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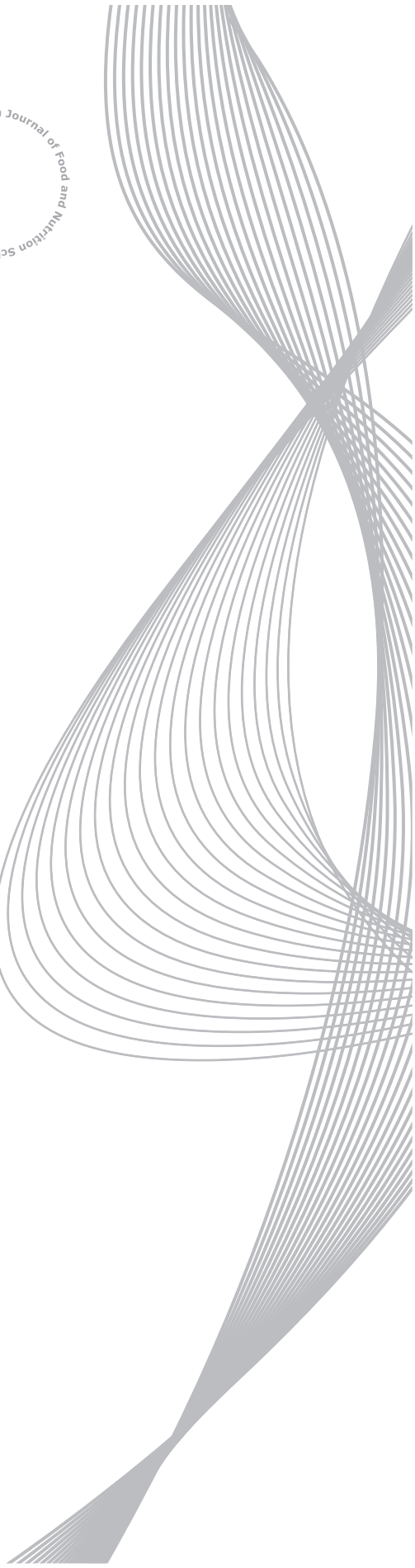

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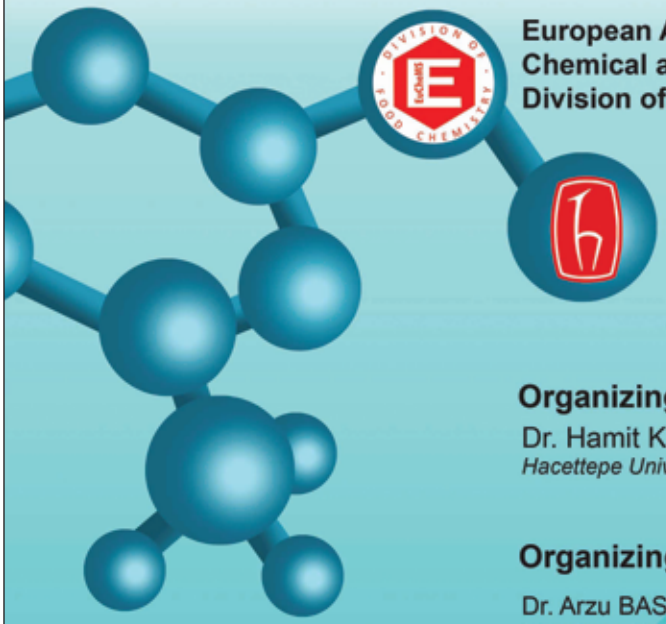

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PREFACE

This conference is the XVIth in the EuroFoodChem series but only the first time that it has been held in Poland, in Gdańsk, a city with a 1000-year old history and the economic, cultural and scientific centre of northern Poland. Our conference is included in the programme of important events across the chemical sciences for the year 2011, which is celebrated as the International Year of Chemistry. The key aim of each of event is to boost the practical applications of the chemical sciences, to promote chemists and chemistry, and to demonstrate the significant role of chemistry in the life of all nations; in particular, the important role of the chemical sciences in the progress of civilization, the protection of health and the environment, in medicine and, what is becoming even more evident, in the science and technology of food.

The year 2011 is also the 100th anniversary of the Nobel Prize that was awarded to Maria Skłodowska-Curie, without doubts the one of most recognized Polish researchers ever. Her researches into radioactivity have had a very considerable influence on people's lives and the results of her researches are continuously being used in, for example, modern cancer treatment.

The EuroFoodChem series of conferences is the flagship of the Division of Food Chemistry of the European Association of Chemical and Molecular Sciences. It has 30 years of development and, over these years, always brings together chemists from all European countries and provides opportunities to meet representatives from other continents and regions to discuss common problems and recent discoveries related to food. It has always had a focus on young researchers and students, the next generation of food scientists and technologists.

The conference here in Gdańsk is supported by the EU FP7 Project "*Unlocking the potential of the Institute of Animal Reproduction and Food Research for strengthening integration with the European Research Area and regional development",* which has the acronym REFRESH, and it is the first out of four that this Institute, one of the Polish Academy of Science's 80 institutes, located in Olsztyn, in north-eastern Poland will organise.

EuroFoodChem XVI is organised together with Chemical Faculty of Gdansk University of Technology, one of the largest faculties in Poland.

The subject matter of EuroFoodchem Conferences has always been concerned with the current problems associated with the factors affecting the quality and safety of food. In recent years, there has developed increasing evidence pointing to the close relation between food and health, especially the relationship between diet and food-related diseases. This is a subject that is of importance to industry, consumers and regulators, and one that requires cross-disciplinary investigation. Since food, apart from its basic nutritional function, can prevent and protect against certain diseases, the efficient and rapid translation of new findings coming from developments in, and applications of, food science into practice can bring substantial improvements in the health of society and this, of course, has very important economic consequences. In addressing these contemporary trends, the title of the Gdansk conference has been chosen to be "*Translating Food Chemistry into Health Benefits*" and has the aim at bringing together specialists in many disciplines working on the Food and Health area. Today, Food and Health is a global driver for industry, a major focus for consumers, a priority for policy makers and a significant challenge for regulators.

We very much hope that this conference will provide a venue for scientific discussion and exchange of information, for the development of common ideas, the initiation of trans-national cooperation and the facilitation of interactions between young researches and students and established experts in the area of Food and Health.

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PLENARY LECTURES

L1

Peter Czedik-Eysenberg, a Creator of European Collaboration in Food Chemistry – a Polish Perspective

Halina Kozłowska

Prof. Peter Czedik-Eysenberg (1929–2001), a graduate in chemistry, honorary professor at the Universities of Graz and Vienna and a long-term industrial chemist, was the enthusiastic and tireless founder of the Working Party on Food Chemistry (WPFC) that, in 1996, transformed into Food Chemistry Division (FCD) as it represented the challenges and opportunities of food chemists across Europe. According to his concept of creating a European network focussing on chemistry and food technology, the WPFC stimulated and supported cooperation between the representatives of European countries,, including those then situated behind the "Iron Curtain". Professor Czedik-Eysenberg chaired the FCD for about 20 years, arranging annual meetings of the national representatives, during which the ongoing problems influencing the quality of food were discussed, and establishing series of conferences meeting the needs and interests of food chemists, including the biannual Eurofoodchem series which is being held here in Poland, in Gdańsk, for the first time this year.

This year is particularly important for Polish chemists because it celebrates the 100th anniversary of the presentation of the Nobel Prize for Chemistry to Marie Skłodowska-Curie. Moreover, the year 2011 has been recognised as the International Year of Chemistry, reflecting the growing appreciation of the significant role of chemistry to human life and development. Again, it is worth stressing the Peter Czedik-Eysenberg's devotion not only to food chemistry as a discipline, but to its practical application, in collaboration with other areas of science and technology, of improving food quality, food safety and for optimising the delivery of health and well-being through diet to consumers.

The first Polish scientist collaborating with Peter Czedik-Eysenberg and FCD was Antoni Rutkowski followed by Jadwiga Wilska-Jeszka, Zdzisław Sikorski, Halina Kozłowska and Mariusz Piskuła. FCD members and Peter Czedik-Eysenberg, in particular, had a strong impact on the development of Polish chemical science – and on the establishment of the Institute of Polish Academy of Sciences in Olsztyn. Through cooperative activities with its Polish scientists, the training of its young people and the organisation of international conferences in Poland, the FCD helped to produce long-lasting links between Polish research institutions and their European partners working in the broad field of food sciences. This cooperation has been stimulating for Polish scientists and their colleagues across Europe.

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L2

Oxidative Stress and Redox Signaling: An Update

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Key words: oxidative stress, oxidants, antioxidants, redox signaling, micronutrients, vascular responses, polyphenols, selenium

The concept of 'oxidative stress', now over a quarter-century old, has gained momentum. The work of many scientists revealed the crucial role of oxidants in signaling cascades and in cell regulation, and the concept of 'redox signaling' is taken into account in the updated definition [1]. Thus, not only counteraction of oxidant-induced damage by antioxidants, but also modulation of signaling events and connection to redox switches come into focus. Our own recent work regards the vascular responses upon nutritional intake of micronutrients, notably polyphenol-containing foods, and their molecular basis. The latter includes modulation of NADPH oxidase activity and its impact on NO and peroxynitrite levels [2]. Likewise, glutathione peroxidase 4 and general issues in selenoprotein biology have come into focus (see [3]).

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SESSION 1: REGAINING TRUST IN ANTIOXIDANTS

ORAL PRESENTATIONS

O1

Are Antioxidants Multifunctional Food Ingredient That Can Impact Both Health and Food Quality

Eric A. Decker

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Key words: antioxidants, lipid oxidation, rancidity, metals, prooxidant

Antioxidants are very versatile food ingredients as they can improve both food quality and health. Unfortunately, many of the methods used to measure the effectiveness of antioxidants do not relate to their ability to either protect foods from oxidation or protect tissues from diseases. This is because most antioxidant assays measure the ability of compounds to scavenge free radicals or act as reductants. However, the ability of compounds to inhibit oxidative reactions is much more complex as these molecules can also bind metals, reduce metals, and produce radicals of varying stability. Variations in these properties can actually result in some compounds promoting oxidation reactions. For example, metal binding properties can inhibit metal-promoted lipid oxidation by preventing redox cycling but can increase prooxidant activity by increasing metal solubility. Likewise, free radical scavengers can inhibit lipid oxidation by producing low energy free radical but can promote lipid oxidation when their redox potential is high enough to reduce metals into their more prooxidative states. The effectiveness of antioxidants is also dependent on physical properties and in particular their polarity which dictates where they partition into biological tissues and foods. The effectiveness of antioxidant in vivo is also dependent on their bioavailability and modification by gastrointestinal bacteria. Since antioxidants have such a broad array of pathways in which they can impact oxidative reactions, it is not surprising that their effectiveness is difficult to predict.

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O2

Phytochemical Characterization of Licuri (*Syagrus coronata (Martius) Beccari*) Seeds: Phenolic Composition and Antioxidant Capacity

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Key words: licuri, antioxidant capacity, phenolic composition, HPLC-MS analysis

Licuri is a palm tree native to the eastern Brazil, in particular the semi-arid area of Caldeirao Grande in the region of Bahia. It produces pulpy fruit bunches (about 1300 fruits per bunch) which dry during maturation becoming edible. Fruits are available all year, with a maximum production in March and April. The main harvesting and manufacturing area is Jacobina, at 300 km far from Salvador. Manufacturing process is carried out manually. Many traditional food products made from both fresh and roasted licuri seeds are available on the local market (liqueur, milk, oil, snacks, biscuits, *etc*.). As the licuri has a great significance for both its socio-economical and nutritional value, local people organized into cooperatives for the handling of harvest, processing and commercialization. This also led to the first scientific studies on licuri, dealing mainly with its nutritional composition. It has been reported that the protein, lipid and carbohydrate content accounted for 11.5%, 49.5% and 13.2%, respectively. Also, some bioactive compounds, as vitamins, have been investigated, while nothing is still known about polyphenols. This work is a contribution to the knowledge of the chemical composition of the licuri seed. In particular, phenolic composition and antioxidant capacity have been investigated. Samples of fresh and roasted licuri seeds were provided by the COOPES cooperative of Bahia. Antioxidant capacity was evaluated by the ABTS and DPPH radical scavenging assays and polyphenols were analyzed by HPLC-MS. Both antioxidant assays showed a lower antioxidant capacity for fresh seeds in comparison to roasted seeds. The main representative polyphenol class in both fresh and roasted seeds was flavan-3-ols, with (+)-catechin, (-)-epicatechin and procyanidin B2 being the most abundant. During the roasting process a significative increase of (-)-epicatechin occurred. Also some flavonols, aglicones and glycosilated forms, were found.

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O3

Antioxidants in Nutrition: What Are They Needed for and What Can They Do?

Tilman Grune

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Key words: antioxidants, nutrition, vitamins, intervention trials

Antioxidative acting compounds are an essential part of our food. This includes several vitamins and numerous other, often plant, compounds. However, the scenario, where in vitro antioxidatively acting compounds are also acting this way in vivo, is seriously doubted in recent times.

Undoubted is the fact, that a high consumption of fruit and vegetables improves health or postpones several (especially age-associated) diseases. However, attempts to limit this effect to one compound or a group of compounds failed, underlined by the failure of a large number of intervention trials. Recent meta-analyses of selected randomized clinical trials (RCTs) in which population groups of differing ages and health status were supplemented various doses of b-carotene, vitamin A, and/or vitamin E found sometimes that these interventions increased the all-cause mortality. We re-analyzed one of this meta-analysis and came to a different conclusion using the same group of studies. This indicates that often the mode of analyses is determining the outcome of the study.

On the other hand it should be seriously questioned, whether the traditional double-blinded randomized clinical trial, which is used in medical testing of single compounds, is the right tool to determine the effect of nutritional interventions. New approaches in testing nutritional interventions and appropriate biomarkers to test theses should be developed and used.

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O4

Antioxidant Activity of the Peptide Fraction from Parmigiano-Reggiano Cheeses at Different Ageing Times

Chiara Bottesini, Sara Paolella, Francesca Lambertini, Gianni Galaverna, Arnaldo Dossena, Rosangela Marchelli, Stefano Sforza

Department of Organic and Industrial Chemistry, University of Parma, Parma, Italy

Key words: antioxidant activity, bioactive peptides, proteolysis.

Parmigiano Reggiano is a well known Italian hard cheese, long ripened, made from raw and partially skimmed cow's-milk [1].

During the ripening time casein degradation occurs, catalyzed by proteolytic enzymes with different specificities [2].

Bioactive peptides encrypted in the casein sequences can be released by this process [3], resulting in compounds which may have different functional effects, including antioxidant activity [4].

In this work we present the study of the antioxidant activity of water soluble extracts (WSEs) of Parmigiano-Reggiano cheeses with different months of ripening. Antioxidant activity was also determined after in-vitro gastrointestinal digestion of the WSEs. The most abundant peptides of the WSEs were also determined by LC/ESI-MS and LC/ESI-MS/MS analysis of the whole fractions and of purified subfractions, in order to correlate the antioxidant properties to the peptide composition.

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O5

Dietary Flavonoids as Antioxidants and Beyond Antioxidants in Target Tissues

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Key words: flavonoid, glucurinide conjugation, inflammation, disused muscle atrophy

Dietary flavonoids are believed to attenuate oxidative stress by acting as antioxidants. Antioxidant activity of flavonoids is derived from their ability to scavenge reactive oxygen species (ROS) and/or inhibit ROS-generating enzymes. Their prooxidant activity may also participate in the attenuation of oxidative stress by inducing the expression of antioxidant enzymes. In addition, cultured cell studies demonstrated that some flavonoids can bind to target proteins directly resulting in the modulation of cellular signaling pathway. It should be noted that glucuroinde/sulfate conjugation during absorption process attenuates their functions as conjugated metabolites are inactive endproducts for the excretion. Nevertheless, quercetin 3-O-β-D-glucuronide (Q3GA), a glucuronide metabolite of quercetin, was found to retain considerable antioxidant activity. We proposed that Q3GA accumulates in activated

macrophages after deconjugation to its aglycone through β-glucuronidase activity under oxidative stress such as inflammation [1]. Several animal studies indicate that quercetin metabolites are slightly but widely distributed in a variety of tissues after short-term ingestion of quercetin. Therefore, these tissues are potential target sites for dietary quercetin in the attenuation of oxidative stress. We confirmed that conjugated quercetin metabolites accumulates in the brain of quercetin-fed rats and suggest that dietary quercetin suppresses oxidative stress in central nervous system by inhibiting monoamine oxidase-A (MAO-A) activity, which yields hydrogen peroxide as a reaction product [2]. Recently we also suggest that dietary quercetin is effective in the prevention of disused muscle atrophy by attenuating oxidative stress as well as ubiquitin ligase expression [3]. It is therefore that likely dietary flavonoids attenuate oxidative stress by acting as both antioxidants and beyond antioxidants when target tissues suffer from oxidative stress.

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O6

Analytical Methods to Determine Antioxidant Capacities of Food Samples

Krystyna Pyrzyńska

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Key words: antioxidant capacity, analytical methods, food samples

Antioxidant capacity is related with compounds capable of protecting a biological system against the potentially harmful effect of processes or reactions involving reactive oxygen and nitrogen species. These protective effects of antioxidants have received increasing attention within biological, medical, nutritional, and agrochemical fields and resulted in the requirement of simple, convenient, and reliable antioxidant capacity determination methods. Many methods which differ from each other in terms of reaction mechanisms, oxidant and target/probe species, reaction conditions, and expression of results have been developed and tested in the literature. In this lecture, the methods most widely used for the determination of antioxidant capacity will be presented with their strengths and limitations. Generally, it is recommended to use at least two different types of methods for the investigation of antioxidant activities of samples.

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O7

The Antioxidant Capacity of the Selected Fruits and Their Preserves – Pilot Comparative Study

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Key words: antioxidant capacity, fruits, photochemiluminescence (PLC), Folin- Ciocalteu (FC)

There is a lot of discussions concerning the validity and repeatability results of the antioxidant capacity in different food products and factors affecting. Such discussion suggest that the precise evaluation of the antioxidant capacity of the diet might me difficult.

Because of the lack validated data concerning antioxidant capacity food products on polish market the work aimed to evaluate the antioxidant capacity of the selected fruits products and possibility to use the data, derived from international validated databases included more results conc. different food products in further diet modifications. Various antioxidant assays were used to measure the antioxidant capacity: photochemiluminescence (PLC), Folin-Ciocalteu (FC), 1,1-diphenyl-2-picrylhydrazyl (DPPH) in the group of selected fruits and their preserves and the results were compared to widely used ORAC (oxygen radical absorbance capacity).

The outcomes showed the high antioxidant capacity various fruit products available on the market. Moreover significant correlations between antioxidant capacity received from PLC method and derived from the international databases ($p<0.05$) were observed. We conclude, that the future studies to evaluate antioxidant activity other group products, comparison and validation study included antioxidant capacity local products and international databases are needed. Such validated data might be beneficial in evaluation antioxidant capacity during diet modifications in civilization diseases.

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O8

Bioactivity of Grapevine (*Vitis vinifera* L.) Chemicals and Products: Focus on Antioxidant Power

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Key words: grape, wine, polyphenols, melatonin, antioxidant power

In grapevine, bioactive metabolites occur mainly in the berry, consumed as fruit and used for winemaking. Grape chemistry is quite complex and some hundreds of compounds have been identified in the genus Vitis, included in the three main classes of natural products, phenylpropanoids, isoprenoids and alkaloids, widely distributed in food plants and medicinal herbs. In particular, the phenylpropanoid pathway leads to polyphenols, consisting of flavonoids, stilbenes (such as resveratrol) and proanthocyanidins, whereas isoprenoid monoterpens are responsible for the wine aroma. Additionally, melatonin, a tryptophan derivative, has been recently discovered in grapevine berry tissues. In the last decades, a lot of studies focused mainly on polyphenols, undoubtedly considered as the archetype of grapevine product bioactivitiy. Probably, the most investigated biological activity of polyphenols is their antioxidant power, though they also possess a plethora of correlated properties, such as antimutagenic, anti-inflammatory, antitumoral, cardio- and neuroprotective activity. Polyphenols act as antioxidants by donating electrons and stopping radical chains. This activity is attributed to the phenolic hydroxyls, increasing with the number of OH groups in their basic structure. Furthermore, the discovery of a new bioactive metabolite in grape, melatonin, itself a powerful antioxidant, adds a new element to further comprehend the pharmaconutritional properties of grape products, besides opening new perspectives in the field of grape research. Due to its amphipathic nature, melatonin can easily cross cell membranes and permeate into different cell compartments. This compound possesses an electron-rich aromatic indole ring and it easily acts as an electron donor for molecules deficient in an electron, thereby reducing and repairing electrophilic radicals. Melatonin may contribute to counteract the cell oxidative burden also indirectly, by enhancing the production of cellular detoxifying enzymes (glutathione peroxidase, glutathione reductase and superoxide dismutase). In any case, even though polyphenols represent the prototype of the health-promoting effects associated with grapevine product intake, these benefits strictly depend on the potpourri of chemicals present in grape tissues, thus supporting the assumption that no particular compound is by itself responsible for the healthy properties widely attributed to grape products.

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O9

Physicochemical Properties of Pomegranate Pestil (Fruit Leather)

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Key words: pomegranate, pestil, total phenolic compounds, antioxidant activity

It is generally admitted that the term “traditional food” refers to a product with specific raw materials, and/or with a recipe known for a long time, and/or with a specific process (Cayot 2007). Pestil is one of the most important traditional foods produced and consumed in a different region of Turkey. It is a product obtained from different kinds of fruits, in our country. Naming of pestil depends on the origin of the fruits used for, like grape pestil, apricot pestil, and mulberry pestil. It has specific taste and high nutritional value. It’s a good source of carbohydrate, energy, minerals such as, Fe, F, Ca, K and vitamin especially thiamine and vitamin B6. Pestil production is used to increase shelf life of fruits without loss of nutritional value and to produce different types of products. Processing steps of pestil depends of the fruit used and consists of sorting, washing, destoning, pre-heating, pressing, starch addition, evaporation, spreading, drying, cutting and packaging. The addition of some additives like nuts and sesame is used for enrichment of the product.

The aim of the study was to determine physicochemical properties of pomegranate pestil (fruit leather). For this reason, pomegranates was washed, cut and then their juice was extracted by using orange juice extractor. In order to increase dry matter and improve taste, saccharose was added. Starch was solving in water and add into fruit juice. The mixture was evaporated up to 68- 70 brix in laboratory type rotary evaporator at 50°C under vacuum. Fruit paste poured on a wrapping paper resistant to oil and dried in vacuum-oven at 58–60°C. Total dry matter, water soluble dry matter, ash, pH, total acidity, total phenolic compounds, antioxidant activity, color (L*, a*, b*) and sensory analysis were done. The results of analysis were important for determining quality criteria and standardization of this traditional product. During the transition period to EU, it is necessary to found modern plants and improve the process of these traditional foods in hygienic conditions with preserving their original peculiarity.

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O10

Search for New Antioxidants: Problems and Prospects

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Key words: antioxidants, herbs, spices, berries, polyphenols

Search, characterisation and application of natural antioxidants remain in the focus of numerous research teams all over the world. The scope of information in this area is extremely large, diverse and rather difficult for systematic reviewing and assessment. For instance, search in the ISI WEB of Knowledge SM database by using keyword combination 'natural antioxidant' gave 7878 hits, including 767 review articles, while other major database PubMed gave 10391 hits including 1353 review articles (time of access 09/03/2011). The interest in natural antioxidants is determined by the universality of their action in various redox systems and consequently broad spectra of possible applications: antioxidative phytochemicals are considered as functional ingredients for pharmaceuticals, functional foods, dietary supplements and other uses. For instance, the interest in natural antioxidants for the stabilisation of lipid containing foods remarkably increased because of emerging information about possible toxicity of synthetic antioxidants as well as consumer preferences towards natural food additives. Herbs, spices, berries, seeds and other plant sources are an important source of natural antioxidants, however, their commercial application in the production of antioxidatively active ingredients for foods are restricted by several factors, particularly high production costs and stable availability of raw materials. Therefore, rosemary and sage preparations remain as the only examples of commercially produced antioxidants from herbs. More than 35 species were tested in our laboratory, including widely used culinary and medicinal herbs as well as much less studied plants. Their extracts and purified fractions containing various phenolic compounds were tested in chemical radical scavenging reactions and lipid containing model systems. Antioxidant and radical scavenging activities as well as the content of phenolic compounds of such materials varied in a very wide range, some of them were found to be promising ingredients with the potential to delay oxidative deterioration of lipid containing foods.

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O11

Diet and Redox Equilibrium of the Organism

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Key words: antioxidants, food, gene expression, prooxidants

Food components may affect the redox status of the body. We rely on the supply of exogenous antioxidants, which although present in relatively low concentrations, are essential components of our antioxidant defense. Food contains also prooxidants, including metal ions and redox-cycling xenobiotics.

Bioavailability of many of these food components (especially flavonoids and metal ions) is limited and consumption of meals or beverages rich in antioxidants brings about only slight changes of the non-enzymatic antioxidant capacity of blood plasma. However, the ratio of antioxidants and prooxidants may be important for the redox balance in the intestines, including the possibility of formation of reactive oxygen species and their reactions with the intestine walls.

More important than direct contribution to non-enzymatic antioxidant activity is the regulatory action of food components on proteins involved in the redox balance of the body: inhibition or stimulation of activities of enzymes and membrane transporters and activation/inhibition of transcription factors controlling the biosynthesis of antioxidant and prooxidant enzymes, enzymes involved in biosynthesis and metabolism of endogenous antioxidants. Thus, the effects of diet on the redox balance of the organism is much broader than a direct contribution of low-molecular weight food components to redox reactions in the body.

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O12

Composition and Antioxidative Activities of Supercritical CO_2-Extracted Oils from Seeds and Soft Parts of Northern Berries

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Key words: antioxidative activity, berry seed oils, fatty acids, supercritical fluids, tocopherols, tocotrienols

The present study investigated the composition and the antioxidative activities of oils from the seeds and the soft parts of a range of northern berries extracted by supercritical CO_2. The seed oils of the species of Rubus, Vaccinium, Empetrum, Fragaria and Hippophaë were rich in linoleic (18:2n-6)

and α-linolenic (18:3n-3) acids with n-6:n-3 ratios of 1:1–1:2. The seed oils of the species Ribes contained also γ-linolenic (18:3n-6) and stearidonic (18:3n-4) acids. In seed oils from European rowanberry (*Sorbus aucuparia* L.) and snowball berry (*Viburnum opulus* L.), linoleic and oleic (18:1n-9) acids together exceeded 90% of the total fatty acids. The sea buckthorn (SB) pulp oil had palmitoleic (16:1n-7), palmitic (16:0) and oleic acids as the major fatty acids. The SB pulp oil and snowball berry seed oil were rich in α-tocopherol (120 and 110 mg/100 g oil, respectively), whereas raspberry seed oil contained a high level of γ-tocopherol (320 mg/100 g oil). Seed oils of cranberry (180 mg/100 g oil), Arctic cranberry (190 mg/100 g oil) and lingonberry (120 mg/100 g oil) are rich sources of γ-tocotrienol. The berry seed oils and the SB pulp oil showed varying peroxyl radical scavenging efficacies (300-2300 μmol α-tocopherol equivalent per 100 g oil) and inhibitory effects on perioxidation of microsomal lipids (250--1200 μmol trolox equivalent per 100 g oil) *in vitro*. The peroxyl radical scavenging activity positively correlated with the total content of tocopherols and tocotrienols of the oils ($r = 0.875$, $P = 0.001$). The SB oils were active in scavenging superoxide anions produced by xanthine-xanthine oxidase system and inhibited Cu^{2+}-induced LDL oxidation *in vitro*. The SB oils also protected purified DNA and rat liver homogenate from UV--induced DNA oxidation in vitro. The results suggest potential of supercritical CO_2-extracted oils from northern berries as nutraceuticals and ingredients of functional foods.

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O13

Current Status of Nutrition and Health Claims in Europe

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Key words: health claims, Europe, Regulation 1924/2006, scientific substantiation, EFSA

Functional foods are closely associated with claims on foods. There are 2 categories of claims on foods: nutrition claims and health claims. Health claims on (functional) foods must be scientifically substantiated. In December 2006, the European Union published its Regulation 1924/2006 on nutrition and health claims made on foods [http://eur-lex.europa.eu/LexUriServ/site/en/oj/2007/l_012/l_01220070118en00030018.pdf]. As concerns scientific evaluation, the EU-project PASSCLAIM resulted in a set of criteria for the scientific substantiation of health claims on foods. The European Food Safety Authority provides the scientific advise to the European Commission for health claims submitted under Regulation 1924/2006 and has hitherto published several hundreds of opinions on health claims, part of which are positive, part which are negative and a few with insufficient evidence [http://www.efsa.europa.eu/en/nda/ndaclaims.htm ; http://ec.europa.eu/food/food/labellingnutrition/claims/index_en.html]. Antioxidant claims have been approved for the general function of vitamins but not for direct health effects in humans. Another issue with claims is consumer understanding. Consumers can hardly distinguish between graded levels of evidence, and they do make only little or no distinction between nutrition and health claims. Consumers understand nutrition and health claims different from scientists and regulators. Therefore, innovation in industry can readily proceed via approved nutrition claims and approved health claims. The market and the shelves in the stores will not be empty; rather they will look different in the years to come [1].

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POSTERS

Bioactive compounds: chemicals *vs* biological effects

P1

Haematopreventive Potential of Sun, Sulphited-Dried Apricot (*Prunus armeniaca* L.) and Its Kernel Against Ethanol Toxicity in Rats

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Key words: apricot, apricot kernel, protection effect, blood constituent parameters, Rrats

The present study was carried to effect of sun, sulphited-dried apricot and its kernel against perturbation induced by ethanol in adult male Wistar rats. The haematopreventive potential of the plant's supplementations were evaluated by measuring blood constituent parameters such as Red Blood Corpuscles (RBC), Hematokrit (HCT), Mean Cell Volume (MCV), White Blood Corpuscles (WBC), Hemoglobin concentration (HGB), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Platelet (PLT) counts. Eight experimental rat groups: I (control), II (20% eth-anol), III (ethanol+ 15% sun-dried apricot), IV (ethanol + 30% sun dried). V (ethanol + 15% sulphited-dried), VI (ethanol+ 30% sulphited-dried), VII (ethanol+ 15% kernel) and VIII (ethanol+ 30% kernel). According to the results, RBC, HCT, HGB and MCHC levels were increased whereas decreased MCV, WBC and MCH levels by ethanol. The cited parameters of III., IV., V., VI., VII., and VIII groups except for WBC were obviously normalized to their control values. This means that apricot attenuated the haematological perturbation induced by alcohol in treated animals as compared to controls. Thus, apricot appeared to be a promising agent for protection against ethanol toxicity.

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P2

Extract from Chicory (*Cichorium intybus* L.) Seeds Improves Glycemia, Atherogenic Index and Antioxidant Status in Rats

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Key words: chicory, caffeoylquinic acids, chlorogenic acid, rutin, the metabolic syndrome

The metabolic syndrome (MS) is a widespread diet-related disorder, defined as a cluster of interrelated risk factors for cardiovascular disease and type 2 diabetes. In the study we aimed to compare the effects of a high-fructose diet supplemented with rutin, a phenolic compound with well-recognized bioavailability and bioactivity, and a chicory seed extract rich in caffeoylquinic acids (CQA) on gut physiology and development of the MS in rats.

A 28-day experiment was conducted on 32 young Wistar males. In comparison with rats fed a standard corn starch diet (group C), the experimental group (group E) was fed a diet with an increased content of cholesterol and fructose, as well as with oxidized soybean oil. Rats from the other two experimental groups were administered the same diet as group E during the first two weeks of feeding, whereas at the beginning of the last two weeks, the diet was enriched with rutin or the CQA-rich extract from chicory seeds, so as the amount of added phenolics was equal in both dietary groups (0.15%).

The diet administered in group E caused hyperglycemia and increased blood serum atherogenicity, but did not induce other manifestations of the MS, *i.e.* dyslipidemia and oxidative stress. Similarly to rutin, dietary addition of the chicory seed extract improved glycemia, which was comparable to that determined in group C. In addition, the extract was found to decrease atherogenic index to the level observed in group C and to increase blood antioxidant status. Both dietary supplements reduced the content of thiobarbituric acid-reactive substances in a kidney and heart tissue when compared with group E.

The potential efficacy of the CQA-rich extract from chicory seeds in improving manifestations of the MS proved to be better than that of rutin, thus the extract might be considered as a dietary supplement for carrying out clinical trials.

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P3

The Effect of Buckwheat (*Fagopyrum esculentum* Moench) Sprouts and Groats Addition to High Fat Diet on Biochemical and Antioxidant Parameters of Plasma in Rats

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Key words: buckwheat, rats, antioxidant, high fat diet, biochemical parameters

This study was conducted to investigate the effects of buckwheat sprouts and buckwheat groats addition to high fat diet on biochemical and antioxidant parameters of plasma and blood reed cells in rats fed a high fat diet.

Buckwheat (*Fagopyrum esculentum* Moench) belongs to the *Polygonaceae* family and to the pseudocereals group such as amaranth and quinoa. It was known that the pseudocereals seeds *in vitro* and *in vivo* have high antioxidant properties and positively affect plasma lipid profile in rats.

As the material, freeze-dried buckwheat sprouts (8 day of germination) and buckwheat groats were used. The experiment was carried out with rats Wistar (three months old, males, *ca*. 250 g of body weight) fed for 5 weeks with either a high-fat (30%) diet or control diet with or without addition of buckwheat sprouts and groats.

After the duration of the experiment, blood was collected from the animals and plasma samples were prepared, then using biochemical analyzer Alize, concentrations of the following biochemical parameters: glucose, cholesterol, triglycerides, AST, ALT, ALP, urea, uric acid, albumin were measured. In all samples we measured the activities of the enzymes: glutathione peroxidase (GSHPx, Paglia and Valentine method), catalase (CAT, Aebi method), superoxide dismutase (SOD, Fridovich method) and also the levels of total and reduced glutathione. Additionally the activity of paraoxonase-1 (PON-1, Eckerson method), levels of protein carbonyl groups (PCO) and the concentration of malonyl dialdehyde (MDA) were investigated. The antioxidant potentials of plasma measured by FRAP method.

The growth in the quantity of fat in diet causes the growth of free radicals, lipogenesis and hypertriglyceridemia which leads to the development of insulin resistance of tissues and obesity.

Data suggest that buckwheat sprouts and groats exert a significant antioxidant potential which may be used in amelioration of oxidant-induced damage.

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P4

Content of Chosen Micro- and Macroelements in Diet of 1st Year Students of Technical University of Łódź

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Key words: macroelements, microelements, diet, nickel, sodium, potassium, iron, calcium, magnesium

Metal ions play crucial role in human metabolism. They play role in energy production, organism homeostasis and as building material. They are inevitably present in body fluids, in the cells, as elements of enzymes or in a free form, necessary for the functioning of human organism. Diet serves as their main source. Therefore, an imbalance in their participation in diet can result in metal ion deficiencies, which would have an impact on many aspects of human health.

Nutrition data was collected with one week diet survey on 1st year students of Technical University of Lodz, Faculty of Biotechnology and Food Sciences. Based on this research the content of several micro- and macroelements in students' diet was assessed. A particular attention was paid to the consumption of elements such as: calcium, magnesium, sodium, potassium and iron. What is more, an average daily consumption of nickel, the metal most frequently causing food allergy, was estimated. An attempt to find a correlation between diet and metal ions concentrations in blood plasma and cells was undertaken.

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P5

Effects of Red Wine Drinking on Total Polyphenol Content and Antiradical Activity of Oral Fluids

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Key words: red wine, polyphenols, antiradical activity, oxidative stress, oral cavity, saliva, crevicular fluid

Nowadays, epidemiological data indicate cigarette smoking and alcohol heavy consumption as the most important risk factors for oral squamous cell carcinoma. However, an independent role of certain alcoholic beverages, such as red wine, in oral carcinogenesis and other oral diseases is still under debate. It seems that the negative effects of ethanol and acetaldehyde, its major metabolite, may be balanced by polyphenols, bioactive compounds contained in grape skin/seeds and extracted during fermentation. Red wine represents one of the most investigated beverages, due to its increasing diffusion all over the world. Its benefits on oral health have been mostly related to the high content of polyphenol compounds; indeed, grape extracts have been proposed in caries and periodontitis prevention, providing a reduction in bacterial adherence on dental surface and growth. Antiproliferative/anticancer properties of grape extracts have been also investigated on oral-squamous cell lines. Therefore, moderate red wine consumption could potentially show a protective role against oral diseases, even if benefits of grape polyphenols, shown by in vitro studies, have not been confirmed by animal/clinical studies yet.

Our study focused on the effects of red wine on the antioxidant status of human oral cavity. Healthy volunteers were recruited to receive red wine obtained from selected grapes. Salivary and crevicular fluid samples were collected 15, 30, 60, 120 and 240 min after administration of 100 mL of red wine. Antiradical activity of oral fluids was measured by DPPH (2,2-diphenyl-1-pycryl hydrazyl) and ABTS [(2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)] radical-scavenging assays, whereas total polyphenol content was determined by the Folin-Ciocalteau assay.

The obtained results seem to indicate that red wine intake increases total polyphenols and enhances the antioxidant status of oral fluids. Moreover, our data suggest that acute red wine administration promotes the ability of oral cavity to defend against free radicals, increasing antioxidant efficiency of oral fluids. Despite further studies are needed to confirm this outcome, a regular, moderate consumption of red wine at meals, preferably associated to a healthy lifestyle, may play a protective role in the prevention of oxidative stress-related oral diseases.

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P6

Fate of Dietary Phytosteryl/-Stanyl Esters upon Digestion by Humans: Analysis of Intact Esters and Their Metabolites In Feces

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Key words: phytosteryl esters, phytostanyl esters, metabolites, *in vivo*, human, feces, hydrolysis

Phytosterols/–stanols and their esters exhibit cholesterol-lowering effects which are associated with a decreased risk of coronary heart diseases. Phytosteryl/-stanyl esters of ferulic acid and fatty acids occur naturally in cereals and vegetable oils. Several functional food products (*e.g.* skimmed milk yogurt drinks, margarines) enriched with fatty acid esters of phytosterols and- stanols are available on the European market. The mechanisms by which these bioactive compounds impart their effect are not completely elucidated. The hydrolysis of the esters appears to be a crucial step. In vitro data and animal studies indicate that the hydrolysis of these esters by digestive enzymes (*e.g.* pancreatic cholesterol esterase) depends on both the phytosterol structure and the acid moiety. So far, research in humans was confined to colectomized patients and the total fatty acid ester hydrolysis was only calculated by determination of the contents of free phytosterols/-stanols before and after saponification. Therefore, data concerning the hydrolysis of individual phytosteryl/-stanyl esters and a consideration of the impact of their molecular structure was lacking. The development of a gas chromatography-based approach allowed the quantification of individual intact phytosteryl/-stanyl esters and their metabolites in functional food as well as in biological samples like human feces. This methodology was applied to follow a randomized human study (n=15) in which skimmed milk yogurt preparations enriched with complex mixtures of phytosteryl/-stanyl esters were employed as substrates. For the first time, quantitative data regarding the metabolization of individual phytosteryl/-stanyl esters depending on their structures and the formation of metabolites in feces of healthy human subjects after oral consumption of foods enriched with complex phytosteryl/-stanyl ester mixtures will be presented.

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P7

Bioavailability of Anthocyanins From Red Cabbage Products

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Key words: red cabbage, anthocyanins, bioavailability, absorption, human metabolism

Anthocyanins are water soluble pigments which are responsible for the red, orange, blue colours of fruit and vegetables. Anthocyanins have a range of biological activities that may produce benefits to humans. However, to exhibit positive effects, anthocyanins have to enter the human systemic circulation. There are several factors that determine the content and bioaccessibility, and thus the bioavailability of anthocyanins. Among them, technological processes and manner of preparing the meals are important factors. Red cabbages are not always consumed in fresh forms. It is often subjected to technological and culinary processing, which may result in a partial changes of anthocyanins profile of the final products. The objective of this study was connected with determination of anthocyanins bioavailability from fresh, fermented, and stewed red cabbage.

In Poland, red cabbage is a good source of anthocyanins (6.7 μmol/g f.w.). In this study, twenty derivatives of cyanidin have been identified in red cabbage using HPLC-DAD-MS method. The core of the identified compounds was cyanidin 3-diglucoside-5-glucoside which sugar substituents were differently acylated. In a crossover study 14 volunteers after 3-day anthocyanins free diet and overnight fast were challenged with a dose of fresh and stewed red cabbage, providing 6.0 mg of anthocyanins/kg of body weight. Following the challenge, volunteers' urine were collected and anthocyanins and their derivatives content were measured with the HPLC-DAD-MS method. Up to 12 derivatives of cyanidin were found in the urine of volunteers. The highest anthocyanins urine excretion rate after red cabbage products consumption (above 100 nmol/h) was found within 1–2h after consumption. Along with time the excretion rate of anthocyanins urine decreased and within 12–24h time interval it was approximately 8.0 nmol/h. In total, within 24 h after consumption less than 1% of the ingested dose of anthocyanins from red cabbage products was excreted with urine.

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P8

Brassicaceae Derived Food and Feed Responsible for Low Level Thiouracil Residues

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Key words: 'natural' thiouracil, feed, livestock, digestion models, U-HPLC-HR-Orbitrap-MS

Since 1981 thyreostats have been banned in the European Union for fattening purposes in livestock. The rightful detection of their abuse is therefore crucial, not only for residue-analysis, but also for public health purposes, since thyreostats have been shown to exert carcinogenic and teratogenic effects.

Recent research has demonstrated the occurrence of the thyreostatic drug thiouracil (TU) in the urine of cattle upon feeding of a *Brassicaceae*-based diet [1]. These results raised the question of the possible semi-endogenous status of low level TU, which would imply the potential erroneous indication of the illegal use of TU. Some vegetables from the Brassicaceae family are known to contain precursors of goitrogens, namely glucosinolates. This well-defined group of secondary plant metabolites undergo enzymatic hydrolysis, upon plant disruption by myrosinase, a plant enzyme and, upon digestion by a similar enzyme produced by intestinal bacteria, releasing a range of breakdown products (nitriles, thyocianates, OZT's…). To this day, the exact pathway of TU formation remains however unknown.

Therefore, during this study a new method was developed allowing TU detection in feed and food matrices [2]. Subsequently, this newly developed method was applied to screen various Brassicaceae derived feed and food samples for the occurrence of natural TU [2]. In summary, broccoli, traditional rapeseed and rapeseed '00' coarse meal displayed the highest concentrations (5.98 μg/kg, 1.45 μg/kg, 1.59 μg/kg). Other samples yielded very low TU concentrations (<1.0 μg/kg) (cauliflower, rapeseed cake) or undetectable signals (feeding cabbage, feed 30% rapeseed '00') due to background noise. In a next step, the execution of in vitro bovine and porcine digestion models is foreseen to allow a step-by-step clarification of the formation mechanism of TU. Finally, U-HPLC-HR-Orbitrap-MS based identification of relevant metabolites should allow the characterisation of alternative biomarkers allowing to discriminate between natural formation and exogenous treatment.

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P9

Anti-Nutritive and Anti-Allergic Properties of Green Tea Extract Depend on Catechins Concentration and Processing

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Key words: catechin, green tea, food digestion, pepsin

Extracts of green tea, especially its major component, epigallocatechin 3-gallate, have profound effect on human health. Its potential impact on immunopathologies such as food allergies, have not been studied at the molecular level.

In this study, we have examined simulated in vitro digestion of several food allergens (beta-lactoglobulin, alpha-lactalbumine, 2S storage proteins of peanuts) in the presence of catechin-enriched extract of green tea, oxidized catechins and a polyhenol-oxidase processed mixtures of food allergens and green tea catechins. We studied tightly-bound catechins to food allergens following extensive diyalisis, as well as influence of catechins on CD3+/CD4+ cells proliferation and basophil activation to corresponding allergens in allergic patients.

Pro-nutritive and anti-nutritive properties of green tea depend on catechins concentration and the level of oxidation. Very complex network of condensed polyphenols and enzymatically cross-linked proteins survive in simulated digestion fluids with ten times extented half-lives of food allergen comparing to corresponding control reactions. Supression of Th cell proliferation in PBMC cultures occurs when catechins are present in culturing media, though the levels of IL-2 and IL--10 cytokines do not change. Basophil activation of allergic patients to corresponding allergens of cow's milk and peanut in a concentration-dependent manner was reduced in the presence of catechins.

Green tea catechins can have pro-nutritive and anti-nutritive properties, which depend on the level of oxidation and processing of polyphenols, may severely influence the faith of protein in the digestion process, and thus the dosage of the protein exposed to the immune system. Co-ingestion of green tea catechins and food allergens may lead to immunomodulation of the response to an allergen via different mechanisms: direct influence on immune cells via suppression of cell proliferation and basophil activation, but also availability and concentration of protein presented to the immune system.

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P10

Radical Scavenging Capacity of Cocoa Polyphenols Triggers Anti-Inflammatory Properties in Human Monocytes and Allows Protective Effects on H9c2 Cardiomyoblast Exposed to Oxidative Stress

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Key words: cocoa, clovamide, epicatechin, oxidative stress

Cocoa polyphenols might be considered an important functional mediator in the healthy diet. Recent researches have confirmed a beneficial effect of cocoa polyphenols on blood pressure, insulin resistance, and vascular and platelet function [1,2]. A range of potential mechanisms through which cocoa exerts its benefits on cardiovascular health have been suggested: activation of nitric oxide, antioxidant/radical scavenging and anti-inflammatory effects. Low and high molecular weight polyphenols of cocoa were previously confirmed acting as protective agents in some in vitro models [3,4].

Aim of this work was to confirm the existing link between radical scavenging properties of cocoa polyphenols (clovamide: (N-[3',4'-dihydroxy-(E)-cinnamoyl]-3-hydroxy-L-tyrosine); epicatechin and methanolic extracts from unroasted/roasted cocoa beans) and some positive benign effects. We consider human monocytes and H9c2 cardiomyoblast cell line exposed to oxidative stress as models. First, clovamide (and cocoa extracts, with minor activity) was showed to be a significant anti-inflammatory agent, limiting the superoxide anion production (maximum effect: 10–8M), decreasing the delivery of TNF-alpha pro-inflammatory cytokine and the nuclear translocation of NF-kB in human monocytes stimulated with phorbol myristate acetate.

We also investigated the capacity of clovamide, epicatechin and phenolic extracts to inhibit ROS (reactive oxygen species) release, induced by H_2O_2 in H9c2 cardiomyoblasts. The protection toward apoptosis induced by H_2O_2 was evaluated too. Both clovamide and epicatechin at micro-nanomolar concentration dramatically inhibit ROS release. Preliminary results confirmed that these polyphenols protect cells from apoptosis. It can thus be concluded that cocoa polyphenols act as functional bioactive compounds able to protect cells from oxidative injury, an acknowledged cause associated with different pathologies (particularly cardiovascular chronic diseases).

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P11

The Inhibitory Activity of Long-Chain Free Fatty acids on Lactic acid Bacteria, Yeast and Mould

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Key words: fatty acids, oils, antimicrobial activity

Lipids represent an important part of our diet. Besides their calorific value, some lipids include fatty acids that are essential nutrients. Lipids have been reported to have antimicrobial activity. However, their properties as potential preservatives of food products have not been fully explored. The antimicrobial activity of fatty acids and derivatives has been known for some time. Several investigations have demonstrated the inhibitory effects of these compounds on vegetative bacteria, yeast and moulds, viruses and tumour cells and bacterial spores.

The objective of this study was to determine the in vitro susceptibility of yoghurt starter culture bacteria (*Streptococcus thermophilus*, *Lb. delbrueckii* subsp. *bulgaricus*) and spoilage micro-organisms (*Kluyveromyces marxianus* and *Penicillium frequentens* to various fatty acids saturated (palmitic acid) and unsaturated fatty acids (oleic and linoleic acids) commonly present in vegetable oils. Linoleic acid was the most inhibitory fatty acid against *S.thermophilus* at 0–1.139 mmol/L at pH 6.9. Oleic acid showed slight inhibitory activity, palmitic acid had no effect against *S.thermophilus* at pH 6.9. The growth of *Lb. delbrueckii* subsp. *bulgaricius* was affected in the presence of linoelic acid at 1.139 mmol/L at pH 6.9, oleic and palmitic acids had no effect. The free fatty acids had no inhibitory activity against *K. marxianus* growth at pH 4 and 6.9. The *P. frequentens* growth was stimulated in the presence of free fatty acids at pH 4 and inhibited slightly at pH 6.9 by oleic and palmitic acids after 12 days incubation expressed as mycelia wet weight. The inhibitory effect of linoleic acid was greater than that of oleic acid.

The antimicrobial activity of free fatty acids seems to depends on microorganism, type, conjugation and concentration of free fatty acid, pH of medium and incubation time. It was concluded that the inhibitory effects of unsaturated fatty acids increased as the number of double bonds in the molecule increased.

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P12

Antimicrobiological Effects of Extracts from Cornelian-Cherry (*Cornus mas* L.) is Related to the Flavonoids Contents and Blood Antioxidant Properties

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Key words: antimicrobial activity, cornelian cherry, enzyme activity, antioxidants, LC/MS,

The growing resistance of many bacterial and fungal strains to antibiotics represents a severe problem in clinical microbiology. Factors such as inappropriate use of antimicrobiotic substances, their limited global pool and the fact that only two new classes of antibiotics (daptomycin and linezolid) appeared commercially in the market within the recent 30 years, persuaded us to search for new active substances.

Recent development concerning the discovery of compounds inhibiting degradation of insects by bacteria in digestive juice of plants belonging to Nepenthes family, can prove regarding the plant's potential as a source of substances with antimicrobiotic properties. There are published data which suggest that Cornelian cherry-derived substances may have antibacterial properties. This information was the basis and stimulus for our studies.

Cornus mas (Cornelian cherry) represents a rich source of phenolic antioxidants. It was suggested that Cornelian cherry has very high antiradical activity based on studies of extracts from this plant.

The aim of our study was the determination of relationship between: (1) composition of polyphenols contained in extracts, (2) antimicrobiotic properties of these extracts, (3) antioxidative potential, and (4) plasma indexes of oxidative stress that were measured by level of oxidative DNA damages, serum paraoxonase 1 (PON1), haemolisates superoxide dismutase (tSOD) and glutathione (GSH) level, lipid peroxide products (tTBARs), Ca, Mg, P by spectrophotometric

method and plasma K and Na content by atomic absorption spectrometry.

The study group consisted of six rats fed with the fodder enriched with liophylised Cornelian cherry from October through November (2009) and a control group consisting of six rats fed with a standard diet. Identification of polyphenols contained in Cornelian cherry plants was done by LC/MS assay.

The findings from this pilot study suggest that antimicrobial effect of cornelian's extract correlated with their antioxidant properties.

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P13

Phenolic Content Extracts Algerian Dates (*Phoenix dactylifera* L.) and Evaluation *In Vitro* of Their Biological Activity

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Key words: phenolics compounds, flavonoids, tannins, *Phoenix dactylifera* L., organic extracts, aqueous extracts, antimicrobial activity, antioxidant activity, haemostatic activity

Date palm fruit (*Phoenix dactylifera* L.) is produced in the Sahara regions and considered a great importance food for the people residing in this area.

Algeria, with its rich and diverse patrimony in date palms, more than 13 million palm trees and 940 varieties, a total production of dates estimated at 440 000 tones. Is one the largest producers of dates occupier the 7th place World (FAO, 2004).

"Deglet Noor" variety for its high nutritional quality and appreciation throughout the world is longer sold nationally and internationally. Common varieties represent 30% of national production are less important economic and intended generally to animal feed. The most widely used are: "Ghars Degla-Beida" and "Mech-Degla".

Various studies have been conducted to determine the chemical composition (sugars, proteins, fats, fiber, vitamins and minerals). However, studies on phenolics components are few and concern only a other varieties. These compounds acquire a increasing interest for their important biological properties and therefore require be further investigated.

The aim of our study was to quantify firstly phenolic compounds (total phenolics, flavonoids and tannins) present in organics and aqueous extracts of three Algerian date varieties, different by theirs consistency (Deglet Noor, Ghars and Mech Degla) and to evaluate *in vitro* the biological activity (antimicrobial, antioxidant and haemostatic) of these extracts. Total phenolics rate was greater for Mech Degla, followed by Deglet Noor and Ghars. The higher values of antibacterial activity were given by DCM extracts, but, alcohol extracts showed a stronger antioxidant activity. The haemostatic activity study showed a haemostatic effect of decoctions and an anticoagulant effect of concentrated decoctions. After that, some correlation tests between the two studied parameters: the content of phenolics and the biological activity of extracts were done and showed a possible role of these compounds in the biological activity.

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P14

Rosemary as Anti-Atherogenic Food Ingredient

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Key words: rosemary, supercritical extract, anti-atherogenic, anti-inflammatory

Nowadays, atherosclerosis, a chronic inflammatory based disease, constitutes the most important risk for cardiovascular complications. Atherosclerosis is normally related to an immune response to plasma oxidized low density lipoproteins (LDLs). Monocytes differentiated into macrophages internalize the oxidized-LDL and produce inflammatory mediators that are responsible for the atherosclerotic lesion.

In the present study, the anti-inflammatory activity of supercritical fluid extracts from Rosemary (*Rosmarinus officinalis*) was investigated. THP-1 macrophages activated by oxidized-LDL were treated with rosemary supercritical extracts and the expression of several inflammatory mediators (TNF-α, IL-1β, IL-6 and IL-10) was measured. Cells were also treated with pure standards of the main components presented in the extracts: carnosic acid, carnosol, 1,8-cineole and camphor, in order to relate the anti-inflammatoty activity with the extracts composition.

Rosemary extracts, mainly the extract with 32% of carnosic acid, significantly reduced the production of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) and increase the production of anti-inflammatory IL-10 cytokine. Among the standards, all presented an important reduction of the level of pro-inflammatory cytokines, although carnosic acid was the most effective. Comparing the anti-inflammatory capacity of extract with 32% of carnosic acid with this presented by the pure standard of carnosic acid, the extract presented a higher anti-inflammatory activity, indicating that this activity was not only related to carnosic acid.

These results suggested that rosemary supercritical extracts presents anti-inflammatory activity and could be used as a food ingredient with anti-atherogenic properties.

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P15

Sauerkraut Juice is Excellent Source of Glucobrassicin Degradation Products – Potential Anticancerogenic Agents

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Key words: ascorbigen, indole-3-acetonitrile, indole 3-carbinol, glucobrassicin, sauerkraut, sauerkraut juice

It is commonly known that a vegetable-rich diet lowers the risk of some cancers incidence in humans. The beneficial effect of Brassica vegetables including cabbage, cauliflower, broccoli and Brussels sprouts is contributed to the presence of sulfuric glycosides referred to as glucosinolates (GLS).

During processing of vegetables GLS undergo hydrolysis to yield variety of biologically active products. Glucobrassicin is one of main indole GLS occurring widely in plants of the genus Brassica. Immediate or secondary degradation products of glucobrassicin including: indole-3-acetonitrile (IA), indole 3-carbinol (IC) and ascorbigen (ASC), have been demonstrated to exhibit anticarcinogenic action by affecting cellular enzymes that participate in biotransformation of xenobiotics.

Our previous studies have shown that the sauerkraut is uniquely rich source of glucobrassicin hydrolysis products released during fermentation. However no data regarding these compounds content in sauerkraut juice were reported.

The objective of this study was to determine contents of IC, IA and ASC in samples of sauerkraut as well as in sauerkraut juice.

The experimental material were 7 samples of commercial sauerkraut. Each sample was divided onto sauerkraut residue and sauerkraut juice and analyzed separately. The content of ASC, IC and IA were determined with the HPLC technique.

The major product of glucobrassicin degradation in the sauerkraut and sauerkraut juice was found to be ASC. Its content ranged from over 2 to ca. 15 and from 5 do 28 μmol/100g for sauerkraut and juice respectively. Contents of IC, IA in sauerkraut and juice were similar and did not exceed 0.12 μmol. Results achieved in the study indicate that fermented cabbage juice rich in glucobrassicin degradation products can be the excellent source of potential anticancerogenic agents in human diet.

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Food composition

P16

Essential Oils as Active Ingredients in Soft Cheese

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Key words: essential oils, food-borne yeasts, food

Yeast *Candida rugosa, Debaryomyces hansenii* and *Saccharomyces cerevisiae* are one of the most common food contaminants. Their development in cheese and other fermented dairy products like yoghurt and kefir results in changes in food texture, color and flavor. Essential oils active against food-borne spoiling yeasts can help to develop natural, minimally processed food with extended shelf-life.

Aim of the work was to check antifungal activity of four essential oils: thyme (*Thymus vulgaris* L.), peppermint (*Mentha x piperita* L.), marjoram (*Origanum majorana* L.) and basil (*Ocimum basilicum* L.) against *C. rugosa, D. hansenii* and *S. cerevisiae* in soft cheese.

The food matrix was previously standardized and then contaminated by active yeasts suspensions up to concentration 106 CFU/g. Estimation of essential oils antifungal activity in soft cheese was conducted according to European Pharmacopoeia 5.0 regulation for "Efficacy of antimicrobial preservation". Antifungal activity of oils was also tested by bioimpedimetric and agar disc diffusion methods in vitro. Yeast strains originated from the Pure Culture Collection LOCK 105, Poland.

Minimal fungicidal concentration of oils varied from 0.1 to 5 μL/mL depending on the yeast strain. Antifungal activity of all oils tested in situ in soft cheese was considerably lower than *in vitro*. This effect can be explained by protective action of food components (*e.g.* lipids and proteins) as well as their interactions with essential oils constituents. Thyme, peppermint and marjoram oils in concentrations of 1 and 1.5% expressed high activity against the tested yeast strains stabilizing the food matrix within two weeks. Similar to in vitro tests, basil oil was the least active. The most and the least sensitive to essential oils were *S. cerevisiae* and *C. rugosa*, respectively. The obtained results prove that thyme, peppermint and marjoram oils due to their high fungistatic activity, can be used to aid stabilization of soft cheese acting both as natural preservatives and flavoring agents.

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P17

Essential Oil of Commercially Available Sage Drops

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Key words: sage drops, essential oil, terpene profile

Saliva officinalis (common sage) is a versatile plant. In the kitchen it is especially used as an aromatic spice. However, above all, it is part of natural medicine. Due to its antioxidant and antibacterial properties sage extracts or tinctures are applied orally or dermally.

For instance, besides the main use as tea, sage is also processed into drops. They are applied to alleviate oropharyngeal inflammations. Therefore, we investigated the essential oil contents and the terpene profiles of commercially available sage drops.

Additionally, on the basis of the terpene profile, possible conclusions of the sage species used were examined.

The results will be presented and discussed.

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P18

Organoleptic Evaluation of Whole Grain Wheat Dietetic Biscuits

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Key words: organoleptic evaluation, biscuits, whole grain cereals

Nowadays, developing functional confectionary products is important to develop a product with acceptable organoleptic quality regarding to appearance, taste, and texture as far is possible since those features are often the most important attributes for the consumer. Therefore, organoleptic evaluation was carried out on the dietetic tea biscuits based on wholegrain wheat flour additionally enriched with different raw materials or different pure fibers. For biscuits preparation, whole grain- and white wheat flour were used as basic flours (standard biscuit) and all modifications of recipe were on account white wheat flour. Added flours were oat-, barley-, buckwheat-, amaranth-, and soya full fat flour and added pure fibers were oat fiber or apple fiber. The organoleptic analysis of the biscuits was conducted by a five-member semi trained panel by method of pointing whereas examined characteristics were appearance, smell, structure and taste. All four organoleptic features were rated on a 1 – 5 intensity scale where 1 represents the lowest grade and 5 the highest one. A general acceptance score was given as a final result of all grades corrected with importance factor of each organoleptic feature. Results of the organoleptic evaluation of examined samples showed the most acceptable biscuits were standard biscuit and biscuit prepared with barley flour with an excellent grade quality, while pure fiber addition resulted with good grade quality. Organoleptic analysis of examined biscuits suggested that careful selection of health enhancing raw materials may ensure both, a functional and sensory agreeable product which could be widely consumed by all populations thus promoting healthy nutritional habits.

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P19

Analytical Investigation of Bioactive Components in Wheat and Wheat Based Products

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Key words: bioactive components, carbohydrate, arabinoxylan, gas chromatography

The importance of dietary fiber consumption in human health has growing evidence, but it is only in recent years that the role of it in preventing chronic diseases is being investigated. Numerous studies has been made on some components of the dietary fiber fraction (cellulose, β-D-glucans) whereas the function of other components as arabinoxylans (AX), galactomannans and arabinogalactan-peptides is less known. The variability of the amount and the rate of these components might be important for desirable raw material selection to produce cereal based products with improved nutritional quality. There are several methods available for the determination of the whole non starch polysaccharide content [1] however a reliable method for the quantification of them in a complex matrix is yet an analytical challenge.

In our study a gas chromatographic method based on the method of Gebruers *et al.* [2] was adapted, optimized and the effect of different analytical conditions – sample preparation, column type, injection parameters, temperature program *etc*. – were reviewed. Whole grain, bread flour obtained from different Hungarian wheat varieties and breeding lines, and pasta products were investigated with the optimised analytical process.

Results show that significant differences are existing among the pentosan content and the rate of pentosan components of different wheat varieties and even of the different

flour fractions. In case of processed food matrices, like pasta products we found a drop in the AX content during the processing, while during the cooking the amount of pentosan is stable. These results can contribute to select the more valuable wheat varieties in breeding process and also to develop milling and food products with enhanced nutritional properties.

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P20

A Pseudo-Cereal: Buckwheat

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Key words: buckwheat, proteins, flavonoids, nutritional value

Buckwheat is a traditional crop in Asia, and Central and Eastern Europe. It belongs to the family of Polygonaceae. Because of its seed resembles cereal grains structurally and chemically, it is usually handled and classed with cereals; however, there is no botanical relationship between buckwheat and other cereals. Buckwheat, a pseudo-cereal, is one of the most important alternative crops and a valuable raw material for functional food production due to its balanced amino acid composition (rich in lysine and arginine), high biological quality of protein, high contents of vitamins (B1, B2, B6 and E), minerals (P, Fe, Zn, K and Mg), polyunsaturated essential fatty acids, sterols, flavanoids rutin and fagopyratol. Phytochemicals and dietary fiber in buckwheat has a major potential as food ingredients, especially for functional and clinical food industry. Buckwheat doesn't contain gluten, so it may be use for patients with coeliac disease. On the other hand, resistance starch content of buckwheat has an important role for preparation of low glycemic index food.

The aim of this review is to inform about functional properties of buckwheat and its products.

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P21

The Contents of Selected Carbohydrates in Common Cattail (*Typha latifolia*)

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Key words: common cattail, glucose, fructose, sucrose, starch

Cattail is an edible plant, commonly found worldwide. Its use as a food source is a potential alternative, particularly for the populations in the Third World. The chemical composition of every plant is dependent on the conditions and environment of its growth.

The aim of the study was to determine the contents of selected carbohydrates (glucose, fructose, sucrose and starch) in cattail depending on the origin, season and morphological parts of plants.

The experimental material comprised common cattail (*Typha latifolia*), harvested in the winter and summer period from three water reservoirs, *i.e.* a pond in the Zielonka Forest (the Wielkopolska province), a lake and a fishing pond in Osieczna (near Leszno). Each of the harvested plants was divided into individual morphological parts (rhizomes, stems, leaves, spikes), and next the material was lyophilized and ground.

It was found that the contents of carbohydrates depended on season and anatomical part of common cattail. There was no influence found of the origin on it. Rhizomes involved the largest level of starch. The value ranged mainly from 60 to 70 g/100 g dried material, irrespective of the place and moment of harvesting. Considerably larger content, so of fructose as well as glucose, were received in all morphological parts of plant in material harvested in summer, than in winter period. However these values ranged from 4 to 7 g of fructose/100 g and from 3 to 6 g of glucose/100 g of dried material. The sucrose content was found only in rhizomes, within all collected material. Furthermore it was noticeably larger in material harvested in winter period (10–18 g of sucrose/100 g) than in summer period (6–9 g of sucrose/100 g of dried material). There was no other oligocarbohydrates found within all collected material.

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P22

The Fatty Acids SFA and UFA of Cold-Pressed Vegetable Oils

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Key words: acid profile, vegetable oils

The specific cold-pressed oils are the valuable source of fatty acids which are beneficial for human health. From a nutritional standpoint, the ratio of fatty acids C18: 3 (n-3) / C18: 3 (n-6) in tested oils influence its beneficial qualities. Among the studied groups of oils, definitely the biggest amount of n-3 fatty acid is found in walnut oil. Oils containing fatty acids n-3 series and oils containing GLA should be included in the daily diet. The content of oleic acid C 18:1, is the highest in hazelnut oil, approximately 77%. In the case of the walnut oil there were small quantities of the form of trans acid -C 18:1 (0.19%). In the group of polyunsaturated fatty acids the form of trans acid occurred in case of sesame oil in the amount of 0.71% of C 18:2 acid. The values of the ratio of polyunsaturated fatty acids to monounsaturated fatty acids ΣPUFA / ΣMUFA in the tested cold-pressed oils were the largest for poppy seed oil and walnut oil. This shows the greatest susceptibility to undergo oxidation by these oils. Fatty acid profiles can be used for classification of a given type of oil due to the MUFA and PUFA.

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P23

Comparative Study of Microelement Accumulating Characteristics of Microalgae

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Key words: Chlorella vulgaris, microelements, bioaccumulation, bioavailability, alginic acid, *in vitro* digestion model

Consumption of microalgae might be regarded as one of the key elements of nutrition of the future, as they are highly abundant in bioactive components. As a consequence examinations on fortification and enhancement of the original biological value of microalgae are in the forefont of interest. *Chlorella vulgaris* and *Spirulina platensis* are unicellular green algae, constituted the focus point of our research, being fairly frequent species available and purchasable in commerce. Emphasis was laid on investigation of extent of microelements' bioaccumulation in cases of (Fe(III), Cu(II), Zn(II), Mo(VI)), in growth media containing diverse amounts of the metals. Bioaccumulating capability *Chlorella vulgaris* was excellent in case of iron, which was studied with a two-week-long experiment in order to get information about the applicability of this alga species for production of functional food with enhanced microelement content. Metal-accumulating capacity of alginic acid being one of the major components of algae was also examined. Adsorption of Fe(II) to alginic acid was the weakest in comparison with copper(II), zinc(II), chromium(III) and chromium(VI).

For the estimation of bioavailability of the algae-bound metals, *in vitro* digestion model experiments have been performed, pointing out that the available amounts of Fe(II) and Zn(II) are considerably higher than that of Cu(II). The studied microalgae with high alginic acid content are suitable for application in microelement fortified functional foodstuffs due to observed pronounced bioaccumulating feature.

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P24

Variability of Macro- and Trace Elements Content in Winter Savory

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Key words: macro- and trace elements, variability, winter savory

Easy to grow, winter savory (*Saturea montana*) makes an attractive border plant for any culinary herb garden. It is most often used as a culinary herb but it also has marked medicinal benefits, especially upon the whole digestive system. The concentration of minerals in the plant are very important because the shortage of indispensable elements affect vegetative and reproductive stage of life cycle and is a cause of typical changes in plant life. Also, minerals are important for the human organism because they are involved in many enzymes and physiological function. Since the adoption of ions in plant can be affected by environmental factors the investigation of minerals content in winter savory was carried out on samples grown under the various topographical conditions in Croatia. After microwave digestion the macro- and trace elements content were determined by inductively coupled plasma-atomic emission spectroscopy (ICP-AES). Statistical analysis revealed that there are significant differences in the amount in all investigated minerals and depending on locality the variability within samples ranged for total ash content from 0.51 – 40.83%, macroelements Na 41.83 – 83.17 %, K 4.32 – 56.08 %, Ca 5.30 – 8.80 %, Mg 14.04. – 102.26 %, trace elements Fe 3.27 – 64.52 %, Zn 29.95 – 107.01 %, Cu 11.06 – 37.06 %, Mn 16.79 – 72.10 %, Al 16.82 – 118.02 %, Ni 14.56 – 113.34 %, B 13.71 – 59.89 %, Cr 31.73 – 108.36 % and Cd from 3.14 – 35.34 %. Revealed levels of toxic and po-

tentially toxic elements (Hg, As, Pb, Cd, Cu and Zn) were compared to valid Croatian Maximum Permissible Concentration (MPC) adjusted to EU regulations.

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P25

Vitamins B1, B2, B6 in Raw and Processed Buckwheat Sprouts

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Key words: buckwheat, sprouts, processing, thiamine, riboflavin, pyridoxine

Buckwheat sprouts are a rich source of vitamins, including water soluble vitamins from B group. Fresh buckwheat sprouts are crispy, with taste accepted by consumers. Since the production of buckwheat sprouts is easy, short and relatively inexpensive, they make an attractive dietary alternative.

In the present study the content of thiamine, riboflavin and pyridoxine in raw buckwheat sprouts and their products was studied. The impact of processing in elevated temperatures (*e.g*. pasteurization, homogenization and brewing with hot water) on these vitamins was monitored during preparation of sprouts preservatives, sprouts homogenate and buckwheat sprouts tea. The first product was made by adding a brine (pH 4.5-5.0) made of distilled water, salt, pepper, sugar and citric acid to 6-day buckwheat sprouts and it was pasteurized at 65°C for 25 min and stored in a closed jar for a week. To prepare homogenate 14-day buckwheat sprouts were poured with distilled water, homogenized and pasteurized at 65°C for 25 min. The last product, buckwheat sprouts tea was made by pouring 2 g of dried 14-days sprouts with 250 mL of hot water followed by infusion separation. Samples of all products were freeze-dried and stored at -20°C until further analysis.

In raw sprouts the content of vitamins from B group (B1, B2, B6) was determined. Their levels were dependent on the length of sprouting which was in turn determined by the kind of the product (sprouting for 6 or 14 days). The content of thiamine (vit. B1) ranged from 0.25 to 0.57 mg/100 g d.m., of riboflavin (vit. B2) from 0.47 to 0.67 mg/100 g d.m., and of pyridoxine (vit. B6) from 86.95 to 101.37 mg/100 g d.m. The product with the highest vitamin B content was buckwheat sprouts tea (0.36 mg/100 g d.m of thiamine, 0.44 mg/100 g d.m of riboflavin and 10.4 mg/100 g d.m of pyridoxine). The homogenate and preserved sprouts were less abundant in these vitamins but their content was still of significance. More details will be provided on the poster.

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P26

Evaluation of Vitamins B1 and B2, Soluble Proteins and Phytic Acid in Buckwheat Enhanced Wheat Bread

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Key words: buckwheat flour, dark wheat flour, buckwheat enhanced wheat breads, thiamine, riboflavin, soluble proteins, phytic acid

Wheat bread is an important part of the diet and the loss of vitamins during breadmaking process is an important nutritional issue. Furthermore, phytic acid content can also be modified. In this study, thiamine (vitamins B1) and riboflavin (vitamin B2), soluble protein and phytic acid contents in buckwheat enhanced wheat bread formulas, composed of dark wheat flour, unhusked common buckwheat flour, salt, yeast and water, was investigated. The buckwheat flour substituted dark wheat flour at amount of 10, 20, 30 and 50% w/w on total flour basis in bread formulas.

The buckwheat flour was almost twice richer source of thiamine, riboflavin and soluble protein, and almost threefold of phytic acid in comparison to dark wheat flour. As a result of the wheat flour substitution by buckwheat flour, the increasing content of B2, soluble protein and phytic acid but not B1, was observed in mixed buckwheat and wheat flours, being the highest at ratio of 1:1 (w/w) on total flour basis. Bread making which consists of mixing, fermentation and baking led to overall reductions of B1, soluble protein and phytic acid while B2 was generally stable in breads when compared to the respective flours. All buckwheat enhanced wheat breads showed comparable level of thiamine, riboflavin and phytic acid with dark wheat bread but they were richer in soluble protein. Among them, the only buckwheat enhanced dark wheat bread formulated on mixed buckwheat and dark wheat flours at ratio of 1:1 (w/w) contained the highest content of soluble protein. Our findings indicate that substitution of dark wheat flour by buckwheat flour in bread formulas had no impact on vitamin B1 and B2, and phytic acid content in buckwheat enhanced wheat breads. Therefore, further studies are necessary due to the presence of other biologically active compounds present in buckwheat flour such as flavonoids which may

confirm higher functionality of buckwheat enhanced wheat breads as compared to wheat ones.

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P27

Phytosterols and Sterol Esters in Diverse Pumpkin Seed Oils

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Key words: pumpkin seed oil, Δ7-phytosterols, phytosterol ester

Phytosterols are secondary plant products and occur in free and esterified form as natural ingredients of plant oils. Due to the Δ7-sterols mainly contained therein, they are significant for the prevention of prostate diseases [Strobl *et al*., 2004; Oelschlägel *et al*., 2007]. Besides synthetic drugs, herbal medicines are increasingly offered as dried kernels or concentrated ethanolic extracts of *Cucurbita pepo* seeds (*e.g.* "Prosta Fink® forte").

Until now, the pumpkin seeds of *Cucurbita pepo* have almost exclusively been in use. Only few data concerning the sterol content of other pumpkin seeds and, therefore, their applicability as herbal medicines are available. Furthermore, hardly any publication about phytosterol ester yields in different pumpkin seed oils can be found, even though there seems to be slightly better ingestion compared to free sterols [Jones *et al*., 2000].

Therefore, we isolated, identified, and quantified the free as well as the esterified phytosterols in different pumpkin seed oils. For this, a separation of the triglyceride fraction was necessary, which was achieved by using a modified silica gel cartridge. The obtained eluates were saponified and subsequently extracted with ether. The phytosterols were finally quantified as TMS derivates.

The sterol composition of the diverse pumpkin seed oils will be presented and discussed.

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P28

Fenugreek as a Source of Plant Sterols

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Key words: fenugreek, genotypes, phytosterols

Fenugreek (*Trigonella foenum-graecum* L.) is an annual herb from the *Papilionaceae-Leguminosae* family. It is generally cultivated in Mediterranean countries and India as a forage crop because of its high content of protein, vitamins, nutritious amino acid composition, and good digestibility by cattle. The seeds of fenugreek are known to have hypoglycaemic, hypocholesterolemic, gastro-, hepatoprotective and antioxidant properties, also stimulates lactation in women.

The seeds of nine fenugreek genotypes grown under the same conditions were used in the study. The lipids were extracted by Folch procedure and sterols separated on a DB-35MS capillary column using a Agilent 7890A gas chromatograph. Phytosterols were identified using a Finnigan Trace 2000 GC coupled to a Finnigan Polaris Q quadrupole ion-trap MS after separation on a DB-5 capillary column.

Different amounts of lipids were observed in all fenugreek genotypes. In lipids 21 phytosterols were identified. Their total content ranged from 14.2 mg/g to 18.8 mg/g of lipids. The amount and composition of individual sterols were affected by the genotype. β-Sitosterol was the main sterol in all samples, ranging from 5.6 mg/g to 8.9 mg/g of lipids. Campesterol and cycloartenol were the other major phytosterols observed and their respective content was 1.2–3.1 mg/g and 1.1–2.8 mg/g. These three sterols constituted from 56–72% of the total amount of all phytosterols. Results of the study show that fenugreek seed may be used as a source of nutraceuticals lowering blood cholesterol level in food applications.

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P29

Chemical Profiles of Wines Produced by Industrial Yeast Hybrids

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Key words: wine yeast, hybrids, acidic wines, L-malic acid

The problem of musts excessive acidity is still a concern of wine industry. In the search for acidic-proof wine yeast decomposing some organic acids, industrial yeast hybrids within *Saccharomyces sensu stricto* complex have been constructed.

The hybrids expressed accelerated L-malate decomposition anaerobically. L-malic acid is regarded as one of the dominant organic acids in fruit musts, so the hybrids usefulness for such acidic environment fermentation was tested.

The aim of the study was to examine chemical profiles of wine fermented by two intraspecific hybrids *Saccharomyces cerevisiae* (HG1–12, HG3–2) and three interspecific hybrids *Saccharomyces cerevisiae* × *Saccharomyces bayanus* (HW2–3, HW2–7, S779/25) in a model YG medium with 100 g/L glucose and 7 g/L L-malic acid. Yeast hybrids obtained by natural hybridization of selected industrial yeasts were deposited in the Pure Culture Collection LOCK 105, Poland. Fermentations were carried out in 110 ml medium in Erlenmeyer flasks during 7 days in 28°C. Chemical analysis were conducted by the HPLC method (citric, succinic, lactic and acetic acids, acetaldehyde, glycerol, diacetyl) and enzymatically (L-malic acid, ethanol).

The hybrids differed in deacidification activity, decomposing from 14.8 to 34.4% L-malic acid. The most effective was interspecific hybrid HW2–3, so its wine was characterized by the best ratio organic acids to sugars. The chemical profiles built by selected metabolites of yeasts were unique for a specific strain. Among organic acids tested, the citric acid was predominant in all wines. The wines were also characterized by elevated glycerol content, up to 20% comparing to the control medium without L-malic acid. The presented results showed that information about fermentation profiles of wine yeasts is useful in the right selection of yeast strain designated for the fermentation of acidic musts and it should be included in the strain collection certificate.

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P30

The Study of the Correlation Between Concentration of Carotenoids Separated from Spinach Leaves and Their Antioxidant Activity

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Key words: carotenoids, spinach, antioxidant activity

During plant leaves development and expansion, pigmentation increases to provide energy through photosynthesis. The physiological age of leaves directly influences colouration and energy production within the plant (leaves, fruits and rots) which is a result of changes in chlorophyll, carotenoid pigments and polyphenols concentrations. The increased colouration in vegetable and fruit tissues associated with maturity is often indicative of increases in especially carotenoid concentrations. Carotenoids indicate the antioxidant actions based on their singled oxygen quenching properties and ability to trap peroxyl radicals. The first one depends on the number of conjugated double bonds of the molecule and is influenced to a lesser extent by cyclic or acyclic carotenoid groups. Also, the nature of substituents in carotenoids are containing cyclic end group.

The antioxidant activity was expressed in percentage (%) RSA (radical scavenging activity). For the assessment of RSA of prepared extracts and reagent DPPH$^{\bullet}$ (1,1-diphenyl-2-picrylhydrazyl) were used.

The main aim of investigations was to determine the total antioxidant activity of extracts from raw and cooked spinach leaves. Besides one sample we obtained higher results of RSA for frozen spinach than for fresh spinach. RSA values for frozen spinach were obtained respectively 16.2 %, 30.3 % and 42.6 %. Otherwise, RSA obtained for fresh spinach did not exceed 19.8 %. Moreover, radical scavenging activity was evaluated for lutein solutions in concentration range of substance from 10 to 100 μg/mL. The less concentration of lutein in the solution gave RSA value 6.2 %, but for ten times higher concentration of lutein (100 μg/mL), obtained values of RSA did not exceed 10.0 %. Obtained results show that lutein as a component of spinach extracts takes an inconspicuous part of the total antioxidant activity of this plant extracts.

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Foodomics

P31

U-HPLC-MS/MS Analysis to Quantify the Antioxidant Content of Tomatoes Subjected to Different Cultivation Conditions

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Key words: tomato, lycopene, β-carotene, α-tocopherol, U-HPLC, MS/MS, liquid-liquid extraction

Tomato (*Solanum lycopersicum* L.) is one of the most popular and extensively consumed vegetable crops worldwide and is consequently fulfilling a key role in the human diet. Tomato constitutes an excellent source of health-promoting compounds including several antioxidants such as the carotenoids lycopene and β-carotene and the vitamins ascorbate and α-tocopherol.

Within this research the effect of salinity level on antioxidant content of tomato fruits was verified. To evaluate the effect of applied salinity treatments, chemical-analytical procedures for the quantification of the fat-soluble antioxidants lycopene, β-carotene and α-tocopherol were optimized.

The optimized extraction procedure was based on liquid-liquid partition and made use of ethanol and hexane. Although in previous papers mainly classical HPLC was used for chromatographic separation, in this study U-HPLC (equipped with a Hypersil GOLD column, 100 x 2.1 mm, 1.9 μm) was preferred. With this technique a significant reduction in analysis time from in general 45 minutes to only 6 minutes was achieved without any loss of chromatographic resolution. In comparison with the frequently used UV-VIS detectors, the usage of a triple quadrupole tandem mass spectrometer allowed a more certain identification of target analytes, due to the higher selectivity.

Optimized procedures were applied on tomato fruits, exposed to one of four salinity treatments (2.5, 4.0, 5.0 and 8.0 dS/m). Average concentration levels for lycopene, β-carotene and α-tocopherol were 50.02, 1.23 and 2.67 mg/kg respectively. Although certain trends could be identified, significant differences were not detectable.

Although the chemical-analytical procedures were successfully optimized and applied, the time consuming and labour intensive features of the extraction procedure were identified as major drawbacks. Therefore a new extraction procedure, based on the recent developed in-tube solid-phase micro extraction, will be optimized. This technique makes use of an extraction column and requires only small amounts of sample and is less solvent consuming.

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P32

Influence of Cultivation Conditions of White Cabbage on the Content of Bioactive Compounds

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Key words: cabbage, glucosinolate, antioxidative activity, cytotoxicity

Epidemiological studies supported by extensive research in human volunteers, animal models and cell culture systems have established the protective role of Brassica vegetables in several types of cancer. This protective effect is associated with the content of health-promoting phytochemicals, which in Brassica vegetables include glucosinolates (GLS) and their breakdown products as well as antioxidants. Their abundance, hence chemopreventive properties depend on cultivar, location and growing conditions. In Europe, owing to their availability in local markets, cheapness and consumer preference, Brassica vegetables may represent the most important foods implicated in prevention of civilization diseases. Therefore, the knowledge of factors influencing the content of health-promoting phytochemicals is of great social importance. The objective of the presented studies was to compare the content of the individual and total glucosinolates, antioxidant activity and cytotoxicity towards human cancer cells for three cultivars of white cabbage (*Brassica oleracea* var. *capitata*) grown in the Northern and Southern regions of Poland. Places of cultivation varied as regards agricultural aspects: organic and industrial cultivation, soil class, intensity of sunlight and risk of pest attack. The obtained results show that both cabbage cultivar and growing conditions have huge influence on the content of bioactive compounds. It is feasible that the cultivar selection could be tailored to specific environmental conditions at a particular location to maximize phytochemical content of Brassica vegetables and thereby to enhance the healthiness of the diet of human populations.

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P33

Influence of Conventional Growing Soils and Se-Fertilization on Vitamin C, Total Phenolics and Antioxidant Capacity of Broccoli

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Key words: broccoli, selenium, fertilization, vitamin C, phenolic compounds, antioxidant capacity

The consumption of Brassica species has been linked with a reduction of the risk of a number of cancers due to the presence of chemoprotective agents recognized as minor dietary components. Among them, vitamin C and phenolic compounds have biological functions centered on the antioxidant properties of food. On the other hand, it is well-known the role of selenium (Se) in prevention of chronic diseases associated with oxidative stress. Due to Se intake especially in most of the European countries is below RDA, the consumption

of Se-enriched foods is increasing markedly in recent years and one of the most practical approaches is the Se-fertilization. However, no data on vitamin C, total phenolics and antioxidant capacity of Se-enriched broccoli have been reported.

In this study, the content of vitamin C, total phenolics and antioxidant capacity of broccoli heads (*Brassica oleracea* L. var. *italica*) cultivated under conventional, different N-fertilized conventional and Se-fertilized growing soils, is reported. The following observations were made to the cultivation under different conventional soils: (1) there was no impact of commercial and N-different forms fertilized soils on vitamin C content in broccoli heads; (2) broccoli cultivated on soils fertilized with different forms of nitrogen such as $(NH_4)_2SO_4$, $NaNO_3$, NH_4NO_3 and $CO(NH_2)_2$ at level 160 kg N/ha showed higher content of total phenolic compounds when compared to those cultivated on commercial soil; (3) the same impact was noted for antioxidant capacity of broccoli heads evaluated by three different assays, being the highest for NH_4NO_3 fertilized soil. The following observations were made to the broccoli cultivated under Se-fertilized soils: (1) application of selenite or selenate at level 10 or 20 g Se/ha caused a decrease in vitamin C by average 33% when compared to commercial and N-fertilized soils; (2) differential effect of Se-fertilized commercial and N- fertilized soils on phenolics content and antioxidant capacity of broccoli there was observed; (3) employed selenate but not selenite offered higher total phenolic contents under Se-fertilized commercial soil whilst selenite at level 10 g Se/ha in $NaNO_3$ and NH_4NO_3 fertilized soils caused a weak increase of phenolic compounds; (4) employed selenite and selenate caused an increase of antioxidant capacity of broccoli which was depend on the type of N-fertilized soil. In general, cultivation of broccoli under higher doses of selenate and selenite fertilized growing soils provided broccoli heads of higher antioxidant capacity and phenolic contents depend on the type of N-fertilized soils.

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P34

Protein Content and Digestibility of Conventionally and Organically Grown Wheat Varieties

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Key words: protein content, protein digestibility, organic farming, wheat

Possible differences in the content of nutrients between organically and conventionally produced crops are still ambiguous, since observed differences are biologically plausible or can be attributed to differences in crop management or soil quality. That indicates a need for further high-quality research in this field so in the frameworks of such attempts this study, dealing with protein content and quality of organically and conventionally grown wheat, has been conducted.

The effect of organic and convectional farming methods (at constant inter row distance and seed rate) on the protein content and digestibility of eight wheat cultivars was studied in two growing seasons. Protein content was determined using the official AOAC (Kjeldahl) method, and protein digestibility was assessed using *in vitro* digestion with pepsin/pancreatin and determination of the nitrogen content in the indigestible residue using micro-Kjeldahl method.

Conventionally grown wheat grain had significantly higher protein content compared to organically grown grain (13.42 g/100g dry matter *vs*. 11.44 g/100g dry matter). In addition to farming method applied, climate conditions also significantly influenced grain protein content since significant differences were observed between two studied growing seasons. Protein digestibility was not affected by farming method applied nor by growing season; similar protein digestibility values were obtained for both organically and conventionally grown grains (81.43% and 82.74% respectively) in both observed growing seasons (82.25% in 2008. and 81.92% in 2009.).

Further investigations involving more wheat varieties, wider time frames and analysis of complete amino acid composition and availability are needed in order to supplement existing scattered evidence and provide new insights relating this interesting topic.

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P35

Biologically Active Components and Element Contents of Tomato Fruits Subjected to Water Stress and Foliar Application of Copper and Magnesium

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Key words: tomato, water stress, foliar application, antioxidants, micro and macro elements

The experiment was conducted on the Experimental Farm of the Department of Horticultural Technology at Szent István University, Gödöllő. The experimental field is brown forest soil, with mechanical composition of sand, sandy-clay and the subsoil water is below 5 m, therefore it cannot influence the water turnover. The experimental design was randomized block, number of replications were four for

each treatments. Brixsol F1 tomato variety was used. There were two different treatments: regularly irrigation, and control as unirrigation. Foliar applications were applied with 0.1% copper solution four times and 0.2% magnesium solution three times during the season, on regularly irrigated and unirrigated plants, as well. Red tomato fruits were collected at harvesting. Nutritionally important compounds as organic acids, carbohydrates, lycopene, total polyphenols, antioxidant capacity, and also element content were measured in the fruits. Regular irrigation resulted in significantly lower Brixo, carbohydrate and lycopene content, antioxidant capacity, magnesium, zinc, manganese, iron and phosphorous levels, but higher level of organic acids. Foliar application of copper and magnesium did not have any effect on lycopene, sodium, potassium and copper levels, as well. Foliar application of copper comparing to untreated plants resulted in a higher carbohydrate and lower dry matter content, organic acid, magnesium, zinc, manganese and phosphorous levels in fruits of regularly irrigated plants, while higher levels of organic acids, antioxidant capacity, and phosphorous levels and lower dry matter content, carbohydrates, magnesium, iron, zinc and manganese levels in unirrigated plants. Foliar application of magnesium had significant decreasing effect on organic acids, dry matter and polyphenol content in fruits of regularly irrigated plants, while magnesium levels increased both in irrigated and unirrigated fruits. From the data of these experiments it becomes clear that water stress as unirrigation has a favourable effect on the level of nutritionally active compounds and some microelements, consequently, using planned water supply and foliar application of microelements can modify the concentration of nutritionally important compounds in tomato fruits.

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Genetic Differences in Response of Sensory Components to the Varying Latitude and Weather Conditions in Sea Buckthorn (*Hippophaë rhamnoides* L.) Juice

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Key words: sea buckthorn, *Hippophaë rhamnoides* L., sugar, sugar alcohol, fruit acid, ascorbic acid, latitude, weather conditions

The study investigated the influence of latitude and weather conditions on the contents of sugars, sugar alcohols, fruit acids and ascorbic acid of sea buckthorn berries of different genotypes. Sea buckthorn berries of four subspecies and fourteen varieties were collected from fifteen natural growth sites in five years. The study provided important profiles of sensory components of sea buckthorn berries and integral information of the correlations between the berry composition and weather conditions.

Among the four subspecies investigated, the wild ssp. sinensis contained the highest levels of fructose (2.61 g/100 mL juice), glucose (2.74 g/100 mL), L-quebrachitol (0.56 g/100 mL), malic acid (4.60 g/100 mL) and ascorbic acid (0.87 g/100 mL) ($p < 0.05$). Citric acid (2.47 g/100 mL, $p < 0.05$) was highest in the ssp. *caucasica* × ssp. *rhamnoides*. Among the fourteen varieties studied, the berries of Chuyskaya were expected to be the sweetest and the most favored with the highest sugar/acid ratio (1.82) and the lowest total acid content (2.79 g/100 mL). In contrast, the berries of Terhi, with the lowest total sugar content (1.51 g/100 mL) and sugar/acid ratio (0.30), were supposed to be the sourest.

In the wild ssp. sinensis collected from six latitudes, the values of fructose, glucose, L-quebrachitol, methyl-myo-inositol, quinic acid, total sugar and sugar/acid ratio increased while the contents of malic acid, ascorbic acid and total acid decreased as the latitude increased. The other varieties/subspecies showed different trends in these values with respect to the varying latitude regardless of the small case number. However, an identically positive correlation between L-quebrachitol and growth latitude was observed in all the varieties investigated. Genotype affected remarkably the compositional response to the weather conditions in the berries. Among all the components, only L-quebrachitol and ascorbic acid showed negative correlations with temperature variables in all the genotypes.

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P37

Effect of Color, Season, Tissue Position on Contents of Glucosinolates in Cabbage (*Brassica oleracea*)

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Key words: temperature, homo-methionine, dihomo-methionine, sinigrin, glucoraphanin

The glucosinolates in 10 cabbage cultivars popularly consumed in Korea and China were identified and quantified. Nine glucosinolates synthesized from homo-methionine (glucoiberin, glucoiberverin, and sinigrin), dihomo-methionine (progoitrin, glucoraphanin, and gluconapin), phenylalanine (gluconasturtiin), and tryptophan (glucobrassicin, 4-methoxy glucobrassicin, and neoglucobrassicin) were detected. The contents of glucosinolates were affected by the season (spring- and fall-sown), the leaf position (inside and out-

side), and the cabbage color (green and red). The spring-sown cabbages contained significantly higher glucosinolates compared to the counterparts by 2.3∼4.3 times. The inner section of cabbages contained more glucosinolates than the outer one by 1.1∼1.8 times. These results suggested that the increase temperature induced glucosinolate production. The green cabbages contained significantly higher glucosinolates synthesized from homo-methionine whereas the red ones synthesized from dihomo-methionine, suggesting that the red ones had the activated enzyme producing dihomo-methionine from homo-methionine. The fall-sown red cabbages also contained significantly higher glucosinolates synthesized from tryptophan by two to three fold compared to the counterparts.

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Link Between Profiles of Bioactive Compounds Present in Strawberry Fruits and Leaves

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Key words: strawberries, fruits, leaves, bioactive compounds, antioxidant capacity

Strawberries are one of the most popular berries cultivated and broadly consumed all over the world. These fruits are characterised by a high content of polyphenolic compounds, mainly anthocyanins, flavonols, flavanols as well as derivatives of hydroxycinnamic and ellagic acid. Due to the composition of bioactive compounds, consumption of strawberries is linked to a risk reduction of many chronic diseases. However, composition of bioactives could differ in terms of strawberry variety, growing conditions, cultivation, and degree of ripeness. It is known that other parts of these fruits as rhizomes and leaves are also rich in polyphenolic compounds. Nevertheless, thorough data regarding the link between content of bioactive compounds present in strawberry fruits and leaves is still limited.

Therefore, in the present study extracts obtained by accelerated solvent extractor (ASE) of strawberry fruits and leaves originating from early stage of development of six strawberry cultivars (Lucy, Z6-T2–3 (Clery x Darselect) Selvik, Darselect, Diana, Clery) were analysed. Content of total polyphenolic compounds and total anthocyanins has been determined spectrophotometrically. Characterization and comparison of UV profile of polyphenolic compounds of respective samples has been performed by HPLC. Also, analysis of antioxidant capacity measured by TEAC ABTS has been performed.

Assessment and comparison of bioactive compounds present in early stage development leaves could possibly give helpful and valuable information for breeders for appropriate selection of strawberries rich in bioactive compounds of particular interest.

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Resveratrol in Shoots, Stems and Leaves of *Vitis vinifera*

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Key words: trans-resveratrol, viniferin, shoots, stems, leaves, analysis

Vineyards cover more than 8.000.000 ha worldwide, characteristically defining the landscape. There is scientific research on ingredients, at molecular biological levels and applied research on the crop itself and all kinds of outside influences.

For the concern of this study, influences on resveratrol concentration in vines, were of specific interest.

Trans-resveratrol (trans-3,5,4'-trihydroxystilbene) is a phytoalexine present in vines, peanuts and japanese knotweed (*Polygonum cuspidatum*) produced in plants under stress conditions. It is one of the most well-known stilbenes with its various oligomer components, the so called viniferins. These stilbenes are one of the most potent natural antioxidants. Recent research work shows the ability of trans-resveratrol to inhibit or delay a wide variety of diseases, including cardiovascular disease and cancer. Lipid peroxidation can be suppressed and stress resistance increased. The viniferins have hepatoprotective properties and can inhibit cytochrome P450 enzymes as well as monoamine oxidase activity.

Viniferins are well known in wine, but only little knowledge is available about their concentration inside the rest of the plant. A comparison of shoots, leaves and stems in the four main Austrian vine cultivars Blaufränkisch, Grüner Veltliner, Rheinriesling and Zweigelt was taken out. Great differences can be observed in the various parts of the plants showing the lowest amounts in leaves and the highest in stems.

The idea could be to produce a preserved extract of the stems stored in the dark and applied as an aid in organic farming as a anti-phytopathogenic agent with a broad spectrum against bacteria and fungi. There is a high potential in optimizing viticulture considering all aspects of a sustainable circular flow management followed by a decisive impact on health benefits of consumers.

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P40

Essential Oils of Different Salvias

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Key words: sage, essential oil, terpenes, thujone

Sage is popular for its manifold applications and has always been used in herbalism. Thereby, the terpenes contained in the essential oil are responsible for the characteristic flavor as well as for the antibacterial effect of the herb.

Of the genus sage, which belongs to the mint family, especially the robust Salvia officinalis, spp. is used economically in Central Europe. Besides the essential oil of common sage, the essential oils of Salvia lavandulifolia and *Salvia sclarea* are, for instance, used by pharmacy and by the perfume industry.

There are approximately 900 species known overall, although they have barely been investigated. For this reason we analyzed several salvias that were received from a botanical garden and an institute for agriculture.

The characteristic differences of the essential oil contents and the terpene profiles of the different species, in part investigated for the first time, were determined. In this context, we also compared the toxicologically relevant α-thujone yields among the diverse salvias.

The results of these inquiries will be presented and discussed.

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Food Metabolomics in the Post-Genomic Era: Specific Fingerprint and Biomarkers for Vegetable Oils and Fruit Juices

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Key words: food metabolomics, vegetable oils, fruit juices, LC/MS, FTIR, chemometry

Metabolomics is an emerging technology which fingerprint and realize the metabolic profile of a living organism or a food product, as a consequence of a cross talk between the genome-transcriptome-proteome complement and the influence of the environmental factors. Metabolic profiles of plants or food samples are comparatively cheaper to generate, than genomic profiles, if high-performance methods are applied: LC/MS or GC/MS, or MS/MS, Raman or FTIR spectroscopy [1].

Our studies were focused on the metabolic profiling of lipophilic (fatty acids, sterols and carotenoids) and hydrophilic (polyphenols, organic acids and vitamins) phytochemicals as biomarkers of metabolic profile, considering plants or plant-derived food, *e.g.* vegetable oils, fruit juices or botanical supplements [2,3].

Based on our experience in this area, we propose a specific metabolomic-metabonomic analysis (fingerprint and quantification) of some food products (fresh fruits, fruit juices and vegetable oils) made by an integrated four-steps analysis: UV-VIS-IR spectroscopy coupled with HPLC, LC-MS, FTIR and chemometry, a last step (using Unscrambled 10.1) which integrates previous analytical data by PLS and PCA analysis.

Some case studies (vegetable oils, fruit juices from different Romanian areas) are presented, including the data analysis by multivariate statistical approaches (PCA and PLS analysis).

Based on these four-steps analysis, specific predictions can be established for routine analysis of many plants or plant-derived foods, establishing data bases for each type of food product and then, supervising the biological and or geographical origin of different similar foods, or checking the technological modification of food quality by specific modifications of metabolic biomarkers.

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P42

A Comparison of Numerous *Cistus* Species and Subspecies – (II) Profiles of the Volatiles with SPME-GC/MS

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Key words: cistus, labdane diterpenes, SPME-GC/MS

The plants of the *Cistus* genus which grow widespread over the Mediterranean area and the Caucasus are used in folk medicine for the treatment of several diseases. Anti-inflammatory, antiulcerogenic, wound-healing, antimicrobial, cytotoxic, and antioxidant properties have been reported for the aqueous extracts and the remedies of the resin secreted from the stems and leaves.

In this study, the volatiles of the dried leaves and the aqueous extracts of 30 plants belonging to 19 different species and subspecies were analysed with SPME-GC/MS. The rather considerable differences in their profiles will be presented and discussed.

The corresponding HPLC profiles will be presented in another poster: A Comparison of Numerous Cistus Species and Subspecies – (I) Profiles of the Polyphenols with HPLC.

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Post-harvest treatment and food quality and safety

P43

Investigation of Acrylamide Formation in Vanillin-Asparagine Model System

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Key words: acrylamide, vanillin, Maillard reaction, heating, model system

The most important point of flavoring agents, applied to enhance or create the flavor of food products, must be non-toxic and not include risk factors during incorporation to food products. Vanillin is one of the most widely used flavoring materials. It contains a highly reactive carbonyl group and draws attention to acrylamide formation, a potential carcinogen in foods.

Previous studies demonstrated that asparagine alone may be converted thermally into acrylamide through decarboxylation and deamination reactions. On the other hand, asparagine, in the presence of reactive carbonyls, is able to generate remarkable amount of acrylamide at high temperatures via the Maillard reaction. This study aimed to understand the role of vanillin on acrylamide formation during its Maillard type condensation with asparagines during heating.

Model systems composed of asparagine alone and asparagine-vanillin were employed to investigate the potential formation of acrylamide during heating. In a tightly closed glass vessel, asparagine alone and equimolar amounts of asparagine and vanillin (0.01 mmol) were singly homogenized with silica gel and 100 μL of water to resemble thermal processing conditions of solid foods having limited water. Model reaction systems were heated at 100°C, 120°C, 150°C, 180°C and 200°C for different times to monitor the formation of acrylamide over time.

The results indicated that remarkable amounts of acrylamide were generated in vanillin-asparagine model systems after heat treatment. The highest amount of acrylamide was measured in the models reacted for 20 min at 200°C. In the absence of vanillin, 0.01 mmol of asparagine generated 7.68×10^{-6} mmol of acrylamide within 20 min of reaction. Addition of equimolar amount of vanillin into asparagines increased the amount of acrylamide formed in the reaction system to 1.03×10^{-3} mmol. The results revealed that vanillin is more effective than reducing sugars such as glucose during Maillard type condensation of carbonyls with amines leading to acrylamide.

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Roasting Affects Quality and Safety of Hazelnuts: Acrylamide, HMF and Computer Vision Image Analysis for Their Monitoring

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Key words: hazelnuts, acrylamide, HMF, Computer Vision Image Analysis

The roasting process contributes to the developing of Maillard-related compounds and to the consequent aroma development. Time, temperature, moisture and roaster type influence the quality and the safety of the hazelnut seeds. Moreover, some potentially toxic compounds were produced de novo during roasting. Recently, two neo-formed contaminants have gained interest because of their high toxicological potential: acrylamide and 5-hydroxymethylfurfural (HMF). Acrylamide (classified by IARC, Group 2A as "probably carcinogenic to humans") is a Maillard-related compound, principally resulting from the reaction of asparagine with reducing sugars. HMF, a furanonic compound which forms as an intermediate in Maillard Reaction as well as from direct dehydration of sugars in acidic conditions (caramelisation), is a widespread heat-induced contaminant in roasted seeds, showing genotoxicity and mutagenicity. HMF is currently used as thermal marker by Maillard Reactions in many foods.

In this study, acrylamide and HMF were evaluated in samples of Tonda Gentile Trilobata cv, roasted in a conventional oven under different conditions of time/temperatures. Simultaneously, the Computer Vision Image Analysis (CVIA) was applied on the study of the colour development, both on the surface and in the inner part of the sectioned seeds, in order to correlate the colour development with acrylamide and HMF.

Acrylamide formation followed a characteristic sharp bell-shape profile, and its concentration reach a maximum of 200 ug/Kg. HMF was recovered in roasted hazelnuts from traces to more than 120 mg/Kg. The colour analysis (Red/Green/Blue computerized analysis of both superficial and inner colour on a pool of roasted seeds) confirmed a reversed correlation between the Red colour component and HMF formation.

Finally, this work confirmed the presence of both acrylamide and HMF in roasted hazelnut, suggesting the CVIA as useful tool to monitoring roasting degree.

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Mitigation of Acrylamide Formation in Biscuits by Different Baking Applications

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Key words: acrylamide, biscuit, baking, Maillard reaction products

During thermal processing of bakery products several reactions occur correlated with sensorial properties. Acrylamide is formed via Maillard reaction (MR) between asparagine and carbonyl compounds at elevated temperatures. The desired consequences of the MR share intermediates with acrylamide formation. Hence, surface browning and flavor formation can be negatively affected as a result of acrylamide mitigating strategies. While reducing the acrylamide content of biscuits, quality parameters should be unaffected to meet consumer perception.

The aim of this study was to mitigate acrylamide formation in biscuits by reducing the thermal load. Decreasing thermal load during baking also decreases acrylamide level, however it also results in insufficient surface browning and flavor development. By adding Maillard reaction products (MRP) to dough as a food grade additive, desired sensorial properties (aroma and color) could be achieved during baking under lower thermal load conditions. Since baking process is simply a drying operation, by ruling out MR, biscuits were baked at different temperatures (170–205°C) and time (11–15 min) to obtain required moisture content (<10%) in the final product. Several MRP systems were tested according to achieve desired sensorial properties. Decreasing the temperature from 205°C (for 11 min) to 170°C (for 15 min) acrylamide level of biscuits was reduced 30% without any significant change in color. Additionally, modifying the recipe by eliminating ammonium bicarbonate resulted in remarkable decrease in acrylamide level. The results demonstrated that eliminating ammonium bicarbonate and decreasing the thermal load, acrylamide formation could be eliminated up to 80% in biscuits without any significant change in sensorial properties.

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Impact of Rye Flour Replacement in Ginger Cakes by Buckwheat Flour on Acrylamide Formation

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Key words: acrylamide, ginger cakes, buckwheat flours

Gingerbread, ginger cakes or ginger biscuits are characteristic sweet cereal products for many European countries that represent an important source of acrylamide exposure from the diet due to relatively high content of this processing contaminant. Acrylamide is a chemical compound which is formed during heat treatment of the wide range of starchy food products. According to the International Agency for Research on Cancer (IARC) acrylamide is classified as a probable human carcinogen of the group 2A and for that reason FAO/WHO recommends to minimize its content in food products.

In the present study the impact of the replacement of 30% portion of rye flour by buckwheat flour in general recipe of ginger cakes on acrylamide content was investigated. Two different types of buckwheat flour were applied. The first light buckwheat flour was produced from unhusked common buckwheat (*Fagopyrum esculentum* Moech) at an ecological farm, whilst the second one was obtained after milling of roasted common buckwheat groats. In the control ginger cake formulated only with rye flour acrylamide content was 466 μg/kg. In ginger cake with buckwheat flour addition the final content of acrylamide was lowered to 258 μg/kg and 239 μg/kg in samples with light flour and that one obtained from roasted buckwheat groats, respectively. Amino acids analysis revealed that buckwheat flours represented low-asparagine source (39 mg/kg in light flour and 40 mg/kg in flour from roasted groats in comparison to rye flour (383 mg/kg) which consequently led to almost 50% acrylamide reduction. Moreover, it was obvious that neither asparagine content nor acrylamide formation in ginger cakes were affected significantly by roasting process of buckwheat. It could be possible that flavonoids such as rutin (quercetin-3-rhamnosyl glucoside) and quercetin as well as other substances with antioxidant properties present in flour obtained from raw and roasted buckwheat groats contribute to acrylamide mitigation.

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Comparison of Acrylamide Content in Ginger Cakes with Different Kinds of Spices

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Key words: acrylamide, antioxidant capacity, ginger cakes, buckwheat

Acrylamide is an undesirable contaminant of thermally processed foods. The content of acrylamide in foods can be reduced by an application of substances allowing an effective elimination of acrylamide in foods. Several recent studies suppose that some antioxidants inhibit acrylamide formation.

The aim of this study was to compare the impact of spices such as clove, cinnamon, allspice, white pepper, coriander, star anise, anise, fennel, nutmeg, cardamom and vanilla in ginger cakes with addition of light flour or flour from roasted buckwheat groat on acrylamide formation. These spices are usually used as components of commercial spice mixes for ginger cake home preparation.

A huge diversity of the impact of particular spices on acrylamide formation in ginger cakes with light flour or flour from roasted buckwheat groat was observed. It was proved out that only anise, white pepper, clove and vanillin reduced acrylamide unambiguously (max. 20 %). On the contrary, coriander and cinnamon promoted acrylamide formation up to 20–50%. Star anise did not affect the acrylamide content. Other spices such as fennel, cardamom, nutmeg and allspice provided inconsistent results.

The present study was intended to the potential use of some spices as suppressors of acrylamide formation, but the effects of selected spices on the final acrylamide content described herein merit a further study.

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Nutritional and Sensory Evaluation of Breads Supplemented with Grape By-Product

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Key words: sourdough mixed rye bread, grape by-product, dietary fibre, phenolic compounds

As the role of diet in the prevention of non-communicable diseases has become more evident, consumers are seeking to improve their diets through variety and healthier food choices; therefore, the food industry and researchers have to continuously improve the variety, quality, taste, and availability of food products such as bread. The grape is one of the world's largest fruit crops, whereof about 80% of the harvest is utilized for winemaking. Grape by-products, which remain after processing, still contain a huge amount of secondary metabolites including phenolic acids, flavanols and anthocyanins.

The aim of the present work was to evaluate the chemical and properties of breads supplemented with grape by-product (GP).

Sourdough mixed rye breads were prepared with the addition of powder made from GP skins at various levels (4, 6, 8 and 10% flour basis). The chemical composition of GP and breads, dietary fibre, ash content, total phenolic compounds, HPLC identification of the phenolic compounds and the antioxidant activity were investigated. In addition, specific volume, sensory characteristic and texture were analyzed.

GP were good sources of bioactive compounds, estimated at the level of 58.95 mg of GAE/g dry starting material, high level of dietary fibre (50.93%) and strong antioxidant activity. Profiles of phenolic compounds of supplemented breads were dominated by procyanidin B1 and B2, catechin, epicatechin, caffeic acid and myricetin. The assay of radical scavenging activity and reducing ability showed that GP addition greatly enhanced antioxidant properties of mixed rye breads. With an increase in the level of GP, the hardness and gumminess of the bread significantly increase. Sensory evaluation of GP enhanced breads revealed that a maximum of 6% GP could be incorporated to prepare acceptable products.

Hence, development and utilization of such functional foods will not only improve the nutritional status of the general population but also helps those suffering from degenerative diseases.

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Detection of Total Phenols, Essential and Toxic Elements in Latvian Whole Grain Bread

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Key words: essential and toxic elements, whole grain bread, flame photometry, FAAS, ETAA, total phenols, spectrophotometry

In this work we represent the results of our survey, which was carried out with the aim of assessing the level of some essential (Na, K, Ca, Mg, Cu, and Zn) and toxic (Cd and Pb) elements in 10 Latvian whole grain rye and/or wheat flour bread samples, which were obtained from local market. The quantities of minerals were determined using flame photometry (Na, K), flame atom absorption spectrometry (FAAS; Ca, Mg, Zn, Cu) and electrothermal atomic absorption spectrometry (ETAA; Pb and Cd) after wet digestion in concentrated HNO3. In addition, moisture and ash content in bread samples were determined. These values were comparable to the literature data. The mean content values in all the samples were (on a basis of product weight) 556±99 mg/100g for Na, 283±58 mg/100g for K, 32±5 mg/100g for Ca, 88±12 mg/100g for Mg, 0.49±0.24 mg/100g for Cu, 1.44±0.34 mg/100g for Zn. Both Pb and Cd were determined below the level of 0,10 mg/100g. Limit of detection (LOD) values were determined for each element. The calculated mean levels of elements were compared with the recommended or regulated maximum levels according to the national legislation.

Whole grain bread, vegetables and fruits are major sources of antioxidants. These substances have properties, which are beneficial for human health. It is known that antioxidants are represented mainly by phenolic compounds, which are concentrated in grain parts such as the bran fraction.

Total phenol content in 10 Latvian whole grain bread samples was detected by spectrophotometry using the Folin-Ciocalteu reagent.

The mean values for phenols in bread samples were ranging from 141.7±0.2 to 607.8±0.2 mg/100g. The results showed, that whole grain bread also was rich in antioxidants as Latvian carrots, beet, pumpkins, radish, potatoes.

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Influence of the Buckwheat Bread Formulation on the Viability of *E. coli* and *P. aeruginosa*

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Key words: buckwheat flour, buckwheat enhanced wheat breads, bread formulation, microbial viability, *E. coli, P. aeruginosa*

E. coli and *P. aeruginosa* are two microbial species affecting foods. *E. coli* is to date, the most well investigated cause of intestinal infectious diseases, and there are many strains with specific virulence factors which cause disease in humans. It is also known that *P. aeruginosa* can cause spoilage of foods at low temperatures, because it is a psicrophilic microorganism. Therefore, these microorganisms compromise both human health and food quality. Nowadays, there is an increased interest for healthier and safety foods for achieving the well being of the food consumers. Bread is a fundamental daily dietary food. Buckwheat bread has been recently received much more attention because it is rich in many bioactive compounds such phenolic compounds like rutin and its metabolites.

The present investigation aimed to evaluate the effect of buckwheat bread formulation on the microbial viability of those microorganisms that may affect both human health (*E. coli*) and food quality (*P. aeruginosa*). The study also intended to gain insight on the contribution of rutin to this property if so. To achieve this goal the effect of different food concentrations of pure rutin as well as two buckwheat flours and four buckwheat enhanced wheat bread samples on the microbial viability was tested. Rutin concentration in food samples was determined by RP-HPLC. Rutin was detected in all samples based on buckwheat. Results seem to indicate those breads prepared mixing wheat and buckwheat negatively affect the viability of both *E. coli* and *P. aeruginosa*. Pure rutin in food concentrations also showed a similar effect in a dose depending manner. Therefore, it may be suggested that buckwheat enhanced formulation may contribute to bread conservation, also increasing the antimicrobial properties of bread. The choice of some ingredients could offers great potential to modulate the bread composition to much better technological and functional properties.

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Pyrrolizidine Alkaloids

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Key words: pyrrolizidine alkaloids, health risk, standard components

Pyrrolizidine alkaloids (PAs) are secondary plant compounds with carcinogenic and genotoxic properties [Mattocks *et al*., 1986]. More than 600 PAs are currently known with a vast structural variety [Chen *et al*., 2010]. They are found in the families *Boraginaceae* (*e.g. Echium* spp.), *Asteraceae* (*e.g. Senecio* spp.), and *Fabaceae* (*e.g. Crotalaria* spp.).

Indigenous PA containing plants are for example Ragwort (*Senecio jacobaea*), Viper's Bugloss (*Echium vulgare*), Borage (*Borago officinalis*), and Coltsfoot (*Tussilago farfara*).

All the PAs that contain a 1,2-double bound in the basic structure (necine) and show an esterification of at least one of the hydroxyl groups in C7 or C9 position with a branched chain acid (necic acid) are protoxins [Crews *et al*., 2009].

These Pyrrolizidine alkaloids are able to react with hepatic P450 enzymes to toxic pyrroles [International Program on Chemical Safety, 1988].

Contamination of animal feed, herbal teas, and honey with seeds or parts of PA containing plants is a serious threat and health risk to consumers.

However, only a few Pyrrolizidine alkaloids are commercially available and could be used for analytical methods. Therefore, our study describes the isolation and characterization of toxic Pyrrolizidine alkaloids from different plants.

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Pyrrolizidine Alkaloids in European Honeys and Honeys from Overseas

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Key words: pyrrolizidine, PA, honey, pollen

Pyrrolizidine alkaloids (PAs) are produced by plants as secondary me-tabolites for protection against herbivores. Contrary to *e.g.* antibiotics and pesticides, PAs are of purely natural origin. Those PAs containing a double bond in 1,2-position are potentially toxic to the liver and are under suspicion to cause cancer.

PAs may potentially occur in a range of foodstuffs, *e.g.* milk, eggs, flour and also in honey. Honey bees collect nectar and pollen from a wide range of plants, including PA-containing plants, from which they transfer PAs into honey. Up to now, there are no official PA-limits for PAs in foodstuffs.

More than 500 honey samples from Europe and more than 4000 samples from some 20 countries outside Europe were analysed for this study. The PAs were extracted by means of solid phase extraction. Separation of PAs was achieved by using HPLC. A triple quadrupole mass spectrometer in MRM-mode (multi reaction monitoring) was used to detect and quantify the PAs. Fragment spectra were obtained for identification of PAs by performing Enhanced Pro-duct Ion (EPI) scans.

The results show that 69% of all raw honeys (bulk honey not yet packaged in containers for sale in retail outlets) were PA-positive. The sum of the analysed PAs ranged from 1 μg/kg to 2334 μg/kg. Moreover, very different PA patterns were observed, depending on geographical and botanical origins of the honey samples. First results on the relationship between the amount of PAs and the abundance of pollen of some PA plants in the honey samples will be presented as well.

PA-concentrations (sum of PAs) in PA-positive honeys available in supermarkets (retail honey) were between 1 μg/kg and 267 μg/kg. 93% of the retail honeys contained PAs.

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Pyrrolizidine Alkaloids in Honey from Switzerland

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Key words: pyrrolizidine, honey, Switzerland, Echium

Studies on honey of various provenance have shown that honey may contain pyrrolizidine alkaloids (PAs) and therefore can be a potential health risk for consumers. To assess the contamination of Swiss honey with PAs, we analyzed 69 honeys of the production years 2009 and 2010. The honeys were collected from diverse climatic areas of Switzerland, including regions north and south of the alps as well as the alpine regions. The honeys were of various botanical origins, mainly of polyfloral and honeydew types. The PA concentration of the honeys was determined by target analysis using an HPLC-MS/MS-system, allowing the detection of 18 different PAs and PA-N-oxides found in the genera Echium, Eupatorium and Senecio. 53% of the honeys contained PAs, while in 47% of the honeys PA concentrations were below the limit of quantitation (LOQ). The LOQs ranged from 1 μg/kg to 3 μg/kg, depending on the PA. The average PA concentration of the positive samples was 7 μg/kg. The highest concentration of PAs (55 μg/kg) was found in a honey from Ticino, an area south of the alps. All the other positive honeys contained

PAs at concentrations below 20 μg/kg. Honeys from Swiss alpine regions (19 out of 21) and areas south of the alps (7 out of 11) tested more frequently positive for PAs as compared to honeys from areas north of the alps (11 out of 37). This probably reflects the different botanicals settings of the northern and southern part of Switzerland.

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Procedure of Determination of Multiresidue Pesticides in Honey Based on Acetonitrile Extraction and Liquid Chromatography–Tandem Mass Spectrometry

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Key words: pesticides, honey, QuEChERS, multiresidue methods

Pesticides are widely used in agricultural practices for pests and diseases control. Slow degradation of pesticides in the environment and extensive or inappropriate use by farmers can lead to the contamination of various ecosystems. The widespread distribution of pesticides caused several problems to apiculture industry. Honey bees are greatly affected by pesticides and transport them to the colony as contaminated nectar which ends was a contaminated honey. These residues finally get to the consumers. This constitutes a potential risk for human health, because of their subacute and chronic toxicity. It is a reason why one of the quality control parameters of honey is the level of residues pesticides. As a consequence of this aspect the control is a growing interest in developing analytical methodologies specifically designed for this type of analysis.

In this work, analytical method employing liquid chromatography–tandem mass spectrometry (LC–MS/MS) with electrospray ionization (ESI) for the simultaneous determination of 37 pesticides in honey was optimized. Sample preparation approach based on acetonitrile extraction followed by dispersive solid-phase extraction (d-SPE) cleanup step was validated according to Method Validation and Quality Control Procedures for Pesticide Residue Analysis in Food and Feed (SANCO/10684/2009). The procedure involved homogenization of a 1 g sample with acetonitrile–water mixture followed by salting out with citrate buffer, magnesium sulphate and sodium chloride. Hereafter, d-SPE technique was carried out using primary secondary amine (PSA) and magnesium sulphate. This combination of cleanup steps ensured efficient extract purification. The recoveries was observed for most analytes and ranged between 70 and 120% (relative standard deviations <20% in most cases). Linearity of the calibration curves was studied in the concentration range between 2–500 ng/g. The method limits of quantification were ranged between 2.31–75 ng/g, which provides the possibility to use this analytical procedure to analysis of real samples.

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The Effect of PUFA Containing Seeds on Quality of Rice Cakes

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Key words: polyunsaturated fatty acids (PUFA), food enrichment, omega-3, omega-6, lipid oxidation, food quality

Food enrichment in polyunsaturated fatty acids (PUFA) is consistent with actual trends in food production. Growing interest in sources of omega-3 and omega-6 acids is a result of consciousness of their bioactive role in human organism. Rice cakes with addition of PUFA containing seeds meet consumers' requirements concerning health, convenience and pleasure.

As unsaturated fatty acids are susceptible to oxidation there is a concern if addition of PUFA containing seeds could cause the degradation of oxidative stability of rice cakes and result in overall quality decrease by influencing sensory, nutritive and safety aspects.

The aim of the present study was assessment of the effect of some oily seeds containing omega-3 and omega-6 fatty acids on quality of rice cakes in aspect of oxidative stability.

The material were rice cakes with flax-seed and evening primrose (4.5 g lipids including 1.3 g of monounsaturated (MUFA) and 2.4 g of PUFA/100 g). As a reference product the "Natural rice cakes" were tested (2.9 g lipids incl. 1.0 g MUFA and 1.2 g PUFA /100 g). The measure of oxidative stability was content of hexanal, a product of linoleic acid deterioration. The samples were stored at 20°C and 40°C and analyzed after 2, 3 and 6 months. Hexanal formation was monitored by the static headspace GC analyses on the Varian 3800 equipped with an FID detector and autosampler Tekmar 7000.

The addition of oily seeds resulted in the adverse oxidative processes in rice cakes. The level of hexanal tripled in comparison to period 0 to level 5.9 ppm after 3 months-period storage at 20°C whilst in natural cakes doubled. At 40°C the hexanal content was properly 31.0 and 4.6 ppm. The extension of storage time resulted in progressive oxidative processes.

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The Influence of Powdered Rosemary on the Quality of Fish Oil During Storage

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Key words: fish oil, rosemary, antioxidant activity

The health benefits resulting from consumption of fish oil are well known. Fish oils are rich sources of n-3 polyunsaturated fatty acids (PUFA) – DHA (docosahexaenoic acid) and EPA (eicosapentaenoic acid). PUFAs have an important role in the prevention and treatment of coronary heart disease and autoimmune disorders. However, PUFAs are very susceptible to oxidation. Oxidation of lipids not only produces rancid odours and flavours, but can also decrease the nutritional quality and safety of the food product. Use of antioxidants is one of the methods that prevent lipid oxidation. In recent decades the interest in natural antioxidants increased, as an alternative to synthetic compounds. One of the natural antioxidants is rosemary (*Rosmarinus officinalis*).

The aim of the study was to examine the effect of rosemary on inhibition of fish oil oxidation. The oil, obtained from salmon skins, with addition of 0.25–2% powdered rosemary was stored in darkness at 4°C and room temperature. The quality of the oil was investigated by periodic determination of peroxide value (PV) an acid value (AV). Also, the induction period (IP) of fish oil with rosemary was determined. PVs of oil containing of 1% rosemary at both tested temperatures were low and did not exceed 15 meq O2/kg (the upper limit allowed for unrefined edible oils) even after 35 days of storage. However, at room temperature the rate of oxidation was significantly higher than at 4°C. The accumulation of hydroperoxides in oil containing rosemary was reduced 6 times at room temperature, while 13 times at 4°C as compared with the oil without rosemary. The AV of oil with rosemary was slightly higher than that for the control sample. Even 0.5% addition of rosemary lengthened the IP twice, and at 1.5% about 9 times. The results showed that powdered rosemary is very effective in protection of PUFAs against oxidation and in improving the stability of the product during storage.

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The Effects of the Process Parameters on Iodine Value and Trans Isomer Formation During Electrochemical Hydrogenation of Rapeseed Oil

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Key words: rapeseed oil, hydrogenation of oil, proton-exchange membrane reactor, trans fatty acids

The increase in the saturation degree of fatty acids present in edible oils by hydrogenation is an important process used by the oil processing industry to change the functional and stability characteristics of oils for its new applications. Unfortunately, conventionally hydrogenated vegetable oils contain high contents of trans fatty acids (TFA) isomers which are harmful to human health. Therefore, the development of alternative technologies for this purpose is of current interest. One of them is electrochemical hydrogenation of edible oils employing a proton-exchange membrane (PEM) reactor, similar to that used in H_2/O_2 fuel cells, with water as the source of hydrogen for fatty acids reduction. This method, probably for the first time described by Pintauro *et al*. [1998], results in significant decrease in TFA formation as compared to the traditional one. We examined the use of electrochemical PEM reactor to partial hydrogenation of rapeseed oil using various materials and methods for construction of membrane-electrode assembly (MEA) and also with different reaction conditions.

The aim of the present study was to determine the effect of hydrogenation conditions (temperature, current density) on the TFA content in partially hydrogenated product. The level of the hydrogenation, expressed by the changes in the iodine value, was also studied. The TFA content as well as the level of the hydrogenation was found to increase with increase in hydrogenation temperature from 50 to 800 deg. C. The level of hydrogenation was also increased by the rise of current density.

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5- Hydroxymethylfurfural as a Quality Indicator of Deep-Fat Frying Oils

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Key words: hydroxymethylfurfural, frying, oil quality, Maillard reaction

During deep fat frying, when heated oil and frying material come into contact, both heat and mass transfers begin along with so many chemical reactions such as Maillard reaction and lipid oxidation. These reactions produce harmful compounds, so called thermal process contaminants that accumulate in frying oil during its repetitive use for practical reasons. It is undesirable to use highly contaminated frying oil because it becomes a significant part of the fried product.

The objective of this study was to evaluate 5-hydroxymethylfurfural (HMF) as a quality indicator. HMF is formed during the Maillard reaction and sugar decomposition reactions at high temperatures. Due to its partial polar structure, it may transfer to oil from food during frying.

In this study, 2.5 g of round shaped model dough composed of 25% sugar was used as in frying material. At each frying cycle 20 grams of doughs were fried in 1 L frying oil for 5 min at 160, 170, 180°C. 50 frying cycles were performed without oil replenishment and 5 mL oil was collected after every five frying cycles. HMF concentrations of doughs and frying oils of every five cycles were measured. After 50 cycle frying at 160°C, 170°C, 180°C, HMF concentration of doughs and frying oils was found to be 1.10, 3.51, 10.57 mg/L and 0.21, 0.73, 1.96 mg/L, respectively. HMF concentration of frying oil linearly increased with number of frying cycles. The transition of HMF from fried dough to oil was found to be ~20% at every frying temperatures. Concentration that HMF in frying oil behave like a contaminant also estimated. In conclusion, HMF should be taken into consideration as a quality indicator of highly used frying oils as it accumulates, and potentially contaminate fried food.

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Degradation of 5-Hydroxymethylfurfural During Yeast Fermentation

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Key words: hydroxymethyl furfural, beer, malt, fermentation, *Saccharomyces cerevisiae*

Maillard reactions and caramelization occur as roasting of malt for the production of specialty beers proceeds, and lead to the formation of HMF [1]. There are some reports suggesting that HMF inhibit the growth of yeast, but it can be stimulatory in some cases [2]. Moreover HMF is utilized by yeast throughout fermentation process. The study was undertaken to investigate HMF degradation kinetics of *Saccharomyces cerevisiae* during fermentation and biotransformation of HMF into hydroxymethyl furfuryl alcohol (HMF alcohol). The yeast growth was also monitored as influenced by the presence of HMF.

HMF content decreased exponentially as fermentation progressed. The degradation rate of HMF was 0.693×10^{-2}/min and 1.397×10^{-2}/min for wort and sweet wort samples, respectively, indicating that sugar enhances the activity of yeast. HMF in wort was converted into hydroxymethyl furfuryl alcohol (79–84 % conversion). Sucrose was converted into glucose and fructose just in the first hour of fermentation. Glucose and fructose contents of dark roasted malt decreased more rapidly than those of pale malt ($p<0.05$). There was no decrease in the number of viable cells during fermentation and yeast count at the 24th hour of the fermentation was higher in the presence of HMF.

The results of present study do not support that HMF may inhibit yeast growth as claimed by others. It is thought that roasting modifies the malt composition that makes the nutrients more available for yeasts and enhances their growth.

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Effects of Far Infrared Treatment on Lipoxygenase Activity and Antinutritional Factors of Soybean Samples

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Key words: far infrared, soybean, trypsin inhibitor, urease, lipoxygenase

Soybean has great importance in nutrition and health due to its high protein and isoflavone content. Consumption of soybean may be associated with reduced risk of cardiovascular diseases, osteoporosis and cancer. In spite of its beneficial effects, consumption of soybean is low because of its beany flavor and antinutritional factors (trypsin inhibitor, urease). Lipoxygenase causes oxidation of polyunsaturated fatty acids in soybean. Trypsin inhibitor adversely affects the enzymes having role in protein digestion. These undesirable compounds can be reduced by using some food processing techniques (cooking, roasting, extrusion, drying, microwave heating) but processes not causing reduction in amounts of constituents having importance in nutrition and health, must be preferred. Infrared treatment which reduces cooking time of some legumes by softening texture can also be used for this purpose.

In this study, far infrared treatment was applied to soaked soybean samples and effects of infrared treatment on trypsin inhibitor, urease and lipoxygenase were determined. Soybean samples (cv. Adasoy, cv. Nazlıcan) were soaked in water (7/40; w/v) for 30 or 45 min and far-infrared treatment (994W, 1263W, 1454W, 1672W) was applied for 5.5 min. Urease activity, trysin inhibitor and lipoxygenase activity of soybeans decreased with increasing infrared power. Tripsin inhibitor of both soybean cultivars was reduced to the values less than 5 TIU/mg at a power of 1454W. Urease activities of the samples treated at 1454W were found to be lower than 0.25 pH difference. In cv. Adasoy, Lipoxygenase-1 and Lipoxygenase-3 were completely inactivated at 1263W and 994W, respectively.

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Oxidative Stability of Flaxseed Meals

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Key words: flaxseed, oxidative stability, γ-tocopherol

The nutritional and health benefits of flaxseed are associated with its biologically active components. However, high concentration of unsaturated fatty acids, mainly alpha linolenic acid, causes high susceptibility to oxidation, therefore flax oil has a very short shelf live. It is believed that efficient antioxidant system is based on other than fat-soluble antioxidants.

The aim of our study was to evaluate how the lack of water-soluble components will affect the oxidative stability of flaxseed meals. Methanol and acetone in four different compositions with water were used to extract components from defatted flaxseed meals. The concentration of total phenolic compounds in obtained extract was measured by Folin-Ciocalteu procedure. Extraction with pure acetone and methanol lead to lower amounts of phenolics in extracts compared to extracts obtained when water was added to these solvents. Extraction using 20% and 40% water in acetone and methanol, respectively, were used for further analysis. Whole flaxseed meal and meal without water/organic solvent extracted compounds were reconstituted with flaxseed oil and stored for 12 days at 35°C. Peroxide value (meq/kg) and degradation of tocochromanols were measured. The rate of oxidative degradation increased with storage time in all analysed samples. In samples extracted with acetone/water, PVs were 95 and 104 meq/kg in gold and brown coloured flaxseeds, respectively, significantly higher than in methanol/water extracted samples. At the end of storage, 60% reduction in the γ-tocopherol amount was observed in samples extracted with acetone/water compared to 30% in methanol/water extracted samples. However, no significant differences were observed between brown and gold coloured flaxseed. Similarly, samples extracted with acetone/water exhibited 71 and 74% decrease in the amount of plastochromanol-8 in gold and brown coloured flaxseed, respectively, compared to 30% in samples extracted with methanol/water. Higher level of degradation of both γ–tocopherol and plastochromanol-8 in acetone/water extracted flaxseed meals suggests that more components with antioxidant activity were removed. In ground flaxseed meal treated as control sample amount of γ–tocopherol and plastochromanol-8 stayed at the same level during storage.

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Application of SPME-GC-FID Technique for the Detection of Meat-Accumulated Organic Solvent Residues Originated from Animal Feed Produced from Oil-Extracted and Recycled Plant Parts

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Key words: hexane, solvent residue, HS-GC

Industrial oil extraction methods apply organic solvents like hexane, thus the monitoring of solvent residue in oils is required by food safety authorities. In the food industry valuable, nutritive side products can be generated during several food processing steps. The further transformation or recycling of these side-products is necessary for the sustainable agriculture. The utilization of side-products of oil processing can be resulted in the production of various feed for animals. In Hungary the rape (*Brassica napus* L.) and sunflower (*Heliantus anuus* L.) are the most popular plants for oil producing. After the oil-extraction process the remaining parts of the plants were dried, homogenized than formed for fish feed.

Method development was required in order to determine the hexane content of the samples of the fish-feed and the fishes as well before consumption. The purpose of our study was to reveal a method suitable for the detection of solvent residues from diverse food and biological samples. With traditional solvent injection method the detection limit was 2 ppm. By the application of headspace gas chromatography (HS-GC) the detection limit improved up to 0.5 ppb. For the headspace sample collection CAR/PDMS fiber was used, cyclohexane was added to the samples as internal standard. The sampling time and the heating period of the samples were tested under various circumstances. However the fish-feed contained detectable amount of hexane in case of the fish samples (muscle, liver and fat parts were analyzed) there could not made distinction between the samples originated before the oral administration of the feed or after that.

This rapid, cost and solvent effect way of the detection of solvent residues from diverse sources can be applied in order to enhance the food safety and it contributes to preserve our environment.

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Mechanistic Insights into Furan Formation in Maillard Model Systems

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Key words: furan, Maillard reaction, model systems, CAMOLA, SPME-GC-MS, alanine

Furan has recently received considerable attention as a possibly carcinogenic compound occurring in thermally processed foods. Relatively high amounts of furan have already been detected in a number of heated foods, particularly in foods which are heat-processed in cans and jars, and in strongly heated foods. Although several food constituents have been identified as furan precursors, multiple formation pathways remain unclear. Therefore, the objective of this study was to investigate the amino acid-dependency of the formation pathways of furan from glucose. These formation pathways were studied in model systems simulating both roasting and pressure cooking conditions, by means of the Carbon Module Labeling (CAMOLA) technique. In addition, the amounts of furan, produced during these reactions, were determined to study whether certain amino acids decrease or enhance the formation of furan from glucose. The experiments showed that both under roasting and under pressure cooking conditions, glucose-derived furan was formed from the intact sugar skeleton and not via fragmentation and recombination mechanisms. No amino acid-dependency was found for the formation pathways of furan from glucose alone. However, some amino acids, especially alanine and serine, did influence the furan production by providing an additional formation pathway. Also, most amino acids enhanced the production of furan from glucose, even if they were not incorporated into the furan skeleton. Surprisingly, over a limited time course of 60 min, the relative importance of totally different formation pathways changed completely in the glucose/alanine model systems.

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Changes of Colour and Non-Enzymatic Browning Indexes of Cloudy Apple-Berry Juices Upon Storage

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Key words: cloudy juice, colour, browning index, 5-hydroxymethylfurfural, HPLC

Cloudy fruit juices, especially apple juice, due to their nutritional value become important products for nowadays consumers. These kind of juices are reach in vitamins and polyphenols but on the other hand they are much more susceptible to browning reactions influencing quality of juice.

In the present study, the quality of four commercial cloudy apple-berry juices upon storage were assessed on the basis of changes in color parameters (L*a*b*) and accumulation of 5-hydroxymethylfurfural (5-HMF) and brown pigments as an indicators of non-enzymatic browning reactions. The formation of brown pigments is related to the increase in absorbance at 420 nm (browning index, BI).

During 6 months of storage at room temperature, juices tested became darker what corresponded to a decrease in L* value. The a* and b* values were shifted to red and yellow hue. The total color difference between fresh and stored juices was not high and it did not exceed 5.8. The changes in color corresponded to the changes in both 5-HMF and brown pigments only for apple-blackcurrant juice. The concentration of 5-HMF in this kind of juice increased by 44% whereas BI by 16%. The concentration of 5-HMF in apple-chokeberry and apple-cranberry was not significantly changed upon storage, however the BI of the latter juice increased by 16%. In apple-elderberry juice the 5-HMF concentration increased by 7%. No changes in BI were observed for apple-chokeberry and apple- elderberry juices. Altogether, the results obtained indicate that the changes in non-enzymatic browning indexes of apple-berry juices upon storage are not high with exception of apple-blackcurrant juice.

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Investigation of the Systematic Availability of the Cyanotoxin Cylindrospermopsin in *Brassicaceae*

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Key words: Cylindrospermopsin, cyanotoxin, *Sinapis alba*, systematic availability

Cylindrospermopsin (CYN), a potent cyanobacterial hepatotoxin, occurs in freshwater worldwide. In many countries, the use of surface water from sources which may be contaminated by cyanotoxins for crop irrigation is common. Therefore, an exposure of humans to these toxins via the food chain seems possible and poses a severe threat to human health. The aim of this study was to elucidate whether CYN can be taken up by the *Brassicaceae Sinapis alba* (white mustard) and is transported from roots to shoots and leaves.

As a first step, lyophilized S. alba plants were spiked with CYN and the recoveries were investigated in order to establish an accurate extraction method for measurement of CYN in plant tissue. Procedures, which basically involve the extraction of the sample with water and (acidified) methanol, are most promising. An extraction efficiency of >90% from spiked plant material could be achieved. For lowering the detection limit for CYN a further cleanup applying a solid-phase extraction (SPE) method was developed. HPLC−MS/MS was used for analysis of the purified and non-purified extracts. To assess the systematic availability of CYN in *S. alba* the plants were germinated for two days prior to exposure to water containing 50 ng/mL of the toxin. After further 5 days leaves and shoots of the seedlings were collected, freeze-dried, homogenized and extracted according to the developed method for HPLC-MS/MS analysis. In the collected material the CYN content reached about 20 % of the level initially used for “irrigation” of the seedlings. The obtained results indicate that CYN is systematically available to *S. alba*, which represents a health risk due to possible toxin introduction into the food chain. Further investigations are necessary to clarify the extent to which field-grown crop plants may be contaminated with cyanotoxins like CYN.

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Allergenic Ingredients in Spices

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Key words: food allergy, spices, allergen detection, nickel

Allergy to spices is not a common phenomenon – it makes up approx. 1–4% of all food allergies and occurs mainly in young people diagnosed with allergy to pollen of mugwort and birch. Most allergies are caused by: aniseed, garlic, coriander, oregano, chili powder, cayenne pepper, green pepper, fennel.

While addition of spices often remains undeclared by food manufacturers, they are found as ingredients in many food products and dishes. What consumers do not always realize is that this is where a source of potentially hazardous allergizing activity lies.

Allergens were identified in few spice plants (like pepper, paprika, fennel, sesame), but in numerous other spices allergens are not yet determined.

In this work we examined allergenicity of specific spices used in bakery industry or patisserie, alternatively utilized for composition of flour dishes. ELISA was applied with the use of rabbit anti-QQQPP peptide antibodies (wheat flour main allergen), as well as sera from people with coeliac disease and also from those afflicted with allergies. Applied methods include SDS-PAGE electrophoresis and immunoblotting. We established correlation between immunoreactivity values of proteins from examined spices, that we determined with regard to anti-QQQPP peptide antibodies, and literature reports describing their allergizing activity. Thereby, we can evaluate allergenicity of a product using anti-QQQPP antibodies *in vitro*, as a supplement for patch testing and problematic, often dangerous provocative testing *in vivo*. We also report frequent occurrence of cross-reactivity between wheat flour proteins and proteins from spices in the case of coeliac disease patients.

In researched spices, we also established nickel concentration, whose ions prevail as a cause for most food allergies and so-called nickel asthma. Share of this element, compared to other raw plant materials, was relatively high. Further steps should be taken to examine how certain processing of spices (temperature gamma radiation) influences their allergenicity.

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Occurrence of Ochratoxin A in Beer and Wine Samples

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Key words: beer, wine, mycotoxin, ochratoxin A, food contaminants

Ochratoxins are a hazardous group of mycotoxins produced as secondary metabolites by several fungi of the *Aspergillus* and *Penicillium* families. Ochratoxins have been detected and determined in foods and beverages, including barley, malt and beer, at ppb levels. Varied analytical methods have been developed for the detection of ochratoxin A (OTA) in cereals, beer and wine. OTA has been classified as possessing nephrotoxic, carcinogenic, teratogenic, genotoxic and immunotoxic properties, as well as other hazardous effects. In addition, it may be implicated in the human disease Balkan Endemic Nephropathy (BEN) and in the development of urinary tract tumours in humans.

A total of 26 wine and beer samples, including 6 white, 6 red wine and 14 beer samples, on the Polish market were analyzed for ochratoxin A (OTA). An analytical method based on immunoaffinity column (IAC) for clean-up and high performance liquid chromatography with fluorescence detection (HPLC-FLD) was used to determine OTA. OTA was detected in all samples at levels of 0.004–0.12 ng/mL, which were below the EU maximum limit. The mean OTA concentration in red wine was slightly higher than in white wine.

This study showed that OTA occurs in wine and beer available on the Polish market but at levels that pose no danger of significant human exposure to OTA from this source.

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Determination of Mycotoxins in Polish Beer

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Key words: mycotoxins, ochratoxin A, trichothecenes, zearalenone, beer, foodstuffs contaminants

Mycotoxins are natural food and feed contaminants, produced by the secondary metabolism of fungi. The maximum levels of these compounds in certain food products are regu-

lated by EU (*i.a.* Commission Regulation (EC) 1881/2006, 1126/2007, 105/2010, 165/2010). However there are still foodstuffs such as beer – in which those values are considered to be set.

The possibility of mycotoxins (especially ochratoxin A – OTA) getting into beer from contaminated grains used in brewing has been pointed out in literature. On the other hand it is considered that OTA can persist fermentation processes, but normally it can be destroyed during the malting process used in the production of beer.

The aim of the study was the determination of OTA as well as other mycotoxins like trichothecenes and zearalenone in fifty-three Polish beer samples coming from major brewing concerns. The samples were collected at random from various shops and supermarkets in Bydgoszcz.

The analytes were determined using HPLC with different detection modes (fluorescence – OTA, MS/MS – trichothecenes and zearalenone). OTA was isolated with the immunoaffinity columns, whereas in case of other mycotoxins analysis acetonitrile and celite were used in extraction and clean-up procedure. The detection and quantitation limits (OTA) were: 0.003 and 0.01 ng/mL of beer, respectively and average recoveries ranged from 79.6% to 85.8% at different spiking levels. LODs and LOQs of other analytes varied between 0.07–4.3 ng/mL and 0.23–14.3 ng/mL of beer, respectively and average recoveries exceeded 95%. The frequency of OTApositive samples was 94%, while the share of samples in which at least one of the other mycotoxins was present, was 98%.

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Evaluation of Beer Freshness Using NIR Spectroscopy

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Key words: beer, aging, NIR, chemometrics

The present work explores the use of NIR spectroscopy for monitoring beer freshness. Beer is an alcoholic beverage obtained by yeast fermentation of cereals germinated in water. Although the main beer constituents are water and ethanol, it also contains a complex mixture of compounds of varied chemical nature and concentration range, originating from both the raw materials and products of alcoholic fermentation. During storage, beer quality gradually decreases, which is usually apparent in appearance of unpleasant flavor, haze, and browning. A variety of analytical methods is used to study the aging processes, due to their complex nature. Recently, several authors have reported the usage of NIR spectrometry for direct analysis of beer.

In this study we used NIR spectroscopy to differentiate between fresh and aged beer samples. Beers of two brands were exposed to a forced ageing process, achieved by a thermal treatment imitating long-term storage. For this purpose, bottled beer was stored alternately at 60°C and 0°C for 24 hour periods. Such thermal cycling allows determining the anticipated period of beer stability, by repeating the cycles, until beer turbidity achieves 2 Units EBC. Each cycle thus corresponds to 30 days of expected beer stability.

The NIR absorption spectrum of beers comprises a complex system of overlapping bands attributable to various combinations and overtones of the fundamental vibrational transitions. That includes intense bands originating from water, and bands characteristic of ethanol and carbohydrates, with much lower intensity. Multivariate analysis of spectra performed using PCA, kNN and SIMCA methods revealed clustering of samples according to their freshness, enabling beer classification according to this parameter based on direct NIR spectroscopy.

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Effects of Different Peeling Methods on Quality of Canned Peppers

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Key words: pepper, canned food, peeling methods

In this study, four different peeling methods were applied for canning of red peppers (*Capsicum annum* L.) and effects of process variation on quality parameters were examined. In addition, two different pasteurisation times were carried out and according to the results, suitability of applications were discussed.

It was determined that, all canned peppers have enough filling proportion, drained / net weight proportion and vacuum on top space. Samples peeled by baking have more protein and sugar content than others. In addition, samples peeled by blanching, have higher amount of carotenoid components, ascorbic acid and oil that are important for health. Pectin which has an importance on viewpoint of hardness was found a bit more in samples peeled by grilling.

The results of sensory analysis of canned peppers were showed that appearance of all samples has statistically non significant difference. Also, samples peeled by caustic and pasteurised for 45 minutes showed a significant difference in colours than others as expected. According to odour criteria, panellists most preferred the samples peeled by grilling and pasteurised

for 45 minutes. Canned peppers peeled by grilling and pasteurised for 35 and 45 minutes were chosen as most preferred samples on viewpoint of taste. For hardness criteria, canned peppers peeled by caustic were the most preferred samples.

When the effects of both pasteurisation time parameters on reliable production of canned peppers were compared, it was concluded that long pasteurisation time had no addition on quality beside the degradation of nutritive elements. For that reason, it was determined that, pasteurisation for 35 minutes was the most suitable application for canning of peppers.

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Impact of Modified Atmosphere Packaging (MAP) on Polyacetylene Content in Ready to Eat Carrots

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Key words: *Daucus carota* L., phytochemicals, polyacetylenes, modified atmosphere packaging (MAP), ready-to-eat (RTE)

The aim of this study was to determine the impact of modified atmosphere packaging on the content of falcarinol-type polyacetylenes (PAs) in ready to eat carrots (*Daucus carota* L).

Polyacetylenes are commonly found in *Apiaceae* such as *Daucus carota* (carrot). Recent studies have focused in PA's from carrots due to potential in reducing the risks of developing diseases such as certain types of cancer, In particular, falcarinol (FaOH) has emerged as the most active polyacetylene in carrots in terms of cytotoxicity against cancer cell lines.

Two 1.5 kg batches of carrot disks were subjected to modified atmosphere packaging using 1) 5% CO_2, 5% O_2, 90% N_2 and 2) 10% CO_2, 80% O_2, 10% N_2 as gas mixtures and 1) Polyester-Polyethylene (PP) and 2) Alert breathable film (Abf) as the two packaging films. The packed samples C for 6 days. Levels of polyacetylenes were°were then stored at 4 determined immediately at day 0, 1, 3, and 6.

Samples were freeze dried, milled and extraction was carried out using an accelerated liquid extractor (ASE 200). Separation and quantification was carried out using liquid chromatography.

From the two gases used to modify the atmosphere for the storage of carrots, Gas 1 (5% CO_2, 5% O_2, 90% N_2) showed a better retention of falcarinol compared to Gas 2 (10% CO_2, 80% O_2, 10% N_2). The Abf film showed better retention of falcarinol than PP. Overall none of the three major polyacetylenes in carrots exhibited significant differences from the control, showing that MAP is a useful way to retain polyacetylene levels in carrots. Therefore MAP may be a suitable technique for the retention of such bioactive compounds from carrots.

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Market Chocolate Products and Trans Isomers of Fatty Acids

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Key words: trans isomers, fatty acids, chocolates, rules of law, monoenoic fatty acids, polienoic fatty acids

Chocolate is one of the products addressed to children, whether in a bar, and a butter, which is a main nutritional problem of excessive consumption of sweets by this age group. Fats for confectionery are characterized by a high content of various groups of fatty acids, especially trans isomers. Isomers of trans-fatty acids (FA) are produced during industrial hydrogenation of vegetable oils. Hydrogenated fats are an essential component of hardened margarines and confectionery fats used to produce such pack products as cakes, chocolates, chocolate bars.

The fact is especially alarming because these products are addressed to children – the youngest consumers who are particularly exposed to the detrimental effects of the aforementioned isomers. The objective of this thesis is to examine the content of trans fatty acid isomers in the selected chocolate products available on the domestic market (in Poland).

The research shows that chocolate products on the domestic market correspond with the standards and do not exceeded legal limits.

Regarding to the trans isomers' content in chocolate, the research shows that the norms are not exceeded. The highest, but still acceptable level of the trans isomers, was detected in the bitter chocolate and milk chocolate produced by one of the leading manufacturers.

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Monitoring of the Contents of High-Intensity Sweeteners in Different Types of Foodstuffs Available on the Polish Market

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Key words: high-intensity sweeteners, HPLC-MS, foodstuffs

The use of sweeteners in food and beverage products is widespread. Nowadays, consumer has almost an unlimited choice of food with sweeteners. Consumption of so called "light food" is still growing. In order to assure consumer safety, it is necessary to control the content of sweeteners in foodstuffs. Food regulations obligate to monitor the content of sweeteners in foodstuffs and their consumption by people in order to ensure that their use does not exceed the acceptable daily intake (ADI).

The objective of the present study was to measure the concentration of nine high intensity sweeteners (acesulfame-K, aspartame, alitame, cyclamate, dulcin, neohesperidine dihydrochalcon, neotame, saccharin and sucralose) in different categories of food available on the polish market. Over 180 samples of different brands of soft dinks, beverages, yoghurts, jams, fish products, fruit and vegetables preserves were analysed by means of SPE-HPLC/MS method. Sample preparation procedure includes extraction with buffer composed of formic acid and N,N-diisopropylethylamine at pH 4.5 in ultrasonic bath and clean-up step by solid phase extraction using Strata-X 33μm Polymeric SPE column. The chromatographic separation of the sweeteners was achieved using a C18 column and gradient elution. MS detection was performed under time-scheduled SIM conditions, by using an electrospray interface operating in the negative ion mode.

A thorough monitoring of the content of sweeteners in foodstuffs is a very important tool in the area of food control. This information combined with food consumption data is essential for assuring food safety and quality. Moreover, these data can be used for further estimation of the average intake of these sweeteners in Poland.

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DSC Thermograms of Melting and Crystallization as a "Fingerprint" in the Evaluation of the Authenticity of Butter

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Key words: differential scanning calorimetry DSC, authenticity, butter

The high price of milk fat results in the use of unfair practices by manufacturers of butter, adding to it much cheaper animal or vegetable fats. Various analytical methods are used to detect butter adulteration, including the most laborious and expensive chromatographic methods. In this study the technique of DSC was applied, based on the fact that every fat has its own characteristic and unique melting or crystallization curve called the thermogram, which is the result of its fatty acid and triacylglycerol composition. Thermograms of melting and crystallization of milk fat with palm oil (usually added for adulteration) were examined in terms of their applicability in the assessment of the authenticity of butter. A Perkin Elmer DSC7 differential scanning calorimeter was used in the analyses. Phase transitions were evaluated related to the process of melting and crystallization of samples of pure milk fat and pure palm oil as well as milk fat with palm oil mixed in various proportions. When analyzing the thermograms it was observed that the detection of the presence of foreign fats in butter may be based both on the thermogram curve shape and individual thermodynamic parameters of melting and crystallization processes, such as their temperature of the beginning or end of the transition, the temperature corresponding to individual peaks, as well as values of melting and crystallization enthalpy (ΔH). As a result of the study on melting of butter with an addition of palm oil, with an increasing amount of oil changes were found both in the thermogram curve shape and the temperature and enthalpy corresponding to individual peaks, and the temperature of the end of transition. High correlation coefficients were obtained for the relationship between the amount of added oil and the value of temperatures: end of transition ($r=0.98$) and peak temperatures ($r=-0.96$; $r=-0.84$). When analyzing the crystallization process of butter with palm oil added, it was observed that with an increase in palm oil addition, the temperature difference between the two peaks characteristic of butter increased linearly ($r=0.99$).

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Determination of Acidity Regulators and Preservatives in Drinks Using Ion Chromatography

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Key words: ion chromatography, acidity regulators, preservatives, beverages, organic acids

Ion chromatography (IC) is a modern and fast method with and high-performance for determining of ionic substances in multicomponent mixtures such as environmental objects, pharmaceutical and food products. Food additives are using to give foods the required organoleptic properties and improve their stability. The control of the food additives concentration is important task for analytical and food chemistry.

The work presented is focused on the determination of the most commonly used acidity regulators such as citric, tartaric, phosphoric, malonic as well as sorbic acid organic acids in water, wine and soft drinks using a single-column personal ion analyzer PIA-1000 (Shimadzu (Japan) with a Shim-pack IC-A1S (4.6 × 100 mm) column and conductivity detector). Parameters of the retention of organic acids on the column as well as separation conditions of citrate, tartrate, malate and sorbate ions in the presence multiplex excess inorganic ions were optimized. Theoretical modeling with a help of Chem v 1.0 software [1] for complex multi-component equilibrium calculations in solutions has been performed to improve separation and determination parameters. The technique developed has been applied to stewed fruit, fruit juices, soft drinks and wines of different manufacturers and can be recommend for the determination of food additives in drinks.

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Antioxidant food components

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Antioxidant Activity of Phenolic Extracts of Sarı Ulak Tarsus Olives grown in Turkey

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Key words: olive extract, total phenol, antioxidant activity, DPPH

Olives are traditional product and one of the most important components of the Mediterranean diet. They are well-known sources of phenolic compounds with important biological properties. Oxidation of oils not only affects their flavour characteristics, but also influences their nutritive value. Antioxidants are added to lipids or foods containing fats to retard the formation of various off-flavours. The most widely used synthetic antioxidants, has been decreasing because they may act as promoters of carcinogenesis, this is in addition to a general consumer rejection of the use of synthetic food additives.

In this study, the total polyphenol content and antioxidant activity of Sarı Ulak Tarsus olives grown and highly consumed in Mersin province of Turkey was investigated in model and food systems and the results were compared to that of synthetic antioxidants such as BHT. Total polyphenol content was estimated with the Folin–Ciocalteau assay. The antioxidant activity of olives was assessed by scavenging of the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical in methanol as well as their ability to reduce the oxidation of olive and sunflower oil was tested at 60°C by schall-oven test. The results showed that Sarı Ulak Tarsus olives had 286 mg/100 g caffeic acid equivalent total phenol content. The radical scavenging activity of Sarı Ulak Tarsus Olives was comparable to BHT in 30, 60 and in final time. The olive extracts were also found to be effective antioxidants in olive oil however BHT was the best antioxidants both in olive and sunflower oil. The results indicated that the Sarı Ulak Tarsus olives are important source of phenolic antioxidants.

It was concluded that incorporation of such extracts may contribute to the health benefit of the consumers significantly and also to prolong the shelf life of food products.

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Antioxidant Capacity of Pancreatic Hydrolysates of Lentil Meal Proteins

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Key words: lentil protein hydrolysates, pancreatin, antioxidant capacity, DPPH, ABTS, photochemiluminescence assay

Free radicals may cause oxidative cellular damage, which increase a risk of cardiovascular diseases, cancer, diabetes, etc. The oxidative processes are undesirable in food technology, since they cause quality losses and shortness of shelf life. Therefore, an intensive search for new natural antioxidants is still ongoing. In the literature there is increasing data about antioxidant activity of peptides and protein hydrolysates. The aim of the study was to obtain pancreatic hydrolysates of lentil meal with varying degree of hydrolysis and to assess their antioxidant capacity.

The pancreatin hydrolysis of lentil meal proteins was carried out at a temperature of 50°C and pH 8.0. The process was controlled using pH-stat technique. Subsequently, hydrolysates with specified degree of hydrolysis (DH) *i.e.* 4%, 8%, 12%, 16% and 20% were obtained. The hydrolysates were characterised by profiling of molecular weight distribution of peptides. The antioxidant capacity was investigated using DPPH and ABTS assays. ACL and ACW kits were applied for integral measurements of lipid/methanol-soluble and water-soluble compounds to assess superoxide anion radicals scavenging ability (photochemiluminescence assay).

The ability of lentil meal protein hydrolysates to reduce both $DPPH^{\bullet}$ and $ABTS^{\bullet+}$ was higher in comparison to native meal. The antiradical potential was increasing along with the increase in DH up to 8%, and reached maximal value of 63.8% and 98.6 μmol Trolox/g, respectively. However, further increase in DH diminished the antioxidant potential. Similar relationship was noted between DH and antioxidant capacity of lipid-soluble (ACL) compounds of hydrolysates. The antioxidant capacity of water-soluble (ACW) peptides proved to be not affected by DH.

The studies carried out justify a finding that pancreatic hydrolysis of lentil meal proteins increases their antioxidant potential. The most active was the hydrolysate with relatively low DH (8%), which contained polypeptides with high molecular weight. It seems that the antioxidant capacity of hydrolysates is affected by hydrophobic peptides to a greater extent.

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Changes in Reducing Activity of Reductones and Phenolic Acids During Reactions with Reactive Carbonyl Compounds

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Key words: antioxidants, Maillard reaction, reductones, phenolic acids, carbonyls

The Maillard reaction, transformation of reducing saccharides in the presence of amino compounds, is among the most important chemical reactions taking place during the food processing and storage. Reducing power arising within Maillard reaction systems is attributed mainly to reductones and compounds with acidic methylene moiety. In addition to oxidation of these reducing compounds, they may be transformed also by non-oxidative processes. There are several kinds of reactive carbonyl intermediates within the Maillard reaction that have a potential to form addition products with the simple reductones and methylene-active compounds. However, to date a little information is known about the transformations and particularly the possible carryover of reducing capability to the consecutive products. Participation of the reactive carbonyls in the reactions with naturally occurring phenolic substances possessing antioxidant activity is also expected as a part of non-enzymatic browning reactions.

This contribution is focused on the evaluation of reducing activity during reactions of low molecular Maillard reducing intermediates norfuraneol and 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one in binary mixtures with various reactive carbonyl Maillard intermediates, products of lipid degradation and derivatives of cinnamic acid (ferulic acid, p-coumaric acid, caffeic acid, chlorogenic acid and sinapic acid). Amperometric method after HPLC separation was used for the evaluation of reducing power. Conversion rates of the reducing activity of parent compounds to the products were assessed. Similarly, the formation of active products in binary mixtures of the phenolic acids with reactive alpha-dicarbonyl and alpha-hydroxycarbonyl intermediates arising in the Maillard reaction and lipid oxidation was investigated, too. Optimum reaction conditions were found for the formation of significant reducing secondary products.

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Phenolic Compounds and Antioxidant Activity of Fractions Extracted from *Capsicum annuum* L.

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Key words: *Capsicum annuum*, phenolic compounds, antiradical activity

Phenolic compounds are secondary metabolites which occur in pepper fruits mainly as derivatives of phenolic acids as well flavonoids. Antioxidant activity of phenolic compounds depend on chemical structure of their. Generally free acids and flavonoids show higher antioxidant potential, than their derivatives. Activity of phenolic compounds fraction isolated from plants depends on contents and chemical structure of presented phenols. Additionally synergistic effect between constituents of fraction is possible.

The aim of presented work was to estimate correlations between content of phenolics in fractions isolated from pepper fruit and their antiradical activity.

Analysis was made for four cultivars of pepper: Capel Hot, Red Knight, Socrates and Shanghay. Placenta and pericarps of the fruits were analyzed separately. Phenolic compounds fraction was isolated by solid phase extraction on C18 column from ethanolic homogenate. Phenolic content was assessed by Folin-Ciocalteu (FC) method and was expressed as chlorogenic acid equivalent, additionally HPLC analysis was performed on WellChrom (Knauer) chromatograph with RP18 column (Vertex Eurosil Bioselect 300Å, 5 μm, 4 x 30 mm). Antiradical activity of phenolic compounds fraction was investigated in DPPH radical model system.

It was found higher total content of phenolic compounds in placenta, than in pericarps of analyzed cultivars of pepper, but higher antiradical activity of fractions from pericarps were noticed. Three main components in phenolic compounds fraction was investigated in quantitative HPLC: 1: trans-p-feruloyl-beta-D-glucopyranoside; 2: trans-p-sinapoyl-beta-D-glucopyranoside; 3: quercetin 3-O-beta-L-rhamnopyranoside -7-O-beta-D-glucopyranoside. High correlations between FC and HPLC method was stated (0.970 for placenta and 0.939 for pericarps). Phenolic content from fruit pericarps correlated well with antiradical activity of their (0.825 with FC and 0.886 with HPLC method). Poor correlations between phenolics from placenta and antiradical activity was noticed (0.472 with FC and 0.430 with HPLC method).

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The Effects of the Exraction Methods on Turkish Olive Phenols

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Key words: olive, Domat, Edremit, Gemlik, antioxidant, fenol

There is increasing interest in olive phenolic compounds because of their biological properties as well as their contribution to the colour, taste and shelf life of olive products. Olive oil is the fat of choice in the Mediterranean area, where the diet has been associated with a lower incidence of coronary heart disease and certain cancers. Phenols in extra virgin olive oil are responsible for its peculiar pungent taste and for its high stability.

Phenolic compounds in natural Turkish olives are characterised by total fenol and total antioxidant capacity. Water and ethanol extracts of three Turkish olive variety (Domat, Gemlik and Edremit) were observed antioxidant properties and fatty acid composition.

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Influence of Technological Processes on Selected Phenolic Compounds in Buckwheat

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Key words: buckwheat grains, by-products, buckwheat groats, phenolic compounds, DPPH

The aim of this study was to determine the content of selected phenolic compounds and water extract from buckwheat products for scavenging effect of DPPH in buckwheat varieties Kora: hull, bran, waste, and cooked buckwheat groats. The raw materials were obtained from the "Grain Plant Podlasie" in Bialystok. The extraction of phenolic compounds was performed using 80% acetone at 50°C for 30 min. The content of phenolic compounds such as rutin, katechin, quercetin, vanillin, kaempferol, and acids: p-cumaric, o-cumaric, gallic, p-hydrobenzoesic, caffeic, sinapic, ferulic were determined using a Rapid Resolution Liquide Chromatography (RRLC).

Determination carried out using the SB-C18 column. Acetic acid solution with the addition of methanol was used as eluent. Antioxidant properties of extracts were estimated based on the capacity of extracts to scavenge the DPPH• radical (1,1–diphenyl–2 picrylhydrazyl). Results were compared with the BHT.

The buckwheat grain as a raw material used in the production of buckwheat groats was characterized by significantly higher content of phenolic compounds in comparison with buckwheat groats. Predominant phenolic compounds was routine. The hull as a by-products contained large amounts of compounds such as rutin, quercetin, and acids: p-cumaric, gallic, p-hydroxybenzoesic and sinapic. Aquas-acetone extracts from buckwheat grains, hull and bran were characterized by highest scavenging effect of DPPH• in comparison with BHT.

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Determining Polyphenolic Antioxidant Distributions Between the Oil, Water and Interfacial Regions of Model Food Emulsions

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Key words: antioxidants, gallic acid, emulsions

Esters of gallic acid (propyl gallate, PG; octyl gallate, OG and dodecyl gallate, LG) are widely used as antioxidant additives in both food and pharmaceutical industries to prevent lipid peroxidation [1]. Estimating its distribution in food emulsions is important because their efficiency in inhibiting lipid peroxidation depends, among other aspects, on their distribution within the different regions of the system.

In the present work we determined the distribution of PG, OG and LG in Corn oil / acidic water / Tween 20 model food emulsions. Antioxidant partitioning [2] is described by two partition constants, POI and PWI which are determined by analyzing the effects of emulsifier concentration on the observed rate constants (kobs) for the reaction between the hydrophobic 4-hexadecylarenediazonium ion (16-ArN2+) and the antioxidant and by determining spectrophotometrically the ratio PWI / POI = PWO, that represents the partition constant of the antioxidant in binary corn oil-water system (that is, in the absence of emulsifier).

The results show that PG is distributed between the interfacial, water and oil regions meanwhile OG and LG are mostly located in the interfacial and organic regions. The effects of a number of parameters on the distribution of the antioxidants is also reported.

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Antioxidant Activity of Gallocatechin Gallate and Epigallocatechin Gallate

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Key words: antioxidant activity, epigallocatechin gallate, gallocatechin gallate, epimers, DFT calculation

The aim of the study was to investigate the influence of pH on the antioxidant activity of catechin epimers: epigallocatechin gallate (EGCg) and gallocatechin gallate (GCg). It was found that the antioxidant activity of catechin epimers, quantified by the TEAC value, increases with increasing pH of the medium. Moreover, EGCg shows higher antioxidant activity than its epimer GCg at the pH above 3.5. Guo *et al*. [1999] reported that the stereochemistry could influence the radical scavenging activity of catechins. Since the pKa values determined for the catechins studied do not differ significantly (7.68 [Muzolf *et al*., 2008] and 7.65 for EGCg and GCg, respectively) it could be concluded that deprotonation of the most acidic OH group in catechins studied do not have an impact on the difference in their antioxidant activity above pH 3.5. To explain differences in the pH-dependent TEAC profiles of EGCg and GCg above pH 3.5 theoretical electronic parameters were calculated both for the neutral and monoanionic forms of the catechins investigated. They included homolytic OH bond dissociation energy (BDE), reflecting the ease of hydrogen atom donation and ionization potential (IP), representing the ease of electron donation. It was found no decrease in the BDE values upon EGCg and GCg deprotonation but IP values are much lower for the deprotonated forms of catechins than for the neutral ones because electron-donating ability becomes much easier upon deprotonation what is in agreement with our previous conclusion [Muzolf *et al*., 2008]. The IP value calculated for monoanionic form of EGCg is about 5.2 eV lower than that calculated for GCg. It could explain the higher radical-scavenging activity of EGCg than GCg with increasing pH of the surrounding medium.

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Spectrophotometric Study on Betanin Degradation under the Influence of Metal Cations

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Key words: betanin, betalains, betacyanins, degradation, colorants

Betanin colorant (E-162) produced from red beet (*Beta vulgaris* L.) structurally belongs to betacyanins which represent a class of N-heterocyclic water soluble plant pigments providing the colours in a wide variety of flowers and fruits. These compounds are the most stabile at pH 5.5, however, their decomposition is influenced by a combination of multiple factors such as pH, water activity, exposure to light, oxygen and temperature.

During storage of betanin, any traces of metal ions which usually come during the preparation process from packaging materials or can be common food constituents catalyse the degradation of betanin. The effect of a range of metal ions on betalain decomposition had been analyzed. The heavy metal ions have the most negative effect on stability of betalains and usually cause discoloration and decrease of their half lives.

In this study, the influence of different metal cations on betanin decay and changes of UV-Vis spectra was investigated in the range of pH 3–8. The strongest effect on betanin degradation was observed at pH 8 for most of heavy metals, however, it was also significant at pH 5–7. The fastest reaction was initiated by the addition of Cu^{2+}, Ni^{2+}, Fe^{2+}, Fe^{3+} and Co^{2+} to betanin solutions. The hipsochromic shift of the absorption maximum after cation addition from λmax 541 nm for betanin to 510–515 nm for Cu^{2+}, 525 nm for Co^{2+}, 525 nm for Fe^{3+} and 505 nm for Ni^{2+}, indicating formation of metal complexes with betanin, was noticed. All the complexes were decomposed during the course of the experiments within 10–60 minutes. Addition of EDTA during the first stages of the reactions resulted in regaining of the original betanin spectra.

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Phenolic Compounds Profile and Antioxidant Activity of *Persea Americana* Mill. Peel and Seed Extracts

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Key words: avocado, seeds, peels, phenolics profile, antioxidant activity

Fruit wastes, produced in considerable amount during processing, comprise of seeds and peels, mainly. They have been discarded for decades. In recent years an increasing interest in its utilisation has been emerging. Since wasted by-products can present similar or even higher contents of antioxidants than fruits themselves they can serve as a source of natural antioxidants. In the presented study phenolic compounds profile and antioxidant activity of avocado (*Persea Americana* Mill.) peels and seeds of two varieties were investigated.

Eighty percent methanolic extracts obtained from lyophilised ground peels and seeds of avocado of Hass and Shepard varieties were characterised for their phenolic compounds profile using HPLC-DAD technique and the structures of the identified compounds were unambiguously confirmed by HPLC-ESI-MS spectra. The presence of 3-O-caffeoylquinic acid, 3-O-p-coumaroylquinic acid and procyanidin A trimers was revealed in seeds of both varieties. On the other hand, phenolic compounds profile of avocado peels extracts differed. The one obtained from Shepard variety was devoted of catechin and procyanidin dimers, which were noted in peels of Hass variety. In addition, peels of both varieties contained 5-O-caffeoylquinic acid and quercetin derivatives.

The differences in phenolic profile resulted in the differentiated antioxidant activity of extracts. The peels extracts possessed higher total phenolic compounds content and antioxidant activity in comparison to seeds extracts. The highest activity was noted for avocado peel of Hass variety in all assays applied *i.e.* $DPPH^{\bullet}$, $ABTS^{\bullet+}$ and reducing power assays. The similar phenolic compounds profile of seeds extracts was reflected in their comparable ability to reduce ABTS cation-radical; Trolox Equivalent Antioxidant Capacity for Shepard and Hass variety amounted to 0.60 and 0.64 mmol/g, respectively.

Overall findings indicate that both seeds and peels of avocado can be utilised as a source of antioxidants.

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Assessment of the Antioxidant Properties of Corn Foodstuffs

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Key words: corn foodstuffs, antioxidant properties, QUENCHER approach, GAR approach, *in vitro* gastrointestinal digestion, antioxidant bioavailability

Cereals including corn or also called maize (*Zea mays*) foodstuffs are relevant dietary component worldwide. Corn contains many powerful phytonutrients whose activity has gone unrecognized because research methods have overlooked them. Phytochemicals may interact with fibre or proteins and they can be released during digestion process. A new approach named by its authors as GAR (Global Antioxidant Response) based on the combination of *in vitro* digestion and the QUENCHER approach, which allow to determine the overall antioxidant capacity avoiding any extraction or hydrolysis procedure, has been reported. GAR procedure provides both information regarding to the bioavailability of the antioxidants and the overall antioxidant capacity of samples.

The present research aimed to gain insight on the antioxidants of cornmeal and corn fibre. Flours from white, yellow and blue corn and a corn starch based product were analyzed. Solid samples were measured by GAR procedure and the free antioxidants composing them were extracted and their content determined by conventional ABTS method. All the samples showed antioxidant power against ABTS radicals. In all cases, the contribution of the free extractable antioxidants was lower than that found for the *in vitro* gastrointestinal digests and about 20 fold lower that that determined by QUENCHER approach corresponding to the overall antioxidant capacity of the samples. The soluble antioxidants resulted less effective against ABTS radicals than the insoluble ones derived from the digestion process. The level of bioavailability of free antioxidants after the digestion process was higher than that free extractable under the conditions here assayed. Antioxidant values obtained for gastric and gastrointestinal digests differed. Corn starch presented the lowest antioxidant power among the food samples under study. Results suggested that yellow and blue cornmeals are healthier food options than the rest of the samples and pinpoint the importance of the digestion process on food antioxidant bioavailability.

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Antioxidant Potential of Selected Tea Products

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Key words: tea, reactive oxygen species, antioxidant activity, DPPH antiradical activity

There are many egzo- and endogenic components responsible for oxidative stress within human cells. At the molecular level it is connected with induction of reactive oxygen species (ROS) generation. They cause an unfavorable conversions of primary biomolecules such as nucleic acids and lipids resulted in changes in cell membrane permeability and serious diseases. During the last decades a lots of efforts was made to find natural sources of antioxidants that can neutralize detrimental effect of the reactive oxygen species. The special attention was paid to various food products used every day, such as fruits, vegetables, wines, teas or coffees. The present paper reports on antioxidant activity of the selected commercial teas from various *Camelia* spp. products.

The experiment was carried out using the hot water extracts from commercial products including white, red, green, blue and black teas. Antioxidant activity of the tea extracts was determined as level of 50% inhibition of the DPPH (1,1-diphenyl-2-picryllhydrazyl) neutralization The obtained results showed the highest antioxidant activity among the water extracts from white teas and the lowest for the traditional black teas. Quite high antioxidant potential also showed the studied green teas, instead the red and blue ones possessed much lower DPPH antiradical activity. The observed tendency was quite stable and not dependant on origin of the tea plants. The paper discuss the importance of the proper selection of tea products for the every day usage, as a natural sources of antioxidants that neutralize the reactive oxygen species.

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Antioxidant Capacity of Rapeseed and its Products

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Key words: rapeseed varieties, rapeseed oils, meal, antioxidant capacity

Rapeseed is the most important source of vegetable oil in Europe and the second most important oilseed crop in the world after soybean.

It has been known that consumption of antioxidant-rich foods is associated with a lower risk of heart diseases, ischemic stroke, cancer, and other chronic diseases. Rapeseed oil is an important source of health-related compounds including polyphenols, sterols, flavonoids, tocopherols, phospholipids in the human diet. Moreover, the correct ratio of omega-6 to omega-3 fatty acids (2.2) for human health occurs natively in rapeseed oil. Therefore improvements in oilseed processing are necessary to produce rapeseed oil with high content of bioactive compounds. Enrichment of rapeseed oil with antioxidants can be achieved by: (1) development of rapeseed varieties with low erucic acid and glucosinolates content and high bioactive components, (2) modification of rapeseed pretreatment before oil pressing, (3) application of enzymes in technological process, (4) supplementation of final product by phenolic extracts. Rapeseed oil derived from cultivars reduced in erucic acid (0%) and glucosinolates (4.2–20.4 micromol/g seed), named canola or double-low "00" oilseed rape quality with high antioxidant capacity (4262–7574 micromolTE/100g) and total phenolic content (890–1821 mgSA/100g) is already classified as one of the healthiest vegetable oil. However, during oil production the significant amounts of bioactive components are lost and antioxidant capacity of refined rapeseed oil is reduced. This fact demands new solutions in rapeseed oil technology.

Different spectrophotometric methods can be usefully employed by the oil processing industry in assessing of antioxidant capacity of raw material (rapeseed), by-product (meal) and oils from various stages of technological process.

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Antioxidant Activity, Phenol and Flavonoid Contents of Portuguese Shrub: *Erica australis*

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Key words: *Erica australis*, phenolics, flavonoids, antioxidant capacity

Since ancient times, humans have used plants and shrubs to treat health problems. One of those shrubs, *Erica* spp. is still used in some countries, in the form of infusion, to treat digestion and renal problems. The aim of this study was to determine the total phenolic and flavonoid content as well as the antioxidant capacity of *Erica australis*.

Samples were dried at room temperature, separated in leafs, flowers, branches, grinded and extracted with water at 95ºC for 15 minutes. Total phenolic (TPC) and flavonoids (TFC) content; antioxidant capacity (TOA); ferric reducing antioxidant power (FRAP); Trollox equivalent antioxidant activity (TEAC) and DPPH radical scavenging activity, were analyzed by standard methods, using a UV-VIS spectrophotometer. All plant parts showed high TPC, with leafs having more 2 times the TPC amount present in flowers, and about 10 times more than the TPC amount present in branches. Flavonoids content was significantly higher ($p<0.01$) in leafs. Flowers and branches showed only slight amounts of flavonoids. In the case of leafs and flowers, the value obtained for FRAP is about 60% of the one obtained in TOA assay, while for branches is 14%. Values obtained for DPPH IC50 are higher than TEAC IC50 for leafs and flowers only. Overall the plant showed a high content in phenolic and flavonoid contents, and a relatively strong antioxidant capacity, with leafs showing the highest antioxidant power. The greater amount of phenolic and flavonoid compounds leads to more potent radical scavenging effect as shown by *E. autralis* extract.

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Spices as Natural Antioxidants in Foods

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Key words: spices, phenol compounds, radical scavenging activity, spectrophotometry, HPLC/DAD

Phenol compounds are main source of antioxidants for humans. They have a variety of biological activities, ranging from anti-ageing, anticancer, to lowering of blood cholesterol level and improving bone strength. Phenol compounds are derived from plants, and are consumed in the forms of fruits, vegetables and spices. Large percentages of phenol compounds are consumed in the form of flavonoids, which may be stronger antioxidants than antioxidant vitamins.

Many spices are known as excellent sources of natural antioxidants, and consumption of spices in the diet may contribute to the daily antioxidant intake. The present study was performed in order to determinate phenol compounds in commonly consumed spices.

Six dried spices (basil, garlic, onion, parsley, celery and dill) were analysed by HPLC and spectrophotometry. For the determination of total content of phenol compounds method of Folin–Ciocalteu, and for radical scavenging activity – 2.2-diphenyl-1'-picrylhydrazyl (DPPH˙) were used. Identification of phenol compounds by comparing retention times and UV spectra with those of standards using high performance liquid chromatography with diode-array detection HPLC/DAD was carried out.

The content of phenol compounds after acid hydrolysis was found in ranges from 956.4 to 2231.0 mg GAE/100 g in garlic and celery respectively. Radical scavenging activ-

ity was determined in a range from 10.9% to 35.7% in garlic and basil respectively. Higher content of phenol compounds was associated with higher radical scavenging activity. Using HPLC/DAD system gallic acid was identified in basil and garlic, chlorogenic acid – in basil, parsley, celery and dill, (+)-catechin hydrate – in basil and parsley, syringic acid, 4-hydroxy-3-metoxycinnamic acid and p-hydroxycinnamic acid – in onion, parsley and dill, o-hydroxycinnamic acid – in parsley and dill, m-hydroxycinnamic acid – in basil and garlic, 3,5-dimetoxy-4-hydroxycinnamic acid – in basil, quercetin-3-rhamnoside – in parsley and celery, quercetin-3-β-D-glucoside – in onion, parsley, celery and dill.

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Preparative Separation of Phenolic Compounds from *Lactuca sativa* L.

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Key words: *Lactuca sativa* L., phenolic compounds, preparative separation

Preparative chromatography was used to isolate and identify the components of phenolic fraction from lettuce var Omega (*Lactuca sativa* L.). Liophylised sample of lettuce was homogenized with 85% ethanol, and evaporated under reduced pressure. Then, it was resuspended in water and poured into a column previously packed with Lichroprep RP-18, 40–60 particle size and preconditioned with methanol and water. Water and 60% methanol solution were used to elute phenolic acids and flavonoids. The solvents were further removed with rotary evaporator (47°C) and dense and sticky residue was then resuspended with water and loaded on the preparative column (3cm x 50cm), previously packed with Lichroprep RP-18, 25–40 particle size, and preconditioned methanol and water. Gradient elution (water-methanol) was used to separate compounds with increasing amount of methanol in the mobile phase to 100%. Fractions were collected and preliminary analysis was carried out by TLC method on silica gel plates SiO_2 F254, in horizontal chambers (DS-L, Chromdes). Fractions that showed identical TLC profiles were combined and then analyzed by HPLC method for purity and phenolic contents. The HPLC system was equipped with a photodiode array detector (PDA) and RP – 18 Atlantis T3 column, 100A, (4.6 x 150 mm, 3 μm). The mobile phase consisted of 0.1% HCOOH (solvent A) and acetonitrile (solvent B) and analysis was under gradient conditions. Fractions that needed further purification were purified by preparative HPLC using RP-18 column Eurospher 100 (8 x 300 mm, 10μm) and then Atlantis PrepT3 (10 x 250 mm, 10μm). The solvents systems were adjusted to single fraction based on results obtained previously on analytical column. Identification was firstly based on UV-Vis spectra recorded on PDA detector, and retention time. Equations and R2 of the calibration curves for some of purified phenolic compounds of *Lactuca sativa* L. were obtained.

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The Bioactive Components and Antioxidant Activity of Olive Leaves

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Key words: olive leaf, total phenol, antioxidant activity, bioactive components

There is a rising interest in natural antioxidants as bioactive components of foods. Olive leaves are one of the by products of farming of the olive grove; they can be found in high amounts in the olive oil industries and they accumulate during pruning of the olive trees. Olive leaves are considered as a cheap raw material which can used as useful source of high added value products. Olive leaf has been known for centuries, and it has been traditionally used to prevent and treat different diseases. Previous investigations carried out on olive leaf extracts have demonstrated hypotensive, hypoglycaemic, hypouricaemic, antimicrobial and antioxidant activities.

The main constituent of olive leaves is oleuropeine, one of the iridoid compund. Secoiridoids and flavonoids are present in higher amount while simple phenols and acids are present in lower amounts in olive leaves. Furthermore, olive leaves contain triterpenic compounds: oleanolic, ursolic and maslinic acids as triterpenic acids and, uvaol and erythrodiol as triterpenic dialcohols; flavonoids (luteoline, apigenine, rutin) and chalcones (olivin, olivin-diglucoside). The factors that may influence the final bioactive content, composition and potential are cultivation zone, agronomical practices, environmental conditions, cultivar, tree and leaf age, leaf development stage and plant material post-harvest treatment (drying process and storage conditions as well as extraction techniques to prepare olive leaf preparations.

Olive leaf which is cheap, effective and alternative source can be considered as important source for multifunctional bioactive phenolic antioxidants of similar potency to olive fruit and exceptional among agri-food byproducts regarding availability throughout the year and composition. The enrichment of processed food with biactive components from olive leaves protects oils against oxidation because the formation of toxic oxidation products is prevented. Such enrichment also benefits human health and prolong the shelf life of food. Thus, commercialization of olive leaf should be considered.

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Relationship Between the Phenolic and Flavonoid Contents and the Antioxidant Activity in *Portulaca oleracea*

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Key words: *Portulaca oleracea*, antioxidant activity, total phenol content, flavonoid content

The interest around natural products has increased in the last years and the scientists tend to obtain new information about plants antioxidants and its importance in medicine, human nutrition and food industry. These compounds, in the human diet, can help to avoid the damages caused by diseases where reactive oxygen species are involved in pathogenesis. The aim of this work was to study the relationship between phenol contents and antioxidant activity in *Portulaca oleracea*. This succulent herb is a member of *Portulacaceae*, that has been ranked the eight most common plant in the world and is listed as one of the most used to medicinal purposes. The water extracts of *Portulaca oleracea* have been certified safe for human consumption because they show no cytotoxicity or genotoxicity.

Samples of *Portulaca oleracea* were collected in same location and the leafs were separated from the other parts of the plant, dried in an incubator for 24 hours at 60ºC and two types of extract were prepared: methanol (ME) and water extracts (WE). Total phenol content was determined by the Folin-Ciocalteu's method, with some modifications. Content of flavonoids were determined by the $AlCl_3$ method. Total antioxidant activity was determinate using the method developed by Prieto *et al*. [1999].

Results show that methanol extraction is more efficient than water extraction. ME has 1.5 times more phenolic compounds, 4 times more flavonoids and about 6 times more antioxidant activity than WE.

This evidence suggests than extracting solvent has interference in the content of phenolic compounds, flavonoids and total antioxidant activity of the sample. Moreover, suggest than in ME the total antioxidant activity is mainly due to the content of flavonoids and not so much to the content of phenolic compounds.

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Antioxidant Potential of Vegetable *Brassicas*

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Key words: antioxidant activity, *Brassica*, DPPH, phenolic compounds

The accumulation of an excess of reactive oxygen species (ROS) can provoke oxidative stress when cell defenses are overcome, leading to the appearance of different pathologies as cardiovascular, inflammatory or neurodegenerative diseases among others. Healthy properties of fruits and vegetables are due in part to the antioxidant compounds they content and their potential to scavenge ROS. One of the groups of food with a high antioxidant potential are the crops which belong to *Brassica* genus. The antioxidant potential of the main Brassica crops has been studied, normally focused in evaluating the final product. However, a clear idea on how the antioxidant potential changes with plant development or an analysis of other parts of the plant which are not normally consumed could be very interesting in order to select the best plant parts to be consumed and the best moment to collect them. This work was focused in evaluating the antioxidant potential of different crops belonging to *B. oleracea* (kale, cabbage, tronchuda cabbage, broccoli, cauliflower) and one vegetable crop of *B. napus* (nabicol) at different times during plant development until the plant reached the state when they are normally consumed, then the final product and also by-products were measured. Antioxidant potential was measured with a DPPH assay and was related to the content and profile of phenolic compounds. Kale showed the highest antioxidant potential compared to the rest of crops at all the times measured and because of that its consumption would be strongly recommended. Some correlations among phenolic compounds, specially kaempferol derivatives, and antioxidant potential were highly significant, indicating that these compounds could be the responsible of the antioxidant capacity. All the crops showed the highest antioxidant activity two months after transplant, when they are still young plants; therefore, this would be the best moment to consume them.

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Antioxidant Activity of Extract of Shea Nut Meal and Its Fractions

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Key words: shea nut, antioxidants, tannins, free radicals scavenging activity

Shea nut meal is a by-product that is residue after fat extraction from shea nuts (*Vitellaria paradoxa*, Gaertn.). It is available in large quantities in West Africa. Due to high content of tannins shea nut is a potential source of natural antioxidants.

Phenolic compounds were extracted from shea nut meal using 80% (v/v) aqueous acetone. Crude extract was applied onto a Sephadex LH-20 column. Fraction I, consisting of low-molecular-weight phenolics, was eluted from the column by ethanol. Fraction II, consisting of tannins, was obtained using water-acetone (1:1; v/v) as the mobile phase. Phenolic compounds present in the crude extract and its fractions showed antioxidant and radical scavenging properties as revealed following studies using TEAC, FRAP, and the DPPH radical scavenging activity. Results of these assays showed highest values when tannins (fraction II) were tested. For example, TEAC of the tannins fraction was 4.65 μmol Trolox/mg, whereas extract and fraction I showed 3.66 and 0.55 μmol Trolox/mg, respectively. The content of total phenolics in fraction II was the highest (490 mg/g). The content of tannins in this fraction determined using the vanillin method and expressed as absorbance units at 500 nm per 1 g was 932. Gallic acid was identified in fraction I using an HPLC-DAD method. Tannin fraction showed the ability to precipitate protein (BSA). The optimum of precipitation was observed at pH 4.0.

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Comparative Determination of Radical Scavenging Capacities of Different Honeys Measured by Various Tests

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Key words: honey, antioxidant, DPPH, ABTS, on-line HPLC

Honey has always been used as a natural sweetener. However, due to its curative ingredients, honey is increasingly used for therapeutic applications. Studies conducted in the last years prove its antibacterial, anticarcinogenic and also antioxidant properties [Gheldof *et al*., 2003; Viuda-Martos *et al*., 2008; Beckmann *et al*., 2009].

For this, the antioxidant capacity of honey is due to the contained phenolic acids and flavonoids [Böhm *et al*., 1998; Pichichero *et al*., 2009; Khalil *et al*., 2010]. The composition of the phenolic compounds and, thus, the antioxidant effect primarily depend on the floral source.

The aim of this research was the determination of the antioxidant capacity of various honey types using a DPPH as well as an ABTS assay. Whereas the published data regarding this topic are very inconsistent, influencing factors such as the pH value, the temperature, and the concentration of honey and reagents were investigated for each system.

To assign the antioxidant potential to certain substances, an on-line HPLC-ABTS screening method for polyphenols in honey was designed. In this, the absorption intensity of the $ABTS^{\bullet+}$ reagent at 630 nm is decreased by radical scavengers after HPLC separation.

Selected results will be presented and discussed.

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Evaluation of the Antioxidant Properties of Fruit and Flavoured Black Teas

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Key words: fruit and flavored teas, antioxidant properties, polyphenol content, CUPRAC, DPPH, FC assay

Antioxidant properties of the water extracts of the commercial bagged fruit and flavoured black teas were evaluated and compared with typical black teas of *C. sinensis*. Total phenolic content by Folin-Ciocalteu (FC) assay, cupric ion reducing antioxidant capacity (CUPRAC) and DPPH radical method were used for these purposes. The content of selected flavonoids and phenolic acids was also determined by high-performance liquid chromatography with tandem mass spectrometry in the negative electrospray ionization mode.

A fast and remarkable decrease in the absorbance of DPPH was observed for black teas, while fruit teas showed slow antioxidant behavior. Black tea infusions exhibit higher trolox equivalent antioxidant capacity (TEAC) values in CUPRAC method than studied fruit teas and after incubation with reagents at 50°C all TEAC values increased. Cluster analysis showed two principal groups of teas in relation of the phenolic composition of tea infusion and the ability to scavenge DPPH radical.

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Evaluation of Polyphenols and Antioxidative Activity of Cocoa and Chocolate Products

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Key words: cocoa, chocolate, polyphenols, antioxidant activity

There is a growing interest in the food industry and in preventive health care in the evaluation of natural antioxidants from plant materials. Cocoa and cocoa products, especially chocolates, are extraordinarily popular consumer goods. They had been identified as a rich source of dietary polyphenols which gained much interest recently due to its antioxidant capacity and its health benefits with a major focus on degenerative diseases. In this study, cocoa powder and various chocolate products with different cocoa fractions ranging between 32% and 85% were analyzed in regard to their content of polyphenol compounds and antioxidant properties.

Cocoa and chocolate products which were manufactured in Austria were defatted and extracted with 80% methanol. The obtained extracts were analyzed for their content of total polyphenols, flavonoids, catechins and proanthocyanidins by standardized photometric methods. The antioxidant activities were determined with the DPPH$^{\bullet}$ radical scavenging method and expressed as Inhibitory Concentration IC50 as well as with the ABTS-radical assay in terms of their Trolox Equivalent Antioxidant Capacity TEAC.

In the different cocao and chocolate products the content of total polyphenols was determined in the range of 3.2 to 23.1 mg/g with the highest amounts in cocoa powder followed by the different chocolate products in the order of their cocoa fraction percentage. The same trend was observed regarding their content of flavonoids (0.4–7.9 mg/g), catechins (0.7–2.6 mg/g) and proanthocyanidins (0.7–3.1 mg/g). All the cocoa and chocolate products showed considerable antioxidant activity in correlation to the content of polyphenol compounds with TEAC-values of 21–396 μmol TE/g according to their cocoa fraction percentage.

The results of this study indicate that cocoa and chocolate products are a major source of dietary antioxidants and consumption of these products offer a potential beneficial impact in maintaining and promoting human health.

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Comparison of Antioxidant Properties and Polyphenol Composition of Special Purpose Coffees Roasted in Poland

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Key words: coffee, antioxidant activity, phenolic compounds

Coffee brews, due to their taste, fragrance and stimulating properties, are amongst the most popular beverages consumed throughout the world. Recent studies have pointed to health benefits associated with coffee consumption that results from content of polyphenols found in this beverage. It has been estimated that coffee-based drinks may contribute up to about 65 % of the total antioxidant intake of the human diet. In this study, five kinds of special purpose roasted coffee brands found on Polish market were characterized by antioxidant activity and phenolic composition. These were: low-irritating coffee Astra with diminished content of 5-hydroxytryptamides, Sati Response supplemented with green coffee extract, Sati-Bio organically grown, aromatized Sati Splendid Moment and coffee Super from local small company.

Chlorogenic acids: caffeoyl-, feruloyl- and dicaffeoylquinic acids in coffee infusions were identified and quantified by reverse phase HPLC with photodiode array and MS detection. The total antioxidant activity was determined by spectrophotometric (ABTS, DPPH, FC) and cyclic voltammetry assays. The profiles of antioxidants were generated using an HPLC system with post-column on-line antioxidant detection based on ABTS and Folin-Ciocalteu reagent (FCR) derivatization. Caffeoylquinic acids were the most abundant antioxidants in all coffee samples. The highest antioxidative potential exhibited coffee enriched with green coffee extract confirming the soundness of such an approach to obtain products of higher healthiness.

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HPLC Analysis of Catechins from *Camelia* spp.

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Key words: catechins, tea, antioxidant activity, HPLC analysis

Free and condensed catechins are frequent secondary metabolites occurring in wide range species of higher plants. They are an important chemical factors that play a significant role in various environmental interactions. There are strong suggestions that they participate as natural nonenzymatic antioxidants in neutralization of free oxygen radicals. The present paper reports on occurrence of the catechins in water extracts of selected commercial tea products.

Hot water extracts of the teas were performed and partitioned with ethyl acetate. The organic phase after desiccation was evaporated until dryness was dissolved in 80% methanol. The MetOH solutions were injected on Microsorb MV 100–5C18 column with ChromSep Guard Cartridge (HPLC Varian ProStar 210 system). The partition was carried out using linear gradient of mobile phase from 20% B to 100% B during 75 min at flow rate 1cm^3/min (solvent A – 1% phosphoric acid and solvent B – 40% acetonitrile with 1% phosphoric acid), Identification of catechins in the methanolic solutions was performed with Photodiode Array Detector ProStar 335. Level of the identified compounds in the studied plant material was determined using the Sigma Chemicals standards.

The HPLC analysis allowed to identify in the tea extracts the following catechin derivatives: (+)-catechin, (-)-epicatechin, (-)-epigallocatechin, and (-)-epicatechin gallate. The dominant compound in water extracts from the all studied teas was (+)-catechin. The white tea extracts contained much higher content of the (+)-catechin than the other tested tea extracts. Usually the with high level of (+)-catechin also contained more (-)-epicatechin, and the tendency was quite stable. The (-)-epigallocatechin, and (-)-epicatechin gallate occurred only in some water extracts from the studied teas in pretty low content. Possible role of the catechins as nonenzymatic antioxidants is discussed.

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Characterization and Quantitative Analysis of Procyanidins in Fruits of Hawthorn Species (*Crataegus* spp.)

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Key words: *Crataegus* spp., hawthorn, phenolics, procyanidin

Leaves, flowers and fruits of hawthorn (*Crataegus* spp., *Rosaceae*) have been widely used as medicinal and food materials in China and in the European countries. Scientific evidence suggested beneficial effects of the extracts and other products of leaves, flowers and fruits of hawthorn on immune functions, sugar and lipid metabolism, cardiovascular health and inflammations.

Phenolic compounds, especially procyanidins and flavonoids, are a major group of bio-active compounds in hawthorn fruits. More than fifty flavonoids have been indentified from leaves, flowers and fruits of hawthorn. Identification and quantification of procyanidins in hawthorn is a challenging task. This is largely because of a lack of commercial reference compounds and deficient separation between procyanidins using high performance liquid chromatography (HPLC).

We investigated the main phenolic compounds in the fruits of C. pinnatifida var. major, the most commonly cultivated variety in China. The phenolic compounds were extracted from the fruits with aqueous ethanol. The extract was further fractionated by polyamide column chromatography, followed by analysis of each of the fraction by HPLC-DAD and HPLC-ESI-MS. Thirty-six compounds were determined and tentatively identified as B-type procyanidins (PA) and their glycosides.

A method of HPLC-ESI-MS with single ion recording (SIR) function was developed and optimized for the quantitative analysis of procyanidins and other phenolics in fruits of hawthorn in our study. This method significantly simplified the quantification of procyanidins in plant materials. Twenty-three samples belonging to four species and a variety of hawthorn (*C. pinnatifida, C. brettschneideri, C. scabrifolia, C. grayana*, and *C. pinnatifida* var. *major*) were analyzed with the HPLC-ESI-MS-SIR method. The total procyanidin contents in hawthorn fruits varied from 2.5 to 36.7 mg/g dry mass. Fruits of *C. pinnatifida* var. *major* and *C. scabrifolia* contained more procyanidins than other species.

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Antioxidant Potential of Tea Extract *Camellia sinensis* Influenced by *Rosaceae* and *Oxycoccaceae* Family Fruit Extracts

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Key words: polyphenols, fruits, ascorbic acid, anthocyanins, free radicals, $DPPH^{\bullet}$, $ABTS^{+\bullet}$, antioxidant activity

Free radicals are main reason for initiation of many degenerative diseases as well as food products deterioration. As the protection for oxidative changes antioxidants are used. Since today's consumers are aware of danger that synthetic additives bring food industry needs to look for new, promising sources of substances with antioxidative potential. One of such sources are commonly consumed fruits as strawberries or cranberries, rich in polyphenols that are major group of future antioxidants.

Aim of the research was to evaluate the antioxidant potential of selected fruits and its influence on the antioxidant activity of yellow tea extract. Material chosen for the research were fruit extracts from selected plants from *Rosaceae* and *Oxycoccaceae* family. As the representatives strawberry (*Fragaria ananasa*), raspberry (*Rubus ideaus* L.), blackberry (*Rubus fruticosus*) and cranberry (*Oxycoccus*) were chosen. Antioxidant potential of fruit extracts and its influence on yellow tea extract (*Camellia sinensis*) activity were analyzed.

Fruits and tea extracts were described by the contents of total reducing substances (Folin-Ciocalteu reagent), anthocyanins and ascorbic acid. The antioxidative and antiradical efficiency of plant extracts were conducted with use of reducing power, FRAP and metal chelating ability. Antiradical efficiency was measured according to protocols with use of $DPPH^{\bullet}$ and $ABTS^{+\bullet}$ radicals.

Results analysis showed that examined plant extracts from *Rosaceae* and *Oxycoccaceae* family exhibited high antioxidative potential. Fruit extracts influenced tea activity by increasing its antiradical potential in presence of $DPPH^{\bullet}$ and no influence on $ABTS^{+\bullet}$ radicals was found.

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A Comparison of Numerous *Cistus* Species and Subspecies – (I) Profiles of the Polyphenols with HPLC

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Key words: *Cistus*, ellagitannins, flavonoids, HPLC-DAD/MS

The plants of the *Cistus* genus which grow widespread over the Mediterranean area and the Caucasus are used in folk medicine for the treatment of several diseases. Anti-inflammatory, antiulcerogenic, wound-healing, antimicrobial, cytotoxic and antioxidant properties have been reported for the aqueous extracts and the remedies of the resin secreted from the stems and leaves.

In this study, the aqueous-methanolic extracts of 30 plants belonging to 19 different species and subspecies were analysed with HPLC-DAD/MS, and the main components were quantified. The rather considerable differences in their profiles will be presented and discussed.

The corresponding GC/MS profiles will be presented in another poster: A Comparison of Numerous *Cistus* Species and Subspecies – (II) Profiles of the Volatiles with SPME-GC/MS.

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Study on Specific Bioactive Components and Antioxidant Activity of Selected Fruits and Vegetables

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Key words: anthocyanins, HPLC-MS, bioactive compounds

There is an increasing interest in the substitution of synthetic food additives, colorants and antioxidants by natural ones. Anthocyanins contribute to the intense colors of berries, cherries and other fruits and vegetables. The most common anthocyanidins are cyanidin, delphinidin, malvidin, pelargonidin, peonidin and petunidin. Anthocyanins, accounts to several hundreds in total, are glycosides of glucose, rhamnose, galactose or other monosaccharides and combinations there of. Our intention was to identify the detectable major and minor natural compounds in fruits and vegetables, establish

their unique ratios, as well as perform comparative studies on their antioxidant capabilities, and point out the suitability for potential application in functional food developments.

Seven plants were selected for this study, including blackberry, black elderberry, black currant, Szomolyai sweet-cherry, rosehip, pumpkin, and horseradish. The chopped samples were extracted with 5 different solvent: hot water, ethanol, ethyl-acetate, acetone, n-hexane. The content of individual and total anthocyanins in extracts were analyzed by HPLC-MS. Separation was conducted on Agilent zorbax SB-C18 5 μm 4.6 x 250 mm column. The solvent system was composed acetonitril (eluent B) and 0.1% TFA (eluent A). Gradient elution program was performed. Pelargonidin-chloride (Sigma), Peonidin-chloride (Fluka), Cyanidin-chloride (Fluka) were used as standards. Antioxidant capacity of the compounds was established by DPPH and FRAP methods. Further aim of this study was to identify major and minor bioactive compounds from different fruits and vegetables, as well as determining their abundance and ratios. The identified compounds are composed of aglycones (peonidin, pelargonidin, cyanidin, petunidin, malvidin, delphinidin), organic components (Ferulic-, coumaric-, malonic- and synapic acid), and sugar components (D-glucose, D-galactose, D-xylose, L-rhamnose). The active component content varied between 0–10 mg/g depending on the used extraction solvents. The antioxidant capacity of each fraction was assessed in order to plan perspectives of application of the identified compounds for further functional food developments.

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P105

Total Antioxidant Capacity and Total Polyphenol Content of the Selected Plant Products Measured by DPPH, ABTS and Folin–Ciocalteu Methods

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Key words: antioxidant potential, polyphenols, plant food, DPPH, ABTS, Folin-Ciocalteu assay

In many studies was proved that plants present high antioxidant potential. In this study antioxidant activity was evaluated in selected products which might improve the total antioxidant capacity of meals by adding its to the dishes. The study aimed to the assessment of antioxidant and radical – scavenging properties of 12 products by DPPH assay (1,1-diphenyl-2-picrylhydrazy), ABTS assay (2,2'-azino-bis-[3-ethylbenzthiazoline-6-sulphonic acid]) and Folin–Ciocalteu Reagent (FCR) for total polyphenols selected spices, seeds, nuts and dried fruits.

In DPPH assay the ability to inhibit the oxidant reaction ranged 1.06–330.91 μM/g and in ABTS assay 0.12–105.56 mg/1g. The ranking of antioxidant activity of products evaluated by DPPH assay was: dried fruits < nuts < seeds < spices. The same relation was observed in ABTS assay. There was a significant correlation between DPPH and ABTS assays ($p \leq 0.05$). Total phenolic contents of tested plant products ranged from 0.008–9.96 mg gallic acid/g. In all methods, spices presented the highest level of total antioxidants and total polyphenols compared to the other groups which were analysed (seeds, nuts, dried fruits).

Summarizing it is worth to underline that spices, dry fruits, or seeds are rich sources of natural bioactive substances. Their addition as a snacks, spices, can effectively improve the antiradical status and capacity of the diet especially in situations when the nutritional habits modification is difficult to obtain.

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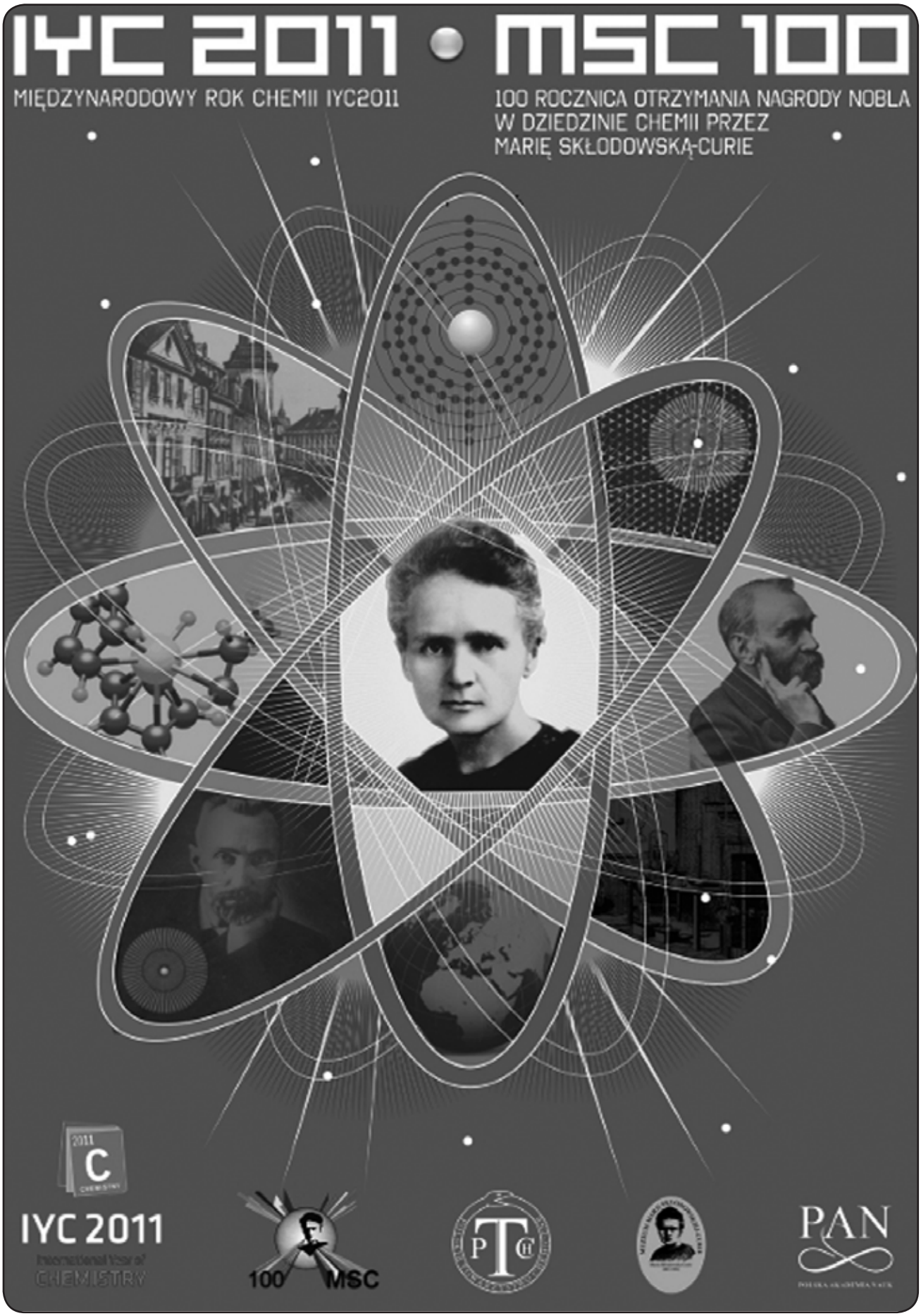
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PLENARY LECTURES

L3

Biological Activity of Dietary Glucosinolates and Opportunities for Their Use in Functional Foods

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Key words: glucosinolates, isothiocyanates, indoles, bioactivity, cancer prevention, vascular health, inflammation

Glucosinolates are the characteristic secondary metabolites found in cruciferous vegetable and salad crops. These molecules comprise a common thio-glycoside moiety with a variable side chain derived from an amino acid precursor. When ingested, the glucosinolate molecule is hydrolyzed to generate a range of biologically active products of which isothiocyanates and indole compounds are the most prominent. The biological activity of these breakdown products is thought to underpin the health benefits of cruciferous vegetables that are evident from epidemiological studies. In this review, I will initially describe the chemical structure of glucosinolates that are commonly found in crop plants, and recent advances in our understanding of their biosynthesis and accumulation. I will then discuss the nature of glucosinolate breakdown products, their absorption and metabolism after ingestion, and our current understanding of their biological activity. Finally, I will discuss the development of novel plant varieties and processed food products with modified levels of specific glucosinolates or their derivatives to enhance human health and well being, and opportunities for future research and development.

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L4

Eggs as a Main Source of New Generation of Nutraceuticals

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Eggs are traditionally widely used for culinary purposes. Recent research results show that due to a high content of bioactive substances, hen eggs are the best material for diet supplements and biomedical applications.

Apart from that, research results and practice in the field of egg production indicate that there are unlimited possibilities for further development of chemical composition of egg matter by natural feeding of layer hens with selected substances. Egg yolk may be enriched with vitamins, n-3 fatty acids, selenium, iodine *etc*. As a result, eggs become nutraceuticals, *i.e.* pro-health food or material for biomedical purposes.

Nature does not know any other food product which is as perfect as an egg. When a normally laid and fertilized egg is provided with energy in the form of heat (39^{o}C) for 21 days, it turns into a living organism (chick) which continues growing and developing. Thus, all substances necessary for its creation are contained in the egg. This fact indicates high biological value of eggs and confirms the perfection (excellence) of their components.

The biological activity of majority of substances contained in egg matter is related to their anti-bacterial, anti-viral and anti-fungal properties and their immunogenic features.

Moreover, numerous research results prove that many substances contained in egg matter have anti-cancer qualities.

Among many biologically active substances found in egg matter, there are some substances of special interest:

Cystatin is one of the smallest egg white proteins (12.7 kDa). It has strong antimicrobial qualities against bacteria, fungi, moulds, yeasts and viruses and also anti-cancer properties.

Lysozyme is one of the most popular proteins (enzymes) and one of the best known substances contained in egg. It is also characterised by antiviral and anti-cancer properties.

Ovomucin – built of two main fragments (220 and 400 kDa) is the largest egg white protein. It inhibits hemagglutination and is an antiviral agent, esp. against flu viruses. Ovomucin shows cytotoxic properties against cancer cells.

Phosvitin is a substance with strong antioxidative properties, very important for inhibiting unfavourable radical reactions leading to numerous diseases. It is rich in phosphate (10%), thus it is an important supplier of organic phosphate.

Immunoglobulin Y (IgY) is widely studied and has found its application in pharmaceutical and para-pharmaceutical practice as acting against infections of alimentary tract.

Phospholipids – mainly egg yolk lecithin, contain unique fatty acids which are indispensable for human body, esp. arachidonic (AA) and docosahexaenoic (DHA) acids. Both acids are necessary for proper functioning of the central nerve system and of the circulatory system.

It has become clear that egg white and yolk proteins are a source of biologically active peptides. Biologically active peptides are considered to promote diverse activities, including opiate-like, metal binding, immunomodulatory, antimicrobial, antithrombotic, hypocholesterolemic, antihypertensive.

This knowledge has become the basis to prepare a special project aiming at enrichment of eggs and the application of biosubstances from eggs isolated using innovative technology.

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SESSION 2: GLUCOSINOLATES ON THE BORDER OF CHEMISTRY AND BIOLOGY

ORAL PRESENTATIONS

O14

Intact Glucosinolates as Bioactive Food Components

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Key words: glucosinolates, nitriles, bioavailability, xenobiotica

Intact glucosinolates – and not only products thereof – are bioactive cruciferous food components. Their biological effects can be harmful or health beneficial depending on their dietary concentration and structural types. The structural variations important for biological effects or bioactivities comprise the structural variations of the glucosinolate side chain (R-groups) including the R or S configurations of the chiral centers at carbon or sulfinyl groups in the side chains, as well as contributions from acyl ester groups on the thioglucose part.

The bioactivities or biological effects resulting from intact glucosinolates present in food or feed to humans or monogastric animals are a result of the glucosinolates and/or transformation products thereof resulting from non enzymatic and/or myrosinase catalysed processes. In the present work the bioactivity of intact glucosinolates has been investigated using *in vivo* rat trials developed as balance studies and as short and long term studies in pigs. Administration in the trials of purified intact glucosinolates and glucosinolate derived compounds revealed concentration dependent effects of the individual compounds.

In vivo investigations have also shown, that the majority of glucosinolates present in diets without myrosinase activities disappear during the passage of digesta through the stomach and the first part of the small intestine. During the recent years, it has been well documented that at least a fraction of the intact glucosinolates in digesta is degraded in the stomach to nitriles and a fraction is absorbed to the blood and excreted as such to the urine both for humans and animals; rats, hamsters dogs and pigs. The present work also comprises *in vivo* trials in pigs that show a comparable biological effect of intact glucosinolates with and without the presence of myrosinase. Although intact glucosinolates are always found to be present in low concentrations in the blood and are only present in the blood for a limited time after ingestion of the compounds, our studies confirm that some glucosinolates as *e.g.* sinalbin are transformed in the liver xenobiotic metabolism to a glucuronide which is also excreted to the urine.

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O15

Linking Plant Sciences and Food Sciences: Quantitative Genetic Analyses of Glucosinolate Degradation During Food Processing in *Brassica oleracea*

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Key words: Brassica, processing, QTL mapping, phytochemicals, broccoli, Chinese kale

Epidemiological studies show negative associations between the consumption of Brassica vegetables and the incidence of certain cancers. The protected effects of *Brassicacea* have been attributed to high levels of health-promoting phytochemicals such as glucosinolates (GLS). Plant breeders are developing Brassica vegetables richer in specific GLS. Next to the initial GLS concentration, the ingested amount of GLS is affected by industrial and domestic processing and storage. The described mechanisms of GL losses are: a.) enzymatic degradation by the endogenous enzyme myrosinase, b.) leaching into the cooking water and c.) thermal degradation. Previously, thermal treatment of five different Brassica vegetables (two *B. napus* and three *B. oleracea* types) revealed differences in the degradation velocity of the same GLS in different vegetables. These results show that the chemical stability is influenced by the plant matrix, which is (partly) genetically regulated.

Thermal degradation rates were studied in a segregating doubled haploid (DH) population, obtained by crossing broccoli and Chinese kale. It was hypothesized that thermal stability of GLS segregates as other phenotypic traits, like *e.g.* flowering time. In order to determine rate constants for the reaction velocity, homogenates of microwaved leaves were heated at 100°C over various times and the GLS concentrations

were analyzed. GLS occurring in all the plants of the DH population are glucobrassicin and glucoraphanin. The degradation could be modeled applying first order kinetics. The estimated degradation rate constants of glucobrassicin differ 3-fold and the rate constants of glucoraphanin differ 7-fold throughout the DH population, which confirms the hypothesis of segregation of thermal stability of GLS. The obtained kinetic data will be combined with molecular markers (QTL analysis) in order to reveal the genetic regulation of thermal GLS degradation during food processing.

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O16

Glucoraphanin from "Cavolo nero Toscano": Gram-Scale Isolation and Biological Activity

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Key words: glucoraphanin, sulforaphane, glucosinolate, *Brassicaceae*

Dietary intake of *Brassicaceae* provides not only nutrients but also a highly interesting class of secondary metabolites beneficial to health, known as glucosinolates (GLs). These compounds constitute a class of pseudo-thioglucosides which, through injury to plant cells, undergo hydrolysis induced by endogenous myrosinase (EC 3.2.1.147) to release isothiocyanates (ITCs) or nitriles depending on physico-chemical parameters and/or the presence of enzyme cofactors.

R-(-)-Glucoraphanin, the major GL contained in broccoli sprouts, is enzymically hydrolysed to R-sulforaphane, a biologically active metabolite responsible for many health benefits [1].

As part of our continued interest in the chemistry of the *Brassicaceae*, and particularly in glucoraphanin, a two-step gram-scale chromatography isolation of this GL, from "Cavolo nero Toscano" (Black Tuscan cabbage) seeds was set up. In precision-cut rat lung slices, glucoraphanin was shown for the first time to modulate the carcinogen-metabolising enzyme systems [2]. This observation challenges the accepted view that the chemopreventive activity of GLs is exclusively mediated by their degradation products, such as ITCs. In a recent study, natural R-sulforaphane generated in situ by myrosinase-catalysed hydrolysis of glucoraphanin was shown to be more potent than non-natural S-sulforaphane in modulating the detoxification enzymes in both rat liver and lung slices [3]. Consequently, the numerous studies referring to racemic sulforaphane may have underestimated the chemopreventive potential of R-sulforaphane to which humans are commonly exposed through standard diet.

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O17

Optimization of Glucosinolate Bioconversion into Isothiocyanates Using Response Surface Methodology

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Key words: broccoli, glucosinolates, isothiocyanates, sulforaphane, response surface methodology

Isothiocyanates are important bioactive compounds from cruciferous plants that have been shown to possess strong anticarcinogenic properties in several cell culture and animal studies. In addition, epidemiological evidence shows that consumption of isothiocyanate-containing foods is associated with reduced incidence of a number of cancers. Isothiocyanates are not found as such in plants; they are formed following enzymatic hydrolysis of their precursor compound glucosinolates. The endogenous enzyme governing this conversion is the thioglucosidase enzyme myrosinases (EC 3.2.1.147). However, other compounds may be formed upon glucosinolate hydrolysis such as isothiocyanate nitriles which are largely inactive. In particular, the presence of the myrosinase co-factor epithiospecifier protein (ESP), as well as reaction conditions such as temperature and pH are known to affect the type of products formed. Yet, no studies to date have focused on the optimization of reaction conditions to obtain maximum conversion of glucosinolates into isothiocyanates in cruciferous vegetables. The obtained isothiocyanate-rich extracts can have multiple applications in the food and phar-

maceutical industry including the preparation of compatible novel products with high nutritional value.

In this study, experimental design and response surface methodology was used to assess the effect of temperature, pH, incubation time, and interaction effects, on the level of total isothiocyanates and sulforaphane content in broccoli extracts. Total isothiocyanate content was measured using spectrophotometric detection following cyclocondensation with 1,2-Benzenedithiol. A new UPLC-MS method using triple quadrupole mass spectrometry was developed to quantify the sulforaphane content. Face Centred Design was used with a total of 17 experimental runs including three replicate centre points. The models obtained for both responses had R2 and Q2 values higher than 0.87. For the response sulforaphane, the model predicted highest levels would be obtained when incubation temperature was in the range 45-50°C at pH 6 and with incubation time between 30-40 minutes.

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O18

Effects of Pre- and Postharvest Factors and Food Processing on Glucosinolates in Brassica Vegetables

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Key words: glucosinolates, bioactivity, health, flavour, plant defence, postharvest, preharvest, food processing, Brassica

Glucosinolates are a group of phytochemicals present in plants of the *Brassicaceae* family, but also in several other species. They are part of a plant defence system, where the glucosinolates are degraded by means of myrosinase enzymes with help of cofactor proteins to release various breakdown products that are deterring herbivores and pathogens. Glucosinolates and their breakdown products in food plants are also important for the flavour, and for various bioactivities after ingestion that can be health-promoting or harmful. The effects on herbivores or pathogens, as well as on flavour and bioactivity are dependent upon the presence and content of specific glucosinolates, but could also include other constituents. In any case it is important to know how the growing conditions, postharvest storage and handling, and food processing and storage will affect the content and profile of glucosinolates in food plants, which typically can have 5-15 different glucosinolates at detectable levels. In addition, the genotype (cultivar) can have a large effect on the glucosinolate profile and level. I will give an overview of the latest results from own and other research on some of these effects for Brassica vegetables, especially cabbage, cauliflower and broccoli. In some cases I will compare with the behaviour of other health-related constituents such as phenolics and vitamin C.

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O19

Thermal Degradation of Sulphur Containing Aliphatic Glucosinolates in Broccoli Sprouts

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Key words: glucosinolates, thermal degradation, structural influence, isothiocyanates, nitriles, broccoli sprouts

Glucosinolates (GSL) are secondary plant metabolites that occur especially in the *Brassicaceae* family. The genus Brassica includes many commonly consumed plants like cabbage, broccoli and mustard. So far, more than 120 GSL have been identified. GSL and their enzymatic hydrolysis products – *e.g.* isothiocyanates (ITCs) and nitriles – are of particular interest in food research because of their alleged bioactivity. Thermal processes such as cooking and canning reduce the GSL levels considerably likewise producing ITCs and nitriles [1, 2].

The aim of this study was the investigation of the thermal induced breakdown of individual GSL in broccoli sprouts with focus on the influence of the chemical structure as well as the influence of different pH to thermal degradation. GSL-breakdown was studied with HPLC-DAD [3]. Additionally thermal breakdown products, ITCs and nitriles, were also tracked by GC-FID. The thermal degradation was studied by heating broccoli sprouts in dry and aqueous medium.

Within each structural group of GSL in broccoli sprouts (indole, olefinic, sulphur containing aliphatic) differences in the thermal-induced degradability were revealed. Basic medium generally destabilised GSL. Within the five analysed sulphur containing aliphatic GSL the oxidative state of the sulphur atom and the side chain length influenced the reactivity. Dependent on reaction conditions, nitriles but also ITCs were identified as degradation products of sulphur (II / IV) containing aliphatic GSL. Aqueous treatment produced more degradation products than dry heat treatment (130°C) probably due to thermal instabilities of the degradation products. ITCs were only found at 100°C (dry and aqueous medium). Due to its thermal instability, 4-Methylthiobutyl-CN was the most predominantly occurring degradation product although glucoerucin was not the major sulphur containing aliphatic GSL in broccoli sprouts.

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[2] MacLeod et al., Phytochemistry, 1981, 20, 977-980.
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O20

Chemical Detoxification of Carcinogenic Heterocyclic Aromatic Amines by Isothiocyanates

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Key words: heterocyclic aromatic amines, isothiocyanates, detoxification

Epidemiological studies revealed opposite trends in relationships between cancer risk and meat consumption on one hand and cancer risk and the intake of brassica vegetables on the other. The increased amount of meat in diet is associated with growing incidence of most common cancers, *e.g.* breast, lung, or colon carcinomas. This increase is partly explained by the presence of carcinogens formed upon thermal processing of proteinous foods. The occurrence of the same types of cancers declines with the frequency of consumption of brassica foods. Such a protective effect is proposed to result from enhanced expression of cytoprotective genes by glucosinolate degradation products. Interestingly, the combination of the mentioned two food ingredients is embedded in culinary tradition in certain regions and some data suggest that the incidence of cancer there is lower than could be expected based on meat intake only.

Cured and/or thermally processed meats may contain carcinogenic substances belonging to the class of amines, respectively N-nitrosamines or heterocyclic aromatic amines (HAA). Chemical properties make these carcinogens prone to the reaction with electrophiles such as isothiocyanates (ITC) found in brassica vegetables. Thioureas, products of this reaction, are stable, thus potentially less genotoxic. We hypothesized that formation of thioureas could occur also in the case of dishes combining meat and brassica vegetables and may represent “chemical detoxification” of amine food carcinogens.

To test this hypothesis, we synthesized thioureas from the most abundant HAA found in heated meat – MeIQx and ITCs present in popular brassica vegetables – allilo-ITC, phenylethyl-ITC and sulforaphane. Mutagenic potency of resulting conjugates in Ames test was up to two orders of magnitude lower than that determined for parent HAA. Also, the rate of metabolism of the thioureas synthesized was higher. These observations suggest that combining meat foods with brassica vegetables may have important nutritional consequences.

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SESSION 3: CHEMISTRY BEHIND FUNCTIONAL ANIMAL PRODUCTS

ORAL PRESENTATIONS

O21

Meat Products as Functional Foods. A Paradox?

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Key words: meat, functional foods, functional ingredients, health and wellness

The emergence of so-called functional foods can today be found in almost every sector of the food industry. Yet, the meat industry seems to be one of the last arenas to embrace the concept of these "foods for health." Perhaps this stems from the fact that meat and meat products possess a marked content of fat, saturated fatty acids, cholesterol, and salt (*NB*, all are deemed as risk factors toward the development of cardiovascular diseases), or because of regulatory restrictions placed upon the additives allowed in fresh and processed meat products. Hence, many challenges are put forward to the meat processor at overcoming these perceived negative health attributes.

Meat and meat products can be modified by including functional ingredients/bioactives considered beneficial (*e.g.*, fruit or cereal fiber {both soluble and insoluble}, phytochemicals, natural antioxidants, vegetal proteins, MUFAs, and PUFAs) or by eliminating/reducing those components considered detrimental to health. When strategies such as fortifying meat with functional ingredients are employed, this can present issues to the processor at maintaining flavor, texture, and shelf-life stability of products, which the consumer has come to expect. So the question becomes, "have new products been fabricated to provide healthy alternatives to traditional meat products or have they simply been rebranded as a marketing aid to capitalize on the functional food revolution?" This presentation will explore the constraints faced by the meat industry at trying to generate functional meat products and then ask the question if a functional meat product truly exists.

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O22

Quantification of Phenolic Compounds in Smoked Meat Products Using Different Glow Smoke Conditions

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Key words: phenolic substances, Frankfurter-type sausages, wiener, smoking conditions, glow smoke, beech wood, Antonacopoulos, Clevenger

The aim of the research project "Minimisation of PAH contents in meat products by optimisation of the conditions of conventional smoking" is not only to reduce undesirable PAH compounds but also to ensure desirable substances such as phenolic compounds. These substances are important to conservation and flavour of smoked meat products. Within the group of phenolic substances, five dominating substances (guaiacol, 4-methylguaiacol, syringol, eugenol, and trans-isoeugenol) are of special interest. For smoking experiments, different glow smoke conditions were applied. These different parameters (smoke density, ventilator velocity, wood moisture) showed an influence on the contents of the analysed phenolic compounds. With increasing smoke generation temperature, the proportion of syringol increased, and the proportion of trans-isoeugenol decreased.

The contents of phenolic compounds in Frankfurter-type sausages were determined by gas chromatography coupled with a mass-selective detector after trimethylsilylation.

For sample preparation, 1 g of homogenised smoked sausage was filled into an insert for an Antonacopoulos apparatus, and the volatile phenolic compounds were isolated by steam distillation. The distillate (300 mL) was extracted with diethyl ether and dried over Na_2SO_4. After evaporation of the solvent, the residue was dissolved in ethyl acetate and cleaned on a silica cartridge. The disadvantage of this procedure is the high consumption of diethyl ether (300 mL).

In order to improve sample preparation, a method using a Clevenger apparatus was developed. With this, the sample was filled into a flask, and 5 mL of organic solvent (density < 1 g/mL) were filled into the Clevenger apparatus. Simultaneous distillation and extraction were performed for three hours. The extract was cleaned on a silica cartridge.

Both analytical extraction methods showed satisfactory recoveries of phenolic substances in smoked sausages. The improved method using a Clevenger apparatus reduced solvent consumption from 300 mL to 5 mL and made it possible to save time.

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O23

Emulsion-Based Meat Products as a Tool for Functional Food

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Key words: meat emulsion, nutrient carriers, nutritional potential

A meat emulsion consists of particles of fibrous meat, including connective tissue and muscle fibers, dispersed with particles of solid fat in a fat-in-water emulsion. From a nutritional standpoint, meat emulsions are considered as a source of protein but with a potentially high lipid content. However, the solid structure of meat emulsions makes them well-adapted as a support for incorporating molecules and nutrients of nutritional interest. Indeed, the fat globule content in the protein-water matrix can be flexibly rearranged, as long as it stays within limits imposed by the sensory properties of the meat emulsion (flavor, texture,...). One of the main levers of action for improving meat emulsions is the raw lipid materials selection process, including replacing saturated fatty acids by unsaturated omega-3 fatty acids or by employing chemical or enzymatic processes (interesterification). It is equally possible to incorporate vegetable oils coupled with thickening agents and/or antioxidants to counter potential oxidative damage. As a measure to counterbalance the loss of flavor tied to the inclusion of nutritionally-valuable but highly-reactive compounds, nutrient carriers (such as carotenoids or lutein) are proposed as a solution for enriching meat emulsions while preserving their nutritional potential. This solution would set technologists the major challenge of ensuring that the vectored carrier molecules are first homogeneously dispersed before then being released from the food matrix at the ideal time (intestinal barrier).

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O24

Characterisation of Conditions Affecting Stability of Oligo-Peptide Derivatives of Potential Health--Preserving Effect

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Key words: small molecular weight peptides

Small molecular weight peptides represent an important family of compounds that play significant role in physiological and biochemical processes as well as in clinical and food research. Beyond the functional properties (antioxidant, antimicrobial activity) of these compounds they can contribute to the development of characteristic flavors such as sweetness and bitterness in various types of food. Several publications have dealt with the separation, detection and identification of these compounds, however the published methods carry difficulties in terms of the quantitative analysis, the sensitivity and reproducibility have been proven to be poor mainly because several amino acid moieties have low UV-absorbing properties.

Our intention was to develop a reliable and sensitive chromatographic method to detect di-, and tripeptides (Aspartame, L-carnosine, L-glutation, Alanyl-glutamine and gamma-glutein) in raw and processed food materials. A HPLC-method was developed to analyze peptide containing complex food samples and raw materials. The detection of free peptides was carried out using evaporative light scattering (ELS) detection, UV detection was accomplished by pre-column derivatization with danzyl-chloride.

Pea, rice and garlic samples have been selected for the study, the extraction procedure was optimized with different solvents: phosphoric-acid, hydrochloric-acid, acetic-acid, ethanol and water, the peptide content was analyzed with the newly developed technique. Antioxidant activity (FRAP) was observed only for the sulphur containing derivatives (gamma-glutein, L-glutation). Garlic extracts have shown the highest antioxidant activity (46 ppm in ascorbic acid equivalents), pea samples have exhibited lower activity (23 ppm) and the lowest activity has been measured for rice samples (19 ppm). The peptide content was varied in the 10-100 ppm region for all derivatives in the examined plant parts. The stability of the sulphur containing derivatives has been found to be low, the stability of these compounds was increased by applying different agents and protection ways such as antioxidants and transition metals and transformation to derivatives.

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O25

Effect of Technological Modification on the Immunoreactive and Allergenic Properties of Cow Milk Proteins

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Key words: milk proteins

Food allergies are considered to affect about 1-2% of adults and 5-7% of children all over the world. There are numerous factors (inherited and environmental ones) which can induce the disease. Cow's milk is one of the most common mixture of protein allergens although it is of high nutritional value, palatability and availability. Cow's milk contains over 100 proteins and peptides which can induce IgE-mediated reaction in allergenic patients. The major allergens in milk from cows (*Bos domesticus*) consist of casein (Bos d 8) and whey proteins: α-lactalbumin (α-la, 14,2 kDa, Bos d 4), and β-lactoglobulin (β-lg, 18,6 kDa, Bos d 5-normally absent in human breast milk). Other allergens of cow's milk include immunoglobulins (<150 kDa, Bos d 7) and serum bovine albumin (BSA, 66 kDa, Bos d 6). Generally, the only way for allergenic patients is to avoid allergenic proteins, but for small children the most widely used alternatives are hypoallergenic formulae. They are based on whey proteins, casein or soya, paradoxically, the most allergenic proteins which are modified in different kinds of technological processes to change their immunoreactive properties. Among the technological processing, thermal processes, enzymatic modification, chemical modification, and fermentation with use of lactic acid bacteria are the most effective considering reducing of immunoreactivity and allergenicity. The molecular basis of changes in the allergenic activity is the inactivation or destruction of epitope, structures, the formation of new epitopes, or the revealing hidden epitopes by denaturation of the native allergen.

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SESSION 4: LIPIDS AS DIETARY HEALTH PROTECTING AGENTS

ORAL PRESENTATIONS

O26

Treatment and Prevention of Disease with Dietary Fatty Acids

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Key words: dietary fatty acids, health, lipid metabolism, diabetes, body weight

Recent publications have added much on our knowledge about the clinical effects of dietary fatty acids. It is long established, that substitution of saturated fatty acids with polyunsaturated fatty acids decreases LDL-cholesterol, a strong risk factor of coronary heart disease. On the other hand, the most common defined lipid disorder in patients with myocardial infarction, familial combined hyperlipidemia, has to be treated with an increase of the amount of unsaturated fatty acids and a decrease of carbohydrates in the diet. Clear evidence exists that diabetes can be prevented by an increased intake of omega-6 polyunsaturated fatty acids and by a decrease of saturated fatty acid in the diet. It is interesting, that the beneficial effect of polyunsaturated fatty acids (omega-6) is independent of the degree of overweight or obesity. An increased intake of polyunsaturated fatty acids is also associated with a lower body weight in patients with a point mutation in the PPAR-gamma gene and a polymorphism of the apolipoprotein A-II gene. Both polymorphisms can be found in about 40 % of an European population. Furthermore there is accumulating data on the role of dietary fatty acids in appetite regulation which also plays an important role in body weight control. There is also evidence that omega-3 fatty acids can have positive effects on sudden cardiac death, but also on depression. In conclusion, there is strong evidence, that the right choice of fatty acids in the diet can strongly contribute to maintaining health and to improve disease.

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O27

Eicosapentaenoic Acid as Mitochondria Protective Agent in Endothelial Cells Exposed to Stress

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Key words: free fatty acids, eicosapentaenoic acid, mitochondria

Exposition of endothelium to free fatty acids may exert different effects depending on saturation and length of chain, including induction of apoptosis and lipotoxicity, as well as prosurvival effects against cell death. Omega-3 fatty acids have been found to favorable modulate impaired endothelial function, as determined by in vitro assessment of vasodilation mechanisms and vasoconstrictive responses, potentially due to enhanced nitric oxide formation and increased vascular smooth muscle relaxation but the mechanism remains elusive.

The aim of the study was to investigate the mitochodria-related effect of FFAs in endothelium model cells (HUVEC) exposed to metabolic stressor.

Endothelial cells (HUVEC human umbilical vein endothelial cells) were preincubated with dietary free fatty acids: palmitic acid (PA), oleic acid (OA), arachidonic acid (AA), eicosapentaenoic acid (EPA) or with sulfur-containing fatty acid analogue tetradecylthioacetic acid (TTA) at 30 μM for 24h. For the last 4 hours of incubation, HUVEC cells were exposed to TNF-alpha at 5 ng/m as cellular stressor.

Mitochondrial metabolic activity was monitored by measurements of the mitochondrial oxygen consumption rates (OROBOROS® Oxygraph-2k) and ATP level. Measurement of mitochondrial membrane potential (MMP) was performed by flow cytometry using JC-1 by and BD Bioimager 855 microscopy.

HUVEC cells were affected by TNF-alpha which decreased the MMP, though the other mitochondrial functions studied were changed not significantly. The mitochondrial respiration, mitochondrial membrane potential and ATP generation was significantly increased by pretreatment of endothelial cells with EPA or TTA.

This study has shown that dietary eicosapentaenoic acid may improve mitochondrial function and exert protective effect in the stressed cells.

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O28

Phytosterols and α-Lipoic Acid Conjugates: Synthesis, LC-MS Analysis and Free Radical Scavenging Capacity

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Key words: phytosterols, phytosterol lipoates, α-lipoic acid, dihydrolipoic acid, free radical scavenging capacity, DPPH, obesity

Plant sterols (PS) are bioactive compounds effective in reducing plasma cholesterol. Fatty acid esters of PS improve their solubility and blending properties to be utilized in various food products. Naturally occurring α-lipoic acid (LA) and its reduced form dihydrolipoic acid (DHLA) are known for their antioxidant activity. In addition, they have shown an array of health beneficial properties against obesity, diabetes, cancer, cardiovascular and inflammatory diseases *etc*. Different LA conjugates have been reported to increase bioactivity compared with the parent compounds. The objective of this study was to synthesize PS esters of LA (PSLA) and DHLA (PSDHLA) in order to increase their cholesterol lowering effect and reducing the risk of atherosclerosis with additional health benefits *e.g.* against oxidative stress.

Synthesis of PSLA and PSDHLA was performed with a pure PS mixture. The derivatives were analysed by RP--HPLC-MS-APCI and their free radical scavenging capacity were assessed by DPPH method. The elution order of the compounds observed in HPLC-MS analysis was DHLA< LA< PS< PSDHLA< PSLA. Baseline separation was not achieved between LA/DHLA, campesterol/stigmasterol and their derivatives. These compounds could be identified by their molecular ions and characteristic fragment ions from the mass spectral data. Remaining percentage of DPPH free radical was measured at the steady state for different concentrations of LA, DHLA, PSLA and PSDHLA. LA and PSLA showed very little, but remarkably high free radical scavenging capacity was observed for DHLA and PSDHLA. Efficient concentration (EC_{50} as a molar ratio) for DHLA and PSDHLA was 0.43 and 0.39, respectively.

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O29

Health-Related Effects of Conjugated Fatty Acids

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Key words: conjugated fatty acids, cancer, obesity, atherosclerosis, hypertension

Conjugated fatty acids (CFAs) are a mixture of positional and geometric isomers of polyunsaturated fatty acids with conjugated double bonds. Reports indicate that CFAs have potent beneficial, health-related effects. However, recent studies suggest that CFAs isomers have different functions.

Conjugated linoleic acid (CLA) is the general term referring to a group of positional and geometric isomers of linoleic acid (LA, cis-9,cis-12 C18:2n-6). Generally, the predominant CLA isomers in ruminant fat are cis-9,trans-11 CLA (c9,t11), and trans-10,cis-12 CLA (t10,c12). However, in many studies the opposing effects of considered CLA isomers have been shown. The t10,c12 isomer of CLA has anticarcinogenic, antiobese and antidiabetic effects, whereas the c9,t11 CLA isomer exerts an antiatherosclerotic effect. Recently, not only for CLA but also for conjugated linolenic acid (CLnA) several unique biological effects have been found. CLnA is one of the highly unsaturated forms of conjugated fatty acids of linolenic acid (LnA, cis-9,cis-12,cis-15 C18:3n-3) with triple bonds occurs in multiple positional and geometric isomers. In contrast to CLA, CLnA has been found abundantly in some seed oils, such as Pomegranate seed oil (cis-9,trans-11,cis-13; 18:3), Calendula oil (trans-8,trans-10,cis-12; 18:3), Bitter gourd oil (cis-9,trans-11,trans-13 18:3) and Catalpic oil (trans-9,trans-11,cis-13;18:3). Bitter gourd oil has been reported to have various medicinal properties, including hypoglycemic, anticarcinogenic, hypotriglyceridemic and hypocholesterolemic effects. Also Catalpic oil has been found to decreased abdominal fat accumulation and improved glucose homeostasis and lipid profile. Although it would be interesting to know the effects of CFAs on humans, there are only few reports concerning the anticancer and antiobese effects of CLA in humans. More detailed evaluations of the physiological bioactivities of CFAs isomers on lifestyle-related diseases in humans and animals will be of great interest in future studies.

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O30

Sterols and Carboxylic Acid-5-Hydroxytryptamides in Selected Tree Nuts

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Key words: pecans, hazelnut, walnut, C-5-HT, phytosterols, sterolesters

The nuts of Pecan (*Carya illinoinensis* L.), hazelnut (*Corylus avellana* L.), and walnut (*Juglans regia* L.) are rich in vegetable oils. They are widely used as human diet and as components in dietetic foods. The content of oil was found to be 55–75%. The fatty acid composition of glyceride oils was reported earlier by several authors. The major fatty acids were oleic and linoleic in hazelnut oils and oleic, linoleic, and linolenic in walnut oil. Beside the oils, the nuts contain a lot of other bioactive substances, such as phytosterols and carboxylic acid-5-hydroxytryptamides.

Carboxylic acid-5-hydroxytryptamides are some of the main constituents of the coffee wax. Wurziger *et al.* first introduced this substance group, amides of serotonin (5-hydroxytryptamine) and fatty acids with different chain lengths. They isolated and characterised the three dominant 5-HT with arachic, behenic and lignoceric acid. Later on Folstar identified C-5-HT with ω-hydroxy-fatty acids. Recently, our working group identified unsaturated and odd numbered C--5-HT in green coffee wax. Until today only Wurziger reported about the occurrence of C-5-HT in pecan and walnut.

Phytosterols are common components of plant foods, especially vegetable oils, seeds, nuts, and cereals. Sterols were found both in free and esterified form. Recent findings that plant sterols and sterolesters lower serum cholesterol levels have focused special interest on the analytical methods applicable in their determination.

Concerning the lack of data and the physiological relevance our investigation has been directed at the determination of the lipid composition of several tree nuts. The fatty acid composition of the sterols and the C-5-HT was studied and compared to that of the respective glyceride oils.

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O31

Influence of the Minor Components of Sunflower Oil on Emulsion Stability

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Key words: oil in water emulsions, emulsion stability, minor oil components, oxidation products, near infrared transmission technique

In this study, the influence of the minor components of sunflower oil on emulsion stability was investigated by using near infrared transmission technique. Monoolein, and lecithin were the minor components used in the present work. The effect of oxidation on emulsion stability was also studied using a representative oxidation product (lauroylperoxide).

Sunflower oil was purified through alumina and the minor components were added to alumina-purified sunflower oil at different levels to form oil in water (O/W) emulsions. The stability of emulsions was measured by Dispersion Analyser LUMiSizer® 612. The measuring principle of this instrument is based on near infrared transmission technique which made it possible to investigate the effects of the minor components (monoolein and lecithin) and oxidation product (lauroylperoxide) at very low levels. The results indicated that the natural minor components of sunflower oil influenced the emulsion stability even at low levels. It was also found that combination of lecithin, monoolein and lauroylperoxide formed more stable emulsions. A closer look on the molecular structure of the minor components revealed that lecithin had the highest hydrophilic-lipophylic balance which supports the better emulsion stability of lecithin as compared to other minor components used in the study.

There are only a few studies using the near infrared transmission technique on food emulsions and it is believed that the present study will lead to other studies investigating the emulsion stability in food products by using this technique.

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POSTERS

Emerging technologies

P106

Role of Alginate Complexes in Trace Metal Fortification of Functional Foodstuff

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Key words: alginate, encapsulation, functional products

Wide range of hydrocolloids are used in food industry to improve consistence of diverse food products including pectin, guar gum and karragene. Nowadays the alginate became popular as well used by the food industry to increase viscosity and as an emulsifier. The chemical compound sodium alginate is the sodium salt of alginic acid. Sodium alginate is a gum, extracted from the cell walls of brown algae. An insoluble colloidal acid in the form of a carboxylated polysaccharide that is abundant in the cell walls of brown algae.

Sodium alginate is a good chelator for eliminating radioactive compounds from the body. As a food additive, sodium alginate is used especially in the production of gel-like foods. It has the E-number 401.

In recent years, sodium alginate has been used in molecular gastronomy at some of the best restaurants in the world. Ferran Adria pioneered the technique. Sodium alginate is combined with calcium lactate or similar compound to create spheres of liquid surrounded by a thin jelly membrane. By the application of this technique sensitive components like vitamins or prebiotics can be protected and encapsulated. Due to its ability to absorb water quickly, alginate can be changed through a lyophilization process to a new structure that has the ability to expand. It is used in the weight loss industry as an appetite suppressant. Our study focuses on the trace metal fortification of functional foodstuffs by the application of alginate. *In vitro* digestion model experiments have been performed in order to estimate the biologically available ratio of the bounded metal content of the fortified products.

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P107

Reduction of Biogenic Amines in Cheese Using Selected Lactic Acid Bacterial Strains and High Hydrostatic Pressure

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Key words: biogenic amines, cheese, starter cultures, high hydrostatic pressure

Biogenic amines in food have great interest from both food quality control and health protection points of view. The consumption of food containing high amounts of biogenic amines is responsible for much pseudo-allergic food related reactions and increased amounts of biogenic amines are associated with poor microbiological quality of the food.

Several efforts have been made in food science and in the food industry to reduce or to prevent formation of biogenic amines in food.

The most implicated food group concerning high biogenic amine contents is fermented food. Many fermented food products contain lactic acid bacteria as dominating group. However, not all bacterial species and strains are able to form biogenic amines. The carefully selected starter cultures and controlled technology may result lower biogenic amine content in fermented food. High hydrostatic pressure is one of the most encouraging alternatives to traditional thermal treatment for food preservation and reduction of biogenic amine content in food.

The aim of this work was to study the influence of selected lactobacillus strains on the formation of biogenic amines during production and storage of cheese produced under laboratory conditions compared with cheese manufactured with industrial starter culture, as well as the effect of high hydrostatic pressure treatment on the final products.

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P108

Ultra- and Nanofiltration of Acid-Whey – Changes in Whey Proteins Profile

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Key words: acid-whey, ultrafiltration, nanofiltration, SDS-PAGE, whey proteins

Acidic-whey obtained after lactic fermentation and acidic coagulation of milk proteins obtained during tvarog (white cheese) production was used as a raw material (WA) in this investigation. The components of the dry matter of the whey were concentrated using three methods of membrane separation: (1) nanofiltration (PWN); (2) nanofiltration with diafiltration (PWD); and (3) ultrafiltration (PWU). After the membrane separation the retentates were dehydrated by spray-drying. In the obtained products the quantitative and qualitative proteins analyses have been conducted. The total proteins content was determined according to the Kjeldahl method and ranged from 11.8 to 13.9% of dry matter. The spray-dried preparations after nanofiltration (PWN) and nanofiltration with diafiltration (PWD) contained about 11% of proteins in d.m. The greatest content (about 18% in d.m.) of proteins was noticed in preparation obtained by ultrafiltration (PWU). SDS-PAGE electrophoresis patterns of PWN preparation showed distinct reduction in protein fractions of molecular mass over 84kDa and proteins fractions ranging from 36 to 45kDa in comparison with the raw material (acidic-whey). For the other two preparations similar SDS-PAGE electrophoresis patterns were found.

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P109

Reduction of Milk Allergenicity Using New Synthesized Cu(II) Complex as Artificial Protease

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Key words: BLG, allergenicity, artificial protease, cu complex

Beta-lactoglobulin (BLG) the major protein in whey, is responsible for most of the bioactive properties of whey proteins and is the major milk allergen. Now days, the design of synthetic metallo-proteases that cleave proteins at a specific site has elicited much interest. Hence, in present project, we have decided to design and synthesized a new class of cooper(II) complex, $\{Cu(dien)OH_2\}(NO_3)_2$, as artificial protease in order to hydrolyzing resistant BLG and examine the allergenicity of fragmented BLG using SDS-PAGE and different spectrophotometric methods (Fluorescence, circular dichroism (CD) and UV-Visible).

At first, BLG incubated with Cu(II) complex at different temperatures of 25, 37 and 50°C for 30 h. Then, SDS-PAGE of incubated BLG with Cu(II) complex at different temperatures were done and represented that we can see fragmented BLG only at temperature of 50°C for 30 h incubation times. Also, increasing fluorescamine intensity measurements prove hydrolyzing or fragmentation of protein in the presence of Cu(II) complex. Intrinsic fluorescence studies of BLG in the presence of different concentrations of complex represents that this complex can bind on BLG at different temperatures of 25, 37 and 50°C. Binding parameters have been calculated using quenching methods. Far CD studies do not show any significant structural changes in BLG upon interaction with different concentrations of Cu(I) complex.

From above results, it can be concluded that our new designed Cu(II) complex has artificial protease activities against model protein of BLG. Also, hydrolyzing of BLG can enhance its fragmentation by proteases and decrease its allergenicity.

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P110

The Biopolymers as Supports of Enzymes

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Key words: collagen, chitosan, EDC, glutaraldehyde, genipin

The rich sources of collagen, untapped in the industrial-scale are the connective tissue waste from fishing industry. The colourless and odourless collagen from the fish skins, can be isolated in a high yield by an exhaustive extraction of the organic acids.

Also very interesting possibilities gives a chitosan, which also has bacteriostatic properties. The Collagen and chitosan sponges can also be used as supports of enzymes.

In many sectors of the food industry there is a possibility to intensify technological processes by using immobilized enzymes. The physicochemical properties of collagen fulfill numerous criteria required for a carrier of enzymes. Its usefulness resulting of the amino acid composition and structure of the fibrillar is a consequence of the high hydrophilicity and high capacity to swell. However the fibrillar nature of collagen allows to form the sponges and microcapsules of the desired size and high mechanical strength.

The hydrophilic nature of the collagen and gelatine is the cause of the high binding of water and can lead to reconstitute the preparations in a contact with the aqueous. This phenomenon can be prevented, subjecting sponges or microcapsules to cross linking process with chemical agents like: EDC (N-Ethyl-N′-(3-dimethylaminopropyl)carbodiimide, glutaraldehyde, genipin (a natural crosslinking reagent) or enzymatic agents for example: transglutaminase.

The cross-linking of polymers improves tensile strength, reduces the capacity to bind water and solubility. In addition, chemical cross-linking of the collagen raises the temperature of denaturation and shrinkage of the collagen. Such characteristics products made of collagen as: the ability to bind water, the solubility depending on pH and temperature and their mechanical properties can be programmed by the appropriate choice of cross linking agent and its concentration.

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P111

Effect of Nanoencapsulation on the Reactivity of Omega Fatty Acids under Thermal Processing Conditions

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Key words: nanoencapsulation, omega-3 fatty acids, lipid oxidation, acrylamide

Encapsulation is useful for developing functional food products via delivery of bioactive compounds.Long chain omega-3 polyunsaturated fatty acids (PUFAs) havea well-established positive effect on health via lowering blood serum triacylglycerol and cholesterol concentration. On the other hand, PUFAs, such as fish oil and flax seed oil, are very difficult to handle in technological point of view because they are very susceptible to oxidation during processing and storage resulting in decreased nutritional value and sensory quality. Encapsulation is one possible way to protect PUFAs against oxidation.

The aim of this study was to show the effect of nanoencapsulation on the reactivity of omega fatty acids under thermal processing conditions. For this purpose, a bread formulation was prepared according to AACC Method 10-10B with omega-3 fatty acids. High amylose corn starch was used to form nano sized complexes with flax seed oil that was converted to powder of microparticles by spray drying. The particles were then incorporated into bread formulation at different amounts to investigate their effects on bread quality characteristics. The effects of encapsulation on the formation of lipid oxidation products and thermal process contaminants including acrylamide and hydroxymethyl furfural (HMF) were determined. Encapsulation significantly decreased the degree of lipid oxidation as measured by the formation of hexanal and nonanal in breads during baking. Increasing the amount of particles in dough significantly decreased the formation of acrylamide and hydroxymethylfurfural in breads. Scanning electron microscopic examination of breads demonstrated that particles added to dough remained intact in the crumb, but partially destroyed in the crust. Comparing to its free form, addition of nanoencapsulated flax seed oil increased final product quality and safety by preventing lipid oxidation and formation of harmful compounds in breads during baking.

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P112

High Pressure Treatment of Fish Muscle: Texture Properties Dependent on Protein Modifications

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Key words: fish, high hydrostatic pressure, proteins, texture

Due to its content of ω-3-fatty acids and high-value proteins fish is an important part of the human nutrition. However, a problem of fish products is their vulnerability to microbial spoilage, and because of the sensitivity of the proteins pasteurization using high temperatures is not possible for all applications. An alternative is high pressure treatment. Proteins forming the structure of fish meat are known to be modified by high hydrostatic pressure (HHP). Therefore, the objective of this study was to correlate the influence of HHP on the texture of fish muscle with modifications of proteins from the contractile apparatus and the connective tissue.

Filet of fresh rainbow trout was pressure treated between 100 and 600 MPa at 30 or 50°C for 10 min. The firmness of the samples was determined using a texture analyzer. After lyophilization total proteins as well as the sarcoplasmic and the myofibrillary proteins were analyzed by SDS-PAGE under reducing and non-reducing conditions and by RP-HPLC. Additionally the content of free sulfhydryl groups was measured.

Treatment at 30°C resulted in increased firmness of the fish meat with increasing pressure. In contrast, the meat disaggregated in its singular myomers at 50°C. From the results obtained by chemical analysis it was concluded that treatment at 30°C resulted mainly in cleavage of non-covalent bonds under pressure leading to reorganization and compression of the proteins. The formation of covalent crosslinks seems to have a minor impact on the texture – only few disulfide bonds and no non-reducible crosslinks were generated. Treatment at temperatures higher than the shrinkage temperature of collagen (50°C) resulted in disintegration of the connective tissue. Therefore, pressure treatment at higher temperatures should be avoided for getting appropriate texture properties.

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P113

Effects of Infrared Treatment on Rice Proteins

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Key words: infrared, rice, protein solubility, electrophoresis

Infrared (IR) treatment is an efficient food processing technology and has gained a great interest in food industry due to its advantages over the conventional heating. It has higher thermal efficiency and fast heating rate/response time in comparison to conventional heating and provides considerable reduction in energy consumption. Infrared heating has applications in drying, baking, roasting, blanching, pasteurization and sterilization of food products. It has been applied to reduce the moisture content of various agricultural products including grains, legumes, fruit and vegetables. Infrared treatment reduces cooking time by providing more open microstructure that enhances rehydration characteristics, increases starch gelatinization degree and reduces levels of antinutritional factors in some legumes. More detailed studies investigating the effects of infrared treatment on various food components are needed.

In this study, infrared treatment was applied to tempered (12% and 15%) and non-tempered rice cultivars (cv. Baldo and cv. Demir) at various IR powers (545, 727, 909, 1127 and 1309 W) and cooking times of rice samples were reduced. SDS-PAGE was carried out and protein solubility values of the rice samples were determined in order to investigate the effects of infrared treatment on rice proteins.

Electrophoresis results indicated that relative intensities of some protein bands decreased with increasing IR powers. The decrease was more evident for the non-tempered rice samples treated at 1309 W power. IR treatment at 909, 1127 and 1309 W powers caused decreases in protein solubility values of non-tempered rice samples. The lowest protein solubility value was obtained for the non-tempered rice sample treated at 1309 W IR power.

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The Influence of Sterilization with EnbioJet® Microwave Flow Pasteurizer on Composition and Bioactivity of Blueberry Honeysuckle Juice

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Key words: sterilization, aronia, blueberry honeysuckle, antioxidant activity, phenolic compounds

Two recent decades marked the increasing popularity of alternative approach to control of civilization diseases emphasizing prophylaxis, including the one involving dietary means. The dietary chemoprevention is associated with the presence of bioactive phytochemicals in food. Consequently, the development of food processing technologies enabling the preservation of often unstable phytochemicals is observed. In this study, fruit juice that is a rich sources of anthocyanins, obtained from blueberry honeysuckle (*Lonicera caerulea* L. var. *edulis*) was used to examine the preservation of plant phytocomplexes and bioactivity upon sterilization with EnbioJet® microwave flow pasteurizer. The chemical properties verified embraced determinations of anthocyanins and other polyphenols by HPLC, total antioxidant activity, as well as profiles of antioxidants by post-column derivatization. The good stability of blueberry honeysuckle phytocomplex during and after processing with EnbioJet® device regardless of time of exposure to microwaves (range of flow rate of juice investigated 1.6 – 4.2 L/min) was confirmed. These results were weighed against changes in antioxidant composition observed in blueberry honeysuckle not submitted to microwave sterilization. The alterations of antioxidant composition in non-microwaved samples were much more evident even in frozen fruit pulp. The changes in chemical composition were paralleled by altered biological activity determined as the inhibition of growth of human colon cancer HT29 cells.

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P115

Application of Response Surface Methodology (RSM) in the Optimization of Infrared Treatment Conditions for Pasting Properties of Rice

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Key words: infrared, rice, response surface methodology, pasting properties

Increasing concern for product quality and the need for minimized food processing and energy costs have lead to a more detailed study investigating the effects of infrared treatment on various food components. This technique is generally used to remove water from cereals and vegetables, increase digestibility levels of animal feed, reduce the cooking time of some legumes and to reduce the levels of certain antinutritional factors in legumes.

Response surface methodology was applied in the optimization of infrared treatment conditions for pasting properties of rice (cv. Negis). Independent variables were selected as tempering moisture content and infrared power. Minimum and maximum levels of tempering moisture content and infrared power were determined in preliminary studies investigating the optimum conditions for obtaining unbroken kernels with acceptable color values. Infrared system (Biasis Ltd. Sti., Turkey) with 12 halogen lamps (Osram Siccatherm bulb, Germany) each having 175 W was used in the study. Three level face centered design was performed with 8 individual points and 3 replicates in center. The levels of infrared powers were 545, 909 or 1309W and the levels of moisture contents were 8.4, 12.2 or 16%. Infrared treated rice samples were evaluated in terms of RVA pasting properties (peak viscosity, trough viscosity, breakdown viscosity, final viscosity, setback viscosity).

As the moisture content increased, peak and breakdown viscosity values of the rice samples increased. Trough and final viscosity values increased as the infrared power increased. Highest trough viscosity and lowest breakdown viscosity values were obtained for the nontempered sample treated at the highest IR power (1309W). Determination coefficients (R2) were found to be 87.4%, 98.8%, 91.6%, 98.0% and 71.3% for peak viscosity, trough viscosity, breakdown viscosity, final viscosity and setback viscosity values, respectively.

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P116

Effects of Far Infrared Treatment on Soybean Proteins

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Key words: far infrared, soybean, protein

Soybeans are an abundant source of proteins that have long been recognized for high nutritional value and excellent functional properties in food. Heat treatment (*e.g.* cooking, microwave treatment, roasting) is generally used to reduce antinutritional factors (trypsin inhibitor, urease activity) and enhance quality of soybean products. Infrared treatment is generally used to remove water from agricultural products and reduce the cooking time of some legumes while softening texture. Infrared treatment can also be used for reducing antinutritional factors in soybean, by choosing correct process parameters that will not cause reduction in amounts of constituents having importance in nutrition and health.

In this study, soybean samples (cv. Adasoy and cv. Nazlıcan) were soaked in water at a ratio of 7/40 (w/v) for 30 or 45 min and far infrared treatment (994W, 1263W, 1454W, 1672W for 5.5 min) was applied in order to reduce antinutritional factors in soybean samples. The objective of this study was to determine the effects of infrared treatment on soybean proteins by using SDS-PAGE and protein solubility. Electrophoresis results indicated that infrared treatment caused decreases in relative band intensities of soaked soybean samples, especially at 1672 W. Intensities of protein bands having molecular weights between 97-66 kDa and those having molecular weights around 55 kDa, 45 kDa and 36 kDa decreased by infrared treatment. Protein solubility values of Adasoy soybean samples decreased with increasing infrared power. The protein solubility values for 45 min soaked samples were found to be higher than those of 30 min soaked samples.

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Mechanical and Antioxidant Properties of Gelatin Films Modified with Fruit's Waste Extracts

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Key words: gelatin films, polyphenols, apple, ashberry, grapes, blueberry, aronia, antioxidant activity, tensile strength, edible packaging materials

Packaging is an integral part of food processing. Its major function is to extend the shelf life and improve the quality of food products. The most often used food packages are those made of nonbiodegradable, synthetic materials. However, during the last years biodegradable and edible packaging materials obtained from natural polymers have attracted everybody's interest. One of the polymers used to form such materials is gelatin – a natural protein recovered from waste materials of food industry. Films prepared from gelatin are friendly for the environment but, unfortunately, they have some unfavorable functional properties. In particular, low moisture barrier properties, and sometimes poor mechanical properties, can limit the applications of gelatin films as packaging materials.

To improve the functional properties of gelatin films, polyphenols from fruits can be added to the film-forming solutions. The interactions of polyphenol and protein functional groups lead to cross-linking that improves the barrier and mechanical properties of the films. Moreover, polyphenols are efficient antioxidants which limit undesirable radical reactions. Therefore, they make gelatin films also bioactive.

This paper is focused on the study of the mechanical and antioxidant properties of films formed from pork gelatin modified with fruit juices and aqueous or ethanol extracts from fruit's wastes. Five species of fruits were used to obtain juices and extracts: apple, ashberry, grapes, blueberry, and aronia.

The results show that the mechanical properties of the gelatin films depend on the species of fruit from which the juice used for modification was obtained, as well as on the kind of extract that was applied. From among the films modified with aqueous extracts, the best mechanical properties were obtained with extract from apple, ashberry, and grapes. Comparing the results regarding unmodified films, the tensile strength was increased from 94 to 103, 107, and 108 MPa, respectively. Using ethanol extracts, tensile strength was improved only in the case of extract from blueberry. Simultaneously, for comparison similar experiments were conducted with fruit juices.

The antioxidant activity of juices, extracts, and the films modified with them was also investigated using three tests: DPPH, ABTS, and Folin-Ciocalteu method.

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P118

Effect of Starch and Maltodextrin on Physical Properties of Soy Protein Isolate-Based Edible Films

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Key words: edible films, soy protein, physical properties

Various natural biodegradable polymers such as protein- and polysaccharide-based edible films can potentially serve as coating materials for environmental friendly packaging. Edible films or coatings have been proved their functional properties as barrier to solute and gas and prolong food quality and shelf life. A new generation of soy-based sustainable plastics and their potential use as alternative resources to be used in packaging applications, has been extensively studied.

This study aimed to better understand the influence of starch and maltodextrin on the behavior of soy protein isolate films. Experimental work was conducted to determine the effect of starch (acetylated di-starch phosphate and starch acetate) and maltodextrin (DE 10.2 and 15.6) on selected physical properties of soy protein isolate-based edible films. Films were cast from heated (70°C for 20 min) alkaline (pH 10) aqueous solutions of SPI at 8 (w/w %), glycerol (50%, w/w, of SPI) starch or maltodextrin (20%, w/w, of SPI). For all types of films thickness, colour measurement, water vapour permeability (at 25°C and for two relative humidities 40-100% and 40-75%), water vapour sorption kinetics (during 24 hours for two relative humidities 11.3 and 75.3%), mechanical properties (tensile strength and elongation at break) and microstructure of soy protein isolate-based edible (SPI) films were determined after conditioning film specimens at 25°C and 50% relative humidity (RH) for 48h.

Both starch and maltodextrin had an effect on film thickness, water vapour sorption kinetics, microstructure, tensile strength and elongation at break. A synergistic effect of starch and maltodextrin was observed on the water vapour permeability at 40-100% relative humidity gradient, which strongly enhance the moisture absorption rates and permeability of SPI-based films. Starch and maltodextrin do not affect colour difference.

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High Hydrostatic Pressure Affects Ascorbigen and Vitamin C Content of Sauerkrauts During Refrigeration

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Key words: sauerkraut, GLS breakdown products, vitamin C, high hydrostatic pressure, refrigeration stored

The increased incidence of cancer has directed much research attention towards the search of compounds having anticarcinogenic properties. Epidemiological studies have showed the protective role of Brassica vegetables against cancer [1], which is attributed to their health-promoting compounds, including glucosinolates (GLS) and their breakdown products as well as antioxidants such as vitamin C. GLS are biologically inactive, but they are hydrolyzed after plant cell damage to release a complex variety of bioactive compounds. Among them, indoles have been shown to effectively inhibit carcinogenesis in experimental models [2]. The enhancement of these compounds in Brassica vegetables could be a cost-effective way of cancer prevention and fermentation could be a valuable technological process for this purpose since it favours the hydrolysis of GLS to several potentially beneficial compounds [3].

High hydrostatic pressure (HHP) is a non-thermal technology for food preservation that inactivates microorganisms causing slight or no deterioration of food quality attributes. HHP has been successfully applied by our group to improve the microbial quality of sauerkraut [4]. However there is not literature data on the effect of HHP on the content of GLS derivatives.

The aim of this work was to evaluate the effect of HHP and refrigeration on the indole GLS breakdown products and vitamin C of sauerkrauts obtained under different conditions.

White cabbage (*Brassica oleracea* L. var. *capitata* cv. Bronco) was fermented by the autochthonous microbiota present on cabbage (natural fermentation, NF) or by a mixed starter culture (*L. plantarum-L. mesenteroides*, 1:1) (induced fermentation, IF) for 7 days using two different NaCl concentrations (0.5% and 1.5%). After that, sauerkrauts were treated by HHP (300 MPa, 10 min, 40ºC) and stored at 4ºC for 0, 1, 2 and 3 months. Ascorbigen (ABG), indole-3-carbinol (I3C) and indole-3-acetonitrile (I3A) contents in raw cabbage and sauerkraut samples were determined by HPLC and vitamin C (vitC) by capillary electrophoresis.

The levels of the studied bioactive compounds depended on the fermentation conditions used. In general, NF sauerkrauts treated by HHP presented higher amount of indol GLS hydrolysis products than pressurized IF-sauerkrauts. Moreover, larger amount of these indole GLS were obtained when cabbage was fermented with 0.5% NaCl compared with 1.5%

NaCl. Although HHP improved the microbial quality of sauerkraut [4], the content of ABG and vitC of HHP-treated sauerkrauts were rather lower than those reported for unpressurised sauerkrauts [3,5], while I3C and I3A contents were in accordance with values found in fermented cabbage [3]. Refrigerated storage of HHP-sauerkrauts at 4°C led to a gradual decrease of ABG content, while no important changes on I3C and I3A were observed. On the contrary, important losses of vitC were found for stored products, and 3-months stored HHP-sauerkrauts presented the lowest vitC amount.

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P120

The Influence of Microwave Drying Parameters on Biologically Active Components Content in Selected Herbs

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Key words: basil, oregano, microwave-convective drying, chlorophyll, polyphenols

Herbs are commonly used to improve taste of prepared food. Herbs contain essential oils, alkaloids, tannins, glycosides, phytoncides, organic acids, vitamins and minerals, which determine their antibacterial and pro-healthy properties. Herbs also containing phenolic compounds, which are a natural source of antioxidants. Lack of these compounds in the human diet leads to disturbances in the body function. Biochemical studies indicate that for the civilization diseases, such as atherosclerosis, cancer, aging, heart attacks, *etc*. are responsible free radicals and their reactive products.

Spice plants are usually used fresh or dried, sometimes as an extracts. There are many methods for drying herbs. However, the choice of suitable technique and parameters, which give high quality product is not so obvious. Therefore, it is necessary to explore effects of various, also non-conventional methods of drying on the herbs quality. A promising method for preserve high quality spices is microwave-convective drying.

The purpose of the study was to examine the changes of bioactive components as chlorophyll and polyphenols content in dried basil (*Ocium basilicum* L.) and oregano (*Origanum vulgare* L.) leaves. There were used microwave-convective drier with different microwave power levels 150, 200 and 300 W and air temperatures 20, 30 and 40°C in nine different parameters combinations.

Drying processes were completed between 15 and 102 minutes for basil and for oregano between 18 and 168 minutes. It was observed that chlorophyll and polyphenols content decreasing during drying. Smaller losses of biologically active components were observed during drying oregano. It was found that the highest chlorophyll content had herbs dried using microwave power of 200 W and air temperature of 30 and 40°C. The longer the drying time, the biggest looses of polyphenols content were observed.

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Encapsulation of the Essential Oil of *Salvia fruticosa* with Different Wall Materials

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Key words: Salvia fruticosa, Greek sage, essential oil, 1,8-cineole, microencapsulation, spray drying

Salvia fruticosa is one of the most important *Salvia* species cultivated as culinary herbs and for medicinal purposes. Essential oil of *Salvia fruticosa* has analgesic, anti-inflammatory, antimicrobial and antioxidant properties. Main essential oil components of *Salvia fruticosa* are 1,8-cineole and borneol. Microencapsulation can provide a physical barrier between the essential oils and the other components and also converts it into a free-flowing powder. Among the other techniques spray-drying is the most common and cheapest to produce microencapsulated food materials. Equipment is readily available and production costs are lower than most other methods.

The present work reports on the microencapsulation of the essential oil of *Salvia fruticosa* by spray drying using gum arabic (GA), β-cyclodextrin (BCD), maltodextrin (MD) and their different combinations as wall materials. The microcapsules were then evaluated for the content of entrapped 1,8-cineole, the main volatile component of the essential oil. During spray drying, the inlet and outlet temperatures were maintained at 180°C and 90±2°C, respectively. Determination of the essential oil composition in plant sample was performed by GC-MS and the amount of 1,8-cineol in microcapsules was determined by using external standard in GC-FID.

The amount of entrapped 1,8-cineole in the microcapsules changed significantly ($P<0.05$) with the carrier materials. Arabic gum was found to be the most effective carrier as alone

for the encapsulation of the essential oil, followed by maltodextrin and β-cyclodextrin. However, the highest retention of 1,8-cineole during spray drying was observed for the combination containing AG:MD (3:2) wall material system. In general, the blends containing higher proportions of AG provided the better entrapment of 1,8-cineole in the samples.

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Influence of Microencapsulation Parameters on the Stability of the Rosemary Aroma During Storage

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Key words: microencapsulation, storage, rosemary aroma, GC-MS

Microencapsulation is a technique increasingly used to close the flavors in the carriers. The main purpose of aroma microencapsulation is to protect them from chemical changes. The most commonly used method for microencapsulation is spray drying. The degree of closed and the amount of flavor on the powder surface is different depending on the type of carrier, conditions of spray drying and storage.

The aim of this study was to investigate the impact of microencapsulation parameters, concentration and type of carrier on the stability of rosemary aroma in microcapsules. Maltodextrin (MD) degree equivalent 10, Arabic gum (GA) were used as the carriers. Drying was carried out at inlet temperature 200°C and two feed flux (1.07×10^{-6} and 1.33×10^{-6} m^3/s). Apparent viscosity of solutions, powders apparent and loose density, particles size and aroma content of in powders were studied. Determination of the composition of the aroma were analyzed by headspace analysis (HS-SPME). The results were pre-processed in the integrated program of the GC-MS.

The increase in the feed flux caused an increase in the size of microcapsules. The increase of diameter of particles obtained with MD caused an increased in closed flavor, while for GA and its mixture with MD particles size increasing caused an decrease in closed inside microcapsules aroma. Application of solutions with higher viscosity (GA and its mixture) also resulted in better retention of flavor inside (60-69%), and thus a smaller amount of flavor on the outside (up to 7%). The particle diameter affected the apparent density of powders. Apparent density of powder with 25% concentration of MD ranged from 760-800 kg/m^3. Increasing the concentration of MD to 30% and also changing the type of media on the GA and its mixture caused an increase in bulk density to 810 $kg/m^3$and 1160 kg/m^3, respectively.

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P123

Novel Processing Techniques and Their Effects on Glucosinolates and Membrane Associated Myrosinases in Broccoli

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Key words: high pressure treatment, pulsed electric field, Brassica, glucosinolates

High pressure (HP) treatment and pulsed electric field (PEF) treatment are among the novel processing techniques which have gained much attention as alternatives to conventional thermal food processing. HP can lead to both pasteurization and sterilization at the right combination between pressure and temperature (HP/HT). The application of pressure compresses tissues, and can cause cell wall breakage and cell membrane disruption, depending on the pressure level as well as the type of vegetable or fruit. In PEF the application of short electric pulses may result in pore formation in the cell membrane, and depending on the treatment intensity the membrane permeabilisation can be reversible or irreversible.

The purpose of this study was to study process-induced changes in membrane associated compounds by HP and PEF. The experiments were performed on Broccoli (*Brassica oleraceae*), which contain glucosinolates and myrosinase (EC3.2.1.147). Disruption of cell membrane, due to cell damage, processing or chewing, leads to contact between glucosinolates and the active myrosinase isoenzymes. This gives the basis for complex mixtures of transformation products, depending on the type of glucosinolates and the conditions in the matrix systems. The glucosinolates from the vegetative parts of broccoli are thus quantitatively dominated by indol-3-ylmethyl glucosinolates and most often the aliphatic glucosinolate glucoraphanin and glucoiberin.

The effect of novel processing was tested on broccoli heads, purée and juice, where processed materials have been analysed for the glucosinolate profiles. Broccoli heads treated with 82°C contained 20.7±4.3 μmol/g, and five different glucosinolates were detected; glucoraphanin (2.8 μmol/g), 4-hydroxyglucobrassicin (0.7 μmol/g), glucobrassicin (5.7 μmol/g), 4-methoxyglucobrassicin (1.5 μmol/g), and neoglucobrassicin (10.0 μmol/g). Various levels of glucosinolate degradation have been seen as effect of HP processing of broccoli heads. The degradation of glucosinolates in PEF processed broccoli purée and juice showed that the enzymatic activity was much more pronounced and seems to result in autolysis during the puréeing and juice making prior to the PEF processing.

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P124

A New Method for Obtaining Trehalose in a Single Step Enzymatic Reaction Using Trehalose Synthase Derived from Extremophilic Organisms

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Key words: trehalose, synthase trehalose, extremophiles

Trehalose (α-D-glucopyranosyl-1,1-α-D-glucopyranoside) is a nonreducing disaccharide in which the two glucose molecules are linked trough a α-1,1-glycosidic bond. Trehalose is readily hydrolyzed to glucose and can be used as a reserve of that sugar in the cell. The presence of trehalose was found in the cells of fungi and yeasts, bacteria, nematodes, insects, eggs, pupae, and some plants. The characteristics of trehalose make it a potential source of many applications in medical, veterinary, pharmaceutical and food industries.

Biosynthesis of trehalose is carried out various known metabolic pathways, including the use of one step enzymatic reactions with trehalose synthase. Other pathway are involving more than one enzymes – like: trehalose-6-phosphate synthase and trehalose-6-phosphate phosphatase or maltooligosyl-trehalose synthase and maltooligosyl-trehalose trehalohydrolase. Alternative, one step enzymatic reactions, uses more complicated or expensive substrates. Bacteria of the phylum *Deinococcus-Thermus* are microorganisms which produce trehalose synthase.

The aim of this study was isolation and cloning of trehalose synthase gene derived from extremophiles microorganism to the expressive vectors in the system of Tabor-Studier and arabinose system and its expression in different hosts. In the second phase of research consisted of the purification of proteins using an initial denaturation of host proteins and metal affinity chromatography.

Recombinant protein was obtained with high purity. Characteristics of studied proteins and possibilities of practical uses were examined. The research activity of all proteins confirmed the ability to convert maltose to trehalose. Molecular filtration allowed the set of protein molecular weight which suggest that it is equal to that of a homodimer.

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Food analyses and bioanalyses

P125

Application of High Performance Liquid Chromatography with UV and Tandem MS Detection for Analysis of β-Carotene in Food Supplement Based on Conifer Needle Extract

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Key words: dietary supplements, β-carotene, liquid-liquid extraction, SPE, liquid chromatography, tandem masspectrometry

Homeopathic drugs and non-synthetic food supplements are getting wider attention recently due to the widespread opinion that synthetically developed drugs are more harmful than those of plant origin. On the other hand, drugs produced according to GMP and tested according to GLP standards have definite and unambiguous composition with clinically confirmed mode of action and possible side effects contrary to food supplements of plant origin. Therefore it is important to develop analytical procedures to establish the composition and concentration of compounds present in dietary supplements.

A reliable and selective analytical method for determination of β-carotene in conifer needle extract using high performance liquid chromatography with UV and tandem MS detection was developed. The HPLC-UV method involves extraction with organic solvent, polar compound removal, clean-up with SPE columns, extract evaporation and dissolution in mobile phase. Application of tandem masspectrometry improves selectivity of elaborated assay and allow to avoid a SPE purification step.

In order to choose the most suitable extraction solvent n-hexane, n-heptane, petroleum ether, cyclohexane, isooctane, MTBE, toluene, dichloromethane, and ethyl acetate were evaluated. For further purification of conifer needle extract pre-packed solid phase clean-up cartridges containing alumina, silica and amino modified silica were tested.

Single factor dispersion analysis was used to ascertain influence of the extraction procedure and instrumental analysis on the obtained results.

The chromatographic separation was achieved on a RP C-18 column using acetonitrile-methanol-dichloromethane (75/15/10 v/v/v) as a mobile phase in isocratic mode. During this study main parameters of the method were checked. The calibration curves were linear in the interval from 5-1000 μg/g with correlation coefficients higher than 0.9997. The recoveries were in range from 92%-107% for 100, 200 and 250 μg/g spiking levels. The precision calculated from interday repeatability was from 1.5% to 3.3% for the same spiking levels.

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P126

A Comparative Study of Raman Lasers Suitability (785 *vs*. 514 nm) for the Characterization of Green and Red Tomatoes Composition

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Key words: tomato (*Lycopersicon esculentum*), carotenoids, lycopene, health benefits properties, Raman spectroscopy

Tomato fruits (*Lycopersicon esculentum*) are one of the most consumed vegetables. These fruits have lots of excellent benefits in human's health and take an important role in the prevention of many human diseases. Among other natural compounds, these characteristics are given by the main constituents of tomatoes, the carotenoids. These conjugated polyenes are a group with some important functions such as pro-vitamin A precursor and antioxidant properties. The most important carotenoid presented in red tomatoes is the lycopene. This compound is the most potent free-radical scavenger among the carotenoids.

Spectroscopic techniques, especially Raman spectroscopy, are suitable analytical techniques to characterize carotenoid organic pigments and other natural components (*i.e*., lipids, phenolic compounds, *etc*.) of tomatoes. Moreover, Resonance Raman effect, achieved with a good selection of laser wavelength (*i.e*., 514 nm laser), can be used to enhance the intensity of certain Raman bands in the Raman fingerprint area (1000-1700 cm^{-1}) of carotenoids and also on Raman bands assigned to overtones and combination-tones. The possibility of direct analysis in a non-invasive way and no pre-treatment requirements, make this technique a fast and easy-to-handle alternative to characterize the main components of fruits and vegetables. In this study, two Raman laser wavelengths (785 and 514 nm) were used to characterize the carotenoid content (among other organic components) of two different tomato ripening stages (green and red). Using these lasers, differences in Raman features of carotenoids and other components of tomatoes are going to be evaluated on the same tomato ripening stage and between the two different ripening stages of tomatoes (green and red). In the literature, most of the works presented are focused on carotenoids structural elucidation using the three main Raman bands of the carotenoids fingerprint area. In this work, an exhaustive Raman assignation of carotenoids and other components of tomatoes will be presented.

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A Fluorescence Test for the Detection of Glucosinolate Degradation

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Key words: glucosinolate, sinigrin, glucoraphanin, myrosinase, intestinal bacteria, fluorescence test

Brassica plants contain glucosinolates, which have chemopreventive properties. These effects are attributed to their main hydrolysis products, the isothiocyanates. Isothiocyanates are formed by myrosinases, which are released from the plant tissue upon injury. Since these enzymes are largely inactivated during cooking we hypothesized that effects observed after the consumption of cooked Brassica vegetables are due to intestinal bacteria that activate glucosinolates.

A novel fluorescence test for the detection of glucosinolate degradation by intestinal bacteria was developed. N-(Iodoacetaminoethyl)-1-naphthylamin-5-sulfonic acid (1,5-I-AEDANS) was used as a thiol-reactive fluorescence dye. Hydrolysis of the thioglucosidic bond of glucosinolates yields an unstable aglycone, the thiohydroxamate-O-sulfonate, which undergoes spontaneous rearrangement reactions to various products, including isothiocyanates. Thiohydroxamate-O-sulfonate contains a thiol group and reacts with 1,5-I-AEDANS. 1,5-I-AEDANS turns from blue into yellow upon reaction with thiol groups and when excited with UV light (365 nm). No yellow signal was obtained when 1,5-I-AEDANS was incubated with sinigrin and glucoraphanin, which do not contain free thiol groups. When these glucosinolates were incubated with myrosinase, a yellow signal was observed due to the reaction of 1,5-I-AEDANS with the formed thiohydroxamate-O-sulfonate. To observe a positive signal for the myrosinase reaction, 1,5-I-AEDANS has to be applied in a minimal concentration of 0.5 mM and the molar glucosinolate/dye ratio has to be at least 10.

Eight different bacterial strains from the human gut where screened for their glucosinolate degrading activity. The strains were incubated in minimal medium at 37°C under anaerobic conditions with sinigrin (10 mM) and 1,5-I-AEDANS (0.5 mM). Positive signals were observed for *Bacteroides distasonis*, *Eggerthella lenta*, *Clostridium orbiscindens* and *Anaerostipes caccae*. Negative results were detected for Blautia producta, *Bacteroides fragilis*, *Escherichia coli* and *Eubacterium eligens*.

The fluorescence test allows a quick differentiation into glucosinolate degrading and non-degrading bacteria. This test facilitates the isolation of glucosinolate degrading bacteria from complex microbial ecosystems.

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Complex Approach for Versatile Characterization of Distinctive Hungarian Propolis Samples

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Key words: propolis, bioactive components, functional properties

Propolis is a mixture of various amounts of beeswax and resins collected by the honeybee from plants, particularly from flowers and leaf buds. These resins are used by worker bees to line the inside of nest cavities, repair combs, seal small cracks in the hive.

Propolis has got outstanding healthy preserving importance due to its high content of beneficial bioactive compounds like polyphenols, antioxidants, vitamins, microelements. Propolis has got various composition depending on the collecting circumstances, geographical characteristics, weather conditions, vegetation and other specific conditions of the area of collection. Propolis changes in colour, odour and probably medicinal characteristics, according to source and the season of the year. Foraging for propolis is only known with the Western honeybee *Apis mellifera*. The Asian species of *Apis* do not collect propolis.

Propolis samples were collected from beekepers of four different regions of Hungary. Propolis samples were extracted with ethanol for the examinations of the basic bioactive components. The examined parameters and the used techniques were as follows: antioxidant activities (DPPH method); total polyphenol content (Folin-Ciocalteu reagent UV-spectrophotometric determination); polyphenolic derivatives (HPLC--PDA); prolin (UV-spectrophotometric determination); trace elements as Iron and Zinc (FAAS); carbohydrate composition (HPLC-ELSD); benzoic acid and esters (GC-MS); B3 vitamin (HPLC). The antimicrobial activities of different samples were determined for Gram-positive and Gram-negative species as well. Total polyphenol content of different samples ranged from 214±4.8% to 274±5.5% (mg/g). The concentration of Zn was found to be 0.47–1.57 mg/kg; Fe 0.46–2.78 mg/kg; B3 content of different samples ranged from 0.6 to 4 mg/kg.

It was revealed that propolis related materials have a potential use as preservatives in the food industry. The potential applicability of the propolis has been studied in food production in order to enhance the bioactive content.

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The Detection of Food Components Capable of Preventing DNA Oxidative Damage by Restriction Analysis

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Key words: oxygen reactive species, pro-oxidative compounds, oxidative modification of DNA, restriction analysis, restriction endonucleases MspI, HpaII, Tru1I, hydrogen peroxide, horseradish peroxidase, prevent oxidative DNA damage, detection of DNA oxidation

Numerous pro-oxidative compounds and oxygen reactive species (ROS) are able to induce oxidative DNA modifications. Such oxygen DNA adducts are known to cause mutations and are regarded to be one of risk factors in cancer development. Therefore, it is important to identify compounds in human environment, that can oxidize or prevent oxidative DNA damage. Both these types of substances can be found in food products.

We propose here a simple approach, exploiting techniques widely used in genetic engineering to detect the oxidative modification of DNA by any ROS generating reactants in a cell-free system, as well as to test the ability of substances (or mixtures) to prevent formation of such lesions. This method uses a DNA amplicon (695 bp) which contains two restriction sites: one containing only GC base pairs recognized by restriction endonucleases MspI or HpaII and the other including only AT base pairs recognized by restriction endonuclease Tru1I. The oxidative modification of the restriction sites abolishes their recognition and thus cleavage by the restriction enzymes. The modified amplicon is submitted to digestion by the above restriction endonucleases and DNA fragments generated are separated by polyacrylamide gel electrophoresis. The inhibition of cleavage indicates the occurrence of oxidative modification of the restriction site(s) simultaneously pointing at the kind of base pairs involved in DNA adduct formation.

The identification of substances (purified or mixtures actually found in food products) capable of preventing oxidative DNA damage can be accomplished by reacting DNA with ROS generating system in the absence and presence of a sample to be tested. For instance, by incubating the DNA amplicon with hydrogen peroxide and horseradish peroxidase (HRP), the formation of oxygen DNA adducts is induced, that inhibits cleavage by restriction enzymes. If the sample whose antioxidative properties are examined, when added to the reaction mixture prevents this cleavage inhibition, it indicates that indeed the protection against oxidative DNA damage occurred. The examples will be given that demonstrate the application of the described technique to detect DNA oxi-

dation by hydrogen peroxide/HRP system and its prevention by selected food components.

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Optimization of Antioxidant Compounds Extraction from Grape Stem by Pressurized Liquids Using Response Surface Methodology

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Key words: grape stem, central composite design, antioxidant activity, phenolic compounds

The response surface methodology (RSM) with a central composite circumscribed design (CCCD) was applied in this study to optimize the extraction of antioxidant compounds from grape stem by pressurized liquids. Three factors were evaluated: extraction temperature (40–100ºC), solvent (etanol:water) (0–100%) and extraction time (1–9 minutes). Moderate extraction temperature and time were chosen in order to avoid compounds degradation. The design included 19 experiments: 8 corresponding to the full factorial design, 6 to the star points (α=1.68179) and 5 to replications of the central point. So that, the operating conditions of the three factors were conducted at five levels. Extraction yield, antioxidant activity and polyphenolic content of the extracts were chosen as response variables. ABTS assay was used to measure the antioxidant activity of the extracts and results were expressed as TEAC values (mmol trolox/ g extract). Total phenolic content was determined with Folin-Ciocalteu reagent and expressed as galic acid equivalents (mg GAE/ g extract), and individual phenolic compounds analysis was carried out by HPLC equipped with a diode array detector. Ethanol percentage turned out to be the most influent factor followed by temperature, whereas extraction time had a weak by significant effect on antioxidant activity and phenolic compounds extraction and non effect on extraction yield. The general behavior was as following: ethanol percentage had a negative and quadratic effect on the response variables, whereas temperature had a positive and linear effect. Extraction time had a positive and linear effect on TEAC values and total phenolics contents. The optimal conditions for the extraction of antioxidant compounds from grape stem turned out to be 20% ethanol:water, 100ºC extraction and 9 minutes as extraction time.

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Optimizing Method for the Measurement of Insoluble Antioxidants in Foods

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Key words: wheat bran; insoluble antioxidants; total antioxidant capacity; ABTS method

Since most assessments of antioxidant capacity (AOC) are based only on the analyses of food extracts, the actual AOC may be underestimated. Recently, several methods for the assessment of total antiradical capacity utilizing quenching of coloured radicals by stepwise or simultaneous determination of dissolved and suspended parts of a food material were introduced. These attempts lead to the development of a simple and rapid method for the determination of total AOC, involving soluble and insoluble forms of antioxidants, in one step (method A).

The aim of this study was to compare three methods based on spectrophotometric monitoring of ABTS radical quenching to determine antioxidant capacity (AOC) in both insoluble and soluble fractions of wheat bran. Method (B) is based on the reaction of ABTS with insoluble antioxidants transferred to the solution after alkaline hydrolysis, while the other two methods are based on the ABTS reaction with insoluble antioxidants bound to the surface of small particles (<0.125 mm) suspended in the solution. In addition to the method (A), we introduced a method (C), where the total AOC was determined using multiple extractions with water and methanol followed by the direct determination of antioxidants in the insoluble residue. Optimisation of both extraction and determination steps was accomplished. The method (C) gave significantly higher total AOC values than method (A), but still by a factor 1.5 lower than method (B) did. However, the results obtained by the method (B) may be overestimated since a part of active functional groups may be involved in bonds unable to participate in the actual AOC. The total AOC of wheat bran was roughly three times higher when method (B) was used instead of (A). This finding is inconsistent with the recently published general conclusion indicating comparable values achieved by the methods (A) and (B) for various commodities.

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HPLC-Online TEAC – Antioxidant Activity of Single Compounds in Complex Mixtures

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Key words: online-TEAC, flavonol glycoside, kale, *Brassica oleracea*, antioxidant capacity, structure-activity relationship

Flavonoids gain much attention due to their health beneficial potential, which is thought to be related to their antioxidant activity (AA). Because of their antioxidant character, resulting from different conjugations, varying numbers of hydroxyl groups, and acylation patterns, flavonoids are able to act as hydrogen- or electron-donating species, and as scavengers of reactive oxygen species [1]. These properties gain in a wide variety of methods to detect the AA.

Due to the large number of antioxidant components in plants, many screening methods for the antioxidant capacity of polyphenols, most of them based on their radical scavenging activities, have been reported [2]. However, all of these methods only detect the overall AA and are not useful for estimating the contribution of single components. A general procedure to assess the antioxidant capacity of single components is separating and purifying them, which is time-consuming. Therefore, more elaborate techniques are required.

Aim of our study was to characterize the contribution of single flavonoids to the overall AA using an HPLC-online TEAC approach. Comparable to post-column derivatization, an HPLC system was coupled directly to the TEAC assay. Taking the results of a structural analysis, obtained by HPLC--ESI-MSn into account [3], distinct structure-antioxidant relationships can be elaborated by using just one sample. The advantages of such an approach are observable, for samples obtain the same overall AA, although they are obviously different. This was exemplarily observed for cooked kale, resulting in similar TEAC values both samples raw and cooked. Only after using the online TEAC approach it was possible to evaluate the distinct changes in antioxidant activity of the different flavonoids and the neo-formed compounds.

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Screening of the Antioxidant Capacity of Selected Spices by Updated Analytical Strategies

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Key words: spices, antioxidant capacity, ABTS test, photochemiluminescence assay, cyclic voltammetry method

In this study the antioxidant capacity of selected spices was provided by updated analytical strategies. The spices collection covered anise, badian, white pepper, fennel, cardamom, clove, coriander, nutmeg, pimento (allspice), cinnamon, vanilla and spice mix for gingerbread. Spices (100 mg) were extracted at room temperature with ethanol or with mixture ethanol/water, (1:1, v/v). The antioxidant capacity of ethanol and ethanol/water extracts of spices was measured against stable, non-biological radicals such as 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulphonate) radical cations ($ABTS^{\bullet+}$) using a spectrophotometric assay, against the key reactive oxygen intermediate – superoxide anion radicals ($O_2^{\bullet-}$) by photochemiluminescence (PCL) assay while reducing capacity was determined by cyclic voltammetry (CV) method. Moreover, the extractable total phenolic compounds (TPC) were determined and their content was correlated with antioxidant capacity of the spices.

The studies showed that mixture ethanol/water was a better extraction solvent of TPC when compared to pure ethanol with one exception made to vanilla. About twofold (cardamom, clove, cinnamon and spice mix for gingerbread), fourfold (anise, fennel), eightfold (coriander and pimento) and twenty fold (badian) increases in TPC were noted in this case. No changes in TPC extracted by both solvents were observed in respect to white pepper and nutmeg. The applied updated analytical strategy provided the highest values of antioxidant capacity of spices when measured by ABTS test, followed by PCL and CV method. The ethanol/water extractable TPC were weakly correlated with results provided by ABTS test ($r=0.67$) and PCL ($r=0.55$) whilst no correlation was noted with CV method ($r=0.16$). In contrast, better correlations were noted for ethanol extractable TPC *vs.* ABTS ($r=0.77$), PCL ($r=0.76$) and CV ($r=0.33$). The clove, cinnamon and spice mix for gingerbread were those spices of the highest antioxidant capacity by updated analytical strategy. Based on the obtained results, the spices used in this study can be divided into groups with low and high antioxidant capacity which can be important for their further application in different food formulations and mitigation strategies against acrylamide formation.

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High-Performance Liquid Chromatographic Method to Evaluate the Hydrogen Atom Transfer During Reaction Between 1,1-Diphenyl-2-Picryl-Hydrazyl Radical and Antioxidants

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Key words: 1,1-diphenyl-2-picrylhydrazyl radical, hydrogen atom transfer, natural antioxidants, HPLC.

1,1-Diphenyl-2-picrylhydrazyl radical (DPPH$^{\bullet}$) is a stable nitrogen centred radical widely used to evaluate direct radical scavenging properties of antioxidants. DPPH$^{\bullet}$ exhibits an absorption band at 515 nm and its bleaching rate is monitored in the presence of various synthetic or natural antioxidants (AOs). In order to avoid the interference of complex coloured natural products used as antioxidant supplements or cosmetics, different HPLC systems have been proposed as alternative techniques to the classical colorimetric one. They also rely upon measurement of DPPH$^{\bullet}$ quenching rate; they are realized either after off-line reaction between AOs and DPPH$^{\bullet}$ [1], or after post-column addition of DPPH$^{\bullet}$ following separation of complex extracts [2]. None of them permit to identify and measure 1,1-diphenyl-2-picryl-hydrazine (DPPH-H), the reduced product of DPPH$^{\bullet}$ resulting from Hydrogen Atom Transfer (HAT), the main mechanism occurring during DPPH$^{\bullet}$–AOs reaction.

We presently report an HPLC method devoted to the simultaneous measurement of DPPH$^{\bullet}$ and DPPH-H. Both compounds were fully separated on a C18 column eluted with acetonitrile-10 mM ammonium citrate buffer pH 7.4 (70:30, V/V). A wavelength of 330 nm was selected, using a diode array detector, to detect simultaneously DPPH$^{\bullet}$ and DPPH-H. DPPH-H was generated from DPPH$^{\bullet}$ using a five-fold excess of reduced glutathione (GSH), to build the calibration curve. A broader linearity range with a lower limit of detection was obtained for DPPH-H (7-71 μM) than for DPPH$^{\bullet}$ (27-71 μM). The method was applied to three commonly used AOs, *i.e.* Trolox®, ascorbic acid and GSH; resulting data were compared with those obtained using spectrophotocolorimetry. The method was also applied to vegetal extracts (algae, fruit juice) with full selectivity.

In conclusion, the proposed HPLC method appears very useful to investigate HAT mechanism during reaction between DPPH$^{\bullet}$ and pure AOs as well as complex matrices.

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Separation of Dehydrogenated and Decarboxylated Betanins by High-Speed Countercurrent Chromatography in Processed Red Beet Root (*Beta vulgaris* L.) Extracts

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Key words: high-speed countercurrent chromatography; betalains; red beet root; *Beta vulgaris* L.

Betalains, red-violet betacyanins and yellow-orange betaxanthins, are water soluble plant pigments [1] which are recently emerging as highly active natural compounds with antioxidative properties and potential benefits to human health. Betanin, the simplest 5-O-glucosylated betacyanin, frequently derived from red beet root (*Beta vulgaris* L.). is important colorant applicable in modern food industry.

Known lability of betalains, *e.g.* their low resistance to elevated temperatures (especially of purified pigments), makes their isolation and purification at higher quantities for further investigations (*e.g.* medicinal, pharmaceutical or analytical research) problematic [1]. In addition, new interesting betalains are usually present in plants at low concentration and their isolation requires tedious and time consuming procedures. Recently, new dehydrogenated and decarboxylated betacyanins have been characterised in heated preparations of red beet root as well as purple pitaya fruit extracts and juices.

In this study, the differences of retention of dehydrogenated and decarboxylated betacyanins in high-speed countercurrent chromatographic (HSCCC) systems operated in the 'head-to-tail' mode were investigated. The separation of betalains in many cases is hindered by their relatively high polarity and low solubility in organic solvents [1]. Therefore, the addition of reagents generating strong ion-pairs with be-

talains in the CCC solvents forcing the polar pigments to the organic stationary phase is necessary [1, 2]. The resulting fractions were analysed by LC-ESI-MS in order to trace numerous isomers of differently dehydrogenated and decarboxylated derivatives of betanin.

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Optimization of Extraction of Polyacetylenes from *Daucus carota* L. using Response Surface Modelling (RSM)

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Key words: *Daucus carota* L., phytochemicals, polyacetylenes, Pressurized Liquid Extraction (PLE), Response Surface Modelling (RSM)

The aim of this study was to optimize the extraction of falcarinol-type polyacetylenes (PAs) carrots (*Daucus carota* L.) through pressurized liquid extraction (PLE) using response surface modelling (RSM) to obtain optimal extraction conditions.

Polyacetylenes are widely distributed in nature and can be found in plants, fungi, lichens, moss, marine algae and invertebrates. More than 1400 different acetylene-type compounds have been characterized in plants, and approximately half of these are polyacetylenes [2]. Among higher plants polyacetylenes are common in several botanic families. PAs are commonly found in *Apiaceae* such as *Daucus carota* (carrot) and *Pastinaca sativa* (parsnip) which are commonly consumed as foods by humans.

These compounds have been lately related with a reduction of the risks of develop diseases such as certain types of cancer and other important diseases [11]. It has been proved as well that falcarinol is the most active one of the polyacetylenes present in carrots in terms of cytotoxicity against cancer cell lines [12–14]. Plants from the *Apiaceae* family are rich in a specific group of aliphatic PAs, containing 17 atoms of carbon and therefore so-called C-17 polyacetylenes [13]. Carrots contain mainly three C-17 polyacetylenes, namely falcarinol (FaOH), falcarindiol (FaDOH) and falcarindiol 3-acetate (FaDOAc).

Three main pressurized liquid extraction parameters were explored using ethyl acetate as extracting solvent. Temperature from 25 to 80°C, pressure from 800 to 1500 psi and number of cycles from 1 to 3. The increase of the number of cycles seemed to have a significant effect (*ca*. 30% for FaOH and 20% for FaDOH and FaDOAc). Higher temperatures and pressures of extraction showed a lower recovery of all polyacetylenes, this can be explained by the termolability of PAs and their possible degradation at higher pressures.

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Challenges and Solutions in Reference Material Development for Quantification of Food Allergens

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Key words: allergy, ELISA, gliadin, coeliac disease

Most people can enjoy every food without any problem. But hypersensitivity reactions (allergy and intolerance) triggered by certain food proteins affect an increasing rate of population. The only effective treatment of these illnesses is total avoidance of the problematic proteins from patient's diet. At the moment in the labelling regulations of European Union defines 14 foodstuffs or components which are responsible for the highest number of these cases.

In order to observe the regulation food manufacturers need right technological solutions, food safety managements and validated analytical methods. At present the most commonly used methods in allergen analysis are ELISA and LFD. Development and validation of these immunoanalytical methods have many challenges. Since ELISA is based on specific immune reactions, it is necessary to know the composition of the allergenic proteins in order to be able to choose the appropriate antibody. Furthermore it presents difficulty that there are neither reference materials nor reference methods. Finally the effects of food processing steps on the allergenic proteins and the results of the analytical methods are not described well.

The work of our group within MoniQA Network of Excellence was to develop incurred reference material for milk, egg and gliadin quantification. The successful production of the selected, baked food matrices with homogenous distribution of allergenic proteins was achieved on lab scale. These model matrices opened the door to make a comparative study of ELISA kits. During our measurements we found significant differences among the results of the kits. RM also gave opportunity to investigate the influence of food processing. The results show drastic decreases in measurable protein content after baking. The stability test is in progress. Our model matrices can offer an alternative solution for producing reference materials for method validation and quality assurance of results.

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Determination of Nystatin in Honey by Liquid Chromatography Coupled with Mass Spectrometry

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Key words: antibiotics, nystatin, honey, LC-MS/MS

Nystatin is the antifungal polyene antibiotics used for bees for the treatment of serious infections. The purpose of this study was to develop and validate a method for determine nystatin residues in honey. Clean-up was performed by solid-phase procedure on a C18 column. After drying of the eluate, the residue was redissolved and further analyzed by reverse phase LC-ESI-MS/MS. The mobile phase consisted of methanol and water with 0.01% formic acid. No MRLs are set for nystatin in honey. The limit of quantitation for nystatin determination in honey samples achieved below 50 ppb.

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Fluorescence of Maillard Reaction Compounds and FAST Index in Breads

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Key words: breads, crumbs, crusts, FIC, fluorescence, Maillard reaction, FAST index

In this study a free and total (free + linked to the protein backbone) Fluorescence of Intermediatory Compounds (FIC) formed at the advanced stage of the Maillard reaction were evaluated in wheat, spelt and rye breads and their crumbs and crusts, baked at 200°C for 35 min and 240°C for 30 min. For efficient release of linked fluorescent Maillard compounds from the protein backbone Pronase was used. FIC were measured at excitation wavelength of 347 nm and emission wavelength of 415 nm, and values were expressed as fluorescence intensity (FI) per milligram of sample. Moreover, the FAST index (Fluorescence of Advanced Maillard Products (FI) and Soluble Tryptophan) was determined in breads and their parts as an indicator of nutritional value damage during thermal process.

The following observations were made: (1) breads, made of wheat, spelt and rye, showed total FIC values generally higher than free FIC values, with one exception noted for bread crust baked at 240°C for 30 min; (2) the highest total/ free FIC ratio was recorded in breads baked at 200°C for 35 min, due to higher total/ free FIC ratio noted in crust of breads baked at 200°C for 35 min as compared to the crust of breads baked at 240 °C for 30 min; (3) it can be concluded that higher temperature with shorter baking time allows to form final Maillard reaction products (melanoidins) with lower in fluorescence; (4) by comparing the FAST indexes, it could be stated that bread nutritional value depends on kind of flour (wheat, spelt, rye) and baking parameters. Following the FAST indexes of crusts (the part of bread with the highest accumulation of Maillard reaction products) it seems that due to lower protein damage and lower formation of advanced Maillard reaction products, baking at 200°C for 35 min is favorable than baking at 240°C for 30 min.

Above results confirm the usefulness of FIC and FAST indexes for measurement of not specific heat-induced markers in wheat, spelt and rye breads.

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Volatile and Odour Active Compounds in Chokeberries (*Aronia melanocarpa*)

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Key words: volatile, odour, chokeberry, anthocyanin

Number of studies show that fruits are a good source of biochemical and daily consumption of them is necessary for decreasing various risk diseases. Between different fruit variety, berries have engaged a great attention for their active substances such as phenolic acids, flavonoids, tannins, and other essential components (vitamins, minerals, organic acids, unsaturated fats). Berries, especially those with dark blue and red colours, have the highest content of anthocyanins and that is associated with health benefits. Therefore choke-

berries are among those with high anthocyanins content. This plant belongs to *Rosaceae* family and is cultivated as an ornamental shrub and for berry production. However, sensory quality is important factor in food applications and that considerably influence consumer preferences.

In this study, volatile and odour active compounds of two cultivars of chokeberries (*Aronia melanocarpa*) juices were studied by solid phase microextraction of head space volatiles and subsequent analysis by gas chromatography, mass spectrometry and olfactometry (SPME-HS-GC-MS-O). Compounds identified in chokeberries juices were mainly breakdown products of fatty acids, followed by terpenoids derivatives, amino acids derivatives and shikimic acid derivatives. The main headspace compounds identified in both cultivars of chokeberries was dill ether, followed by hexanal, benzaldehyde, 1-hexanol and (E)-2-hexenal. Odour active compounds were detected and characterised by a trained panel of judges in the course of GC-O by using detection frequency analysis. 1-Penten-3-ol, ethyl butanoate, ethyl isovalerate, heptanal, 1-octen-3-ol, nonanal, dill ether, carvone, ethyl decanoate, beta-damascenone were found to be the important odour active components for chokeberries aroma, while rest five compounds were detected and characterised by judges remained unidentified.

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P141

Strategy for the Identification of Key Odorants in Food

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Key words: flavour analysis, food, olfactometry, gas chromatography

Flavour comprising the aroma and taste impression, plays an important role in consumer acceptance of food products. Therefore, the studies on contribution of individual volatile components into aroma of food products are interesting and grow in populatity. The problem of aroma compounds is also important from an analytical point of view.

For analysis of volatile compounds in food matrix, gas chromatography-olfactometry (GC-O) is frequently used. In this technique odor active compounds are determined by trained human assessors. The main goal of GC-O studies is to determine the importance of each compound in shaping volatile composition of the product. Olfaction lets distinguish more aroma compounds than common detectors. Thus this technique seems to be very good solution in flavour analysis. Usually GC-O is connected with flame ionization detector or mass spectrometer.

In gas GC-O few quantitative methods exist for evaluation of the intensity of odours and their influence on the food sample flavour. These methods can be categorized into three groups: dilution to a threshold, detection frequency and direct intensity. The most difficult is finger span method which is a variant of direct intensity methods. To perform the analysis correctly, the assessors training is required. Only a qualified assessor can carry out the analysis properly, reliable and with good repeatability. Assessors should learn how to generate peak with a good repeatability and how to distinguish changes in intensity of a single olfactory sensation. After the training the assessor are ready to perform analysis correctly. This study shows an example of assessors training and identification to be evaluate food quality of selected food products.

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P142

Characterization of Flavour Profile of Blue Honeysuckle Berries

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Key words: blue honeysuckle berry, food analysis, flavour profile, GC×GC-TOFMS

Food flavour is the one of the main factor that has great influence on customers preference. For this reason, the dietary and nutritional aspects, as well as aromatic features, should be ensured by food products. Such an approach inclines to search and manufacture new, healthy and flavourful foodstuffs based on natural products, especially fruits and vegetables. The blue honeysuckle berries (*Lonicera caerulea* L.) are valuable regarding health benefits, including decreasing the risk of various forms of cancer and cardiovascular diseases. These benefits are resulted from high antioxidant activity of the berries. In spite of mentioned facts, there are no information about aroma profiles of *Lonicera* berries.

In this studies, the flavour compounds of berries of different blue honeysuckle cultivars were isolated by headspace solid-phase microextraction (HS-SPME), and analyzed with an in-house developed two-dimensional gas chromatography (GC×GC) system. The utilization of time-of-flight mass spectrometer (TOFMS) revealed complex aroma profiles of blue honeysuckle berries including esters, alcohols, aldehydes, ketones, phenolic compounds, furans and terpenes. 54 of those volatiles were positively identified based on both linear temperature programmed retention indices (LRPRI) and deconvoluted mass spectra of reference stan-

dards. Important flavour compounds previously described in blueberries, including aliphatic esters, "green leaf volatiles" (GLVs; hexyl- and hexenyl-derivatives) and terpenes, were also found in this study. However, some of the volatiles present in blue honeysuckle berries, such as (-)-menthol (peppermint-spicy note) and fenchone (herb-woody note), are distinctive for this type of berries. Additionally, some of detected monoterepenes have healing properties, particularly menthol has analgesic property. This preliminary study shows that selected aroma compounds can be markers for a single blue honeysuckle cultivar (*e.g.* phenylethyl alcohol for "Brązowa" berry).

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P143

Assessing Adulteration of Extra Virgin Olive Oil with Lower Quality Oils Using Spectroscopic Techniques

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Key words: olive oil, FTIR, NIR, VIS

The feasibility of the various spectroscopic techniques for the estimation the adulteration level of extra virgin olive oil with lower quality olive oils will be presented.

Olive oil is widely consumed in the Mediterranean countries. The growing demand for extra virgin olive oil is attributed to its superior organoleptic characteristics (aroma and taste), remarkable antioxidant properties and potential health benefits. The high prices of virgin olive oil compared to other commonly used vegetable oils, make it prone to adulteration with less expensive oils. The common modifications of extra virgin olive oil are both the addition of refined olive oil and deodorized-only lampante oil. This latter is virgin oil with an unpleasant taste, subjected to a mild thermal deodorization for the removal of the undesired flavor. Various analytical techniques have been utilized for detecting and quantifying the adulteration of the extra virgin oil. In recent years, spectroscopic techniques have become more popular, as reliable methods for assessing genuineness of the extra virgin olive oil and revealing fraudulent blends with lower quality oils.

In this study the performance of various spectroscopic techniques in assessing adulteration of extra virgin olive oil with lower quality oils was investigated and compared. Absorption spectra in the near-infrared, infrared and visible ranges were recorded for extra virgin olive oil blended with refined and deodorized olive oils. Multivariate analysis of the spectra using PLS1 regression was used to evaluate concentration of the extra virgin olive oil in the blends. Similar performance levels in quantifying the composition of oil mixtures were found for all of the examined spectroscopic techniques.

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P144

NMR as a Method for Screening of Fatty Acids Composition in Edible Oils

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Key words: edible oils, fatty acids, GC-FID; 1H NMR; 13C NMR

From a nutritional standpoint, lipids rich in cis-mono- and polyunsaturated fatty acids (FA) are considered to provide positive health benefits while saturated and trans FA are considered to present negative health implications [1]. Due to these generalizations and the public's perceptions, the compositional makeup of a lipid is commonly required information on nutrition labels. Such nutrition labeling compositional data (NLCD) is generally obtained by gas chromatography-flame ionization detection (GC-FID), considered as reference method [2].

In recent years, new methods to the determination of FA composition by nuclear magnetic resonance (NMR) have been developed. The objective of this work was a comparative study on the efficiency to determine FA composition of different methodologies based on 1H NMR [3–5], 13C NMR [1] and GC-FID [2]. For this purpose we have analysed the two most common edible oils (sunflower and olive) used in the Mediterranean diet. The NMR study was acquired in the unaltered whole sample without pre-treatment. Furthermore, 1H NMR spectra gave additional information through the minor components about the preservation and quality of the samples. 13C NMR has a wider spectral window and provides more information allowing the identification of each individual FA, included cis and trans, and the determination of the percentage of each FA in the position (sn-1,3; sn-2) of the triglyceride backbone. However, 13C NMR spectrum needs long acquisition times due to its low sensibility.

Through 1H NMR spectra we can obtain in few minutes the NLCD of oils with the same accuracy and reproducibil-

ity that GC-FID. These characteristics make 1H NMR a very useful technique for quality screening in edible oils.

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P145

Fluorescence Spectroscopy for Monitoring Thermal and Photo-Oxidation of Cold-Pressed Vegetable Oils

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Key words: cold-pressed oils, thermal oxidation, photooxidation, fluorescence

The present work investigates the use of fluorescence techniques for monitoring of auto- and photooxidation of cold pressed vegetable oils.

The quality of vegetable oils may be affected by oxidation. Appropriate control of these processes is important to ensure the quality of vegetable oils during their shelf life and domestic processing. A variety of parameters is monitored for this purpose, often using chemical methods. Such measurements are usually laborious and time- and reagent-consuming, requiring several analytical procedures for each parameter. In this context, spectroscopic techniques are an interesting alternative. Among spectroscopic techniques the interest in fluorescence methods for rapid analysis of edible oils has grown steadily in recent years. The benefits of fluorescence spectroscopy include its enhanced selectivity as compared to others spectroscopic methods, and its high sensitivity to a wide array of potential analytes. The fluorescent analysis takes advantage of the presence in oils of natural fluorescent components and products of oxidation.

In this work oxidation of cold-pressed edible oils was studied using total luminescence and synchronous scanning fluorescence methods. Spectral bands were identified originating from fluorescent oil components, mainly tocopherols and pheophytins, and products of oxidation. The changes in fluorescence characteristics were correlated to the changes in the conventional quality parameters of oils. The results showed that fluorescence-based analytical methods provide convenient means to monitor oxidation of cold-pressed oils.

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P146

The Application of Synchronous Fluorescence Spectroscopy and SPA-LDA Analysis for the Classification of Olive Oils

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Key words: food quality, olive oil, synchronous fluorescence spectroscopy, linear discriminant analysis, successive projection algorithm

The aim of the study is to evaluate the potential of the synchronous fluorescence spectroscopy and chemometric methods for the classification of different types of olive oils: extra virgin olive oils, refined olive oils and pomace olive oils. Processes such as refining are responsible for changes in the content of polyphenols, tocochromanols and compounds from the chlorophyll group. Thus, types of olive oils exhibit differences in fluorescence intensities, which makes it possible to distinguish between them on the basis of their fluorescence spectra. Synchronous fluorescence spectra were acquired in the region of 240–700 nm with the wavelength interval ($\Delta\lambda$) of 10, 30, 60 and 80 nm. Olive oils were classified by Successive Projection Algorithm (SPA) combined with Linear Discriminant Analysis (LDA). The application of LDA requires spectral variable selection from the synchronous fluorescence spectra for building well fitted models. Successive Projection Algorithm (SPA) was carried out to select effective wavelength variables from the full spectra for further classification analysis. The classification error of the LDA method was in the range from 2.5 to 6.3% depending on the wavelength intervals ($\Delta\lambda$) and number of variables in the model. The best classification accuracy was obtained for LDA model with 10 variables and wavelength interval ($\Delta\lambda$) equaled of 10 nm.

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P147

Differentiation of Pork and Beef from Meat Mixtures and Processed Products on the Basis of Skeletal Muscle Myosin Light Chain Isoforms

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Key words: skeletal muscles, myosin light chains, meat authenticity, 2-DE, MS

Bearing in mind increasing number of incidents of meat products adulterations as well as occurrence of food allergies to meat proteins derived from specific animal species, there is a growing demand for the elaboration of rapid and effective methods of meat species identification in food products. This study indicates the possibility of pork and beef differentiation on the basis of skeletal myosin light chain (MLC) isoforms. Observations were performed on raw meat, meat mixtures and processed meat (raw and cooked sausages).

Two-dimensional electrophoresis separations revealed species specific differences in molecular weight and pI of the fast essential/alkali (ELC) two isoforms (MLC1f and MLC3f). The correct identification of the analyzed myosin isoforms was confirmed using mass spectrometry analysis. Comparing MLC isoforms separated from raw meat and processed meat products, it was found out that MLC isoforms are relatively stable proteins quite resistant to technological processes. In this case different electrophoretic mobility was observed between swine and cattle MLCs. That is why the method based on MLC isoforms could be employed as an effective tool for species identification of meat and meat products. The proteomic approach could be used as a tool supporting methods based on DNA analysis, especially in view of the fact that, in recent years, a considerable progress has been observed in methodology applied in proteomic research.

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Functional foods

P148

Investigation of Functional Food Components and Parameters Affecting their Stability

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Key words: storage life, functional food, vitamins

There has been increasing interest in recent years for healthy life styles, especially the intake of antioxidants, vitamins and food supplements. Variegate alimentation and the intake of essential nutritive are necessary for health-preserving. The role of vitamins is inevitable in our life but the low consumption of fresh fruits, vegetables causes declination in the amount of vitamins in the human body thus biochemical processes (the metabolism, the energy transport and the renewal processes) can not work properly. In Hungary the majority of mortality can be attributed to illnesses relating on the inappropriate alimentation. The fact is that the reduction of the related chronic and non- infectious diseases can not reach without the changing of the eating habits.

The demand the appearance of food products on the market that have positive health effects and contribute the preservation of our health is on the rise. Healthy lifestyle becomes more and more popular as well as the role of the functional food products in the healthy diet the economically well developed countries. The functional food has got traditional appearance; some of the ingredients have special nutritive and/or physiological benefits beyond the traditional characteristic of the basic food. As a result of this, it promotes the prevention of diseases, improves the physical and mental condition as well. Its positive health effects have to be scientifically justified.

The aim of our investigation to establish the conversions and determine the lifetime of the chosen vitamins, which are very important for functional product development, by modeling different technological conditions like temperature, pH, matrix-effect. By the obtained results we can estimate the optimal storage circumstances and the appropriate technological conditions during the food processing in order to preserve as much vitamin as possible. Thus storage life of vitamin enriched foods can be estimated from the viewpoint of the efficiency of bioactive components.

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P149

Optimization of the Low Calorie Candied Chestnut Production

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Key words: chestnut, candied chestnut, aspartame, acesulfame-K, maltitol

As a valuable energy source for children, young and aged people, chestnut was one of the important fruit. In recent years, chestnut fruits have become more important in human health because of their nutritional qualities and potential beneficial health effects. Chestnut contains P, Mg, Cl, Ca, Fe and Na minerals; vitamin C, vitamin B1, vitamin B2 and niacine. It is rich for sugar, protein, oil and its energy value is 200 Kcal/100 g. In our country, candied chestnut is a distinguished sweet and identified with Bursa. Peeled chestnuts are covered with a piece of cheesecloth and boiled in water then sugar syrup (80^{o} brix). This high sugar content of this product limits the consumer group. Because health and nutrition consciousness of the consumers are improving and people having some health problems especially diabetics could not eat this type of products.

The aim of this research is to optimize candied chestnut production with the use of some sweeteners (aspartame + acesulfame-K and maltitol). Energy value of the product was decreased as 40%, 50%, 60% and 70%. Candied chestnuts were pasteurized at 95°C for 25 min and stored at room temperature. Total dry matter, total sugar, reducing sugar, total acidity, ash, starch, protein, oil, and color (L*, a*, b*) and sensory analyses were applied to raw material and low calorie candied chestnuts. The most suitable recipe was determined according to the results of the analysis.

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P150

Evaluation of Trapping Methylglyoxal Capacity of Cereal Extracts as Anti-Ageing Dietary Sources

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Key words: ageing, AGEs, dicarbonyls, glycation, dietary extracts, cereal

Advanced Glycation end-products (AGEs) accumulation in long-lived proteins is involved in the pathogenesis and physiological complications related to ageing. Then, strategies to reduce AGEs formation and/or accumulation are been intensively investigated nowadays.

Dietary compounds acting as AGEs scavengers or by retarding its formation could be used as potential strategies in promoting a healthy ageing. However, those strategies to promote an antiglycative capacity can be achieved from different routes according to the mechanisms of action of the active substances, such as antioxidants or scavenging reactive carbonyl species, among other. Methylglyoxal (MGO) is a reactive dicarbonyl intermediate generated during the glycation between reducing sugars and amino groups of proteins, lipids, and DNA, is precursor of AGEs and exert direct toxicity to cells and tissues.

Direct trapping capacity towards reactive physiological dicarbonyls is evaluated in cereal extracts. Extracts are obtained from subproducts of cereal processing as refination, and obtained by an environmental friendly process.

Degree of the trapping capacity towards methylglyoxal of the cited dietary extract is compared with well-know AGE inhibitors, such as pyridoxamine and aminoguanidine. Dose-response curves are investigated in order to evaluate the feasibility of the application of these extracts as a dietary anti-ageing adjuvant. In addition, trapping capacity under physiological conditions is also evaluated in a cookie resembling model system enriched with the selected dietary extracts. Effect of the thermal treatment will be discussed.

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Functional Properties of Dietary Fiber of Wheat--Barley Bread

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Key words: dietary fiber, functional properties, whole barley flour, starters, bread

Products with new functional and nutritional properties are a condition for a higher acceptance of barley in human nutrition. The objective of this research was to assess the functional properties so as water binding capacity (WBC) and cations exchange capacity (CEC) of the dietary fiber of wheat-barley bread. This bread was obtained with barley sour doughs, containing 30, 40 and 50% whole barley flour (WBF), fermented with freeze-dried LV1 (*Saccharomyces chevalieri*, *Lactobacillus casei* and *brevis*) and LV2 (*Saccharomyces chevalieri, Lactobacillus brevis*) starters, respectively.

Water binding capacity (WBC) and cations exchange capacity (CEC) of dietary fiber of wheat-barley bread were determined according to methods of McConnell *et al.* [1974], and Robertson *et al*. [1980], respectively. In the above methods the conditions of analysis (pH environment, soaking time, and temperature) were modified adapting them to environment existing in the human digestive tract.

In addition, in all samples, the dietary fiber (TDF), soluble (SDF) and insoluble (IDF) as well as neutral dietary fiber (NDF) and its fraction contents were determined.

The results show that the WBC of dietary fiber of wheat-barley bread with 40–50% barley sour doughs fermented by starter LV1 was higher than sample with 30% WBF, fermented by LV1. However, the opposite trend occurred in the case WBC of the fiber of bread fermented by LV2 starter. Higher WBC values of dietary fiber of bread with 30% sour dough fermented by LV2 were found.

The increased CEC values of the fiber of wheat-barley bread with increasing sour dough in samples were observed. CEC of dietary fiber of bread with 30–50% barley sour dough fermented by LV1 was higher compared to samples fermented by LV2. Some differences in the dietary fiber and its components in the examined breads were found.

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P152

Effects of Functional Rice Cake on the Loperamide-Induced Constipation in Rats

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Key words: functional food, rice cake, constipation, fermentation

A rice cake, a popular traditional food, is often consumed as a convenient replacement for regular meals in Korea. However, it contains limited amount of dietary fiber and so not ideal for people with constipation which is getting more serious among the working people. We attempt to develop functional rice cake rich in dietary fiber, with a longer shelf life and good organoleptic characteristics. A few strains of heterofermentative lactic acid bacteria were isolated from kimchi and used to ferment wet-milled rice flour for their ability to inhibit the microbial spoilage of rice cakes. The functional rice cake was made with the fermented rice dough. Psyllium and resistant starch then were added to increase dietary fiber content. The effect of the functional rice cake on constipation was investigated using male Sprague Dawley rats after loperamide-injections. Fecal moisture contents, dry weights of feces, and cecal contents showed a notable increase by the administration of the functional rice cake for 10 days. In addition, increased weights of colonic tissue and length of colon were observed. The contents of short chain fatty acids in cecum increased; accordingly, the pH of cecal contents decreased as well. However, contrary to our expectation, the amount of colonic mucin was not significantly altered. The results suggest that rice cake could be developed into a functional fast food for constipation after further investigation.

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Effect of Rye Bread Enriched in Green Tea Extract on Body Weight Gain, Visceral Fat Contents and Lipid Absorption in Rats

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Key words: functional foods, green tea extract, obesity, rats

In numerous studies shown that green tea (GT) and its active compounds possesses various health benefit *i.e.* against obesity, hypertensive, arteriosclerotic, glycemic, and cholesterolemic.

This study evaluated body weight gain, visceral fat contents, and lipid absorption rate in rats fed a normal diet and hypercaloric diets based on rye bread enriched with green tea extract (GTE).

Adult male Wistar rats were placed into 4 dietary groups (n=24); 1) a negative control group fed a normal caloric diet (ND); 2) a positive control group (HRB) fed a hypercaloric diet containing control rye bread powder; 3) and 4) groups fed the same diets as positive control group but the rye bread powder was enriched with 0.8 and 1.1% GTE respectively (HRB0.8% and HRB1.1%). After 8 weeks the animals were killed. Blood and adipose tissue samples were collected. The significant lower energy dense of feeding diet observed in ND group considerably suppressed ($P<0.05$) body weight gain and visceral fat development in comparison with the other groups of rats fed a hypercaloric diets based on rye bread powder, but additive of 1.1% GTE to the rye bread resulted in smaller ($P<0.05$) body weight gain (by 6.6%) and size of visceral fat (by 8%) when compared to those fed a hypercaloric diet with control rye bread. The NC rats fed a normal caloric diet resulted in lower contents of total fecal lipids (0.11 ± 0.01 g/100g feces) in comparison with rats fed a hypercaloric diet based on rye bread powder (HRB0.8% and 1.1%: 0.63 ± 0.14 g/100g feces). Total fecal lipid concentrations did not differ between the HRB0.8% and 1.1% groups were greater (by 28 and 34%) than in HRB rats ($P<0.05$).

These data indicate that rye bread enriched with 1.1% GTE could be promising tool in prevention of obesity.

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P154

Effects of Stabilization Process on Dietary Fiber of Intermediate Onion By-Products

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Key words: onion by-products, dietary fiber, pasteurization, sterilization

Spain is one of the main onion producers (23% of European production), providing a high level of residues (15% of production), including onion bulbs that are discarded during selection steps. It is necessary to search for possible ways of utilization of these residues to obtain new sources of high-value functional ingredients. The objective of the present study was analyzed the effect of onion waste processing, as well as the effect of stabilization process on fiber fraction of an intermediate onion by-product to evaluate its potential use as source of dietary fiber. The raw onion was squeezed in a press obtaining an intermediate product named "Paste". Pasteurization and sterilization were carried out to stabilize. The dietary fiber was determined using an enzymatic-gravimetric method. The results are the media of different onion varieties. The Paste without processing (control) exhibited 29 % dry weight (DW) of Total Dietary Fibre (TDF), being the Insoluble Dietary Fibre (IDF) the main fraction (86 %). The onion waste processing produced an increase (18%) of total dietary fiber respect to raw material. The thermal treatment produced a general decrease of IDF and an increase of SDF was found respect to the control. The pasteurization process showed the highest decrease in IDF fraction (40%) and an important increase in SDF fraction (70%). However, sterilization exhibited lower decrease in IDF (7%), but higher increase in SDF (124%). In consequence, stabilized products showed better ratio SDF: IDF (1:2 or 1:3, in pasteurized or sterilized products, respectively) than control (1:6), thus, the heat treatments produced an onion fiber solubilisation. Processing treatment along with stabilization process produced intermediate by-products with higher fiber content and better SDF: IDF ratio than raw material. Therefore, the product obtained could be use as functional ingredient with high levels of DF.

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Use of White Grape Pomace as a Source of Dietary Fibre and Polyphenols in Biscuits

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Key words: biscuits, phenolic compounds,dietary fibre, sensory analysis, texture analysis

Dietary supplements and food fortification are a potential alternative route to the consumption of minor plant components and dietary fibre that may have health benefits. Among fruits, grapes constitute one of the major sources of phenolic compounds, and grape pomace is rich in phenols. Even after contact with the fermenting wine, grape pomace contains high concentrations of both dietary fibre and phenols, with potential antioxidant activity.

The purpose of this study was to partially replace wheat flour in the formulation of biscuits with white grape pomace (WGP). It was also aimed to investigate the effect of WGP addition on the physical and sensory properties of the cookies when used with grape fibre.

Biscuits were prepared with the addition of powder made from WGP skins at various levels (10, 20 and 30%, based on the wheat flour used). The chemical composition of WGP powder and biscuits, dietary fibre, total phenolic compounds, and the antioxidant activity were investigated. In addition, width, thickness, sensory and rheological characteristics, and texture were analyzed.

WGP is a rich source of fibre and polyphenols. Also in view of the antioxidant property of pomace, it would play an important role in prevention of diseases. The biscuits made with the addition of WGP were sensorially acceptable, containing significantly more phenols and dietary fibre. However, as the WGP level increased the biscuits hardness and thickness decrease. Control biscuits were crisper compared to samples with addition of WGP and had the highest brightness compared to the WGP enriched biscuits, due to the enzymatic browning.

WGP could therefore be a potential source of antioxidants; it may also have technological applications as a natural food additive, and possibly nutritional benefits due to its composition, in the design of healthy (functional) foods. Hence, development and consumption of such therapeutic bakery products would help to raise the nutritional status of the population.

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P156

Antioxidant Properties of Buckwheat Enhanced Wheat Breads

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Key words: buckwheat flour, dark and white wheat flours, buckwheat enhanced wheat breads, antioxidant properties

Common buckwheat (*Fagopyrum esculentum* Moench) is recognized as a health promoting food which offer many beneficial health effects for consumers. In this study, antioxidant properties of buckwheat enhanced wheat bread formulas, composed of dark or white wheat flour, unhusked common buckwheat flour, salt and yeast, was investigated. The buckwheat flour substituted dark or white wheat flour at amount of 10, 20, 30 and 50% w/w on total flour basis. The breads were baked in electric oven at 230°C for 30 min.

The antioxidant properties of buckwheat enhanced wheat breads were characterized by their chelating and reducing power, and antioxidant capacity measured against $ABTS^{\bullet+}$, $DPPH^{\bullet}$ and against $O_2^{\bullet-}$ radicals by photochemiluminescence (PCL) assay.

The studies showed higher antioxidant properties of reference dark wheat bread as compared to reference white wheat bread. The antioxidant capacity formed by water and lipid soluble antioxidants (PCL assay) and reducing power were threefold higher, chelating power was above fivefold higher whilst scavenging capacity against $ABTS^{\bullet+}$ and $DPPH^{\bullet}$ radicals was increased by 18% and 21%. Therefore, only substituting from 30 to 50% of dark wheat flour in the bread formula with buckwheat flour resulted in higher antioxidant properties of enhanced dark wheat bread, being generally twice better with comparison to dark wheat bread. On the other hand, substituting 10, 20, 30 and 50% of white wheat flour in the bread formula with buckwheat flour resulted in almost linear increase of chelating and reducing power, scavenging activity against $ABTS^{\bullet+}$ and $DPPH^{\bullet}$ radicals and antioxidant capacity against $O_2^{\bullet-}$. The antioxidant properties of buckwheat enhanced white wheat breads, considered as above, were almost fivefold higher for bread with 50% buckwheat flour substitution when compared to those noted in commonly consumed white wheat bread. The improved antioxidant properties of buckwheat enhanced wheat breads might be due to the incorporation of phenolic compounds, mainly rutin and quercetin, which had been shown to possess antioxidant activity. Overall, buckwheat enhanced wheat breads could be developed as a food with more effective antioxidant properties.

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Isolation of Heart Healthy Peptides Derived from *Palmaria palmata* and Incorporation of These Peptides in Bread

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Key words: bioactive peptides, macroalgae, functional food.

Cardiovascular disease (CVD) is the main cause of death in Europe accounting for over 4.3 million deaths each year. Hypertension is one of the major, yet controllable risk factors in CVD. The renin-angiotensin system (RAS) is capable of regulating hypertension. One strategy in combating hypertension is based on manipulating various stages of RAS. This is achieved principally by inhibiting two essential and rate limiting enzymes involved in the system; angiotensin-I converting enzyme (ACE-I) and renin. Another strategy in combating CVD is to inhibit enzyme platelet activating factor acetylhydrolase (PAF-AH). A proatherogenic role has been postulated for this enzyme based on its ability to generate two key pro-inflammatory mediators; lysophosphatidylcholine (LPC) and oxidised non-esterified fatty acids (oxNEFAs).

A number of peptides have already been isolated from different species of macroalgae that exhibit various bioactive properties including ACE-I inhibitory peptides. This study focuses on bioassay guided extraction of ACE-I, renin and PAF-AH inhibitory peptides from the red macroalga *Palmaria palmata* and examines the viability of incorporating these peptides in bread.

Extracts of lysopholised *Palmaria palmata* were obtained by accelerated solvent extraction (ASE) using water, ethanol and acetone. Protein was extracted from *P. palmata* by ammonium sulphate precipitation according to the method of Galland-Irmouli *et al*. [1999]. Fermentations of the crude macroalga and the protein extract were prepared using three proteolytic enzymes; flavourzyme, alcalase and papain. The biological activity of all extracts were assessed using commercially available kits to determine ACE-I, renin and PAF-AH inhibitory activity. An RP-HPLC method was developed and used in tandem with the bioassays to isolate the bioactive

peptides from the macroalgal extracts. After incorporation of the bioactive algal fractions into bread, the bioactivity was again examined to determine any possible loss of activity during the baking process.

To further characterise the structure of the identified bioactive molecules a combination of mass spectrometry and NMR experiments will be performed.

Sensory assessment to determine how the bread is perceived in terms of smell, sight, taste and touch will be carried out. First quantitatively using triangle tests, hedonic scales and acceptability ratings, and also qualitatively using focus groups to identify key sensory attributes.

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North American Wild Rice – rich source of nutraceuticals

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Key words: wild rice, γ-oryzanol, phytosterols

Wild rice is harvested for millennia by aboriginals on the American continent. It belongs to the genus *Zizania* and is growing as an aquatic cereal. Wild rice varieties are predominantly grown naturally in lakes, rivers and streams in the Great Lakes region and the Northern part of the Canadian prairies.

The content and composition of sterols and γ-oryzanol in eight wild rice (*Zizania palustris*) samples grown in different parts of the North America were compared to standard brown rice (*Oryza sativa* L.). Wild rice lipids contained significantly higher amounts of total sterols, ranging from 70 to 145 g/kg, compared to 27 g/kg in brown rice lipids. The composition of phytosterols was affected by the growing region. In all samples campesterol, β-sitosterol and cycloartenol were the main components of rice lipids. These phytosterols contributed from 54 to 75% of the total sterol amounts. Variety of minor phytosterols was identified including: clerosterol, Δ7-avenasterol, citrostadienol, 23-dehydrositosterol, gramisterol.

Phytosterols together with ferulic acid form a complex mixture of compounds known as gamma-oryzanol. Total amounts of γ-oryzanol in the North American wild rice lipids varied from 459 to 730 mg/kg compared to 459 to 613 mg/kg in brown rice. Differences in the amounts of γ-oryzanol were followed by disparity in the composition. HPLC/MS separation and identification led to obtain 6 to 10 different oryzanols where the main compound was 24-methylenecycloartenyl ferulate. Results suggest that γ-oryzanol content is affected by the rice origin, variety and growing conditions. γ-Oryzanol as well as phytosterols are known to possess antioxidant and cholesterol lowering properties, wild rice could be recognized as better health promoting food containing nutraceuticals than regular rice.

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New Enzyme-Resistant Dextrins from Corn Starch – from Structure to Functionality and Health

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Key words: thermolysis, dietary fibre, dextrin, esterification, enzyme-resistance, citric acid

Overweight, obesity, and diabetes are major health threats, which become worldwide epidemics. For intervention of these serious health problems, and to provide healthy food choices to meet consumers' needs, scientists and food industry face a major challenge in producing new products with reduced caloric values.

Starch-based products are staple ingredients for people from around the world. The lifestyle of modern society demands the use of these ingredients, as they are components of foods, that are easy to prepare, economical and taste good. However, because these ingredients are rapidly and fully digestible, they can lead to elevated level of blood glucose immediately after ingestion. Therefore, it is necessary to look for new less digestible food ingredients.

To meet this demand, we have tried to produce, and characterize new enzyme-resistant dextrins from corn starch.

Resistant dextrins were prepared by thermolysis of corn starch in the presence of hydrochloric, and citric or tartaric acids. Physico-chemical characteristics of dextrins including water solubility, acidity, reducing sugar content, FTIR spectra, molecular weight distribution and weight average molecular weight (Mw) have been done. Tests on resistance of dextrins to human digestive enzymes using AOAC Official Method 991.43 and 2002.02, and enzymatic-spectrophotometric Englyst method have been carried out. In addition, the stability of dextrins in simulated gastric and intestinal fluids was evaluated by an *in vitro* method.

The properties of dextrins produced by thermolysis and derivatizing reaction processed simultaneously depended on concentration of organic acid applied. Dextrins prepared with 0.1% (dry starch basis, dsb) organic acid showed Mw of 2×10^3–3×10^3 g/mol (aver. DP of 15–20) and high water solubility. The enzyme-resistance of those dextrins was about 50%.

The increase in organic acid concentration to 40% (dsb) resulted in significant increase of Mw of dextrins to 1×10^4–10^5 g/mol, resistant fraction content to more than 60%, and decrease in solubility.

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Study on Intrinsic Composition of Purple Corn as Natural Antioxidant Resource and Development of Novel, Anthocyanin Rich Functional Foodstuff

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Key words: purple corn, anthocyanins, bioactive components, food supplement

Natural colorant materials have gained growing interest, because of the wide color range and proved beneficial health effects inducing applications in pharmaceutical and food industries. Anthocyanins occur in fruits and vegetables having high rate of antioxidant, anti-mutagenic and anti cancer activities and being indispensable for well-argumented functional food development.

One important source of plant anthocyanins is purple corn (*Zea mays* L.), which has been already used for coloring beverages, jellies, candies. The subject of our studies was to develop and characterise a dietary supplement tablet and a tea that are made from the red coloured cob of purple corn, which got the code BZ during breeding.

The main focus of the research was yielding and identification of anthocyanin derivatives from purple corn. Major practical outcome of the research is the elaboration of the composition and the manufacturing technology of specially flavored tea and nutritional supplement capsules with enhanced antioxidant activity.

Cyanidin, peonydin and pelargonidin glucosides have been identified in the corn samples, in total the presence of 10 different active components and their isomers was justified. The ratio of the specific antioxidants has also been determined. Taking the average values of the extracts originating from various plant parts, the ratio of the three aglycons in the samples is the following: cyanidine : pelargonidin : peonidin = 3 : 2 : 1. The antioxidant capacity of the tablet was found to be 300 mg/g in ascorbic acid units.

The developed dietary supplement and tea can be produced from purple corn at a low price in large quantities having unambiguous physiological benefits. Colouring materials of the corn-cob of the purple corn have health-protecting effects due to their certified high antioxidant activity. The previously depicted functional foodstuffs (antioxidant rich tea, capsule and biscuits) are already available in commerce.

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Health-Promoting Compounds and Biological Activity in Se-Enriched Sauerkraut

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Key words: sauerkraut, glucosinolate hydrolysis products, selenium biotransformation, antioxidant activity, inflammation

Selenium (Se) is an essential micronutrient as it is an integral component of antioxidant enzymes [1]. Moreover, organoSe species exert a chemopreventive action against cancer through inhibition of proinflammatory responses [2]. Se intake, especially in Eastern European countries, is below the recommended dietary allowances (55 μg/day for men and women) [3]. Sauerkraut is a source of health-promoting compounds such as antioxidants and glucosinolate (GLS) hydrolysis products and results from the lactic acid fermentation of white cabbage. Lactic acid bacteria are able to transform inorganic Se into organoSe compounds during fermentation process [4]. Therefore, lactic acid fermentation of white cabbage with selenium could be used as an approach to increase human Se intake and health-promoting properties of sauerkraut. The objective of this study was to obtain Se-enriched sauerkraut from white cabbage (*Brassica oleracea* L. var. *capitata* cv. Megaton). In addition, the potential antioxidant and anti-inflammatory activity of selenized sauerkrauts as well as some of its bioactive compounds was also investigated. For this purpose, 0.3 mg of sodium selenite/Kg of fresh cabbage (1.6 mg Se per Kg of dried cabbage) was added. Cabbage was further submitted to natural fermentation at 0.5% NaCl for 7 days. Selenium species, indole GLS hydrolysis products [ascorbigen (ABG), indol-3-carbinol (I3C) and indol-3-acetonitrile (I3A)], and vitamin C (vitC) were analysed by ICP-LC, LC and CE, respectively. Antioxidant capacity was determined in sauerkraut extracts as oxygen radical antioxidant capacity (ORAC). Sauerkraut extracts, Se-methylselenocysteine (MeSeCys) and ABG were tested by their ability to inhibit nitric oxide (NO) production in LPS-induced RAW264.7 macrophages.

Results showed that total Se concentration increased from 0.07 to 1.29 μg/g dry matter in selenized sauerkraut. Furthermore, natural fermentation with selenite induced the formation of MeSeCys (0.79 μg/g dry matter). Indole GLS hydrolysis products increased noticeably (P≤0.05) after fermentation. Se enriched-sauerkrauts exhibited higher (P≤0.05) I3C and I3A content while ABG and vitC content slightly decreased (P≤0.05). Regarding biological activity, Se-enriched sauerkrauts showed higher (P≤0.05) antioxidant capacity (163 μmol Trolox/g d.m.) than conventional sauerkraut. Moreover, Se-enriched sauerkraut extracts exhibited improved (P≤0.05) inhibition of NO production compared to raw cabbage and conventional sauerkraut. MeSeCys was more potent inhibitor (IC50=25.2 μM) of NO production in LPS-induced macrophages at a concentration 38 times lower compared to ABG (IC50=970.54 μM). Consequently, Se-enriched sauerkraut could be considered as a premium source of health-promoting compounds and could aid in the prevention of chronic diseases.

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Investigations on Exploitation Perspectives and Yielding of Diverse, Antioxidant-Rich Plant Extracts

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Key words: Antioxidant, FRAP, DPPH, extraction

In accordance with the general trend of increasing number of health-conscious consumers, food industrial innovations aim at involvement more and more natural food additives with possible positive biological impacts. This fact has encouraged research on revealing the feature and availability of natural compounds deriving from fruits and vegetables. Anthocyanins contribute to the intense colors of berries, cherries and other fruits and vegetables. Anthocyanins being major plant pigments have antiradical and antioxidant activities, so they may exert positive physiological and therapeutic effects depending on their bioavailability and metabolism. Our intention was to compare the efficiency of 6, commonly applied extraction procedures and to assess the antioxidant capacity of the yielded extract in respect of applicability in functional foodstuffs.

Seven plants were selected for this study, including blackberry, black elderberry, blackcurrant, Szomolyai sweet-cherry, rosehip, pumpkin, and horseradish. The applied solvents were hot water, ethanol, ethyl-acetate, acetone, n-hexane. FRAP and DPPH methods were applied in order to establish their antioxidant activity. The measured antioxidant activity in different extracts was used to compare the efficiency of the applied extraction solvents. The best solvents were ethanol; hot water and acetone to extract antioxidants. Among all fruits and vegetables tested, rosehip had the highest antioxidant activity, black elderberry, Szomolyai sweet-cherry, blackberry, blackcurrant and finally the vegetables. The phenol content should result in higher antioxidant activity in unripe fruit. More then 40-fold differences have been measured between FRAP and DPPH values in various fruits and vegetables providing solid basis for establishment the priorities for potential functional foodstuff applications.

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Antioxidant Activity of Isochromans Derived from Hydroxytyrosol

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Key words: virgin olive oil, phenolic compounds, hydroxytyrosol, isochromans, antioxidant activity, FRAP, ABTS, ORAC

Hydroxytyrosol (HTy) and their esters derivatives are natural compounds present in the phenolic fraction of virgin olive oil. These biophenols have shown to be good antioxidants, with remarkable biological properties of potential benefit in the prevention of some pathologies associated to oxidative stress such as cancer or cardiovascular disease [1–3]. In the last years, other minor components derivatives from hydroxytyrosol have been identified in the phenolic fraction of virgin olive oil with 6,7-dihydroxy-isochroman structure [4]. However, these free olive oil biophenols are scarcely soluble in lipid media, which limited their used as antioxidant additives in based lipids foods. For this reason, the search for new derivatives that could maintain the functional characteristics of the original compounds, with enhanced lipophilicity and, therefore, intestinal bioavailability, is convenient. In this sense, synthesis of several lipophilic

derivatives from olive oil phenols have been already published [5–9].

In the present communication, the synthetic procedure and the antioxidant activity of isochromans derivatives from HTy will be presented. Results obtained using different methods for the antioxidant capacity, such as FRAP, ABTS and ORAC will be shown.

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Evaluation of Selected Fruits Extracts from *Rutheacae* and *Punicaceae* Family Influence on Tea *Camellia sinensis* Extracts Antioxidant Potential

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Key words: fruits, polyphenols, ascorbic acid, anthocyanins, free radicals, DPPH$^{\bullet}$, ABTS$^{\bullet+}$, antioxidant activity

Antioxidative potential of plant constituents are main subject of many research. Alternative for synthetic natural antioxidants constituting mainly from polyphenolics are used for lengthening the shelf life of food products, especially containing lipids. Free radicals action is very important for human organism as well as for food products oxidative stability. Radicals production is normal process in humans, but its excessive production leads to degenerative diseases. There are many results standing up for polyphenols as active radicals scavengers and antioxidant agents, since fruits are consumed frequently it would be valuable to know their antioxidative potential.

Present research aimed at the evaluation of antioxidant effectivity of selected fruits and its influence on tea extract's potential. Material chosen for the research were fruit extracts from selected plants: *Rutheacae* – citrus (*Citrus sinensis*), lime (*Citrus aurantifolia*), grapefruit red (*Citrus* x *paradisi*); *Punicaceae* – pomegranate (*Punica granatum*) and yellow tea leaves (*Camellia sinensis*).

Plant extracts were characterized by the content of total reducing substances (Folin-Ciocalteu reagent), ascorbic acid and anthocyanins. Antioxidative efficiency evaluations were conducted with use of FRAP, reducing power and metal chelating ability. Also antiradical efficiency with use of DPPH$^{\bullet}$ and ABTS$^{\bullet+}$ radicals was tested.

On the basis of received results it was stated that examined fruit extracts exhibited antioxidant potential and significantly influenced antioxidative potential of tea extract.

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Nutritional Profiling of Wheat Germ Oil for the Value Added Baked Products; Correlation with Lipid Profile Management

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Key words: wheat germ oil, α-tocopherol, octacosanol, cookies, lipid profile management

The main objectives of present research were to characterize wheat germ oil (WGO) for its quality attributes and utilize it to enhance the nutritional value of cookies. As far as composition of WGO is concerned, the dominant tocopherol isomer was α-tocopherol with concentration of 1605 mg/kg oil. Similarly, a notable amount (104.5 ppm) of fatty alcohol i.e. octacosanol was also observed. Moreover, fatty acid profile of WGO showed that oleic acid (14.69%), linoleic acid (56.99%) and linolenic acid (9.51%) were predominant fractions. Afterwards, WGO was added at the levels of 0, 25, 50, 75 and 100% in cookies formulations; increasing concentration enhanced the tocopherol isomers in cookies. Furthermore, the cookies containing WGO upto 50% discovered to be acceptable regarding their physical and sensory attributes. Later on, addition of WGO in the diets of Sprague Dawley rats for a period of 42 days reduced serum cholesterol and LDL-cholesterol concentration significantly ($P \leq 0.05$). Moreover, thiobarbiteuric acid reactive substances (TBARS) were also decreased. These findings support the potential use of wheat germ as an edible oil as it contain essential fatty acids, alcohols and natural antioxidant whose combined effects play a crucial role in reducing lipid peroxidation, which is ultimately useful in decreasing the risk of CHD (coronary heart disease).

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Berry Seed Oils as a Source of Bioactive Compounds in Functional Foods

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Key words: berry seed oils, bioactive compounds, fatty acids, phytosterols, tocopherols

Recent years have witnessed the growing consumption of processed food which is devoid of many important nutrients (vitamins, minerals, enzymes). The above leads to a depletion of our daily diets, and the resulting deficit increases the risk of various diseases. The risk of nutritional deficiency can be minimized through food enrichment and the consumption of functional foods containing bioactive components that deliver health benefits.

Berries are a rich source of a wide variety of bioactive compounds. They contain various nutrients and bioactive substances such as antioxidants (vitamins, carotenoids, flavonoids), polyunsaturated fatty acids, free amino acids and trace minerals. The most popularly consumed berry fruits are strawberries, raspberries (red and black), blueberries, cranberries and blackberries.

Berry fruit seeds, the waste product of food processing, contain oil which is rich in bioactive components such as polyunsaturated fatty acids, antioxidants (vitamins, enzymes) and phytosterols.

Selected berry seed oils obtained from cranberry, strawberry, red raspberry were analyzed to determine their quality and nutritional characteristics. The peroxide value was 1.85 meq O_2/kg of red raspberry oil, 2.26 meq O_2/kg of strawberry oil and 4.41 meq O_2/kg of cranberry oil. Oils from the seeds of strawberries, cranberries and red raspberries are a very rich source of polyunsaturated fatty acids (PUFA) of the (n-3) family with a 28.16%, 30.19% and 34.09% share of total FA, respectively. The total PUFA content of the analyzed seed oils reached 74.53%, 67.88% and 82.25% of total FA, respectively. Phytosterol levels ranged from 464.3 to 692.1 mg/100 g for strawberry and cranberry, respectively (red raspberry seed oil – 538.4 mg/100 g). The content of tocopherols was determined at 139.4 mg/kg for cranberry seed oil, 278.2 mg/kg for strawberry seed oil and 2047.2 mg/kg for red raspberry seed oil.

The oils obtained from cranberry, strawberry and red raspberry seeds are particularly rich in essential fatty acids and antioxidants. They are also characterized by a pleasant fruity smell. Owing to their unique composition and a high content of bioactive compounds, berry seed oils can be a significant component in functional foods.

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Brewers' Yeast Autolysate – New, Functional Food Component

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Key words: brewer's yeast, yeast extracts, autolysates, nutritional value, functional properties

In the recent years we have observed growing interest of food industry in the brewing by-products, such as spent brewer's yeast. A new direction in spent brewers' yeast application is production and use of yeast extracts and autolysates. At present, more and more interest focuses on the yeast extracts obtained from spent brewers' yeast and used as flavour substances in spice compounds and dish concentrates. The aim of this study is to examine the possibilities of obtaining protein autolysates from spent brewer's yeast with specific functional attributes such as designed content of free aminoacids and aminoacids bounded in polypeptides with different molecular weight. Such autolysates could be used in the production of food for special use, functional food and diet supplements similar to protein hydrolysates obtained from milk proteins and gluten produced so for. The tested material was spent brewer's yeast Saccharomyces cerevisiae with protein content of 45 to 49%. Autolysis process was conducted with the use of laboratory autolysis reactors between 6 and 20 hrs in temperature of 47°C. When the process was finished, temperature was increased to 95°C for 15 minutes in order to inactivate lytic enzymes. Properties of obtained autolysates were evaluated by determination of:

- total aminoacid content and free aminoacid content with high efficient liquid chromatography supported by UV/VIS detector,
- molecular weight detection with use of mass spectrometer with laser ionization/desorption,
- antioxidant properties determined with $ABTS^{\bullet+}$ method,
- sensory quality determined with quantitative descriptive analysis /QDA/.

Depending on the set parameters of autolysis process, the obtained products were characterized by diversified free aminoacid content of 15.9 to 25.1% respectively after 6 and 20 hrs of autolysis, whereas molecular weight of proteins in the obtained autolysates ranged from 1000Da to 6000Da. The obtained values are comparable to free aminoacid and peptide content which may be found in produced preparations derived from different proteins and used in dietary supplements or food for sportsmen.The obtained autolysates characterized by good antioxidant properties of 165 to 212 mmol TEAC/100ml, which were significant affected among others by hop polyphenolic compounds and therefore present in the barm used for autolysate production. The obtained autolysates were characterized by diversified taste

profile with the significantly sensible bitter aftertaste from the bitter substances extracted from hop and advantageous changes along with prolonged autolysis process time and increase in free aminoacid content in particular glutamic acid. Thy conducted studies have shown that there is a possibility of obtaining new, functional food component – yeast protein autolysate, valuable from the nutritional point of view with designed functional properties from the by-product such as spent brewer's yeast which could be applied in the production functional food and dietary supplements.

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Properties of Crackers Supplemented with Different Resistant Starches

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Key words: resistant starch, dietary fibre, cracker quality

Dietary fibre as a class of compounds includes a mixture of plant carbohydrate polymers, both oligosaccharides and polysaccharides, *e.g.*, cellulose, hemicelluloses, pectic substances, gums, resistant starch, inulin. It may also be associated with lignin and other non-carbohydrate components (*e.g.*, polyphenols, waxes, saponins, cutin, phytates, and proteins resistant to digestion). Resistant starch (RS) is the starch fraction that is not hydrolyzed in the small intestine but may be fermented in the colon. Due to its similar physiological properties, it is generally considered as a constituent of dietary fibre. Resistant starch is composed of four groups (RS1: physically inaccessible starch; RS2: ungelatinised starch granules; RS3: retrograded starch; and RS4: chemically modified starch).

In this study, three different commercial RS samples (RS2-Hylon VII, RS3-Novelose 330 and RS4-Fibersym) were incorporated into the cracker formulation at different levels (15%, 30% and 45%; flour basis) and their effects on the quality parameters (length, width, thickness, weight and peak breaking value) and dietary fibre contents of the crackers were evaluated. The commercial starches used in this study had a significant increasing effect on the dietary fibre/resistant starch content of the crackers. However, they did not have substantial deteriorative effect on the quality parameters of the samples. It can be concluded that commercial starch preparations with high RS content have a great potential in the baking industry.

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P169

The Investigations of the Marmalades of Sweet Rowanberries as an Example of a Functional Food

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Key words: marmalade, sweet rowanberries, chemical and physical parameters

The rowanberries (*Sorbus aucuparia*) are small orange-red "fruits" of a rowan tree. These berries have been described as an important source of flavonoids, and their antioxidant activity affects reactive oxygen species and lipid peroxidation; therefore they are suitable for production of health-food products. The ripe wild rowanberries are eatable, but very tart in flavour. Sweeter and less astringent than wild rowanberries are different cultivars of sweet rowanberries and hybrids with other species. The aim of this experiment was to prepare new product – the marmalades of sweet rowanberries with apples in different proportions, and to determine chemical and physical properties of experimental samples.

The experiments were done in the Faculty of Food Technology of Latvia University of Agriculture. The berries of cultivars Sorbus aucuparia 'Moravskaya Krupnoplodnaya', 'Michurinskaya Krasnaya', 'Businka', 'Nevezhinskaya', 'Granatnaya', 'Alaya Krupnaya', and Sorbus hybrida chosen for the production of marmalades are characterized by the high content of ascorbic acid and total carotenoids. The marmalades are made from puree of rowanberries and purees' mixtures with apples. The content of soluble solids, the colour and firmness of the experimental products were analysed. For determination the soluble solids content the refractometric method was used. The colour (L*a*b*) of samples of marmalades was measured by colorimeter ColorTec-PCM and firmness – by texture analyser TA.XT.plus.

The results showed that sweet rowanberries are good raw material for preparation it's in marmalades. The analysis of firmness showed that the marmalade from mixture of rowanberries and apples (30%:70%) had a fairly hard texture.

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Innovative Honey Based Food Products

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Key words: honey based products, sensory quality, nutritional value, functional properties

In reply to high consumer demands, producers bring to market food products with new sensory attributes, pro-health properties and convenient to use. As a part of this trend is the new line of honey based food products. The aim of this study was to evaluate the quality of a new line of innovative, honey based products, in particular their sensory quality, nutritional value and functional properties. Research material consisted of honeys with the addition of fruit juices (raspberry, lemon, cranberry), royal jelly, propolis and bee pollen. Basic composition (sugars, dry matter, extract) were performed in accordance with the guidelines contained in the Polish Standards. Evaluation of antioxidant activity was made by the ABTS method. The content of polyphenolic compounds was assessed using the Folin-Ciocalteu method and hydroxymethylfurfural (HMF) content was made by HPLC method. Tested products were characterized by unique flavor attributes. Addition of fruit juices or other bee products, affected positively the taste of honey, bringing features such as fruity, sour, spicy, creamy. Reducing sugars content, was consistent with the applicable quality requirements for honey, above 60–100 g, while sucrose content was below 5 g/100g. Antioxidant activity of products ranged from 0.20 to 0.93 mmol TEAC/100 g and total phenolics content ranged from 10 to 112 mg GAE/100 g product. The highest content of polyphenols and antioxidant activity was characterized by a honey with propolis, while the lowest values were determined in honey with royal jelly. The tested values were higher than the control honey of 5–78%. Products meet quality requirements for honey in the range of safety, including appropriate low content of heavy metals (lead, arsenic) and HMF (less than 4 mg/100 g). High content of the extract (about 80%) makes these products microbiologically safe. Storage tests, during six months at room temperature, showed that the products were characterized by an unchanged quality. Studies have shown that rated products were characterized by favorable sensory attributes, high nutritional value and functional properties that exceed the traditional honey.

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Woad (*Isatis tinctoria* L.) Buds: a Potential Functional Food

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Key words: woad, *Brassicaceae, Isatis tinctoria*, polyphenols, glucosinolates, functional food

In the past edible wild plants were considered a valuable food resource by rural populations worldwide, especially during famine or war time. Nowadays their role in the human diet has changed: the consumption of these plants does not answer anymore to the need for food, but to the emerging request for health promoting compounds. Wild plants represent in fact a rich source of vitamins, fibres and bioactive compounds, useful for the human health. In Sicily, Italy, rural inhabitants are still used to consume wild plants. Among these, the flower buds of woad (*Isatis tincoria* L.), belonging to *Brassicaceae* family, are collected in the abandoned lands, in the late winter, to be consumed after boiling. In order to determine the nutraceutical value of this kind of food, fresh flower buds were collected around Mount Etna in Sicily over two years. The biochemical analysis revealed that woad buds contained considerable amounts of bioactive compounds, like polyphenols and glucosinolates, higher than other *Brassicaceae* vegetables. Polyphenols possess well-known antioxidant properties, while glucosinolates are precursors of chemopreventive compounds (isothiocyanates) generated by the myrosinase enzyme contained in the *Brassicaceae* tissues. For these reasons the woad flower buds could be proposed as a potential functional food, or dry extracts may be produced as diet integrator. The effect of cooking on the content variation of the main bioactive compounds has been also investigated.

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Utilization of Kolesom (*Talinum paniculatum*) Roots Enriched with Ginsenoside Phytochemicals by Producing Ready to Drink Beverage to Overcome Men Sexual Dysfunction

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Key words: kolesom (*Talinum paniculatum*), ready to drink beverage, men sexual dysfunction, ginsenoside phytochemicals

Sexuality and its manifestation constitute some of the most complex of human behavior. Wibowo [2007] reported that in 2005, there are 322 million men who have sexual dysfunction around the world and 10% of the total male population in Indonesia. Sexual dysfunction in men refers to the inability to perform normal sexual intercourse. Sexual dysfunction includes erection, premature ejaculation, decline of sexual potency, sexual behavior imposed, failure detumesence, and orgasm disorder. Substances that can increase sexual stimulation are called afrodisiaka. Usually, food produced to overcome the problem of sexual dysfunction in men is herbal medicine and tonic. However, herbal products and tonic have a weakness like they have a bitter taste and impractical for consumption.

Based on the description, we propose the innovation in making ready to drink beverages from kolesom roots extract. Kolesom (*Talinum paniculatum*), which generally grows at 5–1250 m above sea level, is one of the plant that have efficacy of afrodisiaka, especially on the roots that have saponin derivatives is called ginsenoside. Kolesom roots contain phytochemical compounds (triterpene/ steroids, polyphenols, and essential oils) and ions such as Na, K, Mg, Ca and Fe. Those ions can support the process of sperm maturation. The process of making this drink was begun with drying ginseng root, boiling, giving some sugar and thickeners, packaging, and pasteurization. The advantages of this drink are practical for consumption and not having bitter taste.

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Reactions of Isothiocyanates May Affect Flavour and Colour of Foods

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Key words: Brassicaceae, isothiocyanates, amino acids, sulphites, off-flavour, discoloration

Brassicaceous plants are widely used in human diet as vegetables, relishes and condiments. Glucosinolates, prominent secondary metabolites of the plants, are decomposed to isothiocyanates (ITCs) by the action of myrosinase when the plant tissues are crushed. Due to their electrophilic character, ITCs react easily with many natural food constituents during food processing and storage. There is a large potential to form off-flavour and discoloration in foods produced from the plants of *Brassicaceae* family.

This work was concerned first with the changes in flavour of both model reaction systems with ITCs and mustard paste. High reactivity of ITCs resulted in significant changes in flavour profile due to the formation of sulphides, thiols, adducts, *etc*., especially by means of nucleophilic aqueous and sulphiting agents. The primary reaction products of ITCs and amino acids/peptides, *i.e.* N-substituted thiocarbamoyl amino acids/peptides and their cyclic forms, derivatives of 2-thiohydantoins, were further transformed in neutral and preferably alkaline media to many consecutive products, some of which are coloured. ITCs were shown to form three groups of coloured structures in the presence of amino compounds. Dehydrodimers of 2-thiohydantoins were yellow to red in dependence on ITC nature and keto-enol tautomerism controlled by pH. They were formed in mixtures consisted of ITCs and amino acids with alpha-methylene group in mild acidic to mild alkaline systems. Blue compounds of two types arose from N-substituted amino acids and ITCs in alkaline media. The condensation products of the 2-thiohydantoins with aromatic carbonyls and heterocyclic carbaldehydes were mostly of yellow colour. We found the most favourable conditions of formation and the kinetics' parameters as well as the stability of several secondary products.

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Effect of Defatting on Some Functional Properties of Whole Grain Barley Flours

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Key words: whole grain, hull-less barley, hulled barley, flour, functional properties, defatting

Two advanced line hull-less barleys and a hulled barley (Tokak cv.) were dry-milled to fine flours as whole grain, and whole hull-less and hulled barley flours (WHBF-1, WHBF-2 and WBF, respectively) were obtained. Protein contents of the WHBF-1, WHBF-2 and WBF were 16.7%, 15.4% and 10.3% on dwb, respectively. Barley flours were defatted with n-hexane at flour to solvent ratio of 1:5, then flours were air-dried at room temperature. Protein contents of the defatted WHBF-1, WHBF-2 and WBF were 18.1%, 15.5% and 10.0% on dwb, respectively. Protein solubility (%) and emulsifying properties were determined at concentration of 1.0% (w/v) as a function of pH in distilled water. For preparing the o/w type emulsions, the soluble flour proteins were homogenized with 50% commercial corn oil for 90 seconds. Water solubility (WS, %) and water binding capacity (WBC, %) of barley flours were also studied after vigorously vortexing and subsequently centrifugation and drying. Water/oil holding capacity of barley flours were also detected after excellently mixing and absorption. SDS-PAGE of the defatted WHBF-1, WHBF-2 and WBF were performed. The solubility properties of barley flours were especially higher in the strong basic region than the acidic region in distilled water. Defatting process improved the solubility especially at acidic region. The lowest solubilities were observed at pH 4 for both forms of barley flours. The results showed that emulsifying properties were greatly affected from the pH of environment. Emulsifying properties of the barley flours were around 50% at extreme pH levels. Minimum emulsifying capacity and emulsifying stability values were obtained at pH 4. WS values of barley flours did not significantly change after defatting, however WBC of barley flours significantly increased. SDS-PAGE provided significant information about the monitoring of molecular weight distributions of the flour proteins.

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Cryoprotectant and Prebiotic Activity of HHazelnut Fiber (*Corylus avellana* L.) Against *Lactobacillus plantarum* and *Lactobacillus crispatus*

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Key words: hazelnut, fiber, *L. plantarum*, *L. crispatus*, prebiotic

Hazelnut perisperm from *Corylus avellana* is a by-products for the confectionery industry. The use of hazelnut skin was previously suggested as a potential source of natural antioxidants and functional food ingredients, for the wealth in polyphenols and dietary fiber. Extracts of antioxidants from hazelnut skin could be used as nutraceutical and dietary supplements [1]. Recently, many authors suggested nutraceuticals studies on the prebiotic properties of fibers isolated from innovative sources, particularly soluble fibers as alternative to FOS and GOS [2].

Aim of this work was to characterize novel bioactive compounds with functional prebiotic activity from hazelnut pellicle, with positive activity on the growth of *L. plantarum* and *L. crispatus*, as well as improving their shelf life after lyophilization. The overall aim was – in terms of technology – the optimization of the fermentative and preservation processes and – in terms of nutritional value – the integration of high added value compounds with functional properties.

Results show that the optimal concentration of insoluble and soluble fiber extracts able to enhance bacterial growth ranged from 0.11 to 0.03%. Defatted polyphenols-free powders have a positive effect on bacterial growth at relatively high concentrations. Polyphenolic fraction fractionated through SPE protocol [3] and characterized by HPLC-DAD, allows to exclude microbial toxicity at the concentrations tested (0.5, 0.25 and 0.11%). The containing-oligomeric procyanidins fraction, leads to a bacterial growth improvement. Moreover, during freeze drying, soluble fibers confirmed a cryoprotective action, comparable with those obtained with inuline, as well as improved bacterial shelf life. All these evidences highlight that functional ingredients from pellicle of *C. avellana* should be considered pre-biotic novel ingredients.

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P176

Chitosan Derivatives, Prebiotics?

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Key words: chitosan, chitin, prebiotics

Chitosan is the deacetylated (to varying degrees) form of chitin, the second most abundant natural biopolymer after cellulose. It has several biological properties useful for the food industry, but the most attractive is its potential use as a food preservative [1]. Some bifidobacteria and lactobacilli have been shown to ferment chitosan oligosaccharides in pure cultures [2]. However, in mixed culture studies bifidobacteria were not increased and some potentially health-negative groups of bacteria increased [3].

In this work, chitosan derivatives, obtained through an enzymatic treatment1, were tested in pH controlled batch cultures to investigate the ability of the faecal microbiota to utilise them. Numerically predominant and functionally significant bacterial groups were enumerated by fluorescence in situ hybridisation and organic acids were analysed by HPLC [3].

High concentrations of lactic and acetic acids, significantly greater from the time 0 h were produced during fermentation of the different chitosan derivatives. Propionic acid increased significantly at 24 h when lactate levels decreased. Although bifidobacteria were not increased in the pH controlled batch cultures, and therefore these CHD do not seem to be prebiotics, they produced short chain fatty acids with beneficial effects for human health in the same levels than fructo-oligosaccharides.

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Impact of food processing on composition and biological outcomes

P177

Changes of Cholesterol in Roasted Meat Products with Addition of Natural Antioxidants During Storage

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Key words: roasted meat products, phenolic antioxidants, cholesterol, oxycholesterols

Lipids and cholesterol itself easily undergo free radical oxidation. As a results of autoxidation of sterols, derivatives of hydroxyl-, keto-, epoxysterols and triols of these compounds are formed, which may have a negative effect on the human organism. Reduction or inhibition of negative oxidative changes in lipids of meat products may be the effect of the addition of antioxidants.

The aim of this study was to estimate the effect of natural antioxidants on changes in cholesterol in frozen roasted meat products. Meat products, weighing 250 g, were roasted at 230ºC for 16 minutes, next frozen and stored for 6 months at -18ºC. All indexes periodically in fresh, not frozen, roasted meat products and after 2, 4 and 6 months of storage were estimated. In all samples contents of cholesterol and oxycholesterols (7α- and 7β-hydroxysterol, 5α,6α- and 5β,6β--epoxysterol, 7-ketosterol, 20-hydroxy, 25-hydroxy and triol) were estimated using gas chromatography technique. Samples with addition of ethanol extract of green tea, ethanol extract of thyme, commercial extract of rosemary, and BHT were compare to sample without addition of antioxidants.

In all samples decrease of cholesterol and increase of total oxycholesterols were observed but antioxidant effect depends on time of storage and used antioxidant. The lowest decrease of cholesterol in sample with addition of thyme extract was observed. The level of cholesterol in other samples was comparable. The content of oxycholesterols was also different. After 6 months of storage the most effective antioxidants were ethanol extract of green tea and commercial extract of rosemary. BHT was a substance, which protected cholesterol as well, but not as effectively as other antioxidants.

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Changes of the Contents of Selected Phenolic Compounds During Storage of Lettuce Heads (*Lactuca sativa* L.) in Cool Conditions

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Key words: lettuce, phenolic compounds, storage conditions

The aim of the study was to evaluate the changes of the contents of phenolic acids: caffeoyltartaric, chlorogenic, caffeoylmalic, dicaffeoyltartaric, dicaffeoylquinic and flavonoid: quercetin derivative during storage of lettuce heads. The study involved pot experiment conducted in a greenhouse of Department of Cultivation and Fertilization of Horticultural Plants of University of Life Sciences in Lublin. The experimental material was lettuce cultivar Omega. After harvest, some plants were directly analysed (fresh plants), while the remaining lettuce heads were cold-stored at 4°C for 7 and 14 days. The changes of the contents of phenolics was evaluated in different parts of plants. Leaf blades (without midrib), whole leaves and stems were dissected and liophylised.

Liophylised material was homogenised with 70% methanol. The mixture was filtered and the extract was concentrated by rotary evaporation under reduced pressure at 47°C and the obtained dry residue was resuspended in water. This extract was purified in a Sep-Pak C18 cartridge. The adsorbed fraction of phenolic compounds was eluted with 60% methanol. Phenolic compounds were separated by HPLC method with PAD detector on a column RP-18 Atlantis T3. The mobile phase was: solvent A-0.1% HCOOH and solvent B-acetonitrile, at a flow rate 1 mL/min. Chromatograms were recorded at 330 nm.

In the whole leaves we observed the decrease of the contents of caffeoyltartaric acid and chlorogenic acid during storage for 7 days, whereas the increase of the level of caffeicmalic acid, dicaffeoylquinic acid and quercetin derivative was noted after 14 days of storage. The same profile was also observed for leaf blades. In stems we recorded the increase of the contents of chlorogenic acid, dicaffeoylquinic acid and dicaffeoyltartaric acid after 14 days of storage, whereas the reduction was observed for caffeoyltartaric acid, caffeoylmalic acid and quercetin derivative after 14 days of storage in cool conditions.

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Storage Stability of Lipid Fraction in Blackcurrant Seeds

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Key words: stability of lipid fraction, blackcurrant seeds, by-products

Growing interests in by-products utilization have been observed during last years. Blackcurrant seeds, by-products of fruit processing are the source of antioxidants, minerals and fiber. Moreover, they are particularly valuable due to high amounts of lipids and the presence of polyunsaturated fatty acids *e.g.* linoleic, α-linolenic and γ-linolenic. These fatty acids are desirable and essential for normal development and function of young organism and good health condition's maintenance.

The presence of unsaturated fatty acids is related with lability of lipid fraction that could limit a potential utilization of blackcurrant seeds. Progressing hydrolysis and oxidative processes may cause sensory deterioration and nutritive value decrease as well as formation of toxic and unhealthy substances. Lipids are exposed to oxygen, light, temperature and tissue and microbial enzymes which accelerate undesirable changes called rancidity. Therefore, storage should be conducted with a special care to ensure proper shelf life and final quality of a product.

The aim of the present work was the evaluation of stability of lipid fraction in blackcurrant seeds during storage at accelerated temperature conditions (60°C in the dark). Two different forms of seeds were assessed: crumbled and non-crumbled. The indicators of stability of lipid fraction, previously extracted according to Folch, were acid value and peroxide value.

High acid and peroxide values prove hydrolytic and oxidative changes occurring during storage of blackcurrant seeds at 60°C. The range and rapidity of acid and peroxide values' changes were differentiated according to form of seeds. Decrease of peroxide value after 12-days storage indicates secondary deteriorative changes.

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Effects of Gamma Irradiation on Sugars, Fatty Acids and Tocopherols of Chestnuts (*Castanea sativa* Miller)

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Key words: irradiated chestnuts, gamma irradiation, sugars, fatty acids, tocopherols

As seasonal products chestnuts have to be postharvest treated to increase their shelf-life. The most common preservation method for chestnuts is the use of chemical fumigation with methyl bromide, a toxic agent that is under strictly use under Montreal Protocol due to its adverse effects on human health and environment. Food irradiation is a feasible alternative to substitute the traditional quarantine chemical fumigation treatment.

The main studies in chestnuts irradiation were done in an Asian variety, which is bigger and sweeter than the European types. However, on Portuguese varieties nothing has been reported. Herein, the influence of irradiation and storage time in sugars, fatty acids and tocopherols profiles/quantities in chestnuts (cv. Longal obtained in Trás-os-Montes, Northeast Portugal), was evaluated for the fist time.

The irradiations were performed in a Co-60 experimental equipment, for 1 h (0.27 kGy) and 2h (0.54 kGy). Sugars and tocopherols were obtained by high performance liquid chromatography (HPLC) coupled to refraction index (RI) and fluorescence detections, respectively, while fatty acids or analysed by gas-chromatography coupled to flame ionization detection (GC-FID). The analyses were performed at 0, 30 and 60 days of storage at 4ºC.

Regarding sugars composition, storage time proved to have higher effect than irradiation treatment. Fructose and glucose increased after storage, with the corresponding decrease of sucrose. Otherwise, tocopherols content was higher in irradiated samples, without a significant influence of storage. Saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids levels were not affected neither by storage nor irradiation. Nevertheless, some individual fatty acids concentrations were influenced by one of both factors, such as the increase of palmitic acid in irradiated samples or the decrease of oleic acid after 60 days of storage.

Overall, irradiation seems to be a promising alternative treatment to increase chestnuts shelf-life, without affecting the profile and composition in important nutrients.

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Effect on Antioxidants Addition on Changes in Cholesterol Content and Its Oxidation Products in Frozen Meat Products

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Key words: meat products, phenolic antioxidants, cholesterol, oxycholesterols

Reactions of oxidative character occurring in meat fat and meat products are one of the major causes of deterioration in their quality. They are responsible for degradation of colour, flavor and texture, as well as losses of nutritive value. Reduction or inhibition of negative oxidative changes in lipids of meat product may be the effect of the addition of natural antioxidants. The most important group of substances with antioxidative properties is represented by polyphenolic compounds belonging to secondary metabolites common plant materials. A rich source of these substances are tea and many spices (rosemary, thyme).

The aim of this study was to determinate effect of addition of selected antioxidants (ethanol extract of green tea, ethanol extract of thyme, commercial extract of rosemary and BHT) on changes in contents of cholesterol and oxycholesterols in meat product made from minced pork meat. Meat product samples were steamed in convection oven at 100ºC, next frozen and stored at -18ºC for 6 months. Contents of cholesterol and oxycholesterols (7α- and 7β-hydroxysterol, 5α,6α- and 5β,6β-epoxysterol, 7-ketosterol, 20-hydroxy, 25-hydroxy and triol) were estimated by gas chromatography. All indexes periodically in fresh, not frozen, meat products and after 2, 4 and 6 months of storage were estimated. All samples were compared with control sample (meat products without addition of antioxidants).

The results shown that all of applied antioxidants demonstrate inhibitory properties to cholesterol oxidation in meat products. Six months of storage of meat products with no addition of antioxidants led to a higher decrease in the cho-

lesterol content than in the samples with their addition. Total cholesterol oxidation products in a control sample (without antioxidants) was higher than in samples with an addition of antioxidants. The strongest antioxidative activity was characteristic for green tea extract.

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Determination of Zinc in Dishes from the Canteen of Military University in Vyškov in the Czech Republic

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Key words: dishes, chemical analysis, content of zinc

In the thesis the content of zinc of thirteen dishes obtained in Military University of Ground Forces in Vyškov was defined by means of the chemical analysis and theoretical calculation. According to the chemical analysis, the biggest amount of zinc was proven in the following dishes: roast chicken with rice and cucumber salad, while the smallest amount of zinc contained fried cauliflower, chips and tatar sauce. Having compared the results of the chemical analysis and of the theoretical calculation, we realized that it is not possible to compare these two methods because their results differ.

Based on theory that midday meal presents 50% of recommended day intake of all nutrients and minerals, it should be the optimum intake of zinc for adult person in ordinary food configuration 6–7.5 mg. These requirements subserve only the dish "Fried cheese, potatoes dumplings, tartar sauce".

According to the chemical analysis results, the largest amount of zinc was found in the dishes including roast chicken with rice and cucumber salad (it was 32 mg), while the smallest amount of zinc contained fried cauliflower, chips and tatar sauce (1.7 mg). The chemical analysis results are not possible to replace by theoretical calculations because they do not respond to each other.

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Fatty Acid and Sterol Changes During Frying of Food Products in Palm Olein and Hydrogenated Canola Oil

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Key words: palm oil, hydrogenated canola oil, frying, fatty acids, sterols

Vegetable oils are one of the most important sources of phytosterols and unsaturated fatty acids in a typical diet containing fried foods. French fries, chicken and fish sticks par-fried in canola oil were fried for 6 days. Fatty acid and sterol compositions were assessed in frying oils and lipids extracted from the par-fried and after 3rd and 6th day of frying.

Palm olein (PO) composed of 45% saturated fatty acids (SFA), 44% monounsaturated fatty acids (MUFA), 11% polyunsaturated fatty acids (PUFA) and 0.5% trans isomers while hydrogenated canola oil (HCAN) 10% SFA, 52% MUFA, 3% PUFA and 35% trans isomers. Lipids from par-fried foods composed of: 8–9% SFA, 59–70% MUFA, 19–30% PUFA and 2–3% trans isomers. Extensive exchange of oils between fried products and frying oil was observed and fats from products fried for 6 days in PO and HCAN contained respectively: 18–21% and 9–11% of SFA, 56–61% and 59–62% of MUFA, 19–20% and 15–17% of PUFA, 1–2% and 13–15% trans isomers. After 6th day of frying the phytosterol content in PO increased from 0.4 to 2.3 mg/g while in HCAN decreased from 6.6 to 3.4 mg/g. The amounts of phytosterols in French fries, chicken and fish sticks were at 6.5, 6.9 and 8.3 mg/g, respectively. After 6th day of frying the amounts of sterols decreased by 64–75% and 34–48% in food fried in PO and HCAN, respectively. The amount of cholesterol in chicken and fish sticks were at 4.0 and 2.3 mg/g. Frying in succession animal and plant origin products caused that cholesterol was observed in the latter at 0.02 to 0.04 mg/g.

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Antioxidant Capacity of Rapeseed and Oils from Different Technological Stages

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Key words: rapeseed, rapeseed oil, HPLC, phenolic compounds, antioxidant activity

Rapeseed (*Brassica napus*) is the most important oil crop in the continental temperate regions and ranks second among oilseed crops produced worldwide. Traditional production of rapeseed oil is based on seed crashing before oil separation The overall process involves seed cleaning, preheating, flaking, cooking, mechanically heated, screw-pressing and solvent extraction with hexane. Natural antioxidant compounds present in rapeseeds and the crude oil (polyphenols, sterols, flavonoids, tocopherols) reveal an important function in prevention and treatment of some chronic diseases and exhibit antiradical activity.

The main goal of this work was the determination of antioxidant capacity, total phenolic content (TPC) and individual phenolic acids (gallic, caffeic, ferulic, sinapic and p-coumaric) in rapeseed and oils obtained from various stages of two different technological lines (Line 1 and Line 2). Extraction of phenolic compounds was carried out using 15 mL of methanol and water mixture (1:1 v/v) during 30 min. Determination of phenolic acids by HPLC method was performed using 2% acetic acid in water (pH=3.2, eluent A) and methanol (eluent B) as mobile phase at a total flow rate of 1 mL/min and gradient elution program at 45 min.

Antioxidant activity determined by FRAP and DPPH methods expressed as μmol of Trolox/100 g of sample varies 454.5–8307.0, 454.6–8310.3 and 453.8–8266.3, 450.9–8300.2 for Line 1 and Line 2, respectively. TPC expressed as mg of sinapic acid/100 g of sample changes 44.6–674.7 and 32.7––712.2 for Line 1 and Line 2, respectively. The predominant phenolic acid in all samples is sinapic acid.

Principal component analysis applied to find the differences between rapeseed and oils from two studied lines revealed the lack of significant differences between Line 1 and Line 2.

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The Contribution Affects of the Some Ingredients in Making Hosmerim

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Key words: inulin, lecithin, agar agar, hosmerim, textural properties.

The unsalted fresh cheese dessert is Hosmerim has short shelf life because of the sugar syrup separation problem. Four different hosmerim samples were produced with lecithine+inulin (1.2%) and lecithine+agar agar to eliminate sugar syrup separation problem. They were kept both in enviromental (approximately 25°C) and refrigeration (5°C) conditions for detection of their quality characteristics. Also some chemical analysis like total dry matter, protein, fat, sugar and ash contents were made for each type of hosmerim. With results obtained from sensory evaluations, quality criteria, preferences and shelf life for each type of hosmerim is determined.

In the hosmerim samples, dry matter and total sugar levels are no consists of significant differences. But textural properties and appearance had affected by different ingredients. The springiness was affected significantly ($P<0.01$) by inulin. The samples added inuline+lecithine (1.2%) had higher springiness values than the others. Springiness was affected inversely according to the amount of dry matter (r=-0.66) and hydrocolloid type (r=-0.80). The samples having the lowest hardness values possessed the highest springiness values. An important correlation was determined between appearance and hardness (r=-0.72), firmness (r=-0.71) and colour (r=0.72). In other words, the appearance scores rise when the hardness and firmness.

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Characterization of Chemical Composition of Dried Acid-Whey Preparations Obtained by Various Membrane Separation Processes

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Key words: acid-whey, ultrafiltration, nanofiltration, chemical components

Whey obtained after lactic fermentation and acidic coagulation of milk proteins obtained during tvarog (white cheese) production was used as a raw material (WA). Acidic-whey components were concentrated selectively by membrane separation: (1) nanofiltration (PWN); (2) nanofiltration with diafiltration (PWD); (3) ultrafiltration (PWU). After the membrane separation processes the concentrates have been dehydrated by spray-drying. In the raw whey and products obtained the content of ash, proteins and lactose was determined. The raw material was characterized by: 1.03 g/cm^3 of density, pH 4.7; dry matter 5.4 to 6.1%; ash 12.4 to 12.7% d.m.; proteins 11.8 to 13.9% d.m., and lactose near 79% d.m. The same indicators were analyzed in products resulting from membrane separation (retentate and permeate) and in final spray-dried product. The total solids of the concentrate (concentrated approximately 5-times) contained 4 to 6.7% of ash and 11 to 19% of proteins. The final powder preparations were characterized by 98% content of dry matter. Preparation obtained by nanofiltration with diafiltration (PWD) showed about 50% lower level of ash in comparison with other two preparations: PWN and PWU. Preparation PWU had the greatest proteins content (18% d.m.) and the lowest lactose content (62.7%). The acid-whey was characterized by high content of potassium 26 mg/g d.m., calcium 20 mg/g d.m., phosphorus 11.5% d.m. and magnesium 2 mg/g d.m. The preparation PWN contained about 15 mg of calcium per 1 g of d.m., potassium and phosphorus were at the same level of 8 mg/g d.m. Whereas, the preparation PWD contained about 10 mg/g d.m of Ca, 6 mg/g s.m of P, and meaningfully lower content of K – 3 mg/g d.m.

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Structure Analysis of the Semimembranosus Muscle (*M.Semimembranosus*) of Dairy Cows Subject to Injection with Three Different Brines

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Key words: semimembranosus muscle, structure, brine, computer image analysis

The aim of the work was to compare changes in the structure of the semimembranosus muscle injected with three different brines (A, B, C) and subsequently tumbled, boiled in water and grilled. The composition of the brines was the following: A) E 451i+E 452i, sugars: saccharose, glucose, maltodextrin; NaCl and sodium ascorbate; B) E 451i+E 452i, NaCl and rosemary extract (Guardian, Danisco); C) E 451i+E 452i, NaCl and tocopherol (Novatol 67, ADM). The tumbling process was conducted in a vacuum tumbler for 3h at 240 revolutions per hour. After tumbling, the muscles were subject to heat treatment using two methods: grilling and boiling up to 90^{o}C in the geometric centre and then maintaining this temperature for 10 minutes in the case of grilling and 30 minutes after the boiling process. Muscle samples were collected during each phase of the experiment in order to make histological specimens. The microscopic images were characterised on the basis of the following muscle fibre parameters: cells' cross-section area, their circumference and the Feret diameter (H and V). The percentage and quantity of muscle fibres in the analysed field of vision of the microscope was also calculated. The obtained results were analysed statistically using the STATISTICA application. The computer analysis of the image showed that the best technological properties characterised brine A, the injection of which resulted in obtaining the largest muscle fibre area after heat treatment compared to muscles injected with brines B and C.

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Effects of Different Drying Processes and Pretreatments on Quality Properties and Nutrients of *Lentinus edodes* (Shiitake) Mushroom

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Key words: mushroom, lyophilization, infrared drying, oven drying, antioxidant activity

In this research, *Lentinus edodes* (shiitake) mushrooms were dried with three different drying methods as; oven, infrared dehydration and lyophilization. Oven and infrared drying were applied at 55±2°C to adjust the last moisture content to ~6%. In lyophilization method, mushrooms were treated at -55°C under 0.5 mbar then were dried to ~9% moisture content. Before these drying methods, three different pretreatments were applied. In the first pretreatment, mushrooms were washed in a solution containing 20 g/L NaCl, 5 g/L citric acid and 0.5 g/L Na-metabisulfide then boiled in the same solution for 3 minutes at 98–100 C°. In the second, the samples were hold in a solution containing 0.5% citric acid, 0.5% ascorbic acid for one hour then, boiled with another solution containing; 0.5% citric acid and 1% NaCl for 3 minutes. In the third, mushrooms were hold in a solution containing 400 ppm Cl_2 and 300 ppm SO_2 for 7 minutes. Mushrooms dried directly, without pretreatments were considered as control group. Antioxidant activity, total phenolic matter, protein and invert sugar contents and rehydration capacity of the dried mushrooms were determined. The color of the dried mushrooms were measured and expressed as L*, a* and b* values. Fe (ppm), Mn (ppm), Zn (ppm), Cu (ppm), K(%), Ca (ppm), Mg (ppm), P (%) contents of the samples were also measured. As the result of the research, lyophilization was determined as the most effective method preserving nutrients content and quality criteria of the mushrooms. Antioxidant activity and total phenolic matter content were found higher in the second pretreatment.

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Changes in Bioactive Carbohydrates During Dehydration Processing on Chickpeas

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Key words: dehydration, legumes, dietary fiber, starch, alfa-galactosides, microestructure

The interest of legumes and their constituents is growing in many developed countries because of the demand for healthy foods. In this sense, legume contain bioactive substances including non-digestive carbohydrates such as dietary fibre, resistant starch and bioactive oligosaccharides (raffinose family oligosaccharides, RFOs), which recently have been reported potential health benefits. For effective utilization of legumes of human nutrition, suitable pre-treatment is necessary before they can be safely used as a food source. Dehydration process application after traditional thermal treatment not only improves nutritional and sensory quality of legumes, but also preserves the structure, prolonged preservation time and quality of resulting products.

Thus, influence of industrial dehydration processing (soaked+cooked+dehydrated) on bioactive carbohydrates and microstructural characteristics were evaluated in chickpea (*Cicer arietinum*). Raw chickpea exhibited important levels of raffinose family oligosaccharides (RFOs), resistant starch (RS) and total dietary fibre (TDF), with insoluble dietary fibre (IDF) as the main fraction (94%). As a result of dehydration process, significant presence of RFOs (43%) and RS (47%) is shown compared to raw flours. In addition, a noticeable increase in both fibre fractions was observed, being higher in soluble fibre (SDF) (59%). The microstructural observations were consistent with the chemical results, showing visible morphological changes, because starch grains became greater, rougher and slightly eroded after dehydration processing. Thus, the significant occurrence of these bioactive compounds in dehydrated flours makes them useful as functional ingredients for food formulation.

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Determination of Antioxidant Values of Hawthorn and Cranberry Fruits Growing in Turkey and Its Products Such as Marmelade and Sauces

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Key words: antioxidant, phenolic compounds, fruit, sauce, marmalade, health

Phenolic substances which are the most important group of natural antioxidants and very important by any ways such as, aroma formation effects, participation to color formation and change, showing antimicrobial and antioxidative effects, causing enzyme inhibition and purity criteria for some foods. It is indicate that phenolic substances show very useful health effects because of lowering cholesterol, inhibiting oxidation of low density lipoprotein, prevent hypertension and cardiovascular disease, and effects as anticarcinogenic and antimutagenic. For this purpose in recent years these foods are used in the prevention of various diseases so the usage has increased substantially worldwide, and consequently, the higher the antioxidant content of food items for the food market is growing rapidly.

Hawthorn and cranberry are some of the fruits which are rich in terms of phenolic compounds grown in Turkey. Although these fruits are grown so much in Turkey, sauce and marmalades, which have functional properties, producing is not very common from these fruits. From fruit to kitchen process, variation of phenolic compounds and chemical properties of these products have not been studied enough in Turkey. Determination the variation of components which have high significance for health is very important during the producing sauce and marmalade from the fruits which have high antioxidant content. These products which have very high content of antioxidants will be sold at very special markets with high prices. Also new products are presented to consumption as, marmalade at breakfast and sauce will be consumed with cakes and ice creams. In this study, the antioxidant values of hawthorn and cranberry fruits growing in Turkey and their products such as marmelade and sauces will be determined.

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Influence of Grinding on Chemical Composition of Coffee Brew and Spent Coffee Extracts

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Key words: coffee brew, spent coffee, grinding, chlorogenic acids, caffeine

The extraction of coffee brew antioxidant compounds is affected by several technological factors such as grinding, coffee/water ratio, roasting degree and water temperature and pressure. Therefore, could be expected that the composition of the residues generated during brewing procedure, called spent coffee, changes according to the coffee brew. The aim of the present work was to establish if the same time of grinding applies to two different coffee varieties affects the extraction of chlorogenic acids in coffee brews and their corresponding spent coffee. One Arabica coffee from Guatemala and one Robusta coffee from Vietnam with the same roasting degree were ground for 20 s. Particle size distribution of both coffees was measured using a sieve shaker. Filter coffee brews were prepared (24 g coffee/400 mL water), and spent coffees were extracted with water at the same conditions using a filter coffeemaker. Six chlorogenic acids (CGA), three caffeoylquinic acids (3-CQA, 4-CQA, 5-CQA) and three dicaffeoylquinic acids (3,4-diCQA, 3,5-diCQA, 4,5-diCQA), and caffeine were quantified by HPLC. The results showed that the same grinding time produced an unimodal particle size distribution in Guatemala coffee, whereas for Vietnam coffee was plurimodal. The extraction of the main antioxidant coffee compounds, such as chlorogenic acids (CGA) seems to be favoured by a larger amount of coarse particles, because Guatemala filter coffee brew and spent coffee aqueous extracts exhibited 16.68 mg and 13.24 mg of total CGA per gram of coffee and spent coffee, respectively, whereas Vietnam filter coffee brew and spent coffee aqueous extracts showed 10.13 mg and 6.22 mg of total CGA per gram of coffee and spent coffee, respectively. In contrast, caffeine was in highest concentration in Robusta filter coffee brews and spent coffee aqueous extracts than in Arabica. In conclusion, grinding should be controlled not only by the time because the structure of different coffee beans, and consequently the extraction of antioxidant compounds, can be affected differently with the same grinding time.

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The Fate of Volatile Markers of Baking Process During the Storage of Bakery Foods

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Key words: volatile compounds, oxidation, biscuits, antioxidants

The definition of bakery products includes a large group of foodstuffs, widely consumed on a daily basis or as occasional foods (*e.g*., cakes, croissant and cookies). Fats and oils are usually added to the formulation of these products for technological, rheological and organoleptical purposes. However, the lipid fraction has been recognized as one of the main causes of deterioration.

The aim of this work was (1) to study the possibility to use volatile compounds as deterioration index in cookies, provided that oxidation is the main process leading to the end of the shelf life; (2) to investigate the effect of green tea extracts (GTE) on biscuits lipid fraction oxidative stability, (3) to compare results obtained by SPME-GC/MS and sensory studies to that of chemical analysis.

Biscuits were prepared in three variations. Control samples were prepared without addition of antioxidants. The other variations were prepared by adding synthetic antioxidant (BHA) and GTE at three different levels: 0.02; 0.1 and 1%. All samples were subjected to storage test for 20 days at 60°C. Biscuits were subjected to sensory studies and instrumental and chemical analysis.

Several volatile components that contribute to the aroma profile of fresh biscuits represented groups of characteristic volatiles produced through lipid peroxidation, Maillard reaction and caramelisation. Volatile markers of baking process identified in fresh samples were furfural, 2-furanmethanol, pyrazine-2,6-dimethyl, and 2,3-dihydro-3,5-dihydroxy-6-methyl-4(H)-pyran-4-one. As oxidation proceeded, the volatile compounds, characteristic for baking process, sharply decreased. In general, up to 16 days of storage those volatiles decrease by about 85% and subsequently after 20 days of storage 92% reduction of those components were noted. Volatile analysis showed a consistent trend with the sensory analysis.

Examples shown indicate that using SPME-GC/MS it is possible to monitor the oxidation process occurring in the biscuits.

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Determination of Partial Baking Time for Cake

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Key words: par-baked product, partial baking time, gluten-free cake

Since gluten-free products for a specific group are produced in smaller amounts, the profitability of companies and the investment on these products might be adversely affected. Partial baking is an alternative production method for eliminating these negative impacts and solving the staling problem in the bakery products. The partial baking time to be applied in par-baked method is very important in terms of the preservation of structural integrity during cake removal from the pan and its preparation for storage. In the present study, preliminary experiments, internal cake temperature change and viscosity profiles obtained by Rapid Visco Analyzer (RVA) were used to obtain partial baking time. For each cake formula, partial baking time determined with the preliminary experiments, is consistent with setting internal cake temperature. The differences among peak viscosities of all par-baked, fully baked and re-baked after partial baking were statistically insignificant ($p>0.05$). This result represents that starch gelatinization was completed and partial baking time was determined correctly for each cake samples. For control cake, chestnut flour cakes, rice cakes and corn flour cake, partial baking times were determined as 17, 17, 16 and 14 min, respectively. Finally, the changes of cake internal temperature and viscosity profiles could be relied on in the determination of partial baking time.

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Bioactivity of Bowman Birk Inhibitors in Thermally Processed Orange Juice

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Key words: soy Bowman Birk inhibitor, thermal stability, orange juice, low pH foods, chemo-preventive functional food

Colon cancer is the second cause of death in Europe. Therefore, its prevention is crucial and functional foods may play a pivotal role on that. The most widely studied bioactive sub-

stances in soy are Bowman-Birk protease inhibitors (BBI protein) and the isoflavones. BBI is a serine protease inhibitor with a well-characterised ability to inhibit trypsin and chymotrypsin. Its chemoprotective effects have been well documented. Although the precise mechanisms by which BBI suppress carcinogenesis are unknown a strong correlation between its ability to inhibit carcinogenesis and its chymotrypsin inhibitor activity has been suggested. BBI's potential to be used as chemo-preventive functional food ingredients has been proposed; however, there are not data related to resistance of BBI proteins to thermal treatment of low pH foods such as fruit juices. Research is needed to evaluate pure BBI as functional ingredient in complex food matrices. The objective of this research is to obtain new health enhancing phytochemicals (BBI) foods.

Orange juice was freshly prepared and divided into aliquots. Citrate buffer 50 M pH 3.7 was employed as simplified orange juice model system. Both samples were supplemented with therapeutic dose of pure BBI (1.75 μM final concentration) and thermally treated under pasteurisation and sterilisation conditions. The concentration and chymotrypsin inhibitory activity of BBI in fresh, supplemented and heated samples were analysed. Data suggest that BBI remains active in the food matrix after both pasteurisation and sterilisation indicating the feasibility of its use as potential natural functional food ingredient.

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Changes of Cholesterol in Deep-Fat Fried Meat Products with Addition of Natural Antioxidants During Storage

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Key words: deep fried meat products, phenolic antioxidants, cholesterol, oxycholesterols

Antioxidants are substances, which can reduce negative changes in fat. Many antioxidants are very effective during storage, but during heating they lose their properties. It is very important to find antioxidants, which will be stable at high temperatures and protect fat throughout the entire thermal process and after this process during storage.

The aim of this study was to estimate the effect of natural antioxidants on changes in cholesterol in deep fried and frozen meat products. Meat products were heated at 160°C for 5 minutes in rapeseed oil, next frozen and stored for 6 months. Contents of cholesterol and oxyphytosterols (7α- and 7β-hydroxysterol, 5α,6α- and 5β,6β-epoxysterol, 7-ketosterol, 20-hydroxy, 25-hydroxy and triol) were estimated by gas chromatography. All indexes periodically in fresh, not frozen, fried meat products and after 2, 4 and 6 months of storage were estimated. Ethanol extract of green tea, ethanol extract of thyme, commercial extract of rosemary, and BHT were used in the study. All samples were compared with control sample (meat products without addition of antioxidants).

In all samples, after frying and storage decrease of cholesterol and increase of total oxycholesterols were observed. The highest decrease of cholesterol during 6 months of storage in samples with addition of thyme extract, BHT and control sample were observed. Decrease of cholesterol level in sample with addition of rosemary extract and green tea extract was lower. Addition of natural antioxidants inhibited the formation of oxycholesterols, but the antioxidant effect depends on used antioxidant. After 6 months of storage the lowest level of oxycholesterols in sample with addition of green tea extract, rosemary extract and thyme extract were observed

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Effects of NaCl, Heat and Protease Modifications on Solubility Properties of Protein Concentrate Isolated from Whole Grain Hull-Less Barley Flour

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Key words: hull-less barley, protein concentrate, solubility, NaCl, heat, enzyme hydrolysis

Whole grain hull-less barley flour (WHBF) was used for the preparation of hull-less barley protein concentrate (HBPC). HBPC was prepared by dilute salt (0.15 M NaCI) extraction (at pH 9) without a reducing agent and then isoelectric precipitation (at pH 5) was applied to collect the proteins without further fractionation. Protein content of the HBPC was 67.3% on dwb. Solubility properties of the HBPC were determined in distilled water at concentrations of 1.0% and 0.25% (w/v), and in 0.25M NaCl at 0.25% concentration. Solubility properties of HBPC were also detected after heat treatments at 55 and 85°C at the concentration of 0.25% in distilled water. Besides, HBPC was hydrolyzed with Alcalase in order to produce hydrolysates of 2% (HBH-1) and 5% (HBH-2) degree of hydrolysis. Solubility properties of the hydrolysates were also determined at the concentration of 0.25% in distilled water and 0.25M NaCl. Solubility properties were studied as a function of pH. SDS-PAGE of WHBF, HBPC, heat modified HBPC and hyrolysates were performed. The solubility properties of HBPC were especially higher in the strong acidic and basic pHs in distilled water. Decreasing protein concentration improved the solubility values at all pHs except

for pH 6 where the lowest solubility was observed in distilled water. Increasing the ionic strength of the medium decreased the solubility values at all pHs except for pH 6. The solubility values of moist-heat treated HBPC were lower than untreated one in the strong acidic and basic pHs. The highest solubility properties were observed with HBH-2 at all pHs in distilled water. The solubility properties of hydrolysates at pH 6 were increased as a result of the limited hydrolysis. SDS--PAGE provided significant information about the monitoring of heat treatment and limited protein hydrolysis.

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Revealing Transformation Patterns and Maillard Reaction Mechanisms in Lysine Fortified, Newly Developed Bakery Products

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Key words: Maillard reaction, functional biscuit, antioxidant capacity

Due to the rapidly growing number of conscious customers in the recent years, more and more people look for products with positive physiological effects which may contribute to the preservation of their health. Therefore the EGERFOOD RKC develops and introduces into the market new functional foodstuffs.

During the baking process the production of compounds with high antioxidant-activity obtained by the reaction of carbohydrates and proteins (Maillard-reaction) was key point. The object of the study was to acquire an extended pathway by the identification of the Maillard-reaction products (MRPs), generated during the baking processes from saccharides and amino acids. For the identification of MRPs involving the melanoidines several model experiments were accomplished and the composition of the samples were precisely analysed. Diverse sugars (saccharose, fructose, glucose, isosugar) and lysine in various ratios were applied in order to create our model systems. During the evolvement of these functional foods different baking temperature were applied in order to serve optimal circumstances for the generation of the MRPs having functional properties. According to the optimal heating temperature the functional biscuits were prepared with the same saccharides and lysine to achieve the outstanding antioxidant activity. FRAP and DPPH methods were applied in order to establish the antioxidant activity of our functional bakery products.

The chemical structures of more than 10 products (Shiff-base, Amadori-products, melanoidines) have been characterised by applying GC-MS, HPLC-MS-ELSD techniques. The transformation processes of saccharides and lysine have been revealed, a reaction pathway has been proposed by the attribution of the identified products which are responsible for the outstanding antioxidant activity of the bakery products. The revealed pathway gets us closer to find the technologically optimal processing circumstances and the appropriate basic materials in order to make them functional to promote our health. A new functional biscuit (LIZINER) was developed with unique composition and enhanced antioxidant activity.

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Amino Acid Composition and Protein Quality Indexes of Traditional Rye Bread and Ginger Cake with Different Flour Extraction Rates

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Key words: rye bread, ginger cake, amino acids, chemical score, protein efficiency ratio

Rye (*Secale cereale* L.) grain cultivation is growing as it is an excellent raw material for high quality and healthy cereal-based foods. It provides carbohydrate and protein as well as a variety of micronutrients. Rye is commonly consumed in Central and North-East Europe as rye bread and ginger cake made of rye flours with different extraction rates. Therefore, the effect of flour extraction rate on protein quality of rye-based products needs to be addressed. The aim of this study was to evaluate the effect of rye flour extraction rate on the amino acids content and protein quality indexes (chemical score, CS; and protein efficiency ratio, PER) of traditional rye bread and ginger cake and to compare them with conventional wheat bread (WB).

Rye flour with extraction rates of 100% and 92% (F-100% and F-92%, respectively), were used. Traditional rye bread was made by fermentation with bakery yeasts and baking at 260°C for 40 min. Traditional ginger cake was prepared by mixing flour, honey and sugar and the mixture was stored at 20–22°C for 5 days. Afterwards, sodium bicarbonate and ginger spice were added and baked at 180°C for 18 min. Conventional WB was used as reference product. Amino acid content was determined by HPLC [1] and protein quality indexes were mathematically calculated [2,3].

The results showed that content of non-essential amino acids (NEAA) was not significantly ($P \leq 0.05$) affected by flour extraction rate either in rye bread and ginger cake. Regarding essential amino acids (EAA), Thr and Leu content was significantly higher ($P \leq 0.05$) in rye bread and ginger cake for-

mulated with F-100% flour, respectively. Similarly, total EAA content was found 9% and 6% higher in rye bread and ginger cake formulated with F-100% flour, respectively. In addition, rye bread formulated with whole rye flour exhibited larger content of total EAA (16%) than WB. Regarding protein quality indexes, F100% rye bread showed greater CS values compared to either F92% rye bread and WB, however, PER values were similar among wheat and rye breads. In the case of ginger cakes, CS and PER values were found slightly lower compared to WB. Hence, whole rye flour (100% extraction rate) could be use as an approach to improve the nutritional quality of traditional rye-based products.

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P199

Effects of Microwave and Hot-Air Popper Methods on Some Characteristics of Popcorn

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Key words: popcorn, microwave, hot-air popper, hexanal, textural properties

Popcorn is one of the most popular snack foods in the world. In this study three types of commercial popcorns seed packages including light butter flavour (14% fat), butter flavour (32% fat) and great buttery taste (44% fat) popped with two different methods; microwave oven and hot-air popper. The effects of popping methods and the types of popcorn seed products on popping volume (cm^3/g), popped kernel size (kernel number/10 g), moisture content, color values (L, a and b), hexanal content as indicator of oil oxidation and some textural characteristics (crispness and firmness) have been determined. Popcorn seed samples popped with hot-air popper showed higher popping volume and popped kernel size. Higher oil level increased the popped kernel size, but decreased the popping volume ($p<0.001$). The moisture contents of the samples in both methods varied between 0.89 and 3.03%. Samples popped with hot-air popper had higher moisture contents and higher L and a values ($p<0.05$). In both methods, oil levels did not significantly alter the moisture content and color values ($p>0.05$). Higher oil contents leaded to higher hexanal concentrations. Popcorn samples popped with microwave method had lower hexanal level ($p<0.001$) than their counterparts produced with hot-air popper. The oil level and popping method significantly ($p<0.05$) affected the textural properties of popcorn. Increasing the oil level and microwave application also increased the crispness and the firmness values. Overall quality of popcorns popped with hot-air method look preferable, but lower hexanal content of popcorns prepared with microwave method should be considered.

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Influence of Temperature and Equilibration Time on the Quantification of Aroma Impact Compounds in Coffee Brews

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Key words: coffee, aroma, static headspace, coffee brews, aroma impact compounds

One of the most contributory factors for the high acceptability of coffee is its aroma, which involves more than 800 volatile compounds. The aim of this study was to optimize the methodology of the main aroma impact compounds extraction in coffee brews with the highest efficiency at lowest time using static headspace-gas chromatography-mass spectrometry (HS-GC-MS). Equilibration time and temperature were the factors studied to choose the optimal conditions for analyzing aroma compounds in coffee brews by a static headspace sampling extraction method.

Five temperatures of equilibration (50, 55, 60, 65 and 70ºC) were studied. Seventy one volatile compounds were identified in Arabica filter coffee brews and the main aroma impact compounds in coffee brews (methanethiol, acetaldehyde, propanal, 2-methylpropanal, 2-methylbutanal, 3-methylbutanal, 2,3-butanedione, 2,3-pentanedione, 3,5-dimethyl-3-ethylpyrazine and guaiacol) were quantified. Increased amounts of aroma impact compounds with temperature increase were found, except in methanethiol, 3,5-dimethyl-3-ethylpyrazine and guaiacol that decreased at 70ºC due to thermal degradation. Consequently, 65ºC was selected as extraction temperature. Then, the extraction of the aroma impact compounds was studied at five different equilibration times: 15, 25, 35, 45 and 55 min at 65ºC. The maximum concentration in the majority of the quantified aroma impact compounds was obtained at an equilibration time of 25 min. In conclusion, the optimal conditions in static headspace for quantification of aroma impact compounds in coffee brews were 25 min at 65ºC.

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P201

How Does Affect Thermal Processing to Functional Properties of Bean Flours?

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Key words: dehydration, bean flours, functional properties

Research has emphasized the utilization of beans in the form of meal and flour for using as functional ingredients in food products. Dehydration is a technology classified as a high temperature process to produce a variety of foods and ingredients and offers numerous advantages including prolonged preservation time, high productivity and quality of resulting products. The objective of this study was to determine changes in functional properties of bean flours as affected by soaking, cooking and dehydration, with a view to providing useful information towards effective utilization of these legumes in various food applications. The raw legume flours exhibited low oil holding capacities, 1.10 mL/g and did not show any change by thermal processing, instead water holding capacities reached 3.45 mL/ g sample after dehydration. Emulsifying activity and foam capacity were higher in raw legumes than thermal processed samples. Nevertheless, swelling capacity showed great increases in legume flours after dehydration process. Thus, the study of the effect of dehydration on functional properties provides useful information for bean flours. These legume flours could be used as functional ingredients in food systems and incorporated into products such as bakery products, seasonings, and sausages among other but sensory and texture analyses of the products would be necessary.

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P202

Effect of Frying Process on Antioxidant Capacity of Vegetable Oils, Meat and Potatoes

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Key words: antioxidant capacity, food, total phenolic content, frying

Vegetable oils, meats and French fries hold an important place in human diet. Vegetable oils are consumed as salad oils, cooking oils, and frying oils. Fried foods are very popular worldwide due to their delicious sensory characteristics. Despite common opinion, the frying process have almost the same or even lower effect on nutrient losses compared to other cooking methods [1,2]. In the frying process, vegetables, meat, potatoes or seafood, are brought in direct contact with hot oil. The food surface becomes golden yellow to dark brown and develops a pleasant fried food flavor. Frying temperature and frying time varies depends on products fried.

The antioxidant activity of studied food products and oils before and after the frying process was determined by a ferric reducing antioxidant power (FRAP) method. Moreover, the total content of phenolic compounds by the Folin-Ciocalteau method was analyzed. Meat products (poultry and pork) and French fries were fried in rapeseed oil, palm oil and olive oil with garlic. The antioxidant activity of meat and French fries before frying ranged between 9.0–15.3 μmol TE (Trolox)/100 g and 273.8– 276.7 μmol TE/100 g, whereas after frying values increased for meet samples from 31.1 μmol TE/100 g to 69.7 μmol TE/100 g, and decreased for French fries 75.4 μmol TE/100 g – 121.1 μmol TE/100 g. However, the antioxidant activity of oils varied from 113.3 μmol TE/100 g to 231.0 μmol TE/100g. The total phenolic compounds in all oils decreased in the range 3.3– 80.2% after frying. Principal component analysis (PCA) was applied for analysis of frying process impact on the antioxidant capacity and TPC of studied food samples.

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P203

Impact of Roasting Conditions (Time and Temperature) on Maillard Reaction Indexes and Antiradical Capacity of Carob

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Key words: Maillard reaction products, carob, roasting, ORAC antioxidant activity

The main goal of this study was to investigate the effect of roasting conditions on antioxidant and browning properties of carob. The formation of Maillard reaction products (MRPs) during roasting was investigated by monitoring changes in browning index, free fluorescence and UV absorbance at 294 nm. The changes of the antioxidant activity were monitored using the ORAC–FL antioxidant assay that was expressed as Trolox equivalent (TE).

Kibbled carob pods were roasted for 0, 5, 10, 15, 30, 60 and 90 minutes at 130, 150 165, 180 and 200°C. Generally, antioxidant activity and MRP formation increased with the increasing roasting temperature and time. In comparison to the raw carob (52.311 μmole TE/g dry matter), the highest antioxidant activity (91.442 μmole TE/g dry matter) was found in carob powder processed at 200°C. Since that sample was found to be organoleptically unacceptable, 30 minute roasting at 165°C (73.809 μmole TE/g dry matter) and 60 minute roasting at 150°C (74.633 μmole TE/g dry matter), were found to be ideal for carob processing due to preserved organoleptic texture and increased antioxidant activity.

The content of UV-A absorbing products, melanoidins and the MRPs formed during roasting correlated positively with measured ORAC values but at different roasting temperatures, different subclasses of MRPs showed the most significant correlations. In samples roasted at 150°C the most significant correlation was found between the ORAC values and the content of pentosidines, pentodilysines, cross links and the pyropiridines while theargpyrimidines and AGEs in general reported the strongest antiradical potential in the processing at 200°C and 165°C.

Obtained results present additional guidelines in choosing proper processing conditions with remark that final choice should primarily depend on the target purpose and desired characteristics of carob derived product and should take into account possible biologically harmful and antinutritive effects of derived MRPs.

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P204

Antioxidant Activity of Melanoidin-Like Polycondensation Products, Isolated from Model Reactions of Amino Acids, Lipid Oxidation-Derived Aldehydes and carbohydrates

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Key words: antioxidant activity, Maillard reaction, lipid oxidation, DPPH, FRAP

Due to the resulting modifications in food colour, flavour, nutritional value and safety, the interaction of lipid oxidation products in the Maillard reaction pathway is of particular interest. Recently, reaction products from such interactions were reported to comprise a significant amount of dietary antioxidants and influence the oxidative stability of thermally processed foods [1]. Since the safety of many commercially used antioxidants is currently being questioned, Maillard-derived antioxidants are promising in the search for natural food constituents with antioxidant properties.

In order to gain more insight in the heat-induced formation of antioxidant compounds from both pathways, Maillard-like reaction products were isolated from model mixtures of amino acids (glycine, L(+)-lysine, L(+)-arginine), lipid oxidation-derived aldehydes (hexanal, (2E)-hexenal), with or without D(+)-glucose or L(+)-ascorbic acid. The antioxidant activity of the water-soluble melanoidin-like polycondensation products, obtained before (WSRP; LMW+HMW) and after dialysis (HMW) was measured employing the DPPH and FRAP assays (expressed as μmol equivalents of Trolox). Although the antioxidant activity varied according to the composition of model system tested, the polycondensation products possessed significantly stronger antioxidant activities than the corresponding unheated initial reactant mixtures. The non-dialyzable high molecular weight fraction (>12 kDa) comprised the major part of the water-soluble antioxidants, derived from amino acid/lipid oxidation product model systems, with or without glucose. The addition of ascorbic acid to amino acid/lipid oxidation product model systems considerably increased the antioxidant properties of the water-soluble reaction product mixtures (before dialysis). In general, the radical scavenging activity, measured with the DPPH assay, was higher than the ferric reducing properties evaluated by the FRAP assay.

Similar trends have previously been reported by other research groups for various amino acid/glucose reaction products, model melanoidins and coffee melanoidin fractions [2,3]. This is, however, the first report of the impact of lipid

oxidation products on the antioxidant activity of melanoidin-like fractions.

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P205

Linear Discriminant Analysis as a Tool to Assess the Effects of Irradiation Treatment and Storage Time on Antioxidant Activity of *Castanea sativa* Miller Skins and Fruits

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Key words: Castanea sativa Miller, gamma irradiation, storage time, antioxidant activity, LDA

Due to the high levels of chestnuts production in Portugal, and the economical importance of their industrial derivatives, it is essential to find technologies that increase chestnuts shelf-life. This kind of study must always be associated with the evaluation of the effects of those technologies in the final quality of the product.

Herein, the effects of gamma irradiation and storage time in antioxidant potential of chestnut (*Castanea sativa* Miller) fruits and skins obtained in Trás-os-Montes, North-east Portugal, was evaluated for the fist time. The irradiations were performed in a 60Co experimental equipment, for 1 h (0.27±0.04 kGy) and 2 h (0.54±0.04 kGy). Bioactive compounds (phenolics and flavonoids) and DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity, reducing power and inhibition of β-carotene bleaching capacity were determined at 0, 30 and 60 days of storage at 4ºC. The results were evaluated through Linear Discriminant Analysis (LDA) to evaluate if the differences induce by irradiation and storage could act as discriminant variables regarding antioxidant potential and bioactive compounds contents.

The obtained results highlighted the higher influence of storage time over antioxidant activity and bioactive compounds availability when compared with the irradiation dose used. In fact, the storage favoured chestnuts antioxidant potential. The activity of some antioxidant defences (non-enzymatic or enzymatic) present in chestnuts apparently increased along the storage time, in response to the oxidative stress inherent to the storage process. The application of gamma irradiation proved to be advantageous for the assayed antioxidant methods, probably due to an increase in the availability of antioxidant compounds such as polyphenols previously linked to the cell wall. Other studies were also performed in order to evaluate the influence of irradiation in chemical composition of chestnuts fruits (other communication in the present congress).

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New Green Solvents for the Extraction of γ-Linolenic Acid from Spirulina. A Chemometric Optimization

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Key words: pressurized liquid extraction, Spirulina, PUFA, experimental design

In present work, the extraction of valuable fatty acids using green extraction techniques such as pressurized liquid extraction (PLE) has been optimized by using a chemometrical approach.

Nowadays the search of functional food ingredients from natural sources is increasing. Likewise, they are more appreciated when they have been obtained using clean extraction techniques, due to both toxicological and environmental reasons. For a long time, supercritical CO_2 extraction have demonstrated to be an effective technique, but it possess certain limitations mainly due to its low polarity. For this reason, the use of new solvents is under study. In the present work, two green solvents have been used, namely ethanol and ethyl lactate. It is remarkable the natural origin and easy biodegradability of both compounds, which can be found in traditionally consumed foodstuff like wine or beer, for example [1].

The most important source of γ-linolenic acid is borage oil, but algae and microalgae have demonstrated to contain

important amounts of this compound; among them, the cyanobacteria Spirulina, has been described as a key source of γ-linolenic acid [2]. Spirulina is easy to grow, but the recovery of γ-linolenic acid is not straightforward.

In this work, optimization of PLE has been performed using an experimental design central composite with four factors at three levels (43), namely: temperature (60–120°C), pressure (500–3000 psi), extraction time (5–15) and ratio ethanol:ethyl lactate (0–100%). These kinds of designs allow wide ranges of study with just few experiments, in this case 30 experiments.

The responses selected for the optimization were: total yield, fatty acid content and γ-linolenic acid concentration in extracts. For its quantification, GC-MS was used previous derivatization by ethylation.

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P207

Model Studies on the Volatiles Generated in Model Mixtures of Lipid Oxidation Products, Amino Acids, and Sugars

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Key words: lipid oxidation, Maillard reaction, model reactions, food volatiles

The Maillard reaction and lipid degradation have been identified as the main reactions responsible for the development of flavor and browning in thermally treated foods. However, in complex food systems, both reactions do not occur separately from each other, and interactions between both reaction pathways can be important. To study such interactions, the volatile compounds resulting from model reactions of various amino acids with different aldehydes originating from lipid oxidation, in the presence and absence of glucose, were analyzed.

The main reaction products identified in these model mixtures were carbonyl compounds, resulting essentially from amino acid-catalyzed aldol condensation reactions. For instance, 2-butyl-2-octenal was by far the most important compound in the headspace of glycine/hexanal model systems (as measured by means of SPME-GC-MS). Apparently, the amino acid has an important role in catalyzing the degradation and further reaction of lipid-derived aldehydes. The same aldol-type reactions had also been identified as the predominant mechanisms responsible for the formation of brown-colored high molecular weight polycondensation products from the same model reactions.

The presence of an amino acid also drastically increased the formation of 2-alkylfurans from the corresponding alpha, beta-unsaturated aldehydes, for instance of 2-ethylfuran from (E)-2-hexenal. Further investigations of 2-alkylfuran formation showed the need of oxidizing conditions and the involvement of radicals in this reaction mechanism.

The share of azaheterocyclic compounds among the volatiles was usually quite low. An important class of compounds, however, were alkylated pyridines, resulting from the reaction of alpha, beta-unsaturated aldehydes with an amino acid. These pyridines were especially important in the headspace of lysine model systems. As such, 5-butyl-2-propylpyridine was the most important constituent of the headspace profile of (E)-2-hexenal/lysine model systems.

Comparison with the better-known Maillard reaction of the same amino acids with glucose and with the results obtained with ternary mixtures of amino acids, lipid oxidation aldehydes and glucose, suggest that amino acid-induced degradations and further reactions of lipid oxidation products may be of considerable importance in thermally processed foods.

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P208

Stability Study of Nine High-Intensity Sweeteners in Different Types of Food Products

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Key words: stability of sweeteners, high-intensity sweeteners, food products

Sweeteners are commonly used for food production. The majority of sugar substitutes, which are approved for use in food chemistry are high-intensity sweeteners. Consumer can enjoy a wide range of food products containing sweeteners.

Stability of food additives under normal conditions of use and storage is a clue of suitability for any particular food application. Therefore, the objective of this study was to measure the stability of sweeteners possessing significantly different chemical properties in typical food products to which they are added.

In order to evaluate the stability of nine sweeteners (acesulfame-K, alitame, aspartame, cyclamate, dulcin, neohesperidine dihydrochalcone, neotame, sucralose and saccharin) in different storage conditions, representatives of three different types of food samples: cola drink, yoghurt, and home-

made fish product were used as blanks for the preparation of fortified samples. They were spiked by adding the appropriate volumes of standard solutions of individual sweetener at one concentration level *i.e.* 50% of maximum usable dose value specified for each food product. The final products were packed in jars and stored at three temperatures: +20°C, +4°C and -20°C for the following time periods *i.e*. 3 days, 1, 2, 3 and 4 weeks. A reference test samples were kept at temperature -80°C. To determine the effect of storage on the sweeteners stability, final analyses of the target compounds were performed by HPLC-MS, whereas sample preparation included an SPE step. The obtained data gave opportunity to evaluate behaviour of sweeteners in different storage conditions. Such data could then be used during storage of food samples with different matrices containing sweeteners.

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Influence of the Microenvironment of Thiol groups in Low Molecular Mass Thiols and Protein on the Reaction with Methylglyoxal

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Key words: methylglyoxal, cysteine, N-acetylcysteine, carboxymethylcysteine glutathione, protein thiol groups

Processing, cooking and prolonged storage of food leads to the formation of methylglyoxal (MG). Intake of low doses of MG over prolonged period of time and increased endogenous MG in some pathological states (diabetes, uremia, oxidative stress, aging and inflammation) causes protein modification, formation of advanced glycation end products (AGEs) and cross-linking. N-terminal and Lys side chain amino groups, the guanidine group of Arg and the sulfhydryl group of Cys present on protein surfaces participate in protein modification by MG. This paper investigated how the microenvironment of the thiol group in low molecular mass thiols [cysteine, N-acetylcysteine (NAcCys), carboxymethylcysteine (CMC) and glutathione (GSH)] and proteins affected the thiol reaction with MG. The SH group reaction course was monitored by 1H-NMR spectroscopy and spectrophotometric quantification. The microenvironment of the SH group had a major effect on its reactivity and on the product yield. The reactivity of SH groups decreased in the order Cys > GSH > NAcCys. CMC did not react. The percentages of the reacted SH groups in the equilibrium state were almost equal, regardless of the ratio of thiol compound/MG (1:1, 1:2, 1:5): 38.1±0.9%; 38.2±0.7% and 39.0±0.8% for Cys; 26.5±0.6%; 26.6±2.6% and 27.4±2.5% for GSH; 10.8±0.9%; and 11.2±0.7% and 12.2±0.9% for NAcCys, respectively. Despite very low levels of thiol groups on the surface of protein molecule (in BSA, approx. 80 times lower than those of amino and guanidine groups), a very high percentage of it reacts (25–85%). On the basis of all results the mechanism of thiol group reaction with methylglyoxal was done.

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P210

Formation of Hydrogen Peroxide in Model Solutions Enriched in Green Tea Extract

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Key words: hydrogen peroxide, polyphenols, antioxidants, reactive oxygen species

Polyphenols are a wide group of antioxidants naturally occurring in fruits, vegetables, and some beverages including tea, wine or coffee. Antioxidants are very important for human health, since the production of reactive oxygen species is thought to be a significant cause of aging and carcinogenesis. It is proved that polyphenols can act as free radical-scavengers, quenching hydroxyl radicals or superoxide anion radicals and may chelate metal ions *etc*.

Contrary to their beneficial effects, it has been recently reported that some polyphenols promote oxidative damage to DNA, lipids and deoxyribose in the presence of metal ions under certain conditions *in vitro*. Presumably, it is an effect of pro-oxidant action of polyphenols which results in creating reactive oxygen species during the autooxidation process. Of great importance is the generation of toxic hydrogen peroxide that can be transformed into reactive hydroxyl radical *via* Fenton reaction. There are some data in the literature concerning the hydrogen peroxide formation in polyphenol-rich beverages, *e.g.* green tea, black tea, coffee.

The aim of the study was to determine the ability of H_2O_2 formation in model solutions enriched in green tea extract. The influence of pH, extract concentration and time of incubation was examined. 0.2% and 0.5% green tea extract solutions were diluted in phosphate buffer (pH from 2 to 11). The concentration of hydrogen peroxide was measured by iodometric method after 0; 1; 3; 4.5; 6; 24 and 48 hours of storage in room temperature.

In solutions with lower pH (under 6) formation of H_2O_2 was not observed. In solutions with pH over 7 the amount of hydrogen peroxide simultaneously increased with the pH growth and incubation time (over 6 hours). The highest level of H_2O_2 was detected after 24-hour-storage and amounted 1.2 mM in solution with pH 10.

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Effect of Trans Fatty Acids on Water in Oil Emulsions Stability

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Key words: trans fatty acids, water in oil emulsions, stability

In this study, trans fatty acid content of fat samples were studied in terms of their influence on emulsion stability. A special effort was given to prepare samples with similar solid fat content but different trans fatty acid level. For this purpose quite a few blends were prepared by mixing fully and partially hydrogenated soy bean oils with palm oil fractions. Then, the blends were mixed with water under high shear conditions to form oil in water emulsions. The stability of emulsions was characterized by using Dispersion Analyser LUMiSizer® 612. This highly sensitive instrument detects the creaming or other forms of emulsion defects through sending near infrared light onto the samples contained in special tubes. Hence, speed and extent of phase separation under centrifugal force can be monitored.

The results showed that trans fat content of oil phase considerably weakened the stability of the emulsions at 20°C. This undesirable consequence was even more evident when the temperature was reduced to 10°C. On other hand, when the temperature was raised to 30°C, no significant effect of trans fat content was found. Stability impairing effect of trans fats might be caused by their relatively rapid crystallization at the oil-water interphase. These crystals can damage the interphase, which may lead to coalescence, flocculation and consequently creaming of the oil phase. This study outlines the effects of trans fats on emulsion stability with possible mechanisms.

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P212

Determining Antioxidant Distributions Between the Oil, Water, and Interfacial Regions of Model Food Emulsions: a Pseudophase Kinetic Approach

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Key words: antioxidant, emulsions, kinetics

Antioxidant, AO, distribution in food emulsions depends on a number of variables including the temperature, acidity, the hydrophobicity and the nature of the oil, emulsifier and AO. Most methods for determining AOs distributions are based on separation and analysis of components in each phase, *e.g.,* by centrifugation or ultrafiltration followed by HPLC analysis of AO concentrations, from where the partition constants are estimated, but they cannot provide estimates of interfacial AO concentrations and hence provide a limited knowledge on antioxidant distributions.

Because it is physically impossible to separate the interfacial region from the oil and aqueous ones, determining antioxidants distributions must be carried out in the emulsion itself. Hence, instead of developing analytical methods to measure antioxidant concentrations in the different regions, we have taken a completely different approach by focusing in the development of methods to determining the partition constants of the antioxidant between the oil-interfacial, POI, and water-interfacial, PWI, regions of the model emulsion. For the purpose, we developed a kinetic approach, based on the reaction of the hydrophobic 4-hexadecylbenzenediazonium, 16-ArN2+, ions with antioxidants.

Here we will comment on the conceptual basis of the method, and will show some relevant results on the distribution of antioxidants such as tocopherol, gallic acid, *etc*. We will also discuss the effects of lyophilization of the antioxidant, acidity, temperature, oil nature, etc on their distribution. The results are of interest for interpreting the effects of antioxidant distributions on antioxidant efficiencies.

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P213

Monitoring of Production Process, Freshness, Authentication and Shelf-Life of Foodstuff by Electronic Nose

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Key words: food safety, food quality, electronic nose, sensors

Food safety is a discipline that comprises all steps in raw foodstuffs processing. Consumers are susceptible to undesirable ingredients or freshness of food products. Thus, it is very important to satisfy consumers and assure food quality. Flavour, colour and taste are as significant as dietary, medical and nutritional aspects. Due to these features, the whole manufacturing process including sanitation requirements as a priority, need to be monitored.

Traditional methods used to analyze aroma of food, especially in monitoring of food process, evaluation of freshness, shelf-life investigation, authentication assessment, spoilage detection, maturity examination, origin differentiation, involve human panels (sensory analysis) or gas chromatography techniques. Both approaches have many disadvantages. Olfactory evaluators are not very reliable, inaccurate and may cause variances. Furthermore, both methods are time-consuming and require sample preparation, which is very often destructive to sample. Most of these problems may be overcame by the usage of electronic nose.

E-noses are known as rapid and non-destructive tools in foodstuff studies. This communicate summarizes achievements and developments in this field. It includes brief information about principle of operation, typical types of sensor and pattern recognition methods applied in this system. The presentation is focused on the examples of e-nose usage in different foodstuff and beverages investigations. The recent developments and future trends of odour-sensing systems are also discussed.

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P214

High Pressure-Modified Starches as Carriers for Phenolic Compounds

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Key words: starch, sorghum, amaranth, aroma compounds, catechin, quercetin, retention, high pressure, HPLC, ^{13}CP/MAS NMR, ORAC

Starch material may be used as a matrix for controlled release of aroma and bioactive compounds or the selective adsorption of bitter components. The binding of organic compounds to starch is based on inclusion complexes formation through hydrophobic bonding in the amylose helix, and/or polar interaction between the hydroxyl groups of starch and ligands, or non-specific sorption to the starch surface. It is known that high hydrostatic pressure evoked changes in starch physicochemical properties what in turn might affect its capability for binding organic compounds.

In view of the above, the studies were subjected to the effect of high pressure treatment on the ability of binding catechin and quercetin by sorghum and amaranth starches.

Sorghum (17% of amylose) and amaranth (pure amylopectin) starch were isolated from the commercial grains [1,2]. The starch-water suspensions (30%, w/v) were subjected to pressure treatment (650 MPa/ 9 mins [3]), and freez-dried. Catechin (10 mg/1g starch) and quercetin (5mg/ 1g of starch) were separately added to the starch-water suspensions. The suspensions were stirred at room temperature (24h), centrifuged and the collected pellets were freez-dried. The compounds bound by the starches were isolated from the pellets by extraction with methanol/water, and the extracts were characterized by HPLC-PAD-MS [4]. The obtained starch-phenolic complexes were examined regarding their thermodynamic (DSC) and structural (^{13}C CP/MAS NMR) properties. The antioxidant activity of phenolic compounds bound by analyzed starches was additionally performed using oxygen radical absorption capacity (ORAC) assay.

The HPLC analysis showed that catechin and quercetin demonstrated higher binding affinity to sorghum than to amaranth starch. The high pressure treatment resulted in an increase in sorption of bioactive compounds by the starch preparations obtained. High pressure-treated amaranth starch demonstrated lower sorption of catechin, however. Although binding of ligand to starch was related to surface

sorption, formation of bioactive compounds with fully hydrated starch can be also assigned to inclusion complexation.

However, the results obtained from thermodynamic and ^{13}C CP/MAS NMR analysis did not reveal that the complexation phenomenon took place in the studied case. The distinct increase in melting enthalpy values observed for starch-phenolic complexes in melting thermograms resulted probably from non-covalent binding of polysaccharides with the phenolic compounds due to hydrophobic cooperative interaction, mostly. The changes in antioxidant capacity of phenolic compounds bound by the starches (native and high pressure-treated) were found to be irregular.

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Nutrigenomics

P215

Ability of Dietary Alpha-Tocopherol and Quercetin to Modulate Expression of RAGE and Other Markers of Oxidative Stress Induced by Advanced Glycation Endproducts in Human Endothelial Cells

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Key words: receptor for advanced glycation endproducts, oxidative stress, inflammatory markers, alpha-tocopherol, quercetin, human endothelial cells

Engagement of the receptor for advanced glycation endproducts (RAGE) by advanced glycation endproducts (AGEs) induces cellular oxidative stress (OS) and upregulates certain pro-inflammatory genes. The beneficial effects of dietary α-tocopherol and flavonoids, such as quercetin, have been attributed to their antioxidant and anti-inflammatory properties. α-Tocopherol is known to act as an antiglycating factor *in vitro* but information concerning the role of quercetin in AGE-mediated responses is lacking. This study investigated the ability of Trolox, quercetin, and quercetin metabolites to modulate AGE-induced increases in oxidative stress and markers of inflammation in human endothelial cells.

Human aortic endothelial cells (HAEC) were pretreated with (a) Trolox (40 and 200 μM), (b) quercetin (40 and 200 μM), (c) a mixture of Trolox (40 μM) and quercetin (40 μM), (d) quercetin metabolites (quercetin 3-glucuronide-Na and quercetin 3'-sulfate-Na, 5–200 μM) and (e) a mixture of quercetin 3-glucuronide-Na or quercetin 3'-sulfate-Na (5–200 μM) and Trolox (40 μM). Pre-treated cells were stimulated with endotoxin-depleted BSA and AGE-BSA (200 μg/mL protein) for 24 h. Trolox and quercetin pretreatment significantly ($p<0.001$) attenuated AGE-induced ROS (hydrogen peroxide and superoxide) production. This in turn resulted in a dose- and time-dependant decrease in RAGE, a marker of the mitogen activated protein kinase pathway (MAPK-1) and tumor necrosis factor alpha (TNF-alpha) mRNA expression, as well as p65 NF-kappaB activation. Mixtures of Trolox and quercetin showed either an additive or synergistic down regulation in the observed endothelial dysfunctions. Quercetin 3-glucuronide and quercetin 3'-sulfate (40 or 200 μM) with or without Trolox also attenuated RAGE, ROS and pro-inflammatory markers. At physiological concentrations (5 or 10 μM), the two quercetin metabolites were ineffective.

The study demonstrates a potential role for food-derived AGEs in the regulation of AGE receptors and subsequent cell signalling pathways associated with pro-inflammatory responses.

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P216

Peptides Derived from Simulated Gastrointestinal Digestion of the Prolamin Fractions Extracted from Different Wheat Varieties: Implications for the Celiac Disease

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Key words: celiac disease, gliadin, simulated gastrointestinal digestion, peptides identification, wheat varieties

Celiac disease is an autoimmune enteropathy triggered by gluten proteins, that develops in some genetically susceptible subjects after gluten consumption [1]. The high proline and glutamine content of gliadins and glutenins make them very resistant to the degradation by digestive proteases and peptides derived from digestion are absorbed into the lamina propria [2], where they cause immunological reactions that damage intestinal epithelium [3]. Gluten content of wheat is highly variable, depending on the plant genetics and the growing conditions [4]. The prevalence of celiac sprue seems to be pro-

moted by an early exposition to a large amount of gluten, when gluten-containing food are introduced in the children diet [5].

In the present work, an extraction and digestion method for the prolamine fraction of wheat was developed. The peptide mixture generated by the simulated gastrointestinal digestion of the prolamin fraction extracted from different wheat varieties was characterized by LC/MS, the compounds giving the highest chromatographic signals were identified also by LC/MS/MS techniques. Peptides were correlated to the amount of α- and γ-gliadin, toxic and immunogenic peptides were identified and semiquantified against a suitable internal standard. The semiquantification values demonstrated strong differences among the varieties tested, both qualitatively (the structure of the peptides generated) and quantitatively (their amount). Samples belonging to the same varieties showed a lower α- and γ-gliadin content, and a smaller amount of toxic and immunogenic peptides upon digestion. Albeit not "safe" for coeliac patients, the use of these varieties in the formulations of baby food could be of great help for lowering the spread of the disease.

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P217

Mitochondrial Function of Human Preadipocytes May Be Modulated by Antioxidants Quercetin and Beta Carotene, and Exogenous Free Fatty Acids

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Key words: quercetin, beta carotene, mitochondrial function

Quercetin, one of the most common flavonoids, and beta carotene (BC) are nutrients which exert antioxidant activities. BC derivatives such as retinoic acid (RA) of BC deeply affect mitochondrial biogenesis. FFAs increase mitochondrial generation of ROS by depolarization of the mitochondrial inner membrane due to the uncoupling effect and by blocking the respiratory chain oxidative phosphorylation (OXPHOS). The effect of these nutrients on metabolism of human preadipocytes is still not well recognized.

The aim of the study was investigated the effect of selected saturated and unsaturated FFA, beta carotene (BC) and quercetin on mitochondrial function.

The human preadipose immortalized (Chub-S7) cells were used. Cells were incubated for 24h with 30μM of FFA (PA, OA, AA, EPA, TTA); BC (3μM, 10μM, 30μM) or with quercetin (10μM, 30μM, 50μM, 70μM, 100μM). Mitochondrial metabolic activity was monitored by measurements of the mitochondrial oxygen consumption rates (OROBOROS® Oxygraph-2k) and ATP generation (ATP Lite Parkin Elmer). Changes in the mitochondrial membrane potential was monitored by flow cytometry (BD) and high thoroughput fluorescent microscopy in vivid cells (BD Bioimager 855).

The different effects of used compounds on mitochondrial activity was observed. Quercetin decreased mitochondrial respiration dependent on concentration. PA decreased ATP generation, the similar tendency was observed in mitochondrial respiration after incubation with EPA and TTA. BC decreased mitochondrial respiration and ATP generation, especially at the low (10μM) concentration. On the contrary AA tended to increase mitochondrial respiration.

In the immortalized human preadipocytes the concentration-dependent inhibitory effect of investigated nutrients (except AA) on mitochondrial functions was evidenced.

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Hypolipidemic Effects of *Morus alba* Leaves Extracts in High-Fat Diet Rats

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Key words: hyperlipidemia, *Morus alba* leaves extracts, rats

Morus alba L. (*Moraceae*) is a good source of antioxidant components such as flavonoids, phenolic acids, vitamins and also alkaloids. Therefore, there are some proofs that *Morus alba* leaves extracts improve lipid metabolism.

The aim of the study was to measure the effect of ethanol-water extracts of *Morus alba* leaves on high-fat diet rats. The 6 weeks experiment was conducted on 22 males Wistar white rats, aged 8 weeks, fed semi-purified experimental diets with cholesterol (1%). Furthermore the addition of *Morus alba* leaves extract on two levels was used. The addition of extracts was calculated on kg of body weight. Two groups AIN-93M diet rats and high-fat diet rats were control groups.

Morus alba leaves extracts treatment showed significant effects on LDL fraction, HDL fraction and total cholesterol in plasma of rats in comparison with control groups ($p \leq 0.05$).

Experimental parameters such as diet intake, body weight gain, feed efficiency were also analyzed.

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Dietary Curcumin from Turmeric Down-Regulates Wilms' Tumor 1 (WT1) Gene Expression Through the PKCα Signalling Pathway in Leukemic Cells

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Key words: curcumin, Wilms' tumor 1, protein kinase Cα

Curcumin is a principal active ingredient in Turmeric (*Curcuma Longa* Linn.). It has been used as food additive, plant-based drugs, and formulation to treat various ailments including cancer for many centuries as seen in traditional Ayurvedic, Chinese, and Thai medicines. Up until now, curcumin has been reported to be anti-leukemia and decrease the Wilms' tumor 1 (WT1) protein level. The WT1 is known as one of the biological markers for leukemia progression. The aim of this study was to investigate the inhibitory mechanism of pure curcumin on WT1 gene expression in K562 cell line. Pure curcumin clearly showed to suppress WT1 gene expression in both dose and time dependent manners. This suppression did not involve in mRNA and protein degradation pathways. However, it involved in PKCα signalling cascade. Moreover, pure curucmin strongly decreased phosphorylation of JNK and c-Jun by phospho-kinase array. These results were confirmed by kinase inhibitors determination. Pure curcumin decreased WT1 protein-promoter binding and WT1 promoter function. Importantly, dietary pure curcumin can be used as anti-leukemic cells and be applied to clinical setting in order to develop an alternative treatment for leukemia patients in the future.

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P220

Effect of Starter Culture and Fermentation Time on Anti-Inflammatory Properties of Fermented Soymilk

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Key words: soymilk, fermentation, starter culture, inflammation

Fermentation with highly proteolytic strains of lactic acid bacteria (LAB) is considered a successful strategy to produce bioactive peptides from different food substrates [1]. The anti-inflammatory potential of soy peptides obtained by enzymatic proteolysis has been demonstrated in cell based models [2]. Therefore, fermented soy-based products might be considered to prevent chronic inflammation which predisposes individuals to several degenerative diseases [3, 4]. This study evaluated the effect of starter cultures and fermentation time on anti-inflammatory activities of soymilk. For these purpose, four soymilk fermentation trials were performed using 1% inoculum (v/v) of both, commercial (CECT LAB strains) and indigenous bacteria. These last ones included Gram positive-catalase negative rod- and coccus-shaped strains isolated from spontaneously fermented soymilk. Starter 1 (control starter) only contained *Streptococcus thermophilus* CECT 986 and Lactobacillus delbrueckii subsp. lactis CECT 372 in a 1:1 ratio. Starter 2, 3 and 4 also included Lactobacillus acidophilus CECT 903, indigenous rod or indigenous coccus, respectively. Inoculated soymilk was fermented at 42°C until final pH 5.0±0.2 (FpH) and also during 24 h (F24). Bacterial counts (CFU/mL), pH and titratable acidity (TTA, °D) as well as the anti-inflammatory potential of fermented soymilk were examined. The anti-inflammatory activity was determined as the inhibition of NO production in LPS-induced RAW264.7 macrophages. Starter cultures showed similar acidifying activity and the soymilk pH fell down to 5.07 in 4.5 h (FpH) and the TTA was 37 °D. By lengthening the incubation (F24), pH reached values of 3.83–3.97, while TTA ranged between 77 °D (starter 2) and 110 °D (starter 4). Differences in viability were observed for starter cultures. Indeed, total LAB population increased 1.5–2.0 log units from inoculation (to about 106 CFU/mL) in all fermentations, but it remained stable until F24 only for starter 2 and 3.

Extract from non-fermented but chemically acidified soymilk (negative control) did not show anti-inflammatory activity. However, FpH soymilk extracts exhibited a noticeable inhibition (28–58%) of NO production in LPS-activated macrophages. Longer fermentation time up to 24 h resulted in higher inhibition of NO in LPS-induced macrophages treated with F24 soymilk extracts (44–71%). Indigenous soybean rod- and coccus-shaped strains improved ($P \leq 0.05$) the anti-inflammatory activity of both FpH and F24 soymilk extracts. In conclusion, indigenous soybean strains improved anti-inflammatory potential of fermented soymilk which might be further enhanced by extending the fermentation time.

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PLENARY LECTURES

L5

Chemists in the Food Industry – Much More Than a Bare Need!

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Key words: food industry, analysis, communication, chemist

It seems anachronistic to strongly advocate chemists in the food industry. The industry would do everything they could to avoid any connotation of food and chemistry. It does not sound good with consumers and especially consumerists. Nevertheless modern food – be it high tech or bio – is not possible without chemists.

In the past almost all senior technical jobs in big food companies were occupied by chemists, companies were product and innovation focused. In the late 1980s the principle of rationalisation took over. Efficiency became the issue and engineers took over. Later shareholder value was unanimously believed in, managed by finance people. By this product and product understanding shifted from the centre of attention to be of more marginal interest. This improved short time companies' balance sheet but eroded their core product expertise. In the "efficiency done"-era, re-focus on the product is urgently needed. Who could do better than chemists?

In development and science, we have reached a point where common sense is not enough anymore to judge things. Specialists need to evaluate processes, screen inventions for their application, and explain the findings of modern analytics, able to detect "almost nothing in almost nothing". This and highly sophisticated new methods like for instance GMO need interpretation and translation into company management. Food legislation does one last thing. Lawyers alone can't do as more and more legislation is threshold value based or influenced. Deep knowledge is needed to get this right – understandable and applicable.

Last but not least we live in a world highly influenced by communication, the media and pressure groups. Own communication needs to be based on true statements. Truth needs understanding of what one is talking about. Coming under public pressure by interested party and reacting to it, needs highly professional evaluation before replying. Both can only be done by people who deeply understand. Chemists do.

Also top level management teams will benefit from chemists. Diversity is needed to meet the challenges of an increasingly complex world. By their way to tackle and to solve problems, chemists do significantly contribute to their company's success.

The food industry needs chemists, they help to analyse, understand, develop, manufacture, and improve as well as to care and protect. They improve the industry's reputation and wealth. They do much very better than just covering a bare need.

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L6

The Application of *In Vitro* and *In Vivo* Transgenic Approaches for Evaluating the Harmful or Beneficial Effects of Foods

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Key words: metabolism, transgenic models, humanised models, antioxidants, nutraceuticals, nutradynamics

Understanding the *in vivo* cytoprotective effects of chemicals and the metabolic pathways with which they interact is pivotal in defining their potential therapeutic benefit. The factors which determine their chemoprotective effects are in essence very similar to those which determine the effectiveness of a therapeutic drug such as absorption, distribution, metabolism and interaction with the target cells. In our research over the last 20 years we have developed a series of transgenic animal models to facilitate our understanding of how chemical agents interact with cells in vivo and to establish their involvement in particular adaptive and cytotoxic response pathways.

We have carried out the deletion of genes such as glutathione S-transferase pi and in a collaboration between CXR Biosciences and TaconicArtemis we have deleted nuclear receptors such as CAR, PXR and PPAR. We have also generated reporter mice for pathways such as the antioxidant signalling pathway mediated by Nrf2 and for oxidative stress. These models include reporters such as GSTP heme oxygenase-1, superoxide dismutase 2 or metallothionine 1. These models can be used to define the induction or attenuation of oxidative stress responses in different cell types by chemical agents.

In addition the effectiveness of a chemopreventive agent will also be determined by its biodistribution and pharmacokinetics. To study this we have made mouse models where the cytochrome P450 system has been inactivated through the conditional deletion of cytochrome P450 reductase in both the liver and GI tract. We have also used this model to determine how metabolism affects the capacity of compounds to activate the Nf2 system.

Finally, in order to address the difficult issue of the species differences in the regulation of foreign compound metabolism, a range of transgenic mouse models have been created which have been humanised for drug transporter proteins, nuclear receptors and the cytochrome P450s. These models will provide a powerful approach to understand how the human metabolism of nutraceuticals may influence their potential therapeutic response and also help define what exposure levels are needed in order for these agents to be effective. Data illustrating the application of these models and their potential in the development of a rational approach to nutraceutical use will be described in this presentation.

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SESSION 5: CHALLENGES FOR FOOD CHEMISTRY IN POST-GENOMIC ERA

ORAL PRESENTATIONS

O32

Probing the Structural Origins and Mechanism of the Bioactivity of Food Polysaccharides

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Key words: pectin, beta glucan, bioactivity

Plant cell wall polysaccharides and starch are considered to be healthy components of our diet. These effects are primarily attributed to their role as dietary fibre and resistant starch. Fermentation of these components in the gut is considered to promote health through modulating the gut microflora and enhancing the production of short chain fatty acids. There is growing interest in more direct aspects of the health-promoting action of food polysaccharides. A number of food polysaccharides have been shown to induce immunomodulatory effects following oral consumption. Chemically-modified pectin and β-glucans are examples of polysaccharides where there is evidence for anti-cancer bioactivity. Certain mechanistic explanations for these effects are believed to involve interactions between the carbohydrates and specific mammalian lectins. Modern biophysical techniques such as force spectroscopy can be used to measure directly intermolecular interactions and to identify bioactive components of complex polysaccharides. The nature of these types of molecular mechanisms, the evidence for specific carbohydrate-lectin interactions and the nature of the bioactive components will be discussed.

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O33

Impact of Industrial Processing on Folate Contents in Green Vegetables

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Key words: vitamin canning loss green beans

Folates are involved in the reduction of neural tube defect and cardiovascular diseases. In the French population, 40% of folates are brought by fruits and vegetables. As fruits or vegetables are often consumed processed, our aim was to determine the loss of folates during processing, and to identify the corresponding biochemical mechanisms.

Samples were collected on a canning chain for green beans on August 2010 in the north of France. Five batches of green beans, all of the same variety except one were followed in the processing chain, each batch corresponding to the harvest of a single field. We sampled the raw material, before and after blanching, before adding covering liquid and the final product. In total for the five batches of green beans two preparation of raw material (intact/cut), two modes of blanching and three sizes of cans were tested. All samples were kept at -80°C until analysis. Folate content was determined after deconjugation and derivatization by HPLC--fluorimetric detection.

The concentration of folates in the initial green beans was quite similar, between 4 and 6.2×10^{-4} mg/g wet matter. For uncut green beans, these concentrations remained constant until the end of blanching. Surprisingly for cut green beans there was a marked increase from raw material to blanching. An increase in folate concentration was recorded after blanching, which might be an artefact of improved accessibility for extraction. Major losses, from 34 to 66%, occurred during sterilization. Just after canning the folate concentration in the covering liquid varied from 5.9×10^{-5} to 2.5×10^{-4} g/L, while in the beans themselves concentrations were 3.4 to 4.1×10^{-4} mg/g wet matter.

Two causes of loss with respect to the vegetables were identified: 1) chemical degradation leading to global loss within the cans, and 2) diffusion to the covering juice leading to loss from vegetable pieces.

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O34

Food Components Targeting the Epigenome

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Key words: epigentics, DNA methylation, histone acetylation, microRNA, green tea, isothiocyanates, cruciferous vegetables, genistein from soy, curcumin

The term "epigenetics" refers to modifications in gene expression caused by heritable, but potentially reversible, changes in DNA methylation and chromatin structure. Given the fact that epigenetic modifications occur early in carcinogenesis and represent potentially initiating events in cancer development, they have been identified as promising new targets for prevention strategies. Major epigenetic mechanisms of gene regulation include DNA methylation, histone acetylation and methylation, and non-coding (micro) RNAs.

Recent years have provided a wealth of information on the potential impact of food components on epigenetic mechanisms. These data have been summarized in a recent review [Huang *et al*., 2011]. Selected studies on (-)-epigallocatechin-3-gallate from green tea, the soy isoflavone genistein, sulforaphane and PEITC found in cruciferous vegetables, and curcumin from turmeric will be presented. Their effects on global DNA methylation, genes silenced by promoter methylation, histone acetylation and methylation, and miRNAs deregulated during carcinogenesis have potential impact on multiple mechanisms relevant for cancer prevention, including detoxification, cell cycle progression, signal transduction mediated by nuclear receptors and transcription factors such as NF-kappaB, apoptosis induction, and others. *In vivo* studies that demonstrate the functional relevance of epigenetic mechanisms for chemopreventive efficacy are still limited.

Future projects will identify best strategies for chemopreventive intervention with micronutrients and dietary food components, taking into account the importance of epigenetic mechanisms for gene regulation.

[1] Huang J., Plass C., Gerhäuser C., Cancer Chemoprevention by Targeting the Epigenome. Curr. Drug Targets, 2010 Dec 15. [Epub ahead of print].

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O35

Validating Allergen Coding Genes (Cor a 1, Cor a 8, Cor a 14) as Target Sequences for Hazelnut Detection *via* Real-Time PCR

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Key words: hazelnut, allergens, real-time PCR

Hazelnut (*Corylus avellana* L.) seeds, belonging to widely consumed tree nuts, are used in a range of confectionery products (filled chocolates or wafers, cereal muesli mixtures and others). Hazelnuts have been shown to contain different allergenic proteins. Among these, major allergens Cor a 1, Cor a 8 and the 2S albumin Cor a 14 were selected as targets to comparatively validate three different sensitive SYBR Green I Real-Time PCR protocols. Our strategy was to prefer single Real-Time PCR reactions, instead of the multiplexed approach, in order to study the effect of each single gene sequence. The second aim was to compare specificity, sensitivity, amplification efficiency, robustness and applicability of the three suggested protocols. We investigated both on the choice of the amplification target and on the matrix effect on different sample foods. Applying statistics on the validation parameters obtained from the three protocols, we showed a significant difference in Ct values. This could turn critical when a high sensitivity method is required for the detection of hazelnut traces, confirming how fundamental the choice of the template during primer design phase is.

Concluding, statistical approach represents a useful tool for the identification of the best performing primer pairs in Real-Time PCR. Cor a 8 gene permitted the identification of hazelnut based ingredients in complex foods, providing a significantly higher sensitivity in the PCR amplification, when compared to Cor a 1 and Cor a 14.

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O36

Food Adulteration and Traceability – New Tools for the Old Problem

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Key words: food adulteration, authenticity, traceability

Food authenticity and traceability are issues of increasing importance in the era of international trade. Consumers demand products of known origin and are often willing to pay more for product related to particular location or botanical origin. Food fraud and adulteration has history as long as food processing and trade. Nowadays it is also a major concern to the food industry, laboratories controlling food quality, equally important for food producers and consumers. Food products classification and labeling according to international standards impose the need for reliable methods to control origin and authenticity of food products.

Among methods used for determination of food origin techniques based on PCR techniques, DNA methods, enzyme immunoassays, biosensors, proteome and metabolome analyses are used. There are applications based on mass spectrometry, especially IRMS, NMR spectroscopy, NIR, UV IR spectroscopy to detect food adulteration. Finally, there are methods based on chromatographic techniques, usually GC and HPLC.

The lecture will be focused mainly on methods based on chromatographic techniques and mass spectrometry used for determination of food origin and for food adulteration detection. Chromatographic methods either oriented at finding and monitoring specific markers for a product, or at "fingerprinting" compounds with the aid of chemometric data processing will be shown. Examples of alcoholic beverages, spices, oils and dairy products will illustrate these approaches

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O37

Plant-Microbes Interactions: Possible Outlook

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Key words: soil microbial activity, plant-microbes interaction, strawberry's productivity

Social, economical and ecological aspects of modern biological science demand increasing the gross yield of 'safe' food as well as decreasing production expenses and preserving ecosystems. Agrarians can solve this complex task by means of carrying out of plant-microbes interaction research in the contest of artificial affected ecosystems and using the peculiarities of these interactions in food production technologies.

In our research we have chosen to study *Fragaria ananasa*, sort Rusanivka and microbial cenosis from the soil under different age plantations of this strawberry. Our research was based on an assumption that the strawberry's productivity is closely connected to the soil microbial activity. Another important point of my investigation was exploring plant's allelopathy impact on soil as a precondition of soil fatigue, which is a significant problem in agrarian countries.

In order to suggest solutions to the above problems I used commonly accepted methods of Mishustin, Vostrov and Petrova. Our experiments were carried out with 3 replications in 4 variations: (1) the second year of strawberry growing, (2) the third year, (3) the fourth and (4) a fallow.

During this research we have established that the highest microbial activity (8.4%) is observed in the first variation – the second year of growing. Besides, this variation showed the highest index of productivity (0.024). Other variations (2, 3, 4) have showed a decrease of microbial activity (7.1%; 3% and 0.2%) and, accordingly, a decrease in productivity index (0.017 and 0.012). We have observed a small (up to 18%) allelopathy impact on soil.

All of the above suggests that there may be a way of stimulating yield increase with the help of expanding soil microbial activity. In other words, stimulating the soil microbial activity, instead of using chemical ways of increasing productivity, may help plants form greater harvest. This research trend could pave the way to ensuring bigger crop productivity in a- "safe" and environmentally friendly manner.

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O38

Foodomics: New Omics for New Foods

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Key words: foodomics, genomics, transcriptomics, proteomics, metabolomics, case studies, colon cancer, diabates

Interaction of modern food science and nutrition with disciplines such as medicine, and biotechnology provides new challenges and opportunities for the advancement of science. As a result, researchers in food science and nutrition are moving from classical methodologies to more advanced strategies, usually borrowing methods well established in medical, pharmacological, and/or biotechnology research. Therefore, advanced analytical methodologies, "-omics" approaches and bioinformatics (together with *in vitro*, *in vivo*, and/or clinical trials) are used, in an integrated way, to approach some key and challenging topics in the modern food science and nutrition era. In this context, Foodomics has been defined as

a new discipline that studies the food and nutrition domains through the application of advanced -omics technologies to improve consumer's well-being, health, and confidence [1, 2]. Thus, Foodomics is intended to be a global discipline that includes all of the emerging working areas in which food (including nutrition), advanced analytical techniques (mainly -omics tools), and bioinformatics are combined. For instance, Foodomics would cover the development of new transgenic foods with molecular tools, the genomic/transcriptomic/proteomic and/or metabolomic study of foods for compound profiling/authenticity and/or biomarkers analysis related to food quality, new investigations on food bioactivity and its effect on human health following nutrigenomics and/or nutrigenetics approaches, development of global -omics strategies to explore food safety issues, *etc*. Specific examples of the Foodomics approach taken in our research group towards colon cancer prevention using functional ingredients, obtained using green technologies, will be presented together with new results on the study of the effects of a diet rich in antioxidants and omega-3 fatty acids on diabetes development.

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SPECIAL SESSION: TRIBUTE TO INTERNATIONAL YEAR OF CHEMISTRY

L7

Plants, Chemistry and the Man and His History – Some Stories Travelling Around the World

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Key words: plants, secondary metabolites, chemical messages, history, dtories, tales

This lecture is an ideal travel around the world telling how plants, their chemical constituents and their "journeys" to other countries or continents have influenced human history, life and tales.

Plants communicate with the surrounding environment, among others, with chemical messages. In general, plants biosynthesize chemical compounds (*i.e.* secondary metabolites) with a structure that has to be specifically and selectively perceived from the target vegetable or animal species to which the message is addressed (*e.g.* pheromones, allomones, induced phytoalexins *etc.*). However, plants and their secondary metabolites have sometimes outdone their role and interfered with several aspects of human life independently on the true reasons the plant has synthesized them for. The influence of plants and their chemical constituents on human life, history and behaviours over the centuries will be illustrated with some examples dealing with plants and magic, mystery, wars, mind and medicine in a journey around the five continents.

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L8

Note by Note Cooking

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Advances in Molecular Gastronomy: methods and models, plus a new fundamental application („note by note cooking") and a lot of new scientific questions which go along.

Since that last lecture on Molecular Gastronomy within the frame of EuroFoodChem, the French Group of Molecular Gastronomy worked a lot, focusing on the study of processes of the kind M@E → M' @ E'. A new analytical method, i.e. *in situ* quantitative nuclear magnetic resonance spectroscopy (d q NMR), was introduced, and it was shown that this fast method was giving access to more saccharides than with conventional methods including extraction and quantitative determination of extract. Indeed this is not the sole advantage, as this method is much faster, and does not use any organic solvent.

In parallel, models were studied for various processes as classified using the complex disperse system/non periodical organisation of space formalism (CDS/NPOS).

Finally as an application of these studies, a new paradigm in cooking was promoted as „Note by Note Cuisine". This new developing trend asks many scientific, toxicologic, technical, technological, artistical and political questions.

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L9

Cuisine, Chemistry and Music; What They Have in Common?

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Science, with its Mediterranean origins, was regarded by the European tradition as belonging to philosophy and the arts (Gr.techne, Lat. Ars). The schools of the ancient Rome and medieval Europe taught so called *artes liberals* ,the liberal arts. These were divided into *trivium,* which consisted of grammar, rhetoric, and logic; and *quadrivium* comprising arithmetic, geometry, music and astronomy. These subjects were also taught in medieval universities at the departments of Liberal Arts constituting preparatory fields for further studies of Theology, Medicine and Law. In the Renaissance artists have achieved the true "liberation" of the arts. At that time common was the idea that architecture, painting, sculpture are all related to each other and therefore they were given a name *arti del disegno* "the arts of drawing". With the foundation of the first academies of the fine arts (beginning with the French "Royal Academy of Paining and Sculpture" in 1648) the artists and the craftsmen started to be recognized as separate. This, however, did not pertain to scientists. It was not until the end of the 17th century when people became aware that what is important in art is not knowledge but talent and good taste, and in this respect art

is different than science. From the 17th century science was becoming more and more autonomous to finally exclude philosophy and the arts in the 20th century. In English and French speaking countries the term *Science* referred merely to mathematical and natural sciences applying to the physical world. In Germany science *(Wissenschaft)* was given broader meaning, including humanities. In Poland it had even wider understanding, encompassing theology and "practical sciences", such as engineering, technology, medicine.

The hermetic trend, tightly linked with religious cults, especially those of ancient Egypt, has brought about the art of alchemy. Alchemy, with its forbidden access to laymen, being at the same time art and mystical science, was in medieval Europe the basic source of knowledge about nature and was closely related to medicine and production of medications. The discoveries and experiments of alchemy gave rise to one of the youngest of all natural sciences – Chemistry.

Does Chemistry nowadays have anything to do with the arts, especially music or painting? Can a chemist still be an artist?

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L10

The Relative Importance of Food Chemistry for Health

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Key words: food chemistry; positive and negative quality; communication model

For many consumers chemistry seems to be a magic and rather mysterious concept. In food chemistry various positive and negative quality factors are communicated to consumers which are often misinterpreted or at least misunderstood. This offers a challenge for food chemists and nutritionists to balance these factors in such a way that the relative importances are clearly accounted for. Regarding the negative quality, we may think of food additives, contaminants, micro organisms and free radicals. As to the positive quality, the overestimation of antioxidants, vitamins, functional food ingredients and biological product can be mentioned.

We developed an 'umbrella view' concept to account for the various positive and negative factors , not only for scientists, but, as a consequence, also for consumers.

The lecture will be presented including magic and musical illustrations.

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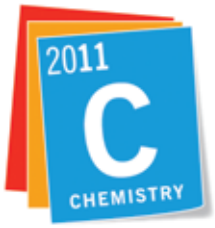

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