicals, as well as soluble fibres, especially β -glucans. Higher lysine content in oat than that in other cereals contributes to better nutritional value of oat grains. Due to high lipid concentration lipolytic enzymes present in the grain could cause hydrolysis followed by oxidation and release of free fatty acids. Therefore, in order to prevent the development of rancidity and off-flavours, hydro-thermal inactivation of lipolytic enzymes before milling is necessary.

The purpose of the present work was to evaluate the effect of oat flour addition to wheat flour on the dough pasting, as well as the fermentation properties. Two different fractions of oat flour (particle size 250-180 and 180-150 μm), obtained from non-treated and hydro-thermally treated oat grains, were selected for the study. Their pasting properties were determined as well as in the mixture with wheat flour of optimal pasting characteristics for baking purposes. The obtained results indicated that utilization of oat pre-treatment had opposite effect on torque of the flour slurry. Slurry containing 100% pre-treated oat flour demonstrated higher torque in comparison to non-treated oat flour, whereas the oat pre-treatment influenced lower peak torque in the mixture with wheat flour. Regardless of oat pre-treatment, slurries prepared from flour blends containing 30% of oat flour fraction $<180\mu\text{m}$ expressed higher torque than those containing 30% oat flours of 250-180 μm particle sizes, as a result of higher starch content in the oat flour fraction. In addition to fermentation capacity, measured by rheofermentometer, all tested doughs showed decreased maximum dough height, whereas doughs containing 30% pre-treated oat flour exhibited higher value than that of non-treated oat flour. Doughs prepared of 30% oat flours of 250-180 μm particle sizes demonstrated higher value of total volume of CO_2 produced during fermentation in comparison to dough containing 30% oat flour of 180-150 μm particle sizes.

Keywords: *oat flour, pasting, fermentation capacity*

ANN MODELLING OF SUSPENSIONS MICROFILTRATION OF BAKER'S YEAST USING MULTICHANNEL MEMBRANE

Aleksandar Jokić, Bojana Ikonić*, Zoltan Zavargo

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: prodanic@tf.uns.ac.rs

Artificial neural networks (ANN) have been widely applied to the identification and control of nonlinear dynamic systems. The goal of this study is application of neural networks for modelling of flux change during time. For ANN calculations input variables were transmembrane pressure (TMP), feed flow rate (Q), suspension concentration (C) and time (t), while neural network had one output value, permeate flux, J_{NSM} , or volume reduction factor, VCR. In the present study, feed forward network is trained using error back propagation method and the optimal number of hidden neurons was 6 in the case of permeate flux, while it was 11 for the volume reduction factor. Results suggest that artificial neural networks are good prediction tool for selected network outputs. It was found that experimental results are in very good agreement with computed ones (coefficient of determination: 0.956 and 0.905, for permeate flux and volume reduction factor, respectively).

Keywords: *membrane filtration, artificial neural networks, baker's yeast*

ANTIFUNGAL ACTIVITIES OF SELECTED ESSENCIAL OILS

Julianna Török Jenei^{1*}, Györgyi Horváth², Anita Vidács³,
Antal Véha¹, Judit Krisch¹

¹Institute of Food Engineering, Faculty of Engineering, University of Szeged,
Mars tér 7, 6724 Szeged, Hungary

²Institute of Pharmacognosy, Medical School, University of Pécs,
Rókus u. 2, 7624 Pécs, Hungary

³Department of Microbiology, Faculty of Science and Informatics, University of
Szeged, Közép fasor 52, 6726 Szeged, Hungary

*Corresponding author:

E-mail address: tnejuli@mk.u-szeged.hu

In this study the anti-yeast and anti-mould activities of fifteen essential oils (EOs) were investigated against clinical isolates of *Candida* species: *C. albicans*, *C. glabrata* and *C. parapsilosis* associated with seafood and dairy products; and the plant pathogen and/or mycotoxin producing moulds: *Rhizopus microsporus*, *Aspergillus fumigatus*, *A. terreus*, *Fusarium solani*. The most effective EOs for determination of minimum inhibitory concentrations (MICs) were selected by screening with disk diffusion method. Best results were obtained with cinnamon, clove and thyme EOs.

The most sensitive yeast was *C. glabrata* (MIC of 0.8 mg/ml). Moulds were less-sensitive than yeasts with the lowest MIC of 1.6 mg/ml of *A. fumigatus* for cinnamon EO.

To investigate the combination effect of the EOs fractional inhibitory concentrations (FICs) were defined with the checkerboard method. In most cases combination of EOs resulted in indifferent or additive effect.

Györgyi Horváth was supported by OTKA PD 104660 grant (Hungarian Scientific Research Fund)

Keywords: essential oils, antifungal activity, minimum inhibitory concentration, checkerboard method

THE EFFECTS OF ALUMINUM ON CALCIUM AND PHOSPHORUS CONTENT IN WHEAT

Andrea Szabó-Nagy*, Antal Véha, Ernő Gyimes

Department of Food Engineering, Faculty of Engineering, University of Szeged,
6725 Moszkvai krt 5-7, Szeged, Hungary

*Corresponding author:

E-mail address: szna@mk.u-szeged.hu

Food packaging, post-use disposal and aluminium foil manufacturing cause environmental pollution. Recently, aluminium foils are recognised as a priority toxin in the United States and Germany. Aluminium is the most frequent metal of the earth crust, but at alkaline, neutral or mildly acidic soils it occurs mainly as insoluble deposit, which is a biologically inactive form. At acidic pH the solubility of the natural, bound Al-forms and of the aluminium foil increase. Environmental problems (some farming practices, industrial contaminations, acid rains) increase the acidity of the soils leading to the mobilization of the Al. More than half of the world's potential arable lands are acidic and Al toxicity is a major factor limiting crop productivity. The toxicity of the trivalent Al form is a factor reducing plant growth and limiting crop productivity, moreover the Al content of edible plant parts could be dangerous for animals and for the people.

Wheat (*Triticum aestivum* L.) is a staple food for more than one third of the world population. The effect of aluminium at acidic pH on the growth and element content of winter wheat (*Triticum aestivum* L. cv. Martonvásári-8) was investigated.

The effect of Al stress was followed in winter wheat seedlings. Plants were grown in a complete nutrient solution with or without Al addition, the growth of plants and Al content in the different plant parts were followed.

Significant difference was found in the phosphorus content, the P translocation to the shoot was inhibited by Al. The Al content of root was one magnitude higher than in the shoot.

Keywords: *winter wheat, aluminium content, environmental pollution*

Acknowledgments: *This study was supported by TÁMOP-4.1.1.C-12/1/KONV-2012-0014 Project.*

THE INFLUENCE OF FAT REPLACER ON INSTRUMENTAL PROPERTIES OF GLUTEN-FREE COOKIES

Marijana Sakač, Nataša Nedeljković*, Dubravka Jambrec, Bojana Šarić, Mladenka Pestorić, Pavle Jovanov, Bojana Filipčev, Anamarija Mandić

Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: natasa.nedeljkovic@fins.uns.ac.rs

A present study was conducted to investigate colour and texture of reduced-fat gluten-free cookies in which part of vegetable fat (30%, 40% and 50%) had been replaced by ground fibre-containing soybean bran in comparison to fullfat (no fat replacement) control cookies.

The colour of the investigated reduced-fat gluten-free cookies was significantly darker compared to the fullfat control cookies indicating a positive effect of soybean bran on cookie colour making them more acceptable to the consumers.

The textural profiles of the examined cookies indicate that increasing amounts of soybean bran in reduced-fat gluten-free cookies increased their fracturability and hardness compared to the full-fat cookie sample.

The obtained results indicated that the soybean bran could be successfully incorporated into the gluten-free cookie formulation as the fat replacer in terms of textural and colour properties.

Keywords: *gluten-free cookies, fat replacer, soybean bran*

OSMOTIC DEHYDRATION OF CHICKEN MEAT IN SUGAR BEET MOLASSES

Vladimir Filipović*, Biljana Lončar, Milica Nićetin, Violeta Knežević,
Danijela Šuput, Tatjana Kuljanin

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: vladaf@uns.ac.rs

Osmotic dehydration is an environmentally acceptable, material gentle drying method, which received considerable attention because of the low processing temperature, base waste material and low energy requirement. The use of sugar beet molasses as an osmotic medium has proven to be good solution for several plant and animal materials, but there is no literature data of dehydrating chicken meat in molasses.

The goal of this research is to investigate the effectiveness of the process of osmotic dehydration of chicken meat in sugar beet molasses.

The investigated parameters of the process were: time and temperature of the osmotic process and concentration of the sugar beet molasses, while the monitored responses of the osmotic dehydration process were: dry matter content, water loss, solid gain, dehydration efficiency index and water activity.

The highest results obtained of DMC 68.69%, WL 0.5810 g/g_{i.s.}, SG 0.1492 g/g_{i.s.} and a_w 0.809, were at maximal process parameters of time, temperature and concentration of the process of osmotic dehydration, since the higher values of process parameters induced the higher mass transfers between molasses as an osmotic solution and chicken meat as a dehydrating medium.

Keywords: *osmotic dehydration, sugar beet molasses, chicken meat*

VALUE CHAIN OF IMPORTANT COMMERCIAL SPECIES OF NON-WOOD FOREST PRODUCTS WITHIN THE STATISTICAL REGION OF VOJVODINA

Milica Marčeta*, Ljiljana Keča

Faculty of Forestry, University of Belgrade, 1, Kneza Višeslava Street,
Belgrade, Serbia

*Corresponding author:

E-mail address: milica.marceta@sfb.bg.ac.rs

Non-wood forest products (NWTPs) exceeding the local use with growing market significance, and assuming an increasing importance of the market, particularly in the expansion of organic production. The research was conducted within the statistical region of Vojvodina. For the purpose of the research twenty-two enterprises were interviewed. All of them are engaged in purchasing, processing and selling of NWFPs. This research was conducted with the purpose of gaining insight into the commercialized quantities of the most important commercial species NWFPs in Vojvodina. The aim of this study was to identify the flows of the purchase of raw NWFPs and the sale of final products, within the scope of the study, in the area of Vojvodina. The subjects of the study are the enterprises dealing with NWFPs purchase, processing and sale, purchased quantities of raw products, and the contingents of final products realized on the domestic and foreign markets. The purpose of the research is to identify trends in the purchase and sale of NWFPs and to create the future predictions. The primary method used is modelling, followed with the statistical methods of trend, regression and correlation analysis. To verify the obtained regression models trend correlation coefficient (R), t -statistics derived estimates of parameters and F -statistics (to assess the significance of the correlation coefficient) were used. For all tests, statistical significance was $\alpha = 0.05$.

Keywords: *NWFPs, Vojvodina, enterprises, trend, value chain*

VALUE CHAIN ANALYSIS OF FOREST MUSHROOMS IN SERBIA

Ljiljana Keča*, Milica Marčeta, Nenad Keča

Faculty of Forestry, University of Belgrade, 1, Kneza Višeslava street,
11030 Belgrade, Serbia

*Corresponding author:

E-mail address: milica.marceta@sfb.bg.ac.rs

Although non - wood forest products (NWFPs) are traditionally linked to local communities, they are becoming increasingly involved in the international trade. The increasing of global demand has enabled the companies from Serbia, in accordance with its capabilities, more oriented towards exports of final products of mushrooms. The objective of this study was to identify and analyze the production-consumption continuum of mushroom value chains in Serbia. Data were collected using a combination of techniques: literature review, focus group discussions and individual interviews in three major mushroom growing regions in Serbia. In order to gain insight into the developmental tendencies of local companies involved in the purchase, processing and marketing of mushrooms, a survey has been conducted in order to define trends in their placement. The purpose of the research has been to determine trends in the exports of certain types of raw and processed mushrooms in Serbia. The main subjects of the research are the quantities of placed NWFPs at the foreign market. The applied methodology is based on the trend analysis of time series which defined the trends of quantities realized at the foreign markets and enabled the projections of exports in the future.

Keywords: *mushrooms, value chain, Serbia, enterprises*

HYDROLYSIS OF LACTOSE IN THE PERMEATE OF MILK UNDER THE ACTION OF THE ENZYME GALACTOSIDASE

Dragana Ilić Udovičić^{1*}, Spasenija Milanović², Mirela Iličić²,
Anamarija Mandić³

¹Higher Technological School of Professional Studies in Šabac,
Hajduk Veljkova 10, 15000 Šabac, Serbia

²Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

³Institute of Food Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: draganailic82@yahoo.com

Nowadays, food industry develops dairy products free of lactose to satisfy the needs of the people suffering from lactose intolerance. Lowering or removing lactose from milk, these products become available for intolerant persons. Galactosidase is one of the widespread enzyme in nature and very important enzyme in food processing.

Hydrolysis of the lactose by β -galactosidase into glucose and galactose, increases the possibility of commercial use of the permeate – byproduct obtained by ultrafiltration of milk during production of cheese or whey.

The objective of this research was to examine the hydrolysis of lactose by applying the enzyme β -galactosidase in milk permeate. The effect of β -galactosidase (isolated from *Kluyveromyces lactis*) at various concentrations (0.1, 0.3 and 0.5 % (w/w)) and reaction temperature 30°C on the degree of lactose hydrolysis in permeate during 60 minutes was investigated.

The hydrolysis of lactose by addition of 0.1% enzyme contributed to 95.15% degree of hydrolyses, but 100 % degree of hydrolysis was achieved after 20 min with 0.3% β -galactosidase and after 10 min when 0.5% enzyme was added. The maximum yield of glucose and galactose was 3.02 and 3.5 2g/100g, respectively.

Keywords: lactose, permeate, β -galactosidase, hydrolysis

INFLUENCE OF GOJI BERRY, PUMPKIN POWDER AND ROSE PETAL EXTRACT ON THE QUALITY OF COOKED SAUSAGES WITH REDUCED NITRITE CONTENT

Dessislava Vlahova-Vangelova¹, Dessislav Balev¹, Stefan Dragoev^{1*},
Boris Kapitanski¹, Kiril Mihalev², Toni Doncheva³

¹Department of Meat and Fish Technology, Technological Faculty, University of Food Technologies, Plovdiv, Bulgaria

²Department of Food Preservation and Refrigeration Technology, Technological Faculty, University of Food Technology, Plovdiv, Bulgaria

³ Rettenmaier Austria GMBH& CO.KG, Wien 1230, Gesslgasse 7/1

*Corresponding author:

E-mail address: logos2000lt@gmail.com

The influence of dried fruit of goji berry (GB) (*Lycium chinense*), butternut pumpkin powder (PP) (*Cucurbita moschata*) and rose petal extract (RPE) (*Rosa damascena Mill*) on lipid and protein oxidation in sausages with 1/2 reduced nitrite content was studied. The sausages were produced with 0.05 g/kg sodium nitrite, and 5 or 10 g/kg dried goji berry fruits resp. pumpkin powder and 0.05 or 0.1 % rose petal extract. The controls with 0.05 or 0.10 g/kg sodium nitrite only were used. In comparison with control samples C, on 6th d of storage statistically significant ($p \leq 0.05$) reduction of total protein carbonyls in samples 0.05% RPE, 0.1% RPE, 0.5 % and 1% GB (50,58%, 50,00%, 44,00% и 46,15% resp.) was detected. The addition of 0.5% and 1% pumpkin powder showed weak antioxidant activity, but the addition of 0.05% to 0.1% rose petal extract or 0.5 to 1.0% goji berry effectively inhibit the protein hydrolysis and oxidation, lipolysis, and lipid oxidation ($p \leq 0.05$) and can be used successfully as additives for development new functional sausages with halfway reduced nitrites content.

Keywords: functional meat products, rose petal extract, goji berry, lipid and protein oxidation, reduced nitrite content

DEVELOPMENT OF NEW FUNCTIONAL COOKED SAUSAGES BY ADDITION OF ROSE PETAL EXTRACT

Dessislav Balev¹, Dessislava Vlahova-Vangelova¹, Stefan Dragoev^{1*},
Kiril Mihalev², Toni Doncheva³

¹Department of Meat and Fish Technology, Technological Faculty, University of
Food Technologies, Plovdiv, Bulgaria

²Department of Food Preservation and Refrigeration Technology, Technological
Faculty, University of Food Technology, Plovdiv, Bulgaria

³Rettenmaier Austria GMBH& CO.KG, Wien 1230, Gesslgasse 7/1

*Corresponding author:

E-mail address: logos2000lt@gmail.com2

An identification of the technological capabilities to develop new functional cooked sausages with ½ reduced content of nitrite, enriched with rose petal extract (*Rosa damascena Mill*) was studied. The experiments were conducted with samples containing 0.01, 0.03, and 0.05 g/kg sodium nitrite, and 0.1, 0.3, 0.5 g/kg rose petal extract. The control samples were produced with 0.05 or 0.10 g/kg of sodium nitrite. The samples were analyzed 1st day after manufacturing and on 6th day of storage at 0 - 4°C. It was found that the addition of 0.03% or 0.05% rose petal extract in the most significant extent contributes to preservation of the sensory properties of studied sausages with half nitrite content. The combination of 0.03 % or 0.05 % rose petal extract most preferably preserves the color characteristics of the sausages, but addition of 0.05% rose petal extract with reducing the nitrite content to 10% was not found so effective. The conclusion was made that the rose petal extract can be used as additive for development new functional meat products with halfway reduced amounts of nitrites. Future experiments are needed for optimization the sausage formulation.

Keywords: *functional sausages, rose petal extract, color, reduced nitrite content*

A PARTICULAR QUALITY ASPECT OF MILK FROM SMALL RUMINANTS

József Csanádi*, Sára Bohata, Antal Véha, Ernő Gyimes

Institute of Food Engineering, Faculty of Engineering, University of Szeged,
Mars tér 7. Szeged, H-6724, Hungary

*Corresponding author:
E-mail address: csanadi@mk.u-szeged.hu

In the last decade, the popularity of goat and sheep milk products shows a rising tendency, but it can be limited by poor quality of raw milk and consequently the poor product quality. Two basic problems can cause problematic quality, namely the poor milk hygiene, and the adulteration. In our opinion, current regulation of Somatic Cell Count (SCC) of small ruminants' milk and the freezing point of goat milk does not contribute to the improving of product quality

SCC from different goat breeds and relation between SCC and the texture properties of lactic curd made from sheep milk were investigated. Samples from Saanen, Native, Alpine, Hungarian White and Alpine x Saanen crossbred goats and from Tsigai sheep were investigated using MT-02 fast SCC unit (Aro Legato, Hungary), standard fluoro-optic method for SCC and Brookfield QTS 25 texture analyser (UK).

A lot of references confirm similar results for SCC of the investigated goat milk ($1.6 - 11.7 \cdot 10^5 \text{ ml}^{-1}$). The general average SCC value was $6.64 \cdot 10^5 \text{ ml}^{-1}$. Furthermore, the SCC of samples did not differ significantly by genotypes and by seasons (spring: $5.85 \cdot 10^5 \text{ ml}^{-1}$; autumn: $6.22 \cdot 10^5 \text{ ml}^{-1}$). The highest difference between the results from MT-02 and fluoro-optical (reference) method was $5 \cdot 10^5 \text{ ml}^{-1}$ but it was a lonely extreme value.

Strong relationship (linear regression) was explored between the SCC of raw sheep milk and texture properties of yogurt, which was made from investigated milk samples having SCC between $1.1 \cdot 10^5 \text{ ml}^{-1}$ and $24.5 \cdot 10^5 \text{ ml}^{-1}$. Higher CSS caused weaker texture properties (Hardness, and "whey draining" or the ratio of syneresis).

Considering our results, we suggest the use of $8.0 \cdot 10^5 \text{ ml}^{-1}$ SCC value as an action limit – as the first step - in order to improve national standards and the quality of milk products made from small ruminants' milk.

Keywords: *somatic cell count, sheep milk, goat milk, texture properties*

Acknowledgments: *This study was supported by TÁMOP-4.1.1.C-12/1/KONV-2012-0014 Project.*

LIPIDOMICS IN FOOD AND NUTRITION RESEARCH

Jana Hajslova*, Milena Zachariasova, Vojtech Hrbek, Josep Rubert

Faculty of Food and Biochemical Technology, Institute of Chemical Technology
in Prague, Technicka 3, 16628 Praha, Czech Republic

*Corresponding author:

E-mail address: jana.hajslova@vscht.cz

Lipids are a large and diverse group of naturally-occurring compounds that store energy, give structure to cell membranes, and, as 'molecular messengers', they serve as signaling molecules. Considering foods nutritional value, lipids are one of the key components, they are e.g. a source of essential components such as polyunsaturated fatty acids (PUFA), they support absorption of fat soluble vitamins etc. For in-depth structural and quantitative characterization of various lipid classes and their distribution within food crops and/or products, instrumental platforms based on advanced chromatographic methods coupled with mass spectrometric detection represent currently the most challenging option. In our studies, we focused on application of these novel strategies for monitoring of lipids changes during storage and processing, i.e. under conditions when they may undergo various degradative processes such as oxidation. Worth to notice that compounds generated through oxidation reactions are related to undesirable sensory and biological effects. In addition to cytotoxic and genotoxic compounds, free radicals, products of lipids peroxidation also co-oxidize some vitamins, and thereby impair the nutritional quality of the foods. A high number of methodologies enabling determination of both primary and secondary oxidation products has been developed and implemented. However, some of these 'classic' approaches such as peroxide value illustrating early stages of lipids oxidation, are highly empirical and their accuracy is rather questionable since the results vary with details of the analytical procedure. Also thiobarbituric acid (TBA) test often applied for measurement of the extent of lipids oxidation has been criticized as being non-specific and insensitive for the detection of low levels of malonaldehyde. Not surprising that introduction of modern instrumental techniques that enable rapid obtaining of more comprehensive and specific information is urgently needed. In addition to implementation of modern analytical methods for assessment of lipids qualitative parameters, we also were concerned with introduction of novel non-target screening strategies enabling lipids authentication. This presentation involves several case studies documenting challenges in lipids analysis: • Simple and fast sample preparation strategy based on partition in ternary solvent system enabling, in a single step, fractionation of fish lipid classes according their polarity. • Application of an ambient high resolution mass spectrometry (HRMS) employing direct Analysis in Real Time (DART) ion source for an assessment of lipids quality with regards to content of primary and secondary oxidation products • Authentication of food lipids using fingerprinting / profiling strategy based on DART-HRMS, lipidomics • Employing supercritical fluid chromatography (SFC) coupled with high definition

mass spectrometry (HDMS) for analysis of frying oils and lipids isolated from human adipose tissue.

Keywords: *lipids, oxidized lipids, supercritical fluid chromatography, high resolution mass spectrometry, fingerprinting, authentication*

TRACEABILITY ACROSS FOOD CHAIN: LESSONS WE HAVE LEARNT

Jana Hajslova*, Milena Zachariasova, Monika Tomaniova

Faculty of Food and Biochemical Technology, Institute of Chemical Technology
in Prague, Technicka 3, 16628 Praha, Czech Republic

*Corresponding author:

E-mail address: jana.hajslova@vscht.cz

Adopting measures ensuring traceability of food commodities across production – processing – distribution chain is currently an issue of high concern since in this way food fraud can be efficiently avoided. Specifically costly products such as e.g. some spices, herbs or food supplements can be very attractive subjects for an economically motivated adulteration. In addition to the replacement of a valuable authentic constituent with a less expensive substitute, also addition of non-authentic substance to mask inferior quality (to improve color, flavor, texture...) is a conceivable fraudulent practice. It should be noted, that, in addition to the traditional threats to the food supply, more risky, 'unconventional' adulterants, such as toxic Sudan dyes, have been recently used in spices.

To avoid these activities, thereby protect both purchasers and consumers, relevant effective analytical strategies have to be introduced. However, current food protection systems are not designed to look for the nearly infinite number of potential adulterants that may show up in the food supply. On this account, 'classic' target methods have been nowadays successively replaced by a comprehensive non-target, fingerprinting procedures. High resolution mass spectrometry (HRMS) is a technique playing a dominating role in this field. The applicability for a particular purpose / performance characteristics of various HRMS(/MS) platforms, including recently introduced ambient MS, will be critically assessed in this presentation. Traceability / authentication case studies employing metabolomic fingerprinting / profiling approaches will be demonstrated on saffron, herbal teas, garlic extract and rose-hips food supplements. The strategies of authenticity markers identification and databases building up will be discussed.

Keywords: *food fraud, adulteration, authenticity, metabolomics, mass spectrometry, fingerprinting*

POTENTIAL USE OF NON-EQUILIBRIUM PLASMAS IN FOOD INDUSTRY

Zoran Petrović^{1*}, Nevena Puač¹, Suzana Živković², Kosta Spasić¹,
Gordana Malović¹

¹Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Zemun,
Serbia

²Institute for Biological Research "Siniša Stanković", University of Belgrade,
Bulevar despota Stefana 142, 11060 Belgrade, Serbia

*Corresponding author:

E-mail address: zoran@ipb.ac.rs

Application of low temperature plasmas that are not in thermal equilibrium allow treatment of thermally sensitive materials, even the living organisms. The potentials that have been demonstrated in scientific literature include sterilization of surfaces to reduce potential contamination and extend shelf life, triggering and inducing faster growth of plants, improving germination of seeds, removal of fungi and spores from the crops. The second line of application includes packaging and treatment of materials required in food industry. Plasmas were successfully used in sterilization of packaging, treatment and coating of plastic bottles and functionalization of surfaces (hyperhydrophobic surfaces or hydrophilization of surfaces). Apart from the direct application in the food production plasma can be used efficiently in decontamination and treatment of waste (purification of water, fuel conversion, decontamination of animal waste). As for diagnostic of the contamination plasma is used in the Proton Transfer Mass analysis which can be used in finding fingerprints of microorganisms that cause contamination. The principal problem in application of plasmas is the added cost and complexity as application has to be made sometimes during preparation or after it.

Keywords: *low temperature plasma, sterilization, surface activation*

GREEN TECHNOLOGIES IN THE VALORIZATION OF AGROFOOD WASTES IN THE FRAME OF THE BIOREFINERY CONCEPT

Ana Rita C. Morais, André M. da Costa Lopes, Rafał Bogel-Lukasik*

Laboratório Nacional de Energia e Geologia, Unidade de Bioenergia, Portugal

*Corresponding author:

E-mail address: rafal.lukasik@lneg.pt

Food production results in the generation of residues at different step of the production chain. A great part of the residues is generated at the agricultural part of the process. Although some of these residues may have already an application as for example feed or bedding, however more energetically and economically efficient use is desirable. Especially that this kind of residues are low-cost bulky feedstock and renewable carbon source, which can be processed and valorised to produce fine chemicals and bio-based commodities fulfilling the requirement of biorefinery concept. However, considering the globally occurring changes, the valorisation of residues made in the frame of biorefinery concept must be done in the green fashion. This way the broadly understood sustainability and bio-based economy requirements can be satisfy.

This work will show some examples of valorisation of food production chain residues using greener methods. The aim of this work is to demonstrate the diverse application methods of ionic liquids and high density fluids in direct integrated valorisation of biomass towards value-added chemicals.

Acknowledgements: *This work was supported by the Fundação para a Ciência e a Tecnologia (FCT, Portugal) through the Bilateral Cooperation project FCT/CAPES 2014/2015 (FCT/1909/27/2/2014/S) and grants SFRH/BD/90282/2012, SFRH/BD/94297/2013 and IF/00424/2013. The work was also supported by CAPES (Brazil) by financing the Pesquisador Visitante Especial 155/2012 project. The support to execute this work was also received from EUBis COST Action TD1203 Food Waste Valorisation for Sustainable Chemicals, Materials and Fuels.*

OPTIMIZATION OF WHEAT STARCH SUSPENSIONS MICROFILTRATION PROCESS

Bojana Ikonić*, Aleksandar Jokić, Zoltan Zavargo, Zita Šereš

Faculty of Technology, University of Novi Sad, Bulevar cara Lazara 1,
21000 Novi Sad, Serbia

*Corresponding author:

E-mail address: prodanic@tf.uns.ac.rs

The objective of this study was to optimize the wheat starch suspensions microfiltration process in order to determine the best operation conditions (transmembrane pressure, suspension flow rate and suspension concentration) in the presence of Kenics static mixer, as a turbulence promoter. Beside the influence of process parameters, the effect of pore size diameter was also taken into account. Used membranes in all experiments were single channel ceramic membranes with 200 nm and 500 nm pore size. The goal of optimization process was maximization of individual responses permeate flux in presence of Kenics static mixer (J_{SM}) as well as reduction of specific energy consumption (ER). Reduction of specific energy consumption was a limiting factor for the use of static mixer and its value significantly decreased with the flow rate, because the permeate flux was not high enough to compensate the pressure drop increase along the membrane channel.

Keywords: *microfiltration, starch, static mixer, optimization*

FOOD SAFETY EVALUATION OF THE PASTEURISING-COOKING THERMAL PROCESSES

Ferenc Eszes*, Gabriella Zsarnóczay, Ernő Gyimes, Antal Véha

Department of Food Engineering of Faculty of Engineering of University of Szeged, H-6725 Szeged Moszkvaikörút 5-7, Hungary

*Corresponding author:
E-mail address: eszes@mk.u-szeged.hu

Concerning thermal processes, different thermal schedule establishing principles are used in the industry. These are mostly based on earlier experience, but nowadays the scientific principles have appeared mainly from the side of authority. Since the companies produce larger and larger amount of products and deliver them to longer and longer distances, there is a need to re-evaluate these principles in the food safety point of view. Therefore, in this paper, the thermal parameters from heat penetration curves were calculated and a survey about the initial and boundary conditions of the applied industrial thermal processes was made. Using this data, simulated calculations of the thermal processes stopped by the different principles were carried out. It was concluded that the earlier principles have to be corrected to fulfill the 12D bacterial destruction and that further investigation is needed for the determination of *Streptococci* population.

Keywords: *thermal process evaluation, pasteurizing-cooking, meat products, food safety*

Index of authors

A

Abdolmaleki Farzaneh, 174
Ačanski Marijana, 71
Aleksić Goran, 159
Aleksić Verica, 78, 79
Alexa Ersilia, 145
Apić Jelena, 118

B

Babić Jelena, 118
Babić Ljiljana, 61
Babić Marija, 173
Babić Mirko, 61
Baenas Nieves, 80, 81, 104
Bagi Ferenc, 121, 129
Balan Daniela, 82
Balanč Bojana, 83
Balev Dessislav, 198, 199
Bamburowicz-Klimkowska Magdalena, 182
Barać Miroljub, 63, 95
Basic Zorica, 84
Bavec Franc, 31, 77
Bavec Martina, 31, 77
Beara Ivana, 78
Bekavac Goran, 71
Belc Nastasia, 33
Belovic Miona, 85, 129, 152, 160
Benedito José, 75, 76
Bezek Katja, 142
Bianchi Giulia, 34, 119
Bjelanović Milena, 168,
Blagojević Bojan, 120
Bočarov-Stančić Aleksandra, 121
Bodroža Solarov Marija, 17, 31, 64,
114, 121, 153
Bogdanović Vladan, 99
Bogel-Lukasik Rafał, 205
Bohata Sára, 200
Bohinc Klemen, 141
Bonos Eleftherios, 10

Borović Branka, 96, 149, 155,
156, 172
Bošković Svetlana, 79
Bozić Biljana, 120
Branković Ivana, 172
Brbaklić Ljiljana, 53
Brdar Milka, 53
Brkljača Jovana, 17, 31, 121
Brlek Tea, 17, 121
Brlek Vlasta, 122
Bucar Franz, 142
Budakov Dragana, 129
Bugarski Branko, 16, 83, 113,
176
Bukara Katarina, 176
Bulajić Snežana, 180
Bulatović Maja, 86, 87
Bursać Mira, 123
Bursić Vojislava, 159

C

Carvajal Micaela, 40, 104
Castillo Rosa, 75, 76
Cattaneo Tiziana M.P., 34
Christaki Eferpi, 10
Ciganović Milana, 170
Csanádi József, 200
Cvejić Jelena, 123
Cvetković Biljana, 160
Cvetković Dragoljub, 38, 68, 150
Cvetković Tina, 142

Č

Čabarkapa Ivana, 72, 124, 148,
164
Čanadanović-Brunet Jasna, 186
Četojević-Simin Dragana, 186

Ć

Ćetković Gordana, 186

Ćirković Miroslav, 15, 45, 46
Ćosos Ladislav, 122
Ćulafić Jelena, 121
Ćupić Željko, 136
Ćurčić Biljana, 137

D

Dapčević Hadnađev Tamara, 8, 189
Daudin Jean-Dominique, 4
da Costa Lopes André M., 205
de Pascual-Teresa Sonia, 81
de la Roza-Delgado Begoña, 24
Dimitrovski Darko, 115
Djekić Ilija, 32
Djilas Sonja, 186
Djinovic-Stojanovic Jasna, 89, 167,
187
Djordjevic Radovan, 16
Djordjevic Verica, 16,
Djordjevic Verica, 83, 113
Djordjevic Vesna, 187
Djukić-Vuković Aleksandra, 19, 21,
179
Džinić Natalija, 65
Demin Mirjana, 88
Demšar Lea, 11
Despotović Saša, 22
Dimić Gordana, 138
Dodić Jelena, 183, 185
Dodić Siniša, 183
Dojčinović Slobodan, 62
Dokić Ljubica, 100, 101, 106
Doncheva Toni, 198, 199
Dragoev Stefan, 198, 199
Dulić Zorka, 44

Đ

Đinović-Stojanović Jasna, 173
Đisalov Jovana, 17, 121
Đorđević Vuk, 123
Đorđević Vesna, 15, 45, 46
Đukić Dragutin, 158
Đurđević-Milošević Dragica, 51
Đurović Ana, 73

DŽ

Džinić Natalija, 154, 165

E

Egelandsdal Bjørg, 168
Eszes Ferenc, 207

F

Ferreres Federico, 80
Filipčev Bojana, 47, 64, 131, 153,
193
Filipović Jelena, 125
Filipović Vladimir, 52, 54, 55, 59,
137, 194
Filipović Vladimir, 90
Finglas Paul, 102
Fišteš Aleksandar, 106
Florou-Paneri Panagiota, 10

G

Gaćeša Bojana, 123
Galanakis Charis, 2
García Miguel Ángel, 76
García-Viguera Cristina, 40, 80,
81
Gavran Jelena, 122
Gerić Tamara, 25
Gherghina Evelina, 82
Giannenas Ilias, 10
Glamočlija Đorđe, 90
Glušac Jovana, 51
Golic Nataša, 13
González Arrojo Amelia, 24
Grabež Vladana, 168
Gradvol Vedran, 161
Grahovac Jovana, 183, 185
Grahovac Mila, 183, 185
Grahovac Nada, 73
Grbić Jasna, 47, 64, 131
Grobelnik Mlakar Silva, 31, 77
Grubelic Mirela, 122
Grujić Slavica, 169, 170

Gubić Jasmina, 52, 126, 137, 148
Guzsvány Valéria, 26
Gyimes Ernő, 192, 200, 207

H

Hadnađev Miroslav, 8, 189
Hajibabaei Ali, 174
Hajslova Jana, 201, 203
Haltrich Dietmar, 20
Hassini Ismehen, 104
Horváth Györgyi, 191
Hrbek Vojtech, 201
Hribar Janez, 30
Hristov Nikola, 53, 127, 152
Hrnjez Dajana, 12, 91, 92
Hromiš Nevena, 35, 39, 48, 166
Hura Carmen, 93, 128
Hura Bogdan, 128

I

Igorov Bogdan, 139
Ikonić Bojana, 190, 206
Ikonić Predrag, 48, 49, 65, 139,
155, 156, 165
Ilić Nebojša, 85, 160
Ilić Vesna, 176
Ilić Udovičić Dragana, 197
Iličić Mirela, 12, 91, 92, 162, 197
Iliev Vasil, 58, 178
Ilin Žarko, 94, 132
Ionescu Mariana, 33
Ionescu Valentin, 33
Iorga Enuta, 33
Isailovic Bojana, 16
Israel-Roming Florentina, 82, 175

J

Jakop Manfred, 31, 77
Jakšić Sandra, 136
Jambrec Dubravka, 36, 64, 138,
153, 171, 193
Janić Hajnal Elizabet, 74, 129, 130,
160, 164

Jankovic Sasa, 89
Janković Vesna, 154, 155, 156
Jeršek Barbara, 141
Jevrić Lidija, 94, 132
Jevtić-Mučibabić Rada, 47, 64,
125, 131
Jocković Bojan, 127
Jokanović Marija, 48, 49, 65, 154,
165
Jokić Aleksandar, 185, 190, 206
Jovanov Pavle, 26, 36, 74, 193
Jovanović Jelena, 97
Jović Mihajlo, 49, 143

K

Kaišarević Sonja, 85
Kalaba Vesna, 50, 51
Kalušević Ana, 16
Kanurić Katarina, 12, 91, 92
Kapetanov Miloš, 118
Kapitanski Boris, 198
Karabegović Ivana, 60
Karadžić Milica, 94
Karaman Maja, 79, 85
Karan Dragica, 97, 155
Kartalović Brankica, 136
Keča Ljiljana, 195, 196
Keča Nenad, 196
Kevrešan Žarko, 152, 160, 164
Kiely Mairead, 102
Klančnik Anja, 23, 141, 142
Klaus Anita, 9, 22
Klimaszewska Marzenna, 182
Knez Željko, 6, 111
Knežević Nada, 43
Knežević Nemanja, 173
Knežević Petar, 78
Knežević Violeta, 52, 54, 55, 59,
194
Kocić-Tanackov Sunčica, 19, 21,
48, 179
Kojić Milan, 13, 112, 127
Kokić Bojana, 17, 72, 124
Koledin Ivana, 108, 110
Kondić-Špika Ankica, 53, 127

Kondjoyan Alain, 4
Korićanac Vladimir, 45, 187
Kos Jovana, 26, 74, 129
Kostadinović Ljiljana, 72
Kostić Aleksandar, 63, 95
Kostić Andrijana, 51
Kostić Ivana, 83, 176
Kostov Georgi, 58, 178
Košutić Milenko, 125
Kovač Jasna, 23
Kovač Renata, 108, 110
Kovačević Dragan, 57
Kovačević Olgica, 70
Kovačević Strahinja, 94, 132
Kozarski Maja, 9
Kozoderović Gordana, 41
Kravić Snežana, 73, 165
Krisch Judit, 18, 191
Kruļj Jelena, 17, 47, 64
Krunić Tanja, 86, 87
Kuljanin Tatjana, 47, 54, 59, 131, 194
Kurćubić Vladimir, 96
Kurinić Marija, 142
Kuzmanović Slobodan, 159

L

Lakićević Brankica, 154, 155, 156
Laličić-Petronijević Jovanka, 88
Langerholc Tomaz, 115
Lazarević Ivana, 181
Lazarević Marina, 32
Lazić Miodrag, 60
Lazić Sanja, 144
Lazić Vera, 35, 39, 162, 166
Leskošek-Čukalović Ida, 22
Lević Jovanka, 72, 124
Lević Ljubinko, 28
Lević Steva, 16
Lilić Slobodan, 96, 97, 156, 172, 187
Lončar Biljana, 52, 54, 55, 59, 194
Lončar Eva, 12
Lončarević Ivana, 98
Lozo Jelena, 13

Lukić Mirjana, 97
Luta Gabriela, 82
Lušnic Polak Mateja, 11

LJ

Ljubisavljević Sanja, 32
Ljubojević Dragana, 15, 45, 46, 136
Ljubobratović Uroš, 44

M

Malović Gordana, 204
Mandić Anamarija, 26, 138, 193, 197
Mandić Marina, 151
Marčeta Milica, 195, 196
Marinković Radovan, 133
Marjanović Balaban Željka, 50
Marjanović Jeromela Ana, 133
Markov Siniša, 38, 68, 150
Marković Smilja, 83
Marković Tatjana, 90
Marković Zoran, 44
Martínez-Ballesta Maria Carmen, 40, 104
Martinov Milan, 163
Martinović Aleksandra, 48, 56, 168
Maslić-Strizak Danka, 172
Mastanjević Krešimir, 57
Mastilović Jasna, 60, 74, 129, 152, 160, 164
Maširević Stevan, 183
Matavulj Milica, 108, 110
Matek Saric Marijana, 122
Matekalo-Sverak Vesna, 97, 167, 187
Memiši Nurgin, 99, 135
Mičić Darko, 28
Migliori Carmela Anna, 34
Mihajlović Sanja, 13, 112
Mihaljev Željko, 136
Mihalev Kiril, 198, 199
Mihociu Tamara Elena, 82

Mikić Aleksandar, 133
Miladinović Dragana, 133
Miladinović Jegor, 123
Milanov Dubravka, 41
Milanović Spasenija, 12, 73, 91, 92,
162, 197
Milašinović-Šeremešić Marija, 7,
100, 101
Milešević Jelena, 102
Milijašević Milan, 45, 46
Milojković - Opsenica Dušanka, 95
Milovac Željko, 133
Milovanović Ivan, 26, 36, 74, 126,
131
Milovanović Ružica, 157
Mimica-Dukić Neda, 78, 79
Miocinović Jelena, 66
Mirade Pierre-Sylvain, 4
Mirković Dušica, 105
Mirković Nemanja, 180, 181
Mitrović Petar, 133
Mišan Aleksandra, 36
Mišić Danijela, 176
Mladenov Novica, 127
Mohylianska Nadiia, 103
Mojović Ljiljana, 19, 21, 86, 179
Morais Ana Rita C., 205
Moreno Diego A., 40, 80, 81, 104
Mraz Balazs, 142
Mustatea Gabriel, 33

N

Namvijitra Peenida, 20
Naydenova Vessela, 58, 178
Nedeljković Aleksandar, 66
Nedeljković Nataša, 36, 171, 193
Nedić Drago, 62
Nedić Tiban Nela, 161
Nedović Viktor, 16, 22, 83, 107,
113, 176, 182
Nešić Kristina, 22, 107
Ničetin Milica, 52, 54, 55, 59, 137,
194
Nikolić Aleksandra, 51
Nikolic Dragica, 89

Nikolić Nada, 60
Nikolic Milica, 112
Nikolov Zivko, 3
Nikšić Miomir, 9, 22, 182
Novakov Nikolina, 15
Novaković Aleksandra, 85, 160,
163, 164

NJ

Nježić Zvonko, 64

O

Obradović Nataša, 86, 87, 113
Odžaković Božana, 169, 170
Ogrinc Nives, 30
Oguzhan Yildiz Pinar, 69, 117
Okanović Đorđe, 15, 96
Onjia Antonije, 143
Orčić Dejan, 78
Ortuño Carmen, 75, 76
Ostojić Sanja, 28, 70

P

Pajić Zorica, 7
Pajin Biljana, 98, 106
Paniagua Ingrid, 75, 76
Pantelić Nebojša, 95
Pantić-Palibrk Vesna, 151
Pastor Kristian, 71
Pavkov Ivan, 61
Pavlović Hrvoje, 161
Pavlović Miloš, 172
Pavlović Olivera, 68
Pavlović Snežana, 159
Pauk Janos, 53
Paunović Dragana, 105, 107
Paunović Dušanka, 180, 181
Pećanac Biljana, 62
Pejić Biljana, 39, 162
Pejin Jelena, 19, 21, 179
Peng Jian, 10
Penko Ana, 11
Perko Tina, 111

Pestorić Mladenka, 64, 153, 160, 171, 193
Pešić Mirjana, 63, 95
Petri Edward, 92
Petronijević Radivoj, 46
Petrović Jelena, 118
Petrović Jovana, 98, 106
Petrović Ljiljana, 65, 154, 165
Petrović Tanja, 95, 105, 107
Petrović Zoran, 14, 187, 204
Petruța Cornea Călina, 175
Petrušić Milica, 180, 181
Pezo Lato, 28, 35, 52, 55, 59, 70, 125
Plavšić Dragana, 52, 55, 64, 72, 124, 129, 137, 138, 148
Podobnik Petra, 141
Podsadni Piotr, 182
Podunavac Kuzmanović Sanja, 94, 132
Pojić Milica, 8, 160, 189
Polak Tomaž, 11
Pop Georgeta, 145
Popovic Aleksandar, 167
Popović Boris, 114
Popović Ljiljana, 39, 91
Popović Senka, 35, 39, 162, 166
Popović Vera, 90
Portanguen Stéphane, 4
Povarova Natalia, 139
Protić Rade, 90
Psodorov Đorđe, 64, 138, 171
Pudja Predrag, 66
Pupavac Snježana, 25
Puač Nevena, 204
Puvača Nikola, 116

R

Rabrenović Biljana, 88
Radanović Dragoja, 90
Radičević Tatjana, 158
Radin Dragoslava, 27
Radojčin Milivoj, 61
Radosavljević Milica, 7, 100, 101
Radosavljević Miloš, 19, 179

Radulov Isidora, 145
Radulović Zorica, 180, 181
Radusin Milan, 163
Radusin Tanja, 160, 163, 164
Radovanović Mira, 66
Rajić Jasmina, 105, 107
Rajić Marina, 38
Rajković Andreja, 32
Rajković Vesna, 108, 110
Rakić Dušan, 106
Rakić Milana, 79
Rakin Marica, 86, 87, 113
Rakin Marko, 113
Rakita Slađana, 189
Rashevskaya Tamara, 109
Raspor Peter, 1, 141, 142
Rašeta Mladen, 97, 172
Rašeta Milena, 85
Rembiałkowska Ewa, 29
Rimac Brnčić Suzana, 43
Ristić Milan, 173
Rizzolo Anna, 34, 119
Ristic Milan, 167
Robačar Martina, 31, 77
Rubert Josep, 201
Rus Cristian, 145

S

Sabljak Iva, 122
Sak-Ubol Suttipong, 20
Sakač Marijana, 26, 36, 98, 171, 193
Samaniego Lourdes, 102
Santini Antonello, 5
Savić Milena, 22, 182
Semenčenko Valentina, 7
Sicuiă Oana-Alina, 175
Silván Jose Manuel, 81
Simin Nataša, 79
Simonović Branislav, 28
Sinković Lovro, 30
Skoufos Ioannis, 10
Smole Možina Sonja, 23, 141, 142
Soldado Ana, 24

Sokovic Svetlana, 112
Spalević Ljiljana, 172
Spasić Kosta, 204
Spiric Aurelija, 167
Stamenković Zoran, 61
Stanković Božana, 169
Stanković Marija, 151
Stanković Marko, 44
Stanković Slavka, 143
Stanojević Slađana, 63, 95
Stavrović Mira, 159
Stefanovic Srdjan, 89, 158
Stevanović Jasna, 25
Stijepić Milka, 51
Stojanov Igor, 118
Stojanović Irena, 144
Stojanović Jelena, 60
Stojanović Zorica, 73
Stojičević Saša, 60
Stošić Milena, 108, 110
Stošić Nataša, 105
Sumalan Renata Maria, 145
Suturović Zvonimir, 73
Suvajdžić Ljiljana, 41, 124
Szabó-Nagy Andrea, 192
Szutowski Mirosław, 182

Š

Šarić Bojana, 36, 74, 171, 193
Šarić Ljubiša, 26, 55, 137, 138, 148, 155
Šekularac Gavriilo, 176
Šereš Zita, 106, 206
Šikić Pogačar Maja, 23
Šimurina Olivera, 17, 47, 64, 131, 153
Škaljac Snežana, 48, 49, 65, 154, 165
Škerget Mojca, 111
Škrinjar Marija, 72, 135, 164
Šmigić Nada, 32
Šojčić Branislav, 48, 49, 65, 154, 165
Šoronja Simović Dragana, 64, 106
Štajner Dubravka, 114
Šumić Zdravko, 94, 132

Šunjka Dragana, 144
Šuput Danijela, 28, 35, 39, 59, 70, 166, 194
Švarc-Gajić Jaroslava, 73

T

Tadić Marinela, 151
Tadijan Ivana, 183, 185
Tanaskovski Bojan, 143
Tasić Tatjana, 48, 49, 65, 126, 155, 165
Temkov Mishela, 67
Tepić Aleksandra, 94, 132
Terzić Dušanka, 7
Terzić Sreten, 133
Terzić-Vidojević Amarela, 13, 112
Tešić Živoslav, 95
Todorović Dalibor, 41
Todorović Goran, 7
Tolinački Maja, 13, 112
Toma Radu, 175
Tomaniova Monika, 203
Tomescu Alexandru, 145
Tomić Jelena, 130
Tomić Nikola, 32
Tomović Mila, 48
Tomović Vladimir, 48, 49, 65, 98, 165, 168
Torbica Aleksandra, 130, 152, 189
Török Jenei Julianna, 191
Torović Ljilja, 78, 146, 147
Trbović Dejana, 44, 45, 46
Trifković Kata, 83, 113
Trkulja Dragana, 53
Troeger Klaus, 167
Trpković Goran, 66
Tsinas Anastasios, 10
Tumbas Šaponjac Vesna, 186
Turlo Jadwiga, 182
Turubatović Lazar, 14, 25
Tzora Athina, 10

U

Ugrenović Vladan, 90, 114

V

Vágvölgyi Csaba, 18
Varga Ana, 72, 124, 137, 148
Vass Imre, 53
Vaštag Žužana, 39, 91
Véha Antal, 18, 191, 192, 200, 207
Velhner Maja, 41
Velebit Branko, 27, 96, 149, 156
Velickova Elena, 67, 115
Velicanski Aleksandra, 38, 68, 150
Veljović Katarina, 13, 112
Veljović Mile, 16, 105
Vesković-Moračanin Slavica, 14, 135, 149, 155, 158
Vidács Anita, 18, 191
Vidaković Ana, 68, 150
Vidrih Rajko, 30
Višković Miroslav, 163
Vlahova-Vangelova Dessislava, 198, 199
Vlajković Jelena, 151, 159
Vojinović-Miloradov Mirjana, 163
Vranić Danijela, 14, 45, 46, 96, 97, 167, 187
Vrvić Miroslav, 63
Vučić Goran, 168
Vučurović Damjan, 183
Vugdelić Marija, 56
Vujanić Marina, 79
Vujić Đura, 71
Vukašinović-Sekulić Maja, 86, 87
Vukelić Nataša, 116
Vukić Vladimir, 12, 91, 92
Vukosavljević Predrag, 107
Vuković Gorica, 151, 159
Vulić Jelena, 186
Vunduk Jovana, 9

W

Weingerl Vesna, 42, 77, 188

Winkelhausen Eleonora, 67, 115

Y

Yamabhai Montarop, 20
Yangilar Filiz, 69, 117
Yegorov Bogdan, 103

Z

Zaboš Nora, 150
Zachariasova Milena, 201, 203
Zafra Isabel, 24
Zamfir Medana, 175
Zarić Danica, 87
Zavargo Zoltan, 190, 206
Zjalic Slaven, 122
Zlatanović Snežana, 70
Zlatković Branislav, 105
Zsarnóczay Gabriella, 207
Zuber Bogdanović Ivana, 56, 180

Ž

Ždero-Pavlović Ružica, 114
Živančev Dragan, 152
Živić Ivana, 44
Živkov-Baloš Milica, 136
Živković Jasmina, 116, 126, 131
Živković Suzana, 204
Žižak Željko, 9
Žlender Božidar, 11
Žnidarčić Dragan, 30

**CIP – Каталогизација у публикацији
Библиотека Матице српске, Нови Сад**

663 / 664 : 658.562 (048.3)
614.31 (048.3)

**INTERNATIONAL Congress “Food Technology, Quality and Safety“ (2 ; 2014 ;
Novi Sad)**

**Abstract book / II International Congress „Food Technology, Quality and
Safety“, Novi Sad, 28-30.10.2014.; [editors Tea Brlek, Milica Pojić]. – Novi Sad
: Institute of Food Technology, 2014 (Novi Sad : Futura). – 207 str. ; 24 cm**

Tiraž 350.

ISBN 978-86-7994-041-4

**а) Животне намирнице – Контрола квалитета – Апстракти
б) Животне намирнице – Хигијена – Апстракти
COBISS.SR-ID 290470663**