Flour - Bread '15 : Book of abstracts of the 8th International Congress Flour - Bread '15

ISSN 1848-2554

8th INTERNATIONAL CONGRESS

FLOUR – BREAD '15

10th CROATIAN CONGRESS
OF CEREAL TECHNOLOGISTS
OPATIJA, CROATIA

October 29-30, 2015

BOOK OF ABSTRACTS

ORGANIZED BY

JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK
FACULTY OF FOOD TECHNOLOGY OSIJEK (PTFOS)

ICC – INTERNATIONAL ASSOCIATION FOR CEREAL SCIENCE AND TECHNOLOGY

In partnership with **CROATIAN FOOD AGENCY**

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

Address of Editorial Board
Faculty of Food Technology Osijek
Franje Kuhača 20, P.O. Box 709
HR-31000 Osijek, CROATIA
Tel.: +385 31 224 300
Fax: +385 31 207 115
e-mail: marko.jukic@ptfos.hr
daliborka.koceva@ptfos.hr

Printed by
Grafika d.o.o.

Edition
200 copies

UNDER THE AUSPICES OF:
Ministry of Science, Education and Sports of the Republic of Croatia
Ministry of Agriculture of the Republic of Croatia
Josip Juraj Strossmayer University of Osijek
Croatian Parliament - Agriculture Committee
Croatian Academy of Engineering

EXHIBITORS
BRABENDER GmbH & Co. KG, Germany (Ru-Ve d.o.o., Croatia)
URŠIČ d.o.o., Slovenia

SPONSORS/SPONZORI

GOLD/ZLATNI
MINISTRY OF SCIENCE, EDUCATION AND SPORTS
MINISTRY OF AGRICULTURE

SILVER/SREBRNI
BRABENDER GmbH & Co. KG, Germany (Ru-Ve d.o.o., Croatia)
URŠIČ d.o.o., Slovenia
GRAND HOTEL ADRIATIC OPATIJA

BRONZE/BRONČANI
INSPECTO d.o.o.
PEKARSTVO KADULJA d.o.o.
HYPO ALPE-ADRIA-BANK d.d
TOURIST BIRO OF CITY OPATIJA

SCIENTIFIC COMMITTEE

Daliborka Koceva Komlenić - President
Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia

Duška Ćurić
Faculty of Food Technology and Biotechnology, University of Zagreb, Croatia

Krešimir Dvojković
Agricultural Institute Osijek, Croatia

Daniela Čačić Kenjerić
Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia

Andrea Gross-Bošković
Croatian Food Agency, Croatia

Ivica Ikić
The Bc Institute for Breeding and Production of Field Crops, Croatia

Katarina Jukić
The Bc Institute for Breeding and Production of Field Crops, Croatia

Midhat Jašić
Faculty of Technology, University of Tuzla, Bosnia and Herzegovina

Marko Jukić
Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia

Dragan Kovačević
Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia

Alojzije Lalić
Agricultural Institute Osijek, Croatia

Jasna Mastilović
Institute of Food Technology in Novi Sad, Serbia

Michaela Pichler
International Association for Cereal Science and Technology (ICC), Austria

Ivana Rukavina
Croatian Centre for Agriculture, Food and Rural Affairs, Institute for Seeds and Seedlings, Croatia

András Salgó
Budapest University of Technology and Economics, Hungary

Drago Šubarić
Faculty of Food Technology Osijek, Josip Juraj Strossmayer University of Osijek, Croatia

Ljiljana Unbehend
Center for practical education of school teacher, Germany

Günter Unbehend
Max Rubner-Institut, Federal Research Institute of Nutrition and Food, Germany

ORGANIZING COMMITTEE

Daliborka Koceva Komlenić (President)	Croatia
Michaela Pichler (Vice-President)	Austria
Mirela Planinić (Vice-President)	Croatia
Jurislav Babić	Croatia
Mate Bilić	Croatia
Andrea Gross-Bošković	Croatia
Vlado Guberac	Croatia
Katarina Jukić	Croatia
Marko Jukić	Croatia
Indira Kosović	Croatia
Dragan Kovačević	Croatia
Zlatko Mijić	Croatia
Ivana Rukavina	Croatia
Drago Šubarić	Croatia
Zvonimir Zdunić	Croatia

CONTENTS

CONTENTS

ORAL PRESENTATIONS

POSTERS

NOVEL BIOACTIVE RICH IMPROVERS/ADDITIVES FROM WHEAT AND SOYBEAN ORIGIN

A. Salgó
Department of Applied Biotechnology and Food Science, Budapest University of Technology and Economics, 1111 Budapest Műegyetem rkp. 3; salgo@mail.bme.hu

The compositional and nutritional quality of cereal-based foods can be enhanced either by giving different improvers/additives into food formulas or by more effective exploitation of natural functional components of raw materials.
Targeted improvements in compositional and/or nutritional quality can be executed by elevating the protein, lipid or dietary fibre content or composition. Dedicated improvements of quality can also be reached by enhancement of bioactive components carrying special nutritional or health supporting functions.
Two different mild physiscal and natural physiological processing technologies were developed to produce novel improvers/additives with dedicated composition.
Using an innovated wheat milling technology a so-called aleuron-reach flour (ARF) fraction was produced with extreme high level of protein and dietary fibre concentration.
By controled short-term germination of soybean a special food improver/additive was innovated which can be used flexible in a broad range of cereal-based food products because of its positive chemical and nutritional components and high levels of bioactives.
The presentation highlights the technological and compositional aspects of novel improvers/additives and present some examples of their typical applications in cereal-based products.

Key words: novel additives, bioactives, high dietary fibre, special milling, germination

TRENDS IN NUTRITION – OPPORTUNITIES AND CHALLENGES FOR BAKERY PRODUCTS

J. Mastilović, A. Torbica, Ž. Kevrešan
University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia; jasna.mastilovic@fins.uns.ac.rs

Consumers' preferences related to nutritional properties of daily diet constituents are developing towards demands for more balanced nutrients intake, avoidance of food additives, utilization of nutritionally valuable parts of raw materials, preservation or even enhancement of content of delicate components susceptible to extreme processing conditions, and other similar issues accompanied with demands for impeccable safety and hygiene of products. Bakery products represent dominant portion of a daily diet for consumers with customary daily diet patterns and thus contribute significantly to final balance of nutritional intake of the consumer. A review of opportunities for innovative bakery products fulfilling one or more abovementioned consumers' preferences will be provided. For selected innovative products the nutritional perspectives, safety and hygiene challenges, sensory effects and economic balances will be discussed. The non-exhaustive list of innovative bakery products that will be reviewed includes: products with nutritionally valuable by-products from diverse food processing industries enhancing protein, fiber, mineral, deficient fatty acids and other nutrients content, products with replacement of additives with natural ingredients with oxidative, emulsifying, humectants or hydrocolloid properties, products obtained according to altered technological processes like grain sprouting instead of milling and others.

Key words: bakery products, nutritional properties, food safety

GOLDEN PATH OF MARKETING OF FLOUR AND BAKERY PRODUCTS FROM CROATIAN FIELDS

M. Vukobratović, D. Živoder, J. Pavičić, P. Tudor
Croatian Agricultural Agency, Poljana Križevačka 185, 48260 Križevci, Croatia,(office in Zagreb: Ilica 101,10000 Zagreb, Croatia); jpavicic@hpa.hr

Flour is the main ingredient of bread, which is produced by mixing flour with water, milk, whey, or some other fluid with the addition of salt or sugar, fat, eggs and yeast. In the last few years production of flour, bread and bakery products is increasing but parallel with that, import of these products in Republic of Croatia is also growing.
Croatian Agricultural Agency has recognized the position of domestic producers, so the Agency decided to brand flour, bread and bakery products with proven traceability under their own brands produced from domestic raw materials in a way that domestic raw material are in the value chain. The main goal of this is to create value-added products at each stage of production as strengthening market positions of all subjects involved in the value chain as well as the conservation of domestic production.
By creating a new brand on all levels of the production chain (Flour from Croatian fields – Bread from Croatian fields) it is trying to influence on improvement of external trade balance in the agricultural and the mill and bakery sector and to the impact on gross domestic product (GDP) growth.

Key words: flour, bread, brand, Croatian Agricultural Agency, value-added product

WHEAT GRAIN CONSERVATION FOR HUMAN CONSUMPTION: CURRENT USE OF PESTICIDES IN ARGENTINA

T. Fonovich[1], V. Sfara[2], C. Pérez-Coll[1,2]
[1]School of Science and Technology, Av 25 de mayo 1405, 1650 San Martín, Argentina; tfonovic@unsam.edu.ar
[2]Environmetal Engineery and Research Institute. National University of San Martín, Av 25 de mayo 1405, 1650 San Martín, Argentina

Grain storage constitutes a critical point in cereal production. There is an increasing tendency to leave the concept of "commodity" and treat grain production as "food", mostly considering its safety, due to grain quality, integrity and absence of pesticide residues. New generation pesticides are less but still toxic substances. Fenitrothion, mercaptothion, chlorpyriphos, dichlorvos, deltamethrin, phosphine and warfarins are still in use for storage in conventional silo. Wheat is usually affected by fungi, which begin to grow on cultures before harvest and afterwards by mite and insects. Silobag have great advantages when compared to conventional silo, like an important decrease in the need of pesticide use. Adverse effects evaluated on human health in relation to grain storage must consider not only people consuming grain, flour and food products but also workers exposure. Occupational disease associated to grain storage consists of allergy and respiratory diseases, due to exposure to dust, mould and pesticides. Residues control taking place nowadays and new technologies have lead to residues level below established limits, as occurs with the fungicide tebuconazole applied on wheat in the field. Diatomaceus earth insect control during grain storage is replacing traditional pesticide control because of its effectiveness and safety.

Key words: grain storage, pesticides, diatomaceous earth

CONTRIBUTION OF BAKERY PRODUCTS TO SALT INTAKE IN CROATIA

M. Jurković[1], D. Sokolić[1], D. Kenjerić[2]
[1]Croatian Food Agency, I. Gundulića 36b, Osijek, Croatia; mjurkovic@hah.hr
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia

High levels of salt are associated with elevated blood pressure and adverse cardiovascular health. Bread is foodstuff that contributes the most to overall salt dietary intake. As such, it is one of the key public health targets for a salt reduction policy. The WHO has set a worldwide target for maximum salt intake at 5 g/day for adults. Therefore, the aim of this paper was to estimate salt intake through bakery products in Croatia and its variations in different regions as well as its dependency on various parameters. The results showed that salt intake from the bakery products are highest in Lika Region where it reaches 3.15 g/day. Intake in other regions of Croatia is lower and similar, and ranges from 2.19 - 2.44 g/day. Detailed analysis has shown that salt intake from the bakery products in regions Dalmacija, Istra and Lika is higher in villages while in regions of northern Croatia, Slavonija and Zagreb intake was higher in towns. Related to gender, intake was higher in men than women in all regions. Considering the nourishment status, intake in regions Dalmacija, Istra and Zagreb is highest in the subgroup of obese individuals, while for regions Lika and northern Croatia intake is highest in the subgroup of persons with normal weight. In Slavonija region intake was highest in the subgroup of underweight people. Regarding age, the salt intake is highest in younger population for all regions.

Key words: bakery products, salt, intake, Croatia

HISTORY AND SIGNIFICANCE OF SALT PRODUCTION AND IODISATION IN SOLANA TUZLA

Š. Đulović[1], D. Ćilimković[1], A. Pirić[1], M. Jašić[2], Z. Đulović Jusić[3]
[1]*Solana d.d Tuzla; Soli 3, Tuzla, Bosnia and Herzegovina; seval.djulovic@solana.ba*
[2]*Tehnološki fakultet Tuzla, Univerzitetska 8, Tuzla, Bosnia and Herzegovina*
[3]*JZU Dom zdravlja Tuzla, ZAVNOBiH-a bb, Tuzla, Bosnia and Herzegovina*

The oldest evidence of salt processing in these areas are from Neolithic period at the end of 4. and the beginning of 5. century BC or more precisely, from 2500 years ago. Solana Tuzla is producing salt industrially ever since 1885. Annual salt production is estimated at around 200 000 tons per year.
Daily salt consumption per capita is 5-15 grams per day. Accurate estimates of consumption of salt for human consummation per capita is 3.5 – 4.5 kg per year. Out of total salt produced, 2-5 % is used for human consumption

- 6 % is used in agriculture
- 15 % is used for spreading on the road against ice
- 70 % is used in industry

In 1952, WHO organized world conference on endemic goiter, and since then, many countries have introduced iodine prophylaxis - iodization of salt.
Iodization of salt provides daily need of iodine in the human body.
As recommended by ICCIDD, WHO, UNICEF for daily intake of iodine by consuming the iodised salt, concentration of iodine in the salt at moment of production should be between 20 and 40 mgJ per kg of salt or between 33.7 and 55 mgKJO_3 per kg of salt. This recommendation is based on a fact that the loss of iodine, from place of production to household, is about 20 %, and that 20 % of iodine is lost during the cooking.
Storage and preservation of salt is of great importance. Incorrectly stored salt can loose 50 % of iodine in 9 months.
Solana Tuzla owns a modern warehouse for 11000 tons of salt. Warehouse has three robots that use smart logic for refreshing supplies with new packed salt.
Considering the fact that one third of population is living with iodine deficiency problem, Solana Tuzla guarantees to its customers that by consuming our products they are surely taking in recommended dosages of iodine in their bodies.

Key words: salt, iodisation of salt, human health

FOOD SAFETY REGULATIONS BASED ON SCIENCE

H. Lelieveld[1], V. Piližota[2]
[1]Ensahlaan 11, 3723 HT Bilthoven, The Netherlands
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; Vlasta.Pilizota@ptfos.hr

It is generally assumed that food for its intended use for human consumption is safe. To protect the consumer many food safety regulations have been devised. But, food safety and regulatory measures should not unnecessarily hamper the availability of human food or hamper the introduction of novel processing methods aimed at retaining the natural healthy properties of food. Substances that had harmed humans were listed as toxic and therefore considered unacceptable in food. At the time that most of the regulations were developed analytical techniques were not well refined yet and absence of toxic substances usually meant less than a few milligrams per kg of product. Unintentionally, absence has got a different meaning with time as with time, the detection limits went down and currently many substances may be detectable in nano- or even picograms per kg of product. In practice this means that where absence of substances is required, the concentration must be between a million or a billion times lower than at the time the regulations were established. Governments have a duty to ensure that the law is maintained and so must food safety inspectors. This may have fundamentally unacceptable consequences, such as consumers being denied essential nutrients and food needlessly being destroyed because it contains harmless concentrations of legally forbidden substances. This happens while it is known for 500 years that toxicity is a matter of concentration.
To ensure the global availability of safe and wholesome food products for all consumers it is of outmost importance to achieve consensus on the science of food regulations and legislation.

Key words: food safety, detection limits, food safety regulations

THE MODEL OF UTILISING THE MARKET RESEARCH AND CRM POTENTIAL IN THE FUNCTION OF PRODUCTION MANAGEMENT IN THE BAKING INDUSTRY

B. Dukić[1], S. Dukić[2], S. Dugandžić[1]
[1] *Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek; Osijek, Gajev trg 7; branimir.dukic@efos.hr*
[2]*duxMission d.o.o.Osijek, Osijek, Dalmatinska 21*

In the 20th century, when the industrial age was reaching its peak, production of many products was based on little or no knowledge about consumer needs. Product volume, type and quality in such production conditions were primarily defined by production potential. As a result, product surpluses, which could not or would not be absorbed by the market, were often generated. Such surpluses in the baking industry are quite common in the Republic of Croatia even today. The growth of competition and the growth of product transparency in the market have led to a global decrease in the margin. This has resulted in the necessity of finding the optimum ways of learning about consumer needs in order to optimise production and reduce product surpluses, thus making production more economically feasible. The potentials offered by the concept of market research and the concept of customer relationship management play a great role in this process. Being an integral part of marketing, these two concepts should be integrated as a model into a management concept for the bakery production to make production of bakery products more economically feasible, i.e. to ensure survival of large non-flexible production systems in the baking industry in particular. Namely, small production systems in the baking industry are very flexible, whereas large systems are facing greater challenges in their efforts to adapt to modern ways of doing business. Therefore, the key element of survival of large systems in modern production conditions is to find a solution to the problem of management information that will ensure production optimisation.

Key words: marketing research, CRM, production management, baking industry

ARE CONSUMERS CONCERNS ON GLUTEN TOXICITY JUSTIFIED?

D. Novotni, D. Ćurić
University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia; dnovotni2@pbf.hr

In last years, wheat and gluten have been accused for obesity epidemics and numerous health problems without clear scientific proofs. For that reason, consumption of cereal products, particularly bread, pasta, cookies and breakfast cereals has dropped significantly. In the same time, world gluten-free market shows an annual growth of 25-30 %. However, wheat- and gluten-related disorders are rather rare: allergy affects about 0.3 % of population, intolerance as celiac disease occurs in 1-2 % of population, and sensitivity prevails in 5-7 % of population. Some of misconceptions are that gluten causes metabolic disorders, addiction and overeating, and that elimination of gluten from diet cures diabetes, obesity, and rheumatic illnesses. Nonetheless, only individuals with genetic predisposition to celiac disease or medically confirmed allergy or sensitivity to gluten and other cereal proteins benefit from exclusion of gluten containing cereals from diet. For this population, development of nutrient dense and attractive gluten-free food is needed. Otherwise, gluten-free diet could result in nutritional deficiencies and low dietary fibre intake. Cereals are basics of human nutrition and regular consumption of wholegrain cereals have been proven to reduce risks for type 2 diabetes, heart disease, colon cancer, and favour weight management. Health Grain Forum Europe has launched *Global research and communication project addressing wheat/gluten avoidance and consumers wellbeing* for unravelling gluten and wheat toxicity.

Key words: gluten-free diet, celiac disease, allergy, gluten avoidance, consumers

POSSIBILITIES OF USING ACORN FLOUR IN PRODUCTS BASED ON FLOUR

M. Polimac[1], D. Koceva Komlenić[2], J. Lukinac[2]
[1]Ivana Gorana Kovačića 6, HR- 31000 Osijek, Croatia; mpolimac@lycos.com
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia

Oaks (*Quercus* spp.) are widespread species of temperate zone of the northern hemisphere including Europe, North Africa, Middle East, Asia and North America. Acorns, the fruit of the oak, have been used in human nutrition for thousands of years and more recently archaeological research confirms that in the past acorns have been an important source of food in different cultures around the world. Today it is used as food in Turkey, Korea, North Africa, China, the USA and as an important part of cultural heritage in some parts of Spain.
Acorn was staple food in the diet of the Balkan peoples, but despite its long culinary tradition acorn has been neglected. The sad fact is that we have forgotten all about nutritional value of acorns that our ancestors knew and used.
The aim of this study is a qualitative analysis of the existing literature concerning the investigation of food products from acorns, primarily the possibility of using acorn flour in products based on flour. Based on citation bases *Web of Science* and *Scopus* 42 articles have been selected that included the period from 1977 to 2015. Most of the studies were published by authors from the United States (14), Italy (6) and China (5). Additional searches were done by using *Google Web Search*. Regarding these results acorn flour can be used in modern diet as a replacement for wheat flour in wide range of applications in food production, primarily production of cakes, cookies, muffins, pancakes, pasta, noodles, flatbreads, pizza crust, pie crust, and also for thickening sauces and soups.
However, analysis of the literature reveals a lack of research in Croatia, and generally points out the need for greater representation of these issues in the future.

Key words: oak, acorn, food, acorn flour, products based on flour

IMPACT OF WHEAT AND BYPRODUCTS OF FOOD INDUSTRY ON THE BISCUITS PROPERTIES

D. Miličević[1], G. Avdić[1], M. Selmić[2], E. Hadžiomerović[1], M. Andrejaš[1], S. Mujdanović[1]

[1]*University of Tuzla, Faculty of Technology, Univerzitetska 8, Tuzla, Bosnia and Herzegovina; dijana.milicevic@untz.ba*
[2]*Factory ˝Pharmamed˝ d.o.o. Travnik, Dolac na Lašvi, Bosnia and Herzegovina*

The properties of the flour, and therefore the products that will make of him, in great part depend of wheat properties that flour were obtained. This primarily means to the amount of protein, water, and granulating when it comes to meal. For most types of biscuit flour does not need have large amount of protein, the amount can be up to 8 or 9 %, except for some types of fermented dough cakes. Due to poor nutritional value, wheat flour can be enriched with other flour types, as well as additives for improving organoleptic biscuits properties. Apple trope, beet pulp and brewer's trope are byproducts of the food industry which have great potential for use in the manufacture of various biscuits types, snack products, etc.
This paper presents the results of biscuits production from 4 varieties of flour wheat, to which were then added apple trope, beet pulp and brewer's trope in differed proportions. Also, was performed the analysis of raw materials, as well as the sensory analysis of the finished biscuits.

Key words: wheat flour, byproducts of food industry, biscuits

POSSIBILITIES OF APPLICATION OF EXTRUSION IN PRODUCTION OF NEW SNACK PRODUCTS

G. Avdić[1], D. Miličević[1], N. Mujkić[2], M. Selmić[3], A. Avdić[1]
[1]*University of Tuzla, Faculty of Technology, Univerzitetska 8; Tuzla, Bosnia and Herzegovina; gordan.avdic@untz.ba*
[2]*Factory ˝Corn flips˝ Food industry, Srebrenik, Bosnia and Herzegovina*
[3]*Factory ˝Pharmamed˝ d.o.o. Travnik, Dolac na Lašvi, Bosnia and Herzegovina*

Extrusion is one of the most promising process that is used in the food industry. The most important advantages of the extrusion and which can be used as a unit operation in the process of food production, or may be the total process whereby food is produced. By changing the process parameters (temperature, pressure), by changing some parameters of the raw materials (moisture, other types of flour), or by combining with other procedures (drying, expanding, sugar coating) may be prepared by large number of different food products.
This paper examined the possibilities of application extruders last generation for the production of certain snack products (flips, bruschetti) with the addition of different flavors (chocolate, cocoa, smoked meat, etc.) and byproducts of the food industry (apple trope).

Key words: extrusion, process parameters, apple trope, snack products

SURVEY OF B-GLUCANS IN DOMESTIC BARLEY'S VARIETIES

A. Lalić[1], G. Šimić[1], V. Krstanović[2], K. Mastanjević[2]
[1]Institute of Agriculture Osijek, Južno predgrađe 17, 31 000 Osijek, Croatia
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; vinko.krstanovic@ptfos.hr

β-glucan is considered useful when it appears in small amounts in cereals but high content can lead to unsatisfactory degradation of cell walls during malting so it's important to determine its content in varieties of barley. For malt production barley with low to moderate β-glucan content is preferable. The aim of this study was to investigate share of β-glucans in 16 varieties (brewing, brewing/feed, feed and hulless varieties) at three representative locations in eastern Croatia: Osijek, Slavonski Brod and Tovarnik over three consecutive seasons (2011-2013). β-glucans were determined using a Megazyme enzymatic kit. Results showed that most varieties have lower or significantly lower β-glucan content than 4 %, a distinct and clear influence of a genotype can be noticed in β-glucan content and no statistically significant influence of a location on β-glucan share has been determined during this three year experiment. Barley varieties used for livestock (feed and hulless varieties) have the higest (feed > 4.4, hulless 4.6 > g/100 g), and brewing varieties have the lowest β-glucan (< 3.6 g/100 g).

Key words: β-glucans; Croatian barley varieties, brewing quality

EFFECT OF GENOTYPE AND ENVIRONMENT ON WHEAT QUALITY IN VCU TRIALS

I. Rukavina[1], I. Varnica[1], Z. Mijić[1], S. Petrović[2], L. Drenjančević[1], S. Guberac[2]
[1]*Croatian Centre for Agriculture, Food and Rural Affairs, Institute for Seeds and Seedlings, Usorska 19, 31000 Osijek, Croatia (ivana.rukavina@hcphs.hr)*
[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture in Osijek, Kralja Petra Svačića 1d, 31000 Osijek, Croatia*

Three winter wheat standard genotypes (Žitarka, Srpanjka and Divana) were grown in VCU trials on two locations (Osijek and Zagreb) during five years (2010-2014). Influence of genetic and environment conditions of locations on wheat quality components (protein content, sedimentation value and wet gluten content) were investigated. In a combined analysis of variance, effect of genotype, environment, and their interaction (GEI) were highly significant for all analyzed traits. All the three traits were influenced more by the year than by the location. Genotype by environment interaction were analyzed by AMMI model and the results are presented by AMMI1 and AMMI2 biplot. Over all environments in average the highest protein content (15.48 %) and sedimentation value (52.98 cm^3 at 14 % moisture) had genotype Divana which also had the highest interaction level according to AMMI1 biplot, while genotype Žitarka had highest wet gluten content (41.05 %). In this investigation Osijek location was favorable for investigated quality traits of protein and wet gluten content.

Key words: wheat, protein content, sedimentation value, gluten content, genotype-environment interaction

THE EFFECT OF GENOTYP, ENVIRONMENT AND NITROGEN FERTILIZATION LEVEL ON INDIRECT QUALITY PARAMETERS AND RHEOLOGICAL PROPERTIES

K. Jukić[1], I. Ikić[1], M. Maričević[1], M. Bukan[1], A. Lovrić[2], H. Šarčević[2]
[1]*The Bc Institute for Breeding and Production of Field Crops, Dugoselska 7, Rugvica, 10 370 Dugo Selo, Croatia; kjukic@bc-institut.hr*
[2]*University of Zagreb, Faculty of Agriculture, Svetošimunska 25, 10 000 Zagreb, Croatia*

The aim of this study was to investigate the influence of genotype, environment and the nitrogen fertilization level on indirect quality parameters as well as the rheological properties of wheat. The study included 19 genotypes of winter wheat (*Triticum aestivum* L.) grown during three years in a total of eight environments (locations-year combinations) at two levels of nitrogen fertilization (80 and 180 kg N/ha). Analysis of variance was conducted over fertilization levels, as well as for each nitrogen level separately using GLM procedure in the SAS statistical program. The results showed that the genotype, environment and nitrogen level, as sources of variability, were highly significant for all investigated quality traits. Among the indirect quality parameters, genotype had the greatest influence on Zeleny sedimentation value (44.6 %), wet gluten (34.2 %) and gluten index (67.8 %). Environment had the greatest influence on falling number (37.7 %) and the protein content was most affected by nitrogen level (32.6 %). Of the farinograph indicators the quality group was influenced by environment to the highest extent (32.1 %), while genotype accounted for the greatest part of the total variability for the remaining farinograph parameters as well as for all exstensograph parameters.

Key words: winter wheat, nitrogen, quality, rheological properties

STARCH BREAKDOWN AND FORMATION OF SUGARS DURING TRITICALE GRAINS GERMINATION

T. Rakcejeva[1], D. Klava[1], I. Cinkmanis[2], R. Galoburda[1], E. Straumite[1]
[1]University of Agriculture Faculty of Food Technology, Department of Food Technology, Latvia, Liela iela 2, Jelgava, LV-3001, Latvia; tatjana.rakcejeva@llu.lv
[2]University of Agriculture Faculty of Food Technology, Department of Chemistry[2], Liela iela 2, Jelgava, LV-3001, Latvia

The present research leading to these results has received funding from the Norwegian Financial Mechanism 2009 - 2014 under Project Innovative approach to hull-less spring cereals and triticale use from human health perspective (NFI/R/2014/011). The purpose of the investigation was to evaluate changes occurring with starch and sugars during triticale grain germination. Triticale grains were steeped for 24 h, and germinated for 12, 24, 36 and 48 hours (t = 30 ± 2 °C, RH = 45 ± 2 %). The following quality parameters were analysed: starch content (Infratec 1241 Grain Analyser), starch structure (microscopy), moisture content (oven-drying) and content of individual sugars (HPLC). Moisture content of a control sample was 13.32 ± 1.00 %, that of steeped and germinated grains – 47.31 – 49.72 %. Starch content decreased by 8 % during grain germination. Triticale starch granules were distributed in two or three size classes. The larger granules (type A) have a lenticular shape and a diameter 10 – 30 μm, whereas type B granules, initiated at a different stage of development than granules A, have a diameter typically below 10 μm and have a block like structure that range from polyhedral to near – spherical. Significant changes were found in a sugar content resulting from starch breakdown, followed by significant increase in fructose, maltose, glucose and sucrose content.

Key words: triticale grains, germination, starch, sugars

STRATEGIES FOR TRANS-FATTY ACID REDUCTION IN BAKED GOODS WITH FOCUS ON CROISSANTS

G. Unbehend[1], L. Brühl[1], V. Schnell[2]
[1]Max Rubner-Institut, Federal Research Institute for Nutrition and Food, Institute for Quality and Safety of Cereals, Detmold, Germany; guenter.unbehend@mri.bund.de
[2]Schnell Der Berliner Bäcker, Torsten Schnell GmbH, Berlin-Weißensee, Germany

Intake of trans-fatty acids changes the LDL-/HDL-cholesterol levels in the blood of the human organism, which has been proven to cause a high risk of coronary heart disease. Therefore the German Association for Nutrition has recommended to decrease the amount of fatty acids in foods. They recommend to reduce the amount to less than 1 % of nutritional energy.A study of the German Federal Institute for Risk Assessment identified still a group of people with higher trans-fatty acid (TFA) intake i.e. male aged between 14 and 34 years. These people consume foods with increased contents of elaidic acid, which was taken as a marker for partially hydrogenated fats. Looking for the sources of this intake of TFA some foods like dairy products, meat, pizza, fried potato products but also bakery products of laminated dough like croissants, pastries or puff pastry had been identified to be contributors of TFA to the diets.
With the proper choice of TFA free deep frying fats, the amount of TFA could be already significantly reduced, so that the use of these fats in the production of fried pastries like doughnuts will be to no risk for human consumption. It is more difficult to reduce the TFA content in puff pastry margarine, because this margarine type meets special technical task during the production process of croissants, pastries and puff pastries. For folding the dough, a very thin dough-/fat-layer is needed. For high quality laminated pastry, the shape and the texture of the primary fat and dough blocks are most important.In a Benchmark study twenty new and common bakery margarines were tested to produce croissants. The bakery margarines had been analysed for TFA content, the fatty acid composition and the melting properties (NMR), while the sensory qualities of the croissants had been assessed from a trained panel including colour, texture and aroma. In addition the croissant volumes had been determined. The identity of the fat blend composition was determined by a computer modelling program using fatty acid composition and the NMR data.
As a result some promising products with TFA contents at below 2 g/100 g fat showed equal performance for croissant production compared to common high TFA products. For some products the temperature control during dough preparation is of crucial importance. While products with high TFA contents often show higher product volumes, the sensory qualities of some bakery margarines with low TFA content reached excellent scores.

Key words: trans-fatty acids, baked goods

THE EFFECTS OF FAT SUBSTITUTION USING PALM STEARIN ON THE PHYSICOCHEMICAL PROPERTIES OF SHORTENED CAKE

M. F Ainil, Z. Chek Hassan, I. Suzila
Department Food Biotechnoloy, Faculty Science and Technology, Universiti Sains Islam Malaysia; chek_zaini@usim.edu.my

Fats used in baking contain trans fatty acid that has been proven to contribute towardsvarious health problems. Palm stearin is used to substitute shortening in different ratiosto observe the effects on the physicochemical properties of cake. Formulations A, B, C, D, and E each has palm stearin substitution of 0 %, 25 %, 50 %, 75 %, and 100 % respectively. All formulations were analysed for its specific gravity, fat content,moisture content, colour analysis, texture analysis and sensory analysis. At 25 % levelof substitution (formula B), moisture content (0.44 ± 0.00 %), fat content (27.75 ± 0.42 %), hardness (1469.4 ± 432.1 N), and overall liking in sensory analysis (5.5 ± 1.10) arefound to be similar with formula A. Formula B for colour analysis 80.84 ± 0.20 (L*), 2.79 ± 0.40 (a*), and 30.30 ± 0.64 (b*) and specific gravity (0.84 ± 0.12) are howeversignificantly different with formula A. It is found that a different substitution ratio doesaffect the physicochemical properties of the cakes. Substitution up to 25 % shows thatit is best in producing cakes most similar to formula A. Further studies need to becarried out in order to find a method that may incorporate higher palm stearinsubstitution as well as palm stearin functionality in a cake system.

Key words: palm stearin, fat substitution, cake

UTILIZATION OF MELOM SEED FLOUR AS FAT REPLACER IN PRODUCTION OF LOW FAT OIL CAKE AND EVALUATION QUANTITATIVE AND QUALITATIVE OF FINAL PRODUCT

G. H. Haghayegh, N. Zavehzad, M. N. Modoodi, Z. Teimouri
Faculty of Agriculture and animal Science, Torbat-e Jam Educational Complex, Khorasan Razavi, Iran; gh2002_haghayegh@yahoo.com

Cake is one of the most popular products in baking industry and consumption due to the relatively high presence in oil field products and the risk of hypercholesterolemia is limited to a specific group of people. Therefore, in this study a complete melon seeds flour at levels 5, 10, 15 and 20 % due to lower cholesterol and unsaturated fatty acids, high-fat alternative to the original formulation of oil cake and the moisture content, specific volume, porosity, texture, crust color and overall acceptability of the samples produced were evaluated. The results showed that the addition of more than 10 % melon seeds reduces the amount of moisture and L* value. However, the specific volume and porosity of 10 % melon seed flour with control samples showed no significant difference ($P < 0.05$). Also the results clearly showed that the samples containing 10 and 15 % melon seed flour and control sample had a similar texture. On the other hand, increasing the amount of melon seed flour in the formulation of oil cake increase the b* value of the samples. The sensory evaluation of samples containing 10 % of melon seed flour as the best example, along with control samples (samples containing oil) were introduced. Thus, 10 % of melon seed flour can maintain the quantity and quality of product and it's a suitable substitutes for oil in oil cake formulation.

Key words: cake, far replacer, melon seed flour, texture, crust color

IMAGE ANALYSIS TESTING OF BREAD WITH NON-TRADITIONAL PLANT RAW MATERIALS

I. Švec, M. Hrušková
Department of Carbohydrates and Cereals, University of Chemical Technology Prague, Technická 5, 166 28 Prague 6 – Dejvice; Czech Republic, Ivan.Svec@vscht.cz

Within a laboratory baking test, performed according to the internal method of the Cereal Laboratory of UCT Prague, wheat bread types containing barley (30 %), chestnut and nopal (5 – 20 %) as well as chia (2.5 - 10.0 %) and teff flour (5 – 20 %) were prepared. Bread quality was described by specific bread volume and shape, crumb penetration and by texture attributes gained by image analysis (mean cell area, cells density). In amounts 5 % and 20 %, chestnut flour decreased bread volumes (from 347 to 215 ml/100 g), while nopal flour effect was significantly stronger (diminishing from 299 to 178 ml/100 g). Rate of crumb penetration correspondingly decreased from approx. 15.0 mm to 5.0 mm. Bread texture got also finer in both cases, mean cell area for e.g. wheat-chestnut bread dropped from 2.55 mm^2 to 1.53 mm^2, and cell count reversely rose from 27 to 37 cells/cm^2. On the other hand, chia and teff flours supported bread sizes rise and impact on crumb morphology was similar. Both chia and teff in recipe caused more open structure (cell areas around 2.6 and 2.1 mm^2, respectively) with statistically different cell densities (approx. 20 a 28 cells/cm^2, respectively). Combination of non-traditional materials with barley flour brought a diminishing of bread quality.

Key words: composite flour, baking test, bread volume, crumb texture, image analysis

PHYSICO-CHEMICAL PROPERTIES AND SENSORY EVALUATION OF WHITE BREAD USING DIFFERENT COMMERCIAL BRANDS OF HIGH GLUTEN FLOUR

Z. Chek Hassan, M. Hana E., I. Suzila
Department Food Biotechnoloy, Faculty Science and Technology, Universiti Sains Islam Malaysia; chek_zaini@usim.edu.my

The study of gluten content in four commercial brands of high gluten flour (A, B, C and D which served as control) and the quality of bread produced from these flour were assessed for physic-chemical and sensory properties. The breads were analyzed for proximate compositions (crude fiber, crude protein, moisture content and ash content), physical (crust colour, firmness, height and weight) and sensory (Quantitative Descriptive analysis test and hedonic test). The flour samples had gluten content that ranged from 11.58-18.88 %. For physical analysis, there were significant differences among all the bread samples in term of firmness. The colour analysis observed that bread C had the highest "a" value and "L" value. The highest value of weight to height ratio was obtained in bread D. Results of chemical properties on bread samples indicated that crude protein ranging from (8.37-10.54 %); crude fiber (from 0.082-1.066 %); moisture (from 27.99-40.95 %); ash (from 0.67 % - 1.02 %); carbohydrate (from 43.41-56.66 %); energy value (from 243.36-292.59 Kcal). From QDA test, bread B and bread D did not differ significantly for each attributes except hardness. Panelists chose bread D as the most acceptable among the other bread samples in hedonic test. The moisture content of bread C was significantly different from other samples at $P<0.05$. The ash values were not significant different among breads A-C, except D, the control sample. There were significant different among all bread samples in term of protein and carbohydrate content. Flour sample C had the highest gluten content which produced bread that had the highest protein, fiber, energy and carbohydrate contents, and had lowest moisture content and moderate ash. Hence, it can be concluded that sample C is the best among the flour samples to produce bread that contains much of the nutritional properties while bread D had the best overall sensory preference.

Key words: bread, high gluten flour, physico-chemical properties, sensory evaluation, brands

GENOTYPE AND ENVIRONMENTAL VARIATION IN PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY OF BREAD WHEAT

D. Horvat, G. Drezner, Z. Jurković, K. Dvojković, M. Viljevac Vuletić, G. Šimić
Agricultural Institute Osijek, Južno predgrađe 17, 31103 Osijek, Croatia; daniela.horvat@poljinos.hr

Among health-beneficial phytochemicals present in whole cereal grains phenolic compounds are the major ones because of their strong antioxidant properties. Eleven wheat bread genotypes (*Triticum aestivum L.*) grown at the Agricultural Institute Osijek during the 2013 and 2014 years were evaluated for total phenolic contents (TPC) and their antioxidant activity (AOA). TPC was determined by Folin-Ciocalteu method and AOA was evaluated using DPPH scavenging capacity. All the assays were done in triplicate from two separate extractions. Considerably variation of TPC within bread genotypes and years were found. TPC value was ranged between 0.573 mg GAE/g_{dw} (Leuta 2014) to 1.153 mg GAE/g_{dw} (Apache 2013). AOA was calculated as DPPH percentage discoloration and ranged between 12.101% (Srpanjka 2014) and 21.557 % (Vulkan 2013). Consideration of TPC and AOC mean values, genotypes Apache, Vulkan and Antonija showed the highest TPC, whereas the highest AOA were found in genotypes Vulkan, Leuta and Antonija. Genotypes Srpanjka and Divana showed the lowest antioxidant properties based on TPC and AOA mean values. The obtained differences among genotypes indicate that through the breeding programmes more attention should be given to the development of new wheat lines with improved health beneficial properties.

Key words: bread wheat, total phenolic content, DPPH, antioxidant activity

MONITORING OF SEED GERMINATION BY A NON-DESTRUCTIVE NEAR INFRARED (NIR) SPECTROSCOPY METHOD

M. Bartalné-Berceli, E. Izsó, S. Gergely, A. Salgó
Budapest University of Technology and Economics, Department of Applied Biotechnology and Food Science, Szent Gellért tér 4, H-1111 Budapest, berceli@mail.bme.hu

The accurate knowledge on the germination process of cereal and other plant seeds makes possible the estimation and planning of nutritional and food-safety properties of new raw materials with a higher physiological value. The mobilization process of germination was compared during controlled germination of wheat and soybean seeds using a non-destructive, NIR spectroscopy method. The kinetic changes of the free/bound water ratio have been shown during the analysis of water absorption and hydration conditions. The maximum absorption of water can be observed at 1155, 1410 and 1900 nm. The kinetic decelerations are significantly dependent on the morphology of seeds and on the variety of seeds. Based on the measured intensities and wavelength shifts at the characteristic wavelengths intensive mobilization of carbohydrates, proteins and lipids has been demonstrated. Absorption maximum can be monitored at 1590 and 2270 nm in case of wheat reserved carbohydrates, while at 2070 and 2180nm in case of soybean proteins and at 1725, 1765, 2310 and 2340 nm for lipids. With qualitative analysis of the spectra the germination process became traceable almost in real time. The NIR spectroscopy is a sufficiently sensitive device for monitoring these biochemical and physiological processes.

Key words: NIR spectroscopy, wheat seeds, soybean seeds

DETERMINATION OF GLUTENIN AND GLIADIN LOCI IN CROATIAN WINTER WHEAT GERMPLASM

S. Marić[1], M. Grgić[1], S. Petrović[1], I. Strelec[2], S. Guberac[1], V. Guberac[1]
[1]*Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, Kralja P. Svačića 1d, 31000 Osijek, Croatia; smaric@pfos.hr*
[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia*

Aim of the study was to examine and determine distribution of glutenin (Glu-A1, Glu-B1 and Glu-D1) and gliadin (Gli-B1 and Gli-D1) loci in twenty Croatian winter wheat varieties using SDS PAGE. Highest frequency at Glu-A1 loci was recorded for subunit 2* (50 %). At Glu-B1 loci subunit 7+9 was dominant with frequency of 45 % while the subunit 7+8 was at second place with 40 %. At these loci lowest frequency (5 %) had subunit 14+15. Subunit 5+10 prevailed at Glu-D1 with frequency of 70 %. At Gli-B1 loci we determined prevalence of subunits 63+67 combination with a frequency of 50 %, while the lowest prevalence had subunit 61 with a frequency of 5 %. Subunits 60, 66 and null allele (N) were also present. At Gli-D1 locus, the most common subunit was 55 with a frequency of 90 %, combination of subunits 55 + 56 + 59 and the subunit 59 were also present with frequency of 5 %.

Key words: winter wheat, germplasm, glutenin loci, gliadin loci

TOTAL PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY OF DIFFERENT BARLEY VARIETIES

G. Šimić, A. Lalić, D. Horvat, Z. Jurković, M. Viljevac Vuletić
Agricultural Institute Osijek, Južno Predgrađe 17, 31000 Osijek, Croatia; gordana.simic@poljinos.hr

Phenolic contents and corresponding antioxidant activities were studied in covered and hull-less whole-grain flours of different barley varieties. Tested samples were collected from field trials at Agricultural Institute Osijek during the growing seasons 2012 and 2013. Barun, Bravo, Bingo, Premium, Vanessa, Tiffany, Maxim and Rex were the representative malting varieties, and GZ-179, GZ-184, GZ-186, GZ-189, GZ-190 and GZ-191 are experimental hull-less varieties. The total phenolic content, as measured according to Folin-Ciocalteu's method, ranged from 1.30-1.78 mg GAE/g_{dw} in 2012 and from 1.17-1.49 mg GAE/g_{dw} in 2013. Antioxidant activity was evaluated as radical scavenging activity with DPPH reagent. The two year results show that hull-less barley GZ-186 was the variety with the highest antioxidant activity and the highest total phenolic content. According to the results from our present study, hull-less barley lines were found to have an average content of phenolics and antioxidant activity higher than malting varieties.

Key words: barley, hull-less, total phenolic content, DPPH

VARIABILITY OF WHEAT QUALITY PROPERTIES IN TEN YEARS PERIOD

D. Horvat[1], D. Magdić[2], K. Dvojković[1], K. Lutrov[1], G. Drezner[1]
[1]*Agricultural Institute Osijek, Južno Predgrađe 17, 31000 Osijek, Croatia; daniela.horvat@poljinos.hr*
[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia*

Wheat quality properties are strongly influenced by genetic and environmental effects. In this study, variability of 24 Croatian wheat cultivars for period 2005 to 2014 is presented. All samples were planted and harvested in Osijek, region Slavonia (Eastern Croatia). For ten years period 18 quality properties were chosen for analysis. Among quality properties, the lowest coefficient of variation had hectolitre weight (1.8 %), water absorption (4.0 %), flour yield (6.2 %) and wet gluten/protein ratio (6.7 %). Protein content varied 9.2 %. Dough rheological properties had coefficient of variation above 30 % in average. Climatic conditions were also compared for the last decade. Basic statistics, principal component and classification statistical analysis were used for processing complex data matrix. Results showed that two years were extremely rainy and two years were extremely dry years in the last decade. Both, rainy and dry years continuously occur in five years cycle. Years 2005 and 2010 were rainy while 2007 and 2012 were dry years. During last decade average air temperature slowly increased while rainfall slowly decreased in period from October to July. Wheat cultivars had similar properties during rainy years while in dry years properties differ. Strong similarities and differences were found among particular wheat cultivars and their quality properties.

Key words: wheat, quality properties, climatic conditions, ten years, variability

TECHNOLOGICAL QUALITY AND GRAIN YIELD OF SOME CHINESE AND CROATIAN WHEAT CULTIVARS

K. Dvojković[1], Y. Bi[2], G. Drezner[1], H. Xu[2], S. Weng[2], X. Chen[2], D. Horvat[1], Q. Xi[2], Z. Zdunić[1], L. Yuan[2], Z. Wang[2], J. Brkić[1], K. Lutrov[1], Q. Shao[2], I. Brkić[1]
[1]*Agricultural Institute Osijek, Department for Breeding & Genetics of Small Grain Cereal Crops, Južno predgrađe 17, 31103 Osijek, Croatia; kresimir.dvojkovic@poljinos.hr*
[2]*Dongying Academy of Agricultural Sciences, Jiaozhou Road No.383, Dongying city, P.O. code 257091, Shandong Province of P.R. China*

High and stable grain yield coupled with god or satisfactory level of technological quality parameters is inevitable for successful wheat production. In order to create or improve successful wheat cultivars in worldwide wheat breeding programs, breeders continuously attempts to broad genetic basis with high average values of traits of interest from new genetic sources. The bilateral intergovernmental scientific project "Exchange of Small Grain Cereal Crops and Maize Germplasm Resources Between Croatia and Yellow River Delta of China" is one of the possible ways for undertaking germplasm enrichment task between Agricultural Institute Osijek and Dongying Academy of Agricultural Sciences. Exchanged wheat germplasm was subjected to diverse observation and testing in field trials in characteristic production practice for each country during growing season 2014/2015. Technological quality parameters, grain yield, test and kernel weight of some Chinese and Croatian wheat cultivars are shown in this paper. According to particular preliminary results of investigated traits obtained in this study, some cultivars with high values of traits of interest and positive response to Croatian growing conditions and agrotechnic measures will be subjected to further testing, analysis and finally get possibility to be included in germplasm enrichment process.

Key words: grain yield, technological quality parameters, growing conditions, agrotechnic measures

THE EFFECT OF OAT β-GLUCAN ADDITION ON COOKING LOSS, COLOUR AND TEXTURAL ATTRIBUTES OF CHICKEN SURIMI GELS AFTER FROZEN STORAGE

K. Mastanjević, D. Kovačević, S. Friščić
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek; kresimir.mastanjevic@ptfos.hr

Cooking loss, texture profile analysis (TPA) and instrumental colour parameters of chicken surimi gels mixed with oat β-glucans (w = 0 – 6 %), after frozen storage were investigated. Chicken surimi gels were prepared from broiler meat, mixed with oat β-glucans (w = 0 – 6 %), quickly frozen and stored for 12 weeks on -30 °C. Instrumental colour measurements (L*, a*, and b* values) were taken using a Hunter-Lab Mini ScanXE. The Hunter L*, a*, and b* values respectively correspond the lightness, greenness (-a*) or redness (a*), and blueness (-b*) or yellowness (b*). Texture profile analysis (TPA) tests were performed using a TA.XT2i Texture Analyzer equipped with an aluminium cylindrical probe P/75. The following parameters were quantified: hardness, springiness, cohesiveness and chewiness. Instrumental colour parameters (L*, a* and b*) and whiteness (L* − 3b*) of chicken surimi gels were significantly (P< 0.05) affected by addition of oat β-glucans. Hardness and chewiness also 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 colour and textural attributes (L*, whiteness, hardness, gumminess and chewiness) and decrease in cooking loss of chicken surimi gels indicate possible interactions between chicken myofibrillar proteins and oat β-glucans.

Key words: chicken surimi, cooking loss, texture, instrumental colour, β-glucans, frozen storage

RESEARCH ON POSSIBILITIES OF MALT PRODUCTION FROM CROATIAN HULLESS BARLEY VARIETIES

V. Krstanović[1], K. Mastanjević[1*], V. Slačanac[1], G. Gagula[2], K. Vacek[2]
[1]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; kristina.mastanjevic@ptfos.hr*
[2]*Student of Faculty of Food Technology Osijek*

This paper investigated the influence of malting procedure on quality indicators of naked barley malt according recommended properties for standard pale malt. The aim was to determine the optimal malting procedure in order to achieve the best results for investigated indicators in relation to the recommended values. The influence of four malting procedure on soluble N share in malt, total N and soluble N ratio (Kolbach index), Hartong number, friability, extract, fine/coarse difference, colour, boiled wort colour, pH, viscosity and filterability of wort, and β-glucane was tested. Malted sample was two domestic naked barley variety (Matko and GZ 184). Four malting procedures have been conducted: (A) standard procedure – control; (B) gently intensive procedure with uniform temperature increase during germination till the end of the process; (C) moderately intensive procedure with increase in germination temperature on the second and third day, and constant germination temperature till the end of the process; (D) procedure with sudden germination temperature decrease after the first day, and constant temperature till the end of the process;. Based on obtained results, and their comparison to results in scientific and technical literature, the efficacy of certain micromalting procedure was evaluated, considering recommended properties of naked barley malt. The results indicate that the resistance to deeper modification of grains (expressed as lower water absorption during soaking grains, and as weaker friability) obviously be the main problem that will need to be solved in the further process of the selection of domestic naked barley varieties for malting. The intensification of the process of germination should be combined with the extension of soaking time, which should lead to improvements of friability of malt and better value for other indicators of malt quality.

Key words: Croatian hulles barley varieties, malting quality, malting procedure

DIRECT POTENTIOMETRY STUDY OF AMYLOSE AND CETYLPYRIDINIUM CHLORIDE INTERACTION

M. Karnaš[1], H. Babić[1], M. Ivić[1], S. Borges[2], N. Sakač[1]
[1]*Josip Juraj Strossmayer University of Osijek, Department of Chemistry, Cara Hadrijana 8a, Osijek, 31000, Croatia; nikola.sakac@gmail.com*
[2]*Faculdade de Paulínia, R. Nelsom Prodócimo, 495 - Bela Vista, Paulínia - SP, 13140-000, Brazil*

Starch mainly consists of two polymer molecules; linear amylose and branched amylopectin. Pure or hydrated amylose forms crystals of double helices with a hydrophilic outside surface and a hydrophobic inner core suitable for forming inclusion complexes with various hydrophobic ligands such as iodine, alcohol, fatty acids and surfactants[1]. Surfactants, like cetylpyridinium chloride (CPC), are surface active agents. They consist of two parts, a lyophilic head group, and a lyophobic tail.
In food processing, surfactants are used as emulsifiers and form the starch-surfactant inclusion complex. This interaction has an effect on the swelling and pasting properties of starch[2] and the characteristics of the resulting starch pastes. Physical properties of amylase-surfactant inclusion complex have provided valuable insights into the functionality of surfactants in starch-containing food systems. Techniques, such as x-ray diffraction, differential scanning calorimetry, nuclear magnetic resonance and others, are very useful but expensive and time-consuming.
The aim of this work was to study the formation of amylose-CPC complex in aqueous media, using simple surfactant electrode and direct potentiometry and observing the change of potential, slope, linear region and critical micellar concentration. Additionally, the interaction was observed by infrared spectroscopy.

Key words: amylose, inclusion complex, surfactant, cetylpyridinium chloride

MONITORING OF HEAT-TREATED WHEAT MILLING FRACTIONS BY NEAR-INFRARED SPECTROSCOPIC METHOD

E. Izsó, M. Bartalné-Berceli, A. Salgó, Sz. Gergely
Budapest University of Technology and Economics Department of Applied Biotechnology and Food Science, address: Műegyetem rkp. 3., Budapest, Hungary, H-1111; izso@mail.bme.hu

The aims of this study is to elaborate near-infrared (NIR) method for testing and recognition of heat-treatment effects in the case of the wheat milling fractions and quality changes of the fractions. These fractions were produced under industrial conditions by Gyermelyi Corp. flour-mill (Gyermely, Hungary) and the heat-treatments were performed by Bühler AG (Switzerland). Standard Hungarian milling fraction (WF80, wheat flour with 0.80 % ash content), cake flour (CF), and experimental, aleurone-rich wheat flour (ARF) were examined. The samples were collected according to heat-treatments, which involved wet and dry heat treated samples and non-treated samples, respectively. The changes of the main chemical components (such as starch, protein, and lipid) analysed by dispersive spectrophotometer using visible and NIR regions of the electromagnetic radiation according to the heat-treatments. Close correlations were obtained between the data of spectroscopic measurement techniques processed by various chemometric methods (e.g. principal component analysis [PCA], cluster analysis [CA]) and the types of treatments. The NIR method was able to detect the deviation of the fractions in the case of the same heat treatment parameters.

Key words: milling fractions, heat-treating, NIR spectroscopy, chemometrics

BAKERY PRODUCTS IMAGE SEGMENTATION WITH OPENCV

F. Čačić Kenjerić, J. Lukinac
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; fcacic@ptfos.hr

Image segmentation is important step in image analysis because it enables extraction of data from them. This field is widely researched as it is base for understanding and interpreting images in fields of machine and computer vision systems. Image segmentation can be broadly categorized as semi-interactive approach and fully automatic approach and algorithm developed lies in either of this approaches. Open source computer vision library (OpenCV) is an open source computer vision and machine learning software library with more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. It has C++, C, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. This paper concentrates on image segmentation of bakery products with algorithms available in OpenCV with use of Python interface and their performance.

Key words: segmentation, OpenCV, bakery products

INFLUENCE OF SOLID-LIQUID EXTRACTION CONDITIONS ON THE PROTEINS EXTRACTION FROM BARLEY GRAINS

A. Bucić-Kojić, I. Strelec, M. Planinić, D. Koceva Komlenić, S. Tomas
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; abucic@ptfos.hr

Influence of extraction temperature (30-90 °C), concentration of ethanol/water solution (30-90%, v/v) and time (10-70 min) on extractability of proteins from barley grains was examined. Barley grain samples were collected from three different locations throughout Croatia: Nova Gradiška (sample BNG), Čakovec (sample BC) and Vinkovci (sample - BV).
Box-Bhenken design of Response surface methodology (RSM) was used for identification of the best extraction conditions and extraction yield optimization.
Total protein content (PC) in extracts was determined by the Bradford method, PCBR and Lowry method, PCLO.
RSM analysis showed that ethanol concentration and extraction temperature had significant effect, while effect of time and interaction of factors on the observed extraction process were not significant.
The optimal extraction conditions were achieved at 90 °C, 60%, v/v ethanol/water and 60 min with predicted maximum protein recovery, PCBR of 15.28 mgBSA/gdb, 16.74 mgBSA/gdb and 20.48 mgBSA/gdb for BNG, BC and BV, respectively. At the same extraction conditions, predicted maximum protein recovery, PCLO were 51.33 mgBSA/gdb, 57.64 mgBSA/gdb, and 56.90 mgBSA/gdb for BNG, BC and BV, respectively.

Key words: extraction, barley grains, protein recovery, optimization

RESISTANCE OF SOURDOUGH STARTER CULTURES TO FREEZING

S. Ajredini, D. Novotni, N. Čukelj, M. Krpan, M. Hruškar, D. Ćurić*
University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia; sajredini@pbf.hr

The aim of this study was to examine tolerance of lactic acid bacteria and yeast strains usually included in sourdough fermentation to blast and vacuum freezing. Freezing was conducted in water suspensions of microorganisms and rye flour (10 % m/m), with or without addition of trehalose (1 % m/m) as a cryoprotectant, and CFU was determined before and after freezing. This study included strains *L. fermentum, L. parabrevis*, *L. plantarum*, *L. reuteri*, *L. sanfranciscensis*, *W. cibaria*, *S. cerevisiae,* and commercial starter cultures Saff Levain LV1 (*L. brevis*, *L. casei*, *S. cerevisiae*) and LV4 (*L. brevis*, *S. chevalieri).* Results showed that influence of applied freezing methods and trehalose addition on microorganism survival was strain specific. Single strain cultures showed to be more resistant to freezing than commercial starter cultures. LV4 *S. chevalieri* was the most sensitive with 5-log CFU reduction after vacuum freezing without trehalose addition. With trehalose addition there was no CFU reduction of LV4 *S. chevalieri* yeast and that was the only case of significant positive effect of trehalose. According to the results, *L. reuteri* and *W. cibaria* appeared as the most suitable for freezing with at least 50 % survival and the lowest variability of survival depending on freezing conditions. These results of microbial survival need confirmation in sourdough freezing environment.

Key words: lactic acid bacteria, yeast Saccharomyces cerevisiae, vacuum freezing, sourdough starter cultures, trehalose

CHARACTERISTICS OF BARLEY SOURDOUGH DURING FROZEN STORAGE

I. Vrana Špoljarić, N. Maričić, D. Novotni*, S. Ajredini, B. Voučko, D. Ćurić
University of Zagreb, Faculty of Food Technology and Biotechnology, Pierottijeva 6, Zagreb, Croatia; ivranaspoljaric@pbf.hr

In this study barley sourdough was fermented by *Lactobacillus reuteri* or *Weissella cibaria* with or without sucrose addition. Sourdough was frozen by immersion or blast freezing and stored for four weeks at -18 °C. Barley sourdough (20 % at dough basis) or native barley flour was mixed with wheat flour to determine its leavening ability by rheofermentometer at 30 °C for 3 h. Cell counts of sourdough bacteria were reduced by 1-2 log in both freezing processes and additionally during storage. In average, sourdough had total titrable acidity 15 mL of 0.1N NaOH and pH 3.8 independently on starter, sugar addition, and freezing conditions. Farinograph consistency of composite bread doughs was 520±20BU at maximum and 480±20 BU at the end of 8 min mixing. Development of composite bread dough with sourdough was in average 30 mm compared to 18 mm with native barley flour. Maximum height of developed composite dough was significantly ($p<0.05$) improved by sucrose addition (+5 %) and diminished with storage time (-9 % in 4 weeks) of sourdough. Maximum height of gaseous production significantly decreased (-32 %) with sourdough storage for four weeks. The results indicate that barley sourdough fermented with either of the cultures could be frozen stored for four weeks and directly used in bread making.

Key words: barley sourdough, leavening, rheofermentometer, acidity, frozen storage

QUALITY OF WHOLEMEAL WHEAT BREAD ENRICHED WITH GREEN COFFEE BEANS

D. Dziki[1], U. Gawlik-Dziki[2], R. Różyło[3], M. Siastała[3], D. Kowalczyk[2]

[1]*Department of Thermal Technology, University of Life Sciences, Doświadczalna Street 44, 20-280 Lublin, Poland, e-mail: dariusz.dziki@up.lublin.pl*

[2]*Department of Biochemistry and Food Chemistry, University of Life Sciences, Skromna Street 8, 20-704 Lublin, Poland*

[3]*Department of Equipment Operation and Maintenance in the Food Industry, Doświadczalna Street 44, 20-280 Lublin, Poland*

Scientific studies have revealed that bioactive components of coffee play a preventive role against various degenerative diseases. Especially green coffee is characterized by unique composition and properties. The objective of this work was to investigate the influence of green coffee beans (GCB) addition on quality and antioxidant properties (AA) of wholemeal bread.

For bread preparation GCB flour (*Coffea arabica*) and wholemeal wheat bread flour, type 2000 were used. Bread flour was replaced with GCB flour at 1 to 5 % levels. Loaf volume, texture, color and sensory properties of bread were determined, as well as total phenolics content (TPC) and AA were evaluated.

The bread supplementation with GCB had little influence on bread volume. The highest volume was obtained for bread enriched with 3, 4 and 5 % of GCB flour. The texture properties of bread crumb (hardness, elasticity, cohesiveness and chewiness) slightly changed as a result of GCB addition. The lightness of bread crumb slightly decreased with GCB addition (average from 46.3 to 42.6). The taste, aroma and overall acceptability of control bread and the bread with GCB substitution levels up to 3 % had the highest liking score. The bread supplementation with GCB caused also an increase of TPC an AA.

Key words: green coffee bean, wholemeal bread, quality

The study was financed by the Polish National Science Centre (grant 2013/09/B/NZ9/01801)

QUALITY AND ANTIOXIDANT PROPERTIES OF BREAD ENRICHED WITH FLOUR OBTAINED FROM ELICITED WHEAT SPROUTS

U. Gawlik-Dziki[1], D. Dziki[2], M. Świeca[1], Ł. Sęczyk[1]
[1]*Department of Biochemistry and Food Chemistry, University of Life Sciences, Skromna Street 8, 20-704 Lublin, Poland, urszula.gawlik@up.lublin.pl*
[2]*Department of Thermal Technology, University of Life Sciences, Doświadczalna Street 44, 20-280 Lublin, Poland*

Elicitation has recently become a popular way to improve the quality of plants, especially in relation to their health-promoting phytochemicals. The objective of this research was to investigate the influence of sprouted flour (SP) addition, obtained from elicited wheat seeds, on quality and antioxidant properties of bread. The bread dough formula was: wheat bread flour (type 750), instant yeast (1 %), salt (2 %), water (optimum), dried (at 80°C) and pulverized sprouts (tested at 5 %, 10 %, 15 %, and 20 % levels). The sprouts were obtained from wheat seeds germinated during four days at 20°C and elicited by *Salix daphnoides* bark extract. Loaf volume, textural properties (TPA test), as well as total phenolics content (TPC) and antioxidant properties (AA) of bread were determined.
The bread supplemented with SP was generally characterized by the lower volume in comparison to control. An increase in the share of SP resulted in the production of bread with decreasing crumb elasticity and increasing hardness. From the other hand, the higher level of SP addition caused an increase the TPC and AA. Taking into account both bread quality and antioxidant properties a partial replacement of wheat flour in bread with up to 10 % SP was proposed.

Key words: wheat, elicitation, spouting, bread, antioxidant activity

The study was financed by the Polish National Science Centre (Grant 2012/07/B/NZ9/02463)

EFFECT OF FORTIFICATION WITH GREEN COFFEE BEANS ON CHELATING POWER OF WHEAT BREAD

U. Gawlik-Dziki[1], D. Dziki[2], M. Świeca[1], A. Durak[1], J. Czyż[3]

[1]*Department of Biochemistry and Food Chemistry, University of Life Sciences, Skromna Street 8, 20-704 Lublin, Poland, urszula.gawlik@up.lublin.pl*

[2]*Department of Thermal Technology, University of Life Sciences, Doświadczalna Street 44, 20-280 Lublin, Poland*

[3]*Department of Cell Biology, Jagiellonian University, Gronostajowa Street 7, 30-387 Cracow, Poland*

Phenolic compounds are able to binding the metal ions to form a complex incapable of promoting oxidation. Thus, phenolics act as "secondary" or "preventive" antioxidants.

Interactions between potentially mastication extractable (BE), potentially bioaccessible (DE) and potentially bioavailable (AE) metal chelators (released during digestion *in vitro*) derived from green coffee and wholemeal wheat flour were studied. For interactions determination the isobolographic analysis was used. Results were compared with those obtained for pure chlorogenic and ferulic acids.

For functional bread preparation green coffee (*Coffea arabica*) beans (GCB) and wholemeal wheat bread flour were used. Bread flour was replaced with GCB flour at 1 to 5 % levels.

Taking into account the isobole shape it may be concluded that chlorogenic and ferulic acids acted antagonistically. Unexpectedly, BE and DE compounds derived from raw materials acted synergistically, whereas additive reaction was found for AE phytochemicals.

GCB addition significantly enriched wheat bread with active compounds. The highest chelating power was found for AE compounds which indicates high potential bioavailability. Resignation from bread consumption for many people is impossible, thus proposed product is a compromise between "traditional" and pro-health food dedicated at this group of consumers.

Key words: green coffee, wheat bread, antioxidant activity

The study was financed by the Polish National Science Centre (grant 2013/09/B/NZ9/01801)

INFLUENCE OF PLANT PROTEIN ON DOUGH PROPERTIES AND QUALITY OF WHOLEMEAL SPELT BREAD

O. Šimurina[1], B. Filipčev[1], Z. Belić[2], D. Jambrec[1], J. Krulj[1], J. Brkljača[1], M. Pestorić[1]

[1]*University of Novi Sad, Institute of Food Technology, Bul. cara Lazara 1, 21000 Novi Sad, Serbia; olivera.simurina@fins.uns.ac.rs*

[2]*Sojaprotein A.D., Industrijska 1, 21220 Bečej, Serbia*

The paper presents the effect of soy protein concentrate (protein content 65 %) as substituent (substituting 20 % wholegrain spelt flour) and pea protein isolate (protein concentration 90 %) as substituent (substituting 5 % and 10 % wholegrain spelt flour) on rheological characteristics of spelt dough and physical and sensory characteristics of spelt bread enriched with proteins.

The stability of dough with the addition of soy protein concentrate was higher than the stability of dough with pea protein isolates, probably due to the different protein behavior and difference in distribution of the protein classes in soybeans and peas.

Applied ingredients exerted different effects on specific volume of the breads. Soy protein concentrate at concentration of 20 % and pea protein isolate at a concentration of 10 % significantly reduce it in comparison to the control bread (from 1.83 ml/g to 1.39 and 1.38 respectively), while pea protein isolate at concentration of 5 % significantly does not reduce this parameter.

The chewiness increases with the addition of 10 % pea protein isolate, while with the addition of pea protein (5 %) and soy protein (20 %) this parameter was not changed significantly compared to the control. An increase in crumb hardness observed after the addition of pea protein preparations clearly indicates that such additions could retard shelf-life of wholemeal spelt bread, while addition of soy protein significantly does not decrease shelf-life. Spelt bread with pea isolated protein (5 %) is the most overall acceptable among analyzed samples.

Key words: wholegrain spelt bread enriched with protein, soy protein concentrate, pea protein isolate

WATER SORPTION ISOTHERMS OF INULIN-MALTODEXTRIN POWDERS

A. Stepien, M. Witczak, T. Witczak, M. Grzesik
Department of Engineering and Machinery for Food Industry, University of Agriculture in Krakow, Balicka 122 Street, 30-149 Krakow, Poland; a.stepien@ur.krakow.pl

Knowledge of the sorption behavior is very useful in predicting the shelf life of food products. Popular method allows to express graphically a relationship between equilibrium moisture content and the water activity at the constant temperature and pressure is sorption isotherm. The aim of the work was to investigate sorption properties of two polysaccharides and their blends.
Moisture sorption characteristics of commercial maltodextrin (DE 6-9), inulin (DP≥23) and maltodextrin-inulin blends at 25°C were studied for water activities ranging from 0.11 to 0.92. The sorption isotherms were determined using the static-desiccator method. The moisture sorption data were used to fit three mathematical models: BET, GAB and Peleg's. The goodness of fit was measured by calculation of coefficient of determination (R^2) and root mean square (RMS). All obtained curves of the powders exhibited a sigmoid shape corresponding to type II according to Brunauer classification. Four-parameters. Peleg's isotherm model was found to be most adequate to describe the experimental data obtained for all powders in whole range of water activity.

Keywords: sorption isotherms, maltodextrin, inulin, equilibrium moisture content

The authors gratefully acknowledge the financial support of the Ministry of Science and Higher Education through project BM-4705/KIiAPS/2015

BROWNING DEVELOPMENT IN BAKERY PRODUCTS ENRICHED WITH FOOD INDUSTRY BY-PRODUCTS

J. Lukinac, D. Koceva Komlenić, M. Jukić, F. Čačić Kenjerić, P. Kolak, T. Efendić
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; jlukinac@ptfos.hr

During baking, the formation of colour is due to the Maillard reaction, and caramelization of sugars. The formation of colour in bakery products during baking is widely known as browning. As well as baking, the development of browning in bakery products is a simultaneous heat and mass transfer process that occurs mostly in a non-ideal system under non-ideal conditions. Besides the major influence of this phenomenon on the initial acceptance of products by consumers, it is the responsible for other relevant changes occurring in food during baking, i.e. production of flavour and aroma compounds, formation of toxic products (e.g. acrylamide), and decrease of nutritional value of proteins. The present work investigates the effect of some dietary fibres from different origins (apple pomace (AP), brewers' spent grain (BSG)) on the bread crust and crumb colour changes during baking. AP, as inexpensive and primary by- product of apple juice and cider production, is a good source of dietary fibres, polyphenols and pectin. BSG is the major by-product of the brewing industry and a good source of protein, cellulose, noncellulosic polysaccharides, chiefly arabinoxylans and lignin.
Because of that, the aim of this study was to investigate the effect of AP and BSG addition (5, 10 and 15%) on bread crust and crumb colour. Colour was measured using a colorimeter. Lightness, redness and yellowness of bread samples fortified with different percentages of BSG were measured as L^*, a^* and b^* value respectively. The change in dark colour was due to the incorporation of AP and BSG. L^* value decreased with the increase of addition of AP and BSG. In contrast a^* and b^* values increased with increasing AP and BSG addition respectively. Colour measurement data indicated that samples with addition dietary fibres (AP and BSG) were darker. Total colour change (ΔE) and browning index (BI) increased proportionally to dietary fibres addition, with more pronounced change in samples with AP addition.

Key words: bread, non-enzymatic browning, colour, apple pomace, brewers' spent grain

POTENTIAL APPLICATIONS OF AIR POTATO STARCH FOR MAKING BIODEGRADABLE-PACKAGING FILMS

J. R. Rendón-Villalobos; F. Rodríguez-González, J. Solorza-Feria, E. Flores-Huicochea
Instituto Politécnico Nacional, CEPROBI. Calle Ceprobi No. 8, Col. San Isidro, Yautepec, Morelos, MÉXICO. 62731; rrendon@ipn.mx

The feedstock starch provides a manifold potential for desired polymer applications, predominantly in the areas of food and pharma industry, technical specialties and packaging materials. The starch was extracted from air potato (*Discorea bulbifera*), containing 29 % of amylose. Air potato starch (3 and 5 % w/w), cellulose (0, 0.05 and 0.1 % w/w) and glycerol (glycerol/starch ratio 1 : 5) were used to obtain filmogenic solution. The films were prepared by casting. DSC, mechanical (TS, E % and EM) and WVP studies of the films were carried out. Glycerol influenced the film characteristics because it establishes hydrogen bonds with the starch matrix, increasing flexibility, decreasing tensile and increasing water mobility. DSC peak temperature (T_p) and enthalpy for gelatinization showed an increase when cellulose was added to the starch system. This increase in T_p was due to the phenomenon of intercalation in the composites. The strength of films made with cellulose, was higher than those of starch alone in all tests. The WVP of both starch films decreased substantially at all sampling times during the whole storage period. In addition, the high amounts of starch present in air potato and their interesting properties makes air potato a possible alternative source of starch.

Key words: air potato starch; biodegradable film; DSC; WVP

HYDROCOLLOID TYPE AND STIRRER GEOMETRY ROLE IN VISCOSITY CREATION OF POTATO STARCH-HYDROCOLLOID SUSPENSIONS

M. Kabziński, P. Ptaszek, M. Grzesik
University of Agriculture in Krakow, Department of Engineering and Machinery for Food Industry, Faculty of Food Technology, 122 Balicka st., 30-149 Krakow, Poland; m.kabzinski@ur.krakow.pl

The aim of the paper is to describe the impact of the hydrocolloid type and stirrer geometry on rheological potato native starch-hydrocolloid suspensions until long-term mixing, under the stepwise changes of stirrer's rotational speed. As thickener in suspensions were used hydrocolloids: carboxymethyl cellulose, guar gum and xathan gum, in 1 % concentration. In experiment anchor, frame and helical ribbon stirrer was used. To describe the rheological characterization of starch-hydrocolloid suspensions determined apparent viscosity changes in time and power characteristics. The parameters of Ostwald-de Waele equation also were calculated. The results of experiment shown the differences between apparent viscosity waveforms in time for various hydrocolloids. The results also shown, that the apparent viscosity values and its changes are depended on stirrer geometry.

Key words: mixer rheometry, close-clearance stirrers, CMC, xanthan gum, guar gum, potato starch

PREDICTING THE TEXTURE OF COOKED PASTA BASED ON MECHANICAL PROPERTIES OF DRIED PASTA

D. Jambrec, M. Pestorić, O. Šimurina, B. Filipčev, N. Nedeljković, M. Sakač, A. Mandić
University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia; dubravka.jambrec@fins.uns.ac.rs

Going up with demands of modern consumers in addition to traditionally produced pasta, there is plenty of non traditional past made from multigrain flours of different cereals and pseudocereals. All these modifications in pasta formulation cause changes in textural properties which are one of the most important properties of pasta quality.
The aim of this study was to develop a model for predicting the texture of cooked pasta by measuring mechanical properties of dried pasta. Textural properties of whole grain pasta with added different levels (0–30 %) of buckwheat flour were measured by a texture analyser (TA.XTPlus). Hardness and brittleness were measured with Ottawa cell. Firmness of the cooked pasta was determined applying the AACC (16-50) method. Correlation analysis was performed to establish the significance and the degree of linear association between two variables at $p < 0.05$. Coefficients of variation (r^2) were calculated, as well.
There was a very high significant correlation between hardness and firmness ($r=0.96985$, $r^2=0.9406$), and high but not significant correlation between brittleness and firmness ($r=0.92639$, $r^2=0.8582$). Coefficients of variation indicated that the variability noted in cooked pasta textural properties in a great extent can be explained by mechanical properties of dried pasta.

Key words: pasta, texture, buckwheat, hardness, firmness

DEVELOPMENT OF LC-MS/MS METHOD FOR DETERMINATION OF ACRYLAMIDE AND 5-HYDROXYMETHYLFURFURAL IN EXTRUDED PRODUCTS

A. Jozinović, Đ. Ačkar, J. Babić, B. Miličević, J. Panak, B. Šarkanj, D.Šubarić
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; jelena.panak@ptfos.hr

In recent years two compounds which received great attention of the numerous scientists because of their high toxicological potential and their wide occurrence in foods are acrylamide (AA) and 5-hydroxymethylfurfural (HMF). The primary mechanism of formation these contaminants in food is associated with the Maillard reaction during processing of food rich in carbohydrates and proteins at high temperatures. Until now, all methods developed for determination of AA and HMF represent their separate determination. In addition, the determination of these harmful compounds in extruded products has been investigated in only a few researches so far. Therefore, the aim of this study was to develop a common LC-MS/MS method for determination of these compounds in a single method. The development of method first included the use of different sources for ionization (ESI - *electrospray ionization;* APCI - *chemical ionization under atmospheric pressure*), usage of different types and gradients of mobile phases (water acidified with formic and acetic acid, and acetonitrile), the use of different types of extraction (aqueous and methanolic) and methods of sample preparation (single and multiple extraction, with or without concentration with purification with the SPE columns and PVDF syringe filters). Finally, the single LC-MS/MS method was developed for analysis of both analytes in one step with duration of 20 min.

Key words: acrylamide, 5-hydroxymethylfurfural, LC-MS/MS method

DETERMINATION OF ANTIOXIDANT CAPACITY AND TOTAL POLYPHENOLS IN PASTA ENRICHED WITH HULL-LESS BARLEY FLOUR

I. Kosović, A. Lončarić, A. Jozinović, M. Jukić, D. Koceva Komlenić
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; ikosovic@ptfos.hr

The aim of this study was to determine antioxidant capacity and total polyphenols of pasta enriched with hull-less barley flour (HBF). Various solvents such as 70% acetone, 70% methanol, acidified methanol ((HCl/methanol/water, 1:80:10, v/v/v) and acidified methanol (1% HCl) as well as extraction assisted with ultrasound (15 min) and by stirring (with magnetic stirrer for 1 h) was also compared.
The phenolic compounds present in cereals as antioxidants contribute to reducing the risk of cardiovascular disease, type 2 diabetes, adiposity, and certain types of cancer. Therefore, the total content of the phenolic compounds could be considered as important quality indicator for evaluation of barleys and wheats. Barley contains higher amounts of phenolic compounds in relation to other cereals. Hull-less barley is usually richer in phenolic compounds compared to hulled. Since barley has greater antioxidant activity than wheat and rice and contains many phenolic compounds, which are concentrated in the outer layer of barley grain, we used HBF (10, 20, 30, 40 and 50%) for enrichment of pasta.
Total polyphenol content and antioxidant activity was determined in dried pasta samples. Samples with addition of 50% HBF had the highest total polyphenol content and antioxidant activity. Comparing extraction methods and different solvents, ultrasound assisted extraction in combination with 70% acetone and 70% methanol was superior for antioxidant activity determination. Extraction by stirring in combination with acidified methanol was superior for total polyphenols determination.

Key words: hull-less barley pasta, antioxidant capacity, phenolic content, extraction method

FORTIFICATION OF GLUTEN-FREE BISCUITS WITH BETAINE

B. Filipčev, J. Krulj, J. Brkljača, O. Šimurina, D. Jambrec, M. Bodroža-Solarov
University of Novi Sad, Institute of Food Technology, Bul. cara Lazara 1, 21000 Novi Sad, Serbia; bojana.filipcev@fins.uns.ac.rs

Betaine is a non-essential nutrient whose principal physiologic function includes osmolyte action and methyl donation in transmethylation reactions. Increased blood concentrations i.e. dietary intake of betaine have been related to decreased risk of cardiovascular disease and metabolic syndrome. This paper investigated the effect of fortification of gluten-free biscuit formulation with varying levels of betaine (0.5, 1, 2, 3 % flour basis) on their quality.
Fortification increased the betaine content in the biscuits 4-21 times in comparison to the control. Betaine loss was estimated to be below 18 %. High betaine fortification level (3 %) caused significantly higher biscuit spread and lower height gain. Textural properties did not significantly vary among the biscuit although 3 % betaine biscuit had somewhat lower strength. Fortification with betaine did not cause difference in the sensory properties except aftertaste. Weak aftertaste was percieved at the highest fortification level (3 %). The ligthness and a* values of biscuits were not different except for the biscuit fortified with 3 % betaine which were darker and higher in a* values. Betaine addition contributed to the yellow tone and color vividness.
It can be suggested that these fortified biscuits seem suitable as an alternative to plain gluten-free biscuits, thus their consumption may be a convenient approach to increase dietary betaine intake.

Key words: betaine, biscuit, quality, texture, fortification

INFLUENCE OF LAYERING MARGARINE WITH REDUCED FAT CONTENT ON THE PUFF PASTRY QUALITY

D. Šoronja-Simović, B. Pajin, Z. Šereš, Lj. Dokić, I. Nikolić, A. Fišteš, J. Zorjan
University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia; dragana@tf.uns.ac.rs

Despite the exceptional sensory characteristics puff pastry have considerably less favourable nutritional value when compared to yeast bakery products. Unfavourable nutritive and high energy values of puff pastry are direct consequence of high share of layering fat (margarine) in puff pastry dough (from 30 up to 100 % on flour basis).
The influence of the low *trans* layering margarine with reduced fat content (samples ML1 and ML2) on puff pastry quality was investigated. The experiments have been planned on the basis of 3^2 factorial design, with independent variables: quantity of margarines (30, 40 and 50 %, on flour basis) and number of fat layers formed during the processing of dough (108, 144 and 256).
Satisfactorily physical properties and puff pastries with good quality were obtained with samples containing 50 % of margarine ML1 and 144 fat layers formed during the processing of dough-lift 2.9; firmness 17.7 kgs; volume 83.5 cm^3 and with total number of points 14.8. Application of ML2 margarine provided puff pastries with significantly better quality. Addition of 50 % ML2 margarine, with the formation of 256 fat layers, resulted in lift of 5.1; volume 112.4 cm^3; firmness 29.5 kgs and excellent sensory quality of puff pastry (19.0 points).

Key words: puff pastry margarine, fat content, trans fatty acids, quality

Acknowledgements
This study was financially supported by the Provincial Secretariat for Science and Technological Development of the Government of Autonomus Province of Vojvodina, Republic of Serbia.

INFLUENCE OF DIFFERENT TYPES OF SOYBEAN FLOUR ON RHEOLOGICAL AND TEXTURAL PROPERTIES OF THE COOKIE DOUGH

J. Petrović[1], B. Pajin[1], I. Lončarević[1], Z. Šereš[1], A. Fišteš[1], D. Šoronja Simović[1], D. Šubarić[2]

[1]*University of Novi Sad, Faculty of Technology, Bul. Cara Lazara 1, 21000 Novi Sad, Serbia; pajinb@tf.uns.ac.rs*

[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia*

Cookies are inexpensive and very popular food, so it is important nutritionally enrich them. Soybeans are an important raw protein, fiber, vitamins and minerals source. Soy protein has been shown to lower cholesterol in hypercholesterolemic individuals, and it favorably affects calcium metabolism and kidney function relative to other high-quality proteins. The aim of this research was to characterise effects of five different types of soybean flour (defatted lightly toasted, defatted toasted, low fat toasted, full fat toasted and soybean protein concentrate) on physical properties of the cookie dough. In the cookie dough 35 % of wheat flour was replaced with soybean flour and modern instrumental methods were applied to examine the dough rheological and textural characteristics.

Key words: soy flour, cookies, rheological properties, textural properties

NUTRITIONAL AND ENERGY VALUE OF BUCKWHEATH CRACKERS WITH CHIA SEEDS (*Salvia hispanica* L.)

B. Rabrenović[1], J. Laličić-Petronijević[1], R. Stikić[2], B. Vucelić-Radović[1], M. Milovanović[1], M. Demin[1]

[1]*University of Belgrade, Faculty of Agriculture, Dept. of Food Technology, Nemanjina 6, 11080 Zemun-Belgrade, Serbia; demin@agrif.bg.ac.rs*

[2]*University of Belgrade, Faculty of Agriculture, Dept. of Agrochemistry and Plant Physiology, Nemanjina 6, 11080 Zemun-Belgrade, Serbia*

Nowadays, contemporary consumers increasingly pay attention not only to the appearance and taste of the product, but also consider the energy and nutritional value. In this study the energy value, based on the content of protein, fat and sugar, as well as nutritional value, based on the content of essential fatty acids, of the buckwheat crackers with different proportions of chia seeds (30 % and 60 %) has been determined. Besides many other beneficial ingredients, chia seeds' lipid profile is composed of more than 60 % of omega-3s, making them one of the richest plant-based sources of these fatty acids - specifically, of linolenic acid. The results of our study indicate that the fat content was quite high, ranging from 32.5 % to 32.9 %, and also the content of protein and carbohydrates (18.3 - 19.1 %; 31.2 - 32.3 %, respectively). The content of linolenic, essential, omega-3 fatty acid in the tested samples ranged from 0.4 to 12.7 %, or substantively increased with the rise of chia seeds amount, as was expected. The results show that the produced buckwheat crackers with added chia seeds have a high energy and nutritional value and can be recommended as a functional food.

Key words: crakers, chia seeds, energy value, nutritional value, omega-3 fatty acid

Aknowledgments:

This investigation was financially supported by the Ministry of Science and Technological Development of the Republic of Serbia, projects III 46001, III 46010, TR 31006 and by EU Commission project AREA, No. 316004

REVIVAL OF PASTRY PRODUCTION-MUSHROOM DECOCTIONS AS PROMISING NEW INGREDIENT

P. Petrović[2], J. Vunduk[1], M. Lučić[1], Đ. Kojić[1], A. Klaus[1], M. Kozarski[1], B. Rabrenović[1], J. Laličić-Petronijević[1], M. Demin[1]
[1]*University of Belgrade, Faculty of Agriculture, Dept. of Food Technology, Nemanjina 6, 11080 Zemun-Belgrade, Serbia; demin@agrif.bg.ac.rs*
[2]*University of Belgrade, Faculty of Technology and Metallurgy, Dept. of Chemical Engineering, Karnegijeva 4, 11060 Belgrade, Serbia*

Decoctions (DSR 1 : 12) prepared from *Meripilus giganteus* (MP) and *Piptoporus betulinus* (PB) fruiting bodies were tested for antioxidant and antimicrobial potential. In DPPH assay radical neutralization was 93.9 ± 0.9 % for PB and 89.1 ± 0.6 % for MP. ABTS assay also showed slightly better antiradical activity of PB (1.84 ± 0.09 mM Trolox eq.) compared to MG (1.72 ± 0.04 mM Trolox eq.). Fe^{3+}-reducing ability of both PB and MG was significant, with absorbances of 3.135 ± 0.098 and 3.370 ± 0.079 at 700 nm respectively, as well as Fe^{2+}-chelating ability, with 83.1 ± 0.9 % and 87.4 ± 0.5 % of chelation. Decoctions were tested against several microbial strains and showed activity against *Listeria monocytogenes*, *Staphylococcus aureus* and *Geobacillus stearotermophyllus*, exhibiting inhibitory and bactericidal activity, at various dilutions. Decoctions also lowered the growth density of *Candida albicans*, compared to control. A part of this investigation was a possibility to improve a pastry production by the addition of powered fruit body (5 %) and decoctions into the dough. This novelty, together with a selected technological process, i.e. hydrothermal preparation of mushrooms, contributed to the remarkable nutritive value of pastry. Moisture, protein, lipid, dietary fiber, ash and starch content of pastry were determined. Sensory properties, appearance, crust texture, crumb texture, aroma-odor of crust and crumb and aroma-taste of crust and crumb were also appraised. Sensory characteristics of evaluated pastry were excellent.

Key words: mushroom decoctions, antimicrobial potential, antioxidant activity, pastry, nutritive value, sensory properties

Aknowledgments:
This investigation was financially supported by the Ministry of Science andTechnological Development of the Republic of Serbia, projects III 46001, III 46010, TR 31006 and by EU Commission project AREA, No. 316004.

THE TEMPERATURE PROFILE DURING COOKIES BAKING AS A FUNCTION OF SUGAR GRANULATION

S. Ahmetxhekaj[1], S. Budžaki[2*], J. Lukinac[2], M. Jukić[3], I. Kosović[3], G. Miljić[2], D. Hrg[2], D. Koceva Komlenić[3]

[1]*Professional Economic High School "Ali Hadri" Peja, 7 Shtatori p.n. 30000 Peja, Kosovo*

[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Department of Process Engineering, Franje Kuhača 20, 31000 Osijek, Croatia; sandra.budzaki@ptfos.hr*

[3]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Department of Food Technology, Franje Kuhača 20, 31000 Osijek, Croatia*

The aim of this paper was to determine the effect of sugar granulation on temperature profile of cookies. Each formulation for cookies differ with respect to used sugar granulation (1000 μm, 800 μm and 50 μm) and baking temperature (180 °C, 205 °C i 230 °C). The temperature was measured with thermocouples type T. The texture of cookies was analysed using the texture analyser, and the colour was determined using a Chroma Meter (Konica Minolta Chroma Meter, CR-400). After baking were measured changes in weight during baking, length, height and water content of cookies.

Results of monitoring the temperature inside the cookies during baking showed that the cookies with smaller sugar granulation in formulation achieved the temperature of water evaporation faster. Results of analysis of texture showed that granulation of sugar do not affect significantly the parameters of strength and endurance. According to results of the total colour change, minimum value had cookies with addition of sugar granulation 800 μm and the largest had cookies with the addition of powdered sugar.

Key words: sugar granulation, temperature profile, texture, colour, cookies

KINETICS MODELLING OF COOKIE BROWNING DURING BAKING

J. Lukinac, D. Koceva Komlenić, S. Budžaki, M. Jukić, M. Lučan, I. Ivić
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; jlukinac@ptfos.hr

The modern food industry relies on the application of the Maillard reaction to produce many foods, e.g. coffee and bakery products that possess the colour and flavour demanded by the consumer. The aim of this study was kinetics modelling of cookie browning during 10 minutes of baking at 205 °C in order to predict the cookie lightness variation during baking. Samples were made in laboratory conditions from different types of flour. Each type of flour was used to make three types of mixing distinguished in water content (standard, S; dry, D and wet, W). The colour of samples was measured using digital image analysis, and quantified using CIELab colour model. Several mathematical model was proposed to predict the development of browning during baking (zero-, first- and second-order kinetics model). Lightness (L^*) variation were supposed to be representative of colour formation reaction. Comparing all the results of total colour change, the samples with the lowest amount of water (the dry mixing) had the lowest value of total colour change. The changes in the lightness values followed a second- order reaction of cookies made from integral flour, flour T-1100 and T-850 respectively. Evolution of lightness of cookies made from T-400 and standard flour followed zero-order reaction. According to obtained results, all tested kinetics model can be used for modelling of cookie browning. Kinetics model is also suitable to suggest how baking profiles should be changed in order to obtain products with a different final lightness.

Key words: cookies, colour, lightness, digital image analysis, kinetics model

INTAKE OF GRAINS AND GRAIN BASED PRODUCT AND DIET QUALITY IN TODDLERS

I. Rumbak[1], K. Petrčić[1*], T. Kunić[1*], T. Ištvanić[1*], I. Colić Barić[1]
[1]University of Zagreb, Faculty of Food Technology and Biotechnology, Laboratory for Nutrition Science, Pierottijeva, Zagreb, Croatia; icecic@pbf.hr
**Student of Graduate Study Nutrition*

Appropriate feeding of complementary and table foods to young children may ensure normal growth, promote healthful eating habits, and help prevent obesity and other health problems during and after childhood. The aim of this study was to estimate intake of grains and grain based products in toddlers. Three days food diary was collected for 102 participants (43 girls and 59 boys). Grains and grain based products contributed with 25.61 % in total daily energy intake. On average, participants consumed 105.46 g of grains daily, and only 63.73 % of participants have met recommendations (MyPlate, United States Department of Agriculture). Refined grains contributed the most in grains intake, with 59.56 g and average consumption of whole grains was 12.76 g. Bread and cereals were most commonly consumed products. This study have provided results that had been missing for a toddler population in Croatia, however, it is necessary to include more participants from different parts of Croatia to provide representative results.

Key words: toddlers, diet quality, grains

IRON CONTENT IN VARIOUS TYPES OF FLOURS

I. Banjari, J. Fako, B. Bilić, I. Dodlek Šarkanj, I. Flanjak
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; ibanjari@ptfos.hr

The annual average consumption of cereal products (including flour, bread and bagels, other bakery products and pasta) in Croatia is 283.84 g/day/person. Bread and bagels, together with flour account for 86.10 % of cereal products consumption, with semi-white and white products prevailing. Cereal products present the basis of a daily diet, and their iron content is considered as a potent modulator in terms of the total dietary intake of iron. The aim was to analyse various types of flour (excluding wheat flours) on iron content. A rapid spectroscopic method for iron determination in fortified and unfortified foods, developed by Kosse et al. (Food Chem 2001; 75 : 371-6) was used for the analysis of spelt, soy, oat, rye, buckwheat, millet and chickpea flour. The lowest content of iron was found in buckwheat flour (2.16 mg/100 g), while soy flour had the highest content of iron (8.83 mg/100 g). In comparison to white and semi-white wheat flour, partial or complete substitution with some of the analysed flours (e.g. soy flour) would result in significantly higher dietary intake of iron from cereal products. Analysed types of flours show the potential for the development of new functional cereal products; specifically bread and other bakery products with high iron content that would eventually tackle the problem of low dietary intake of iron.

Key words: various types of flours, cereal products, dietary intake of iron

THE EFFECT OF DIFFERENT TYPES OF SOY FLOUR IN TEXTURE AND SENSORY CHARACTERISTICS OF WHEAT BREAD INCREASED NUTRITIONAL VALUE

Z. Belić[1], O. Šimurina[2], D. Jambrec[2], B. Filipčev[2], M. Pestorić[2]
[1]*Sojaprotein A.D., Industrijska 1, 21220 Bečej, Serbia; zorica.belic@ victoriagroup.rs*
[2]*University of Novi Sad, Institute of Food Technology, Bul. cara Lazara 1, 21000 Novi Sad, Serbia*

The aim is to consider the application of different types of soy flour on the textural and sensory characteristics of special wheat bread increased nutritional value and the corresponding. Applied the following flour: full-fat toasted soybean flour, defatted lightly toasted soybean flour, semi-fat toasted soybean flour, defatted toasted soybean flour and soybean protein concentrate. Different types of full-fat soybean flour contains min 50 % protein and 20 % fat min, different types of defatted soybean flour containing min 50 % max protein and 1.5 % fat, while soybean protein concentrate containing 65 % protein min and max 1 % fat. Soy protein supplemented cereal proteins deficient amino acids such as lysine, threonine, methionine and tryptophan, and their combination in the human diet is important, especially if it is wheat bread as the preferred food. The highest sensory evaluation was given wheat bread with 15 % of the full-fat toasted soybean flour and 2 % soybean protein concentrate. Different types of soy flour yielded very similar effects in terms of bread volume, firmness and resilience of the wheat bread. The changes in flavor were minor.

Key words: soybean flour, high protein wheat bread, texture, sensory characteristics

BIOACTIVE COMPOUNDS IN DURUM WHEAT: OLD LANDRACES VS IMPROVED CULTIVARS

M. Palumbo, S. Licciardello, N. Virzì, F. Sciacca
Consiglio per la ricerca in Agricoltura e l'analisi dell'economia agraria (Crea), Corso Savoia, 190 - 95024 Acireale (CT) Italy; massimo.palumbo@entecra.it

Deficiencies of micronutrients are a major global health problem and about three billion people in the world are estimated to be deficient in key vitamins and minerals, particularly iron and zinc (FAO, 2013). In this research the concentrations of microelements were assessed in ancient durum wheat landraces and in improved cultivars. The genotypes were evaluated in three years in experimental trials carried out in Sicily with a RCBD and plot size of 10 m^2. The micronutrient content of the whole caryopses was determined by means of ICP-OES (Optical Emission Spectroscopy). The obtained dataset underwent multivariate statistical processing for principal component analysis (PCA) and cluster analysis. The results showed in the three years statistically significant genetic variability among the tested genotypes and significant differences based on t-test were pointed out between the two groups. Higher concentrations for the most of micronutrients (in particular Fe, Mn and Zn) were detected in landraces than in modern varieties. The multivariate statistical processing for principal component analysis (PCA) highlighted the distance between the modern varieties and the ancient landraces. Cluster analysis clearly distinguished Sicilian landraces from the improved modern cultivars.

Key words: durum wheat, bioactive compounds, cultivars

THE CORRELATION OF BUCKWHEAT GRAIN PHENOLIC COMPOUNDS WITH RESISTANCE TO MYCOTOXINS

I. Keriene[1], A. Mankeviciene[1], S. Bliznikas[2], S. Fedaraviciute[1], R. Cesnuleviciene[1]
[1]*Lithuanian Research Centre for Agriculture and Forestry, Akademija, Lithuania; ilona.keriene@gmail.com*
[2]*Institute of Animal Science, Lithuanian University of Health Sciences, Baisogala, Lithuania*

One widely-investigated alternative solution to mycotoxins problem is to search for natural compounds with a proven antifungal power. The phenolic compounds, characterised by antifungal properties, extracted from buckwheat grain were quantified and identified in the samples. Analysis of correlation-regression between total phenolics, rutin, quercetin, *p*-hydroxybenzoic, 3,4-dihydroxybenzoic, *p*-coumaric, ferulic, vanillic and sinapic and mycotoxins deoxynivalenol (DON), T2 toxin (T2), ochratoxin A (OCHA), aflatoxin B1 (AFLB1)) was performed to ascertain if phenolic compounds can influence the concentrations of mycotoxins in buckwheat grain.
Regression-correlation analysis showed that DON content in buckwheat grain significantly decreased with increasing total phenolic content: correlation coefficient $r = -0.867$, $P<0.01$. It is likely that rutin plays an important role in this process, which is evidenced by the influence of rutin on DON was determined. The inhibitory effect of 3,4–dihydroxybenzoic on DON was identified, $r = -0.765$, $P<0.01$, and a negative correlation of *p*-hydroxybenzoic with OCHA content was detected ($r = -0.635$, $P<0.05$). Therefore, phenolic compounds, which significantly reduced the concentration of DON and OCHA, AFLB1 and T2 acted on the contrary. We think that more favourable conditions for the synthesis of those toxins are formed. This implies the occurrence of interactions of the phenolic compounds with mycotoxins which may reduce their overall effectiveness.

Key words: mycotoxins, phenolic compounds, regression-correlation analysis

KEY FACTORS INFLUENCING MYCOTOXIN PRODUCTION IN ORGANICALLY GROWN WINTER *SPELT* WHEAT GRAINS

A. Mankeviciene, I. Keriene, D. Jablonskyte-Rasce, S. Maiksteniene
Lithuanian Research Centre for Agriculture and Forestry, Akademija, Lithuania; audre@lzi.lt

The research results enable comparison of *spelt (Triticum spelta* L.) cv. 'Franckenkorn' and common wheat (*Triticum aestivum* L.) cv. 'Toras' grain contamination with mycotoxins deoxynivalenol (DON), zearalenon (ZEA), and T-2/HT-2 toxin (T-2/HT-2). The grains were produced in an organic production system on a heavy loam soil (*Endocalcari Endohypogleyic Cambisol).* Mycotoxins were detected by the ELISA (immunoenzyme) technique using NEOGEN diagnostic mycotoxin test kits. A photometer *Multiskan MS* with 650 nm light filter was used for results reading.
Analysis of the data from 2010-2013 experimental years revealed that *spelt* grain samples were less contaminated with mycotoxin DON than those of common wheat; however, in *spelt* glumes DON concentration was 5 times higher. Similar trends were identified for the concentrations of the other mycotoxins tested (ZEA, T-2/HT-2) in grain. The concentrations of all the three *Fusarium* – produced mycotoxins detected in *spelt* glumes were signally higher than in grain (from 2 to 5 times). It was also found that *spelt* wheat grains were less contaminated with all mycotoxins detected compared with common wheat.
Spelt grains have glumes, which are a unique protection system shaped by nature and which give a partial protection for grain against harmful environmental factors and mycotoxins.

Key words: *spelt* grain, common wheat grain, mycotoxins, organic farming

PRESENCE OF A POTENTIALLY TOXIGENIC ASPERGILLUS SPECIES IN WHEAT FLOUR

D. Plavšić[1], G. Dimić[2], Đ. Psodorov[1], Lj. Šarić[1], A. Mandić[1], I. Čabarkapa[1]
[1]*University of Novi Sad, Institute of Food Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia; dragana.plavsic@fins.uns.ac.rs*
[2]*University of Novi Sad, Faculty of Technology, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia*

Different types of wheat flour are present in the human nutrition. For the purpose of the milling product processing, as wellas for a direct human consumption, the most significant wheat species are: wheat, rye, corn, rice, buckwheat and others. The most common contaminants of grain flour and their products are molds. Water activity (a_w) of the wheat grain and flour, in most cases reach values between 0.70 and 0.86, allowing an optimal growth for a xerophile molds, including *Aspergillus* species. Some of them synthesize and excrete the secondary metabolites, mycotoxins with different level of toxicity, in a substrate.
The aim of this work was to determine of *Aspergillus* species present in buckwheat, corn and rice flour, as well as the frequency of present species and potentially toxigenic molds.
Aspergillus species are isolated from all the samples of flour. It was determinate ten *Aspergillus* species: *A spergillus flavus, A. niger. A. versicolor, A. terreus, A. candidus, A. penicillioides, A. glaucus, A. wentii, A. fumigatus* and *A. sydovii.* The isolated *Aspergillus* species are potentially toxygenic. The most frequently isolated species of *Aspergillus* was *A. flavus* (60 %), than *A. candidus* (33.3 %) and *A. niger* (26.67 %).

Key words flour, molds, *Aspergillus* species, *A. flavus*

EXAMINATION OF MICROBIOLOGICAL AIR POPULATION IN DIFFERENT CONDITIONS

Z. Katalinić, L. Lenart
Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia; lidija.lenart@ptfos.hr

It is known that the atmosphere is a very inappropriate medium for the life of microorganisms, because they neither grow nor reproduce in the air. However, they may enter the air in different ways. For example, various air currents can bring a multitude of microorganisms into the airspace. People can significantly contaminate the airspace by sneezing, coughing, spitting and even breathing, with their secretion droplets. Microorganisms can enter the airspace with dust particles, clothing, footwear etc. Most dust is generated by peeling and discarding of the human skin, so the microorganisms enter the airspace along with it. Appropriate temperature and humidity of the medium cause gathering of a large number of micro-organisms both in solid and liquid mediums and in the air. Therefore, this study sought to compare the quantity of bacteria and mold in the air in differently sized rooms, daily populated by different number of people, all under the influence of an associated daily temperature and relative humidity. The measurements were caried out once a month during the academic year 2014/2015 Significant statistical differences were found between the individual measurement results.

Key words: microbiological population of air, contamination, aerobic mesophilic bacteria, molds

HEMP PRODUCTS FOR FOOD AND MEDICINE USING

M. Hrušková, I. Švec
University of Chemical Technology Prague, Department of Carbohydrates and Cereals, Technická 5, 166 28 Prague 6 – Dejvice, Czech Republic, Marie.Hruskova@vscht.cz

Hemp (*Cannabis sativa)* is an annual plant that is native to China and remained for centuries as an important material for food, industrial and medical purposes. As a source of cannabinoids belongs to controversial, but due to its excellent nutritional profile, non-gluten protein, fat and fibre it has a potential in bakery products. Protein, fat and starch rates are known to be 30 - 33 %, 7 - 13 %, approx. 40 %, respectively. Seed contains a significant level of beta-carotene, vitamins B_1 and E and higher portion of iron and zinc. Cannabis increases the "gastric fire" (i.e., digestion and, therefore, appetite), the "generative fire," and it is mentioned in one of the earliest Indian medical works (dated in era from 400 BC to 600 AD). The prime medicinal uses were for nervous system, gastrointestinal tract and as an aphrodisiac. Whole seeds can be used as component of cereal sticks, biscuits and purees, or it may season pasta, rice or sausages. For bakery products, 10 % and 15 % was recommended as acceptable. Wheat-hemp cut off cookies had pleasant coffee brown colour and specific by-taste. Pasta containing hemp products from hulled and dehulled seeds were characterised by up to four times higher fibre content compared to wheat ones.

Key words: hemp products, cannabinoids, bread, biscuits, pasta

CHARACTERIZATION OF BUCKWHEAT-ENRICHED WHEAT BREAD AND ITS HEALTH BENEFITS

N. Nedeljković, M. Sakač, E. Stokić, M. Pestorić, A. Mandić, A. Mišan, D. Jambrec, O. Šimurina, P. Jovanov
Institute of Food Technology in Novi Sad, University of Novi Sad, Bulevar cara Lazara 1, 21000 Novi Sad, Serbia; natasha.nedeljkovic@fins.uns.ac.rs

The buckwheat-enriched wheat bread was produced by the substitution of wheat flour with the wholegrain buckwheat flour at the level of 50% in the white bread formulation. Hydrothermal treatment of wholegrain buckwheat flour prior to the bread production was applied to improve sensory profile of the final product.
The mentioned substitution resulted in better nutritional properties of the buckwheat-enriched wheat bread as well as in better sensory quality compared with the wheat bread. Higher sensory score of the buckwheat-enriched wheat bread was obtained by the consumer test. The preference test showed that 71.88 % of the consumers gave the advantage to the buckwheat-enriched wheat bread.
In addition, functional characteristics of the buckwheat-enriched wheat bread were improved, implying higher total dietary fibre content and increased antioxidant capacity, resulted from 4.29 times higher total phenolics content.
Antihyperlipidemic efficiency of the buckwheat-enriched wheat bread was tested in normal weight patients on statin therapy over one-month dietetic intervention. Significant decrease in total cholesterol and LDL-cholesterol, as well as the ratio of LDL/HDL cholesterol was obtained. This finding confirms health beneficial effects of buckwheat components, i.e their positive effects on certain markers of atherosclerosis.

Key words: buckwheat-enriched wheat bread, wheat bread, quality, sensory properties, antihyperlipidemic effect

CROATIAN CONSUMERS` ATTITUDES AND PURCHASE INTENTIONS TOWARDS FUNCTIONAL COOKIES

N. Čukelj*, D. Novotni, B. Voučko, I. Vrana Špoljarić, P. Putnik, D. Ćurić
University of Zagreb Faculty of Food Technology and Biotechnology;, Pierottijeva, Zagreb, Croatia; ivranaspoljaric@pbf.h

Cookies are widespread confectionary cereal based product. Recently it was recognised that cookies can be easily transformed into nutritionally valuable functional product, while retaining the taste. However, this type of functional product can live on the market only if consumers adopt it. Therefore we investigated purchase habits of Croatian consumers towards cookies, and their willingness to buy cookies enriched with omega-3 fatty acids and lignans - compounds which are in western diets present in insufficient amounts.
Online survey was used to collect data among 1035 consumers, of which 73 % were women, and 97 % in the age range 15-65 years. Most participants had job, higher education degree (65 %) and 60 % of them lived in urban areas. Survey included questions about consumption and purchase of cereal products, cookies and flaxseed; importance of knowing nutritional value of cookies and interest for buying enriched cookies. Nutritional knowledge and awareness were also investigated.
Results show that 93 % of subjects consume cookies, while 61 % do not eat flaxseed at all or eat it less than once a month. Among subjects interested in purchasing enriched cookies (82 %), the most interested groups are women, the elderly, and people with higher nutrition awareness and higher level of nutrition knowledge.

Key words: consumer attitudes, purchase intentions, functional cookies, flaxseed, lignans

INFLUENCE OF GERMINATION TIME ON GRINDING CHARACTERISTICS AND ANTIOXIDANT ACTIVITY OF WHEAT SPROUTS

D. Dziki[1], U. Gawlik-Dziki[2], M. Domin[3], K. Kozłowicz[3]

[1]*Department of Thermal Technology, University of Life Sciences, Doświadczalna Street 44, 20-280 Lublin, Poland, e-mail: dariusz.dziki@up.lublin.pl*

[2]*Department of Biochemistry and Food Chemistry, University of Life Sciences, Skromna Street 8, 20-704 Lublin, Poland*

[3]*Department of Refrigeration and Food Industry Energetics, Doświadczalna Street 44, 20-280 Lublin, Poland*

Germination of cereals is an inexpensive and effective method to enhance the antioxidant capacity. The purpose of this work was to examine the influence of germination time on grinding characteristics and antioxidant properties of wheat. The seeds of Polish winter wheat cultivars cv. Bogatka (*Triticum aestivum*, ssp. vulgare) were sprouted for 2, 4, 6 and 8 days at 20 °C. After sprouting, the seedlings were dried at 80 °C until the moisture content of the sample 14 % (wb). The control and sprouted seeds were ground using a laboratory knife mill. The particle size distribution, average particle size and the grinding energy indices were determined. Beside this the antioxidant activity of flour was estimated using an improved ABTS decolorization assay and expressed as EC_{50}. The obtained data showed that time of sprouting had a significant influence on the particle size distribution and grinding energy indices. As the time of sprouting increase the average particle size decreased and the specific grinding energy decreased too (average from 29.3 to 14.9 $kJkg^{-1}$), whereas antioxidant activity of sprouted flour increased (decrease of EC_{50} from 332 to 144 $mg_{dm} \cdot ml^{-1}$). The results showed that as the time of germination increased the grinding effectiveness and antioxidant activity increased too.

Key words: wheat, spouting, grinding, antioxidant activity

The study was financed by the Polish National Science Centre (Grant 2012/07/B/NZ9/02463)

ACORN FLOUR – NATURALLY GLUTEN FREE

M. Polimac[1], D. Koceva Komlenić[2]
[1]*Ivana Gorana Kovačića 6, HR- 31000 Osijek, Croatia; mpolimac@lycos.com*
[2]*Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia*

Gluten intake causes gastrointestinal disorders in celiac and intolerant patients. The current trend of consuming gluten free products has added to the demand for these industry products. Digestive health reasons, weight management, and nutritive value of these foods are some of the reasons that have been driving the gluten-free products market. Manufacture of gluten-free products requires the use of preselected raw materials. The number of such ingredients is limited; therefore, the acorns could become one major food source and an attractive novel ingredient for the future. The objective of this paper was to perform and document a complete production cycle of acorn flour starting from the foraged tree nuts, collected in October in Slavonia (east Croatia). The results of physical and chemical investigations of differently treated samples of oak acorn are also presented in this paper. Oak acorn, *Quercus robur* L., (belonging to Fagaceae family) was investigated in native and thermally treated forms. The acorns were allowed to dry naturally and then shelled. The meal was coarsely ground and dried at 40 °C for 24 h and milled. Produced acorn flour contains 4.56 % fat, 6.48 % protein, 36.86 % hemicellulose, 14 % cellulose and 1.96 % minerals.

Key words: gluten free products, oak acorn, acorn flour

IMMATURE HULL-LESS BARLEY GRAIN APPLICATION IN FUNCTIONAL DAIRY PRODUCT

J. Zagorska, D. Karklina, I. Cinkmanis, A. Vecstaudza, L. Skudra
Latvia University of Agriculture, Faculty of Food Technology, Department of Food Technology, Liela iela 2, Jelgava, LV-3001, Latvia; jelena.zagorska@llu.lv

Present research has been supported by the National research programme "AgroBioRes" (2014–2017), project No. 4 "Sustainable use of local agricultural resources for qualitative and healthy food product development" (FOOD). The purpose of the research was to investigate immature hull-less barley use in yoghurt production. For the experiments immature and mature hull-less barley 'Irbe', pasteurized skimmed milk, and starter culture Yo-Flex Harmony was used. The following quality parameters were established using standard methods: content of vitamins B1, B2, E, and individual sugars; yoghurt samples were also analysed for lactic acid bacteria count, pH, titratable acidity, and viscosity. Relatively high vitamin and individual sugar content was established in immature cereals comparing with mature ones. Furthermore, the positive effect of the added immature cereals on lactic acid bacteria development in yoghurt was found – higher bacteria count was in samples with grain additive, obtained results were confirmed with pH and titratable acidity. Significant influence of analysed cereals on yoghurt viscosity was established. As a result, immature grain additive has prebiotic effect on lactic acid bacteria growth and allows production of yoghurt with functional properties.

Key words: immature cereals, yoghurt, lactic acid bacteria.

ECONOMIC RESULTS OF SPELLED PRODUCTION

Lj. Ranogajec, J. Kanisek
Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, Kralja P. Svačića 1d, 31000 Osijek, Croatia; lranogaje@pfos.hr

On the family farm from Slavonia and Baranja, the total amount of 7.357,53 kn/ha was spent in the production of spelled. The most significant segment of total costs are the costs of mechanization. Machinery is used 11.31 h/ha, for which the amount of 2.692,97 kn/ha was allocated, which makes 36.6 % of total costs. With applied mineral fertilizers which are allowed in organic production, cattle manure valued 700.00 kn/ha was also used in production. Therefore the total cost of fertilization is 1.403,19 kn/ha, which represents one-fifth of the total amount. Sowing was done with 180 kg of seeds, valued 828.00 kn/ha, with the 11 % share of total costs. After harvesting and drying of 2,800 kg/ha grain amount, with sale price of 2.60 kn/kg and stimulus of 3.759 kn/ha, the total output value of 11.030,00 kn/ha was accomplished.
After covering the costs of spelled production, the profit was 3.672,47 kn/ha. In the production, 158.80 kg of spelled grain is produced per hour of human labour, while 6.3 hours of human labour per ton is spent. The production is economical, and the coefficient is 1.5. Profitability rate is 33.3 %, which means that investment of 100 kn will result in the profit of 33.3 kn.

Key words: spelled, costs, revenues, profit

THE IMPACT OF THE APPRECIATION OF THE KUNA TO THE COMPETITIVENESS OF CROATIAN MILLING INDUSTRIES

D. Balaž, K. Zmaić
Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, Kralja P. Svačića 1d, 31000 Osijek, Croatia; davor.balaz@gmail.com

The aim of this study was to determine the impact of the strengthening exchange rate on the competitiveness of the milling industry in Croatia. The research methodology is based on an analysis of the movement of the kuna through the comparison of the purchase prices of wheat and flour market prices in Croatia. Today was a judgment currency variation in relation to the specifics of separate industrial sectors. We analyzed the economic risk due to the threat of inflation kuna exchange-dosing in terms of structural disproportions in a separate market, with the impact of objective market circumstances of joining the European Union, manifest imported flour low prices whose impact on domestic production can not be controlled. Question appreciation of the kuna on the one hand and inflation risk on the other hand is in conflict with respect to the isolated mill sector, and the overall economy. Competitive uncertainties largely contributes to the continued trend of reducing the number of mills, with fully a certain progression. Conducted research and performed the corresponding analysis revealed the specifics of the impact of exchange rate on the competitiveness of separate industry sector.

Key words: appreciation, exchange rate, competitivity, milling industires, Croatia

EFFECTS OF DEFATTED SOY FLOUR AND PROCESSING TEMPERATURES ON QUALITY CRITERIA OF SPAGHETTI

A. Ansari
Gradate Student of Azad University at Science & Research Center, 119-Khaiam gharbi-mehrvila, 3139656756, Karaj, Iran; amiransari203@yahoo.com

Spaghetti was prepared by replacing defatted soy flour (DSF) with wheat flour at 10 % and 20 % (w/w) levels and gluten 4 %. Then they extruded at two distinct temperatures of 35 & 50 °C, and dried at two different temperatures of 55 & 90 °C. The color properties, protein content, cooking loss, cooked weight, firmness, Isoflavone, lysine amino acid and fiber of finished spaghetti were measured. Also chew-ness, firmness, stickiness, color and flavor of cooked spaghetti at the optimum time (20 min) were evaluated by a trained sensorial group. To determine the effects of modifying agent addition in spaghetti, xanthenes gum at two levels (0.2-0.4 %) was added to spaghetti dough containing 20 % soy flour and 80 % wheat flour. This sample was extruded at 35 °C and dried only at 55 °C.with regarding to correlation of sensorial analysis and physicochemical analysis, drying temperature 55 and extrusion temperature 35and defatted soy flour 20 % and xanthan gum 0.4 % was offered in soy spaghetti formulation. So this production is hi protein and include 50 ppm Isovlovone and 0.3 % Lysine amino acid.

Key words: spaghetti, gluten, defatted soy flour, xanthan, SEM, cooking loss, cooking weight, firmness, drying and extrusion temperature

AUTHOR INDEX