

PROCEEDINGS
OF THE 5TH
INTERNATIONAL
CONFERENCE
ON THE QUALITY
AND SAFETY
IN FOOD PRODUCTION
CHAIN

Department of Animal
Products Technology
and Quality Management
Wrocław University of Environmental
and Life Sciences

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WROCLAW
19-20 September
— 2011 —

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Materials financed by the Polish Ministry of Science and Higher Education

Editors are not be held responsible for the contents of the submitted abstracts

ISBN 978-83-7717-070-0

WYDAWNICTWO UNIwersytetu PRZYRODniczego we Wrocławiu

Redaktor Naczelny – prof. dr hab. Andrzej Kotecki

ul. Sopocka 23, 50-344 Wrocław, tel. 71 328 12 77

e-mail: wyd@up.wroc.pl

Nakład 170 + 16 egz. Ark. wyd. 12,0. Ark. druk. 14,25.

Druk i oprawa: F.P.H. „ELMA”

Ladies and Gentlemen,

The quality of food products depends on all elements of an environment, in which production is conducted. Soil, water air and feed contamination decided about the quality of plant and animal raw materials and may limit their use in food production. Food processing methods, food additives, preservation, packaging and labeling technologies also decided about the health quality of food.

Production of food is a complex and long chain of biological, chemical, physical, economic and psycho-sociological processes. It is also strongly conditioned by many religions. It is, however, a key existential element of mankind and all economic and political activities must be subordinated to the idea of quality of life, sustainable development and, first of all, to the basic existence needs of the humans.

Food science is a wide spectrum of knowledge covering fundamental and applied sciences. Food processing technologies are based on the latest scientific achievements and are closely integrated with the food legal regulations. The knowledge of biological principles governing the production of materials to be processed is equally important. Thus, food production requires monitoring of process in whole production chain "from field to table".

All aspects of food production chain is strongly connected with quality of life. The improvement of the quality of life is in focus of many groups research, worldwide. This improving includes such factors as functional food products, food products of natural origin, nutraceutical, diet supplements, as well as advances in biotechnology.

The population of Europe is getting older and that is why a new style of life should be promoted. It is expected that in the year 2030, over 30% of the European population will be alder than 60 years. It is assumed that in 2050, ca 30% of the population will be persons aged 80 and more. Due to this fact, the main objective of social policy is to promote healthy style of life, physical activity, individualized prevention and therapy, balanced diet and consumption of natural biologically active substances, including nutraceuticals.

The Wrocław University of Environmental and Life Sciences is developing very large research in area of the modern technologies including novel food nutraceutica, biomedical products – all for the idea connected with improvement quality of life. First of all Wrocław University of Environmental and Life Sciences is actively involved in the activities promoting the quality and safety of food in the food production chain and it participates in all national and European initiatives. One of the forms of such activity is organization of international conferences.

The first International Conference in the cycle of "Food Quality and Safety" was held in the year 2000, the present, fifth conference in the cycle, has been divided into five sections, that is:

1. Food preservation and packaging systems
2. New Technologies and methods for the improvement of food products, nutraceuticals and biomedical preparations

3. Food analytics
4. Safety systems in food production chain
5. Information and education systems in building consumer awareness

The organizers of the conference would like to wish all participants effective discussion, constructive debate and pleasant time during your stay at this university and in our beautiful City of Wrocław, the capital of Lower Silesia.



Prof. Tadeusz Trziszka
Chairman of the Conference Organizing Committee

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Ambrozik- Haba J., Semeriak K., Zimoch A., Jarmoluk A.

HYDROCOLLOIDS AS STABILIZERS OF LOW FAT EMULSION

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The aim of this study was to check stabilisation capability of emulsions with an addition of 5% (w/w) rapeseed oil and polysaccharide hydrocolloids.

Experimental dispersions included following hydrocolloids: locust bean gum, guar gum, konjac gum, tara gum, xanthan gum or mixture of those polysaccharides. Hydrocolloids were used in three different concentrations. The measurements of emulsions included: storage stability, emulsifying activity, emulsion stability, viscosity. Results were statistically analysed using Statistica 6.0.

Xanthan gum used as the stabilizer in low fat emulsions showed the highest stability impact. It was found that for 100% of the emulsifying activity and emulsion stability was a necessary addition of guar gum, xanthan gum or Konjak at 1.5, 1 or 0.15%, respectively, or by using a mixture of two or three hydrocolloid component, independent of the polysaccharide concentration. Xanthan gum and guar gum had the most significant influence on viscosity emulsions.

Key words: emulsion, hydrocolloids, stabilizers, xanthan, guar

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Babij K.¹, Dąbrowska A.¹, Trziszka T.¹, Ożyhar A.²

**OBTAINING A RECOMBINANT EGG-SHELL PROTEIN
OVOCLEIDIN-17 USING A PROCARYOTIC EXPRESSION SYSTEM**

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Proteins that appear in the eggshell matrix seem to play a key role in initiating, stimulating and controlling the process of eggshell mineralization, as well as in protecting the embryo against microbial infections. Ovocleidin-17 (OC-17) is a major component of an chicken eggshell extracellular matrix. It is present in glycosylated (23 kDa) and non-glycosylated form (17 kDa) and exhibits antimicrobial properties against several bacteria species, like *Bacillus subtilis*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Wellman-Labadie et al, 2008).

The aim of the research was obtaining a recombinant form of ovocleidin-17 (rOC-17) in *E.coli* prokaryotic expression system. The synthetic gene of ovocleidin-17 was cloned into the pQE80L (Qiagen) expression vector. The heat shock method was used for the transformation of *E.coli* B21 with the obtained OC-17/pQE80L construct. The expression of recombinant protein was induced by isopropyl β -D-1-thiogalactopyranoside (IPTG) addition to the final concentration of 1mM in growing in 37°C bacterial culture. The presence of the recombinant protein was determined by the electrophoretical comparison of bacterial cells lysates protein patterns in samples taken before and after 1,2,3 and 4 hours after induction with IPTG. It was shown that the rOC-17 is present in the culture after one hour of culturing and it's amount is accumulating with time. The purification of rOC-17 was performed with the use of affinity chromatography on His Select Cobalt Affinity Gel (Sigma) under denaturing conditions with buffer supplemented with 8 M urea. The SDS-PAGE analysis of collected at 280 nm peak fractions shows the presence of single band with molecular weight about 17 kDa which corresponds the molecular weight of chicken OC-17.

Key words: egg shell proteins, ovocleidin-17, recombinant protein

Performed during the realisation of project No. POIG.01.03.01-00-133/08- "Innovative technologies of production of biopreparations based on new generation eggs (OVOCURA)". The project is co-financed by the European Regional Development Fund within the Innovative Economy 2007–2013 Operational Programme.

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Balcerek M., Pielech-Przybylska K., Książkowska M., Patelski P.

**INTERMEDIATE PRODUCTS OF PLUM PROCESSING
AS RAW MATERIALS FOR FRUIT DISTILLATES PRODUCTION**

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Technical University of Łódź, Łódź, Poland*

Interesting group of spirit drinks are natural fruit vodkas (brandy, eau de vie) which according to the Council Regulation (EEC) No 1576/89 are the spirit drinks with the minimum alcoholic strength of 37.5% v/v, made exclusively by distillation process of fermented fruit pulp, fermented fruit mash, fruit macerate (also partly fermented) in ethyl alcohol, vodka or distillate, to the alcohol strength at less than 86% v/v. Very popular stone fruit brandies in Eastern and Central Europe are plum brandies (slivovitz) prepared from fresh Węgierka plums.

This study aimed at evaluation of intermediate products of plum processing as potential raw materials for fruit distillates production (used for fruit brandies preparation).

The raw materials for distillates production were intermediate products of plum var. Węgierka processing, i.e. pulp, concentrate and syrup after candisation of plum, obtained from polish fruit processing factories. Fermentation worts were prepared through the dilution of mentioned semi-products to the extract ca. 17–18°B_{lg}. Selected samples of the mashes were supplemented with sucrose from 6 to 12% w/w. Activit preparation (Institut Oenologique De Champagne, France) (20 g/100 l) and (NH₄)₂HPO₄ (150 g/100 l) were also added as nutrients for yeast. Fermentations were started by addition of raisins (150 g/100 l) as a source of microorganisms or by using dried wine yeast *S. bayanus* (Fermentis, Division of S.I. Lesaffre, France) (40 g d.m./100 l), at the temperature of 17–18°C. Raw spirits containing 20–23% v/v ethanol, obtained by using of according to the law of parallel-current working apparatus, were then moved into the apparatus equipped with a birectifier (dephlegmator according to Golodetz), to remove 3% of heads and to get ethanol concentration up to 75% v/v.

Chemical composition of the investigated intermediate products of plum processing, especially high content of total sugars (from 38.20 g/100 g of pulp to 67.88 g invert sugar /100 g of syrup after candisation) makes them attractive raw material for fruit distillates production – it could provide a high yield of ethanol. The composition of worts significantly affected the fermentation times. The shortest time of process, lasting approximately 7–8 days was observed for the worts prepared from plum pulp fermented with *S. bayanus* wine yeast. The completion of fermentation of plum concentrate and syrup after candisation-based worts

was observed after ca. 10 days. A longer initial phase was noted during spontaneous fermentation (raisins with their native microflora) and in a consequence fermentation of these worts resulted in lengthening of the overall process time to ca. 16 days.

The highest concentration of volatile compounds, expressed as a sum of acetaldehyde, ethyl acetate, isoamyl acetate, n-propanol, 2-methyl-1-propanol, n-butanol, 2-methyl-1-butanol and 3-methyl-1-butanol (5214.48 mg/l spirit 100% v/v) was determined in distillate obtained from plum pulp-based wort, fermented with participation of microorganisms present on the raisins surface. Concentrations of these compounds determined in the remaining distillates ranged between 2927.29 mg (syrup after candisation of plums, with addition of 6% sucrose, *S. bayanus*) and 4853.99 mg/l spirit 100% v/v (plum pulp, with addition of 6% sucrose, *S. bayanus*). The results demonstrated that the concentrations of volatile compounds in the obtained plum distillates exceeding 200 grams per hectolitre of 100% v/v (i. e. 2000 mg/l) and low content of undesirable compounds (methanol and hydrocyanic acid) meet the requirements of the Council Regulation (EEC) No 1576/89. Moreover their good flavour makes tested intermediate products of plum processing attractive raw materials for fruit distillates production.

Key words: plum, distillates, fermentation, volatile compounds

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Balcerek M., Pielech-Przybylska K., Patelski P., Dziugan P.

**SUGAR BEET AND RAW JUICE – INTERMEDIATE PRODUCT OF ITS
PROCESSING AS RAW MATERIALS FOR BIOETHANOL PRODUCTION**

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Application of ethanol as a biofuel decreases the dependence on crude oil import, increases the energy independence of the country and reduces green house gas emissions to the atmosphere. Bioethanol can be produced from all feedstocks containing mono-, oligo- and polysaccharides. Sugar beet and intermediates from processing are very good raw materials for ethanol production due to their content of fermentable sugars.

This study aimed at evaluation of sugar beet and raw juice as potential raw materials for ethanol production. Effect of composition of worts prepared from sugar beet (after pressure cooking) and method of raw juice-based worts pretreatment and their pH on fermentation dynamics and ethanol yield was determined.

Sugar beet and raw juice were obtained from the sugar factory in Dobrzelin (Poland). Fermentations were carried out by using dried distillery yeast (2.0 g/L), strain As-4, purchased from the yeast factory in Maszewo Lęborskie (Poland) or Ethanol-Red (0.5 g/L) (Lesaffre, France). $(\text{NH}_4)_2\text{HPO}_4$ (0.3 g/l) was used as nutrient for yeast. Selected samples of sugar beet-based worts were supplemented with enzymatic preparation Cellustar (cellulase) (0.1 mL/L) (Novozymes, Denmark). Sugar beet and raw juice were analyzed by methods recommended in sugar industry: worts before and after fermentation by methods recommended in distilleries.

Fermentation trials revealed that both As-4 and Ethanol-Red yeast strains ensured the complete fermentation of sugar beet and raw juice-based worts within less than 72 hours and ethanol yield from ca. 88 to 94% of theoretical. Supplementation of mashes prepared from sugar beet with $(\text{NH}_4)_2\text{HPO}_4$ is needed to keep their high fermentation activity. Moreover, treatment of mentioned worts with supportive enzymatic preparation containing cellulase had significant impact on an increase of fermentation dynamics and ethanol yield up to 96% of theoretical compared to reference wort (without addition of Cellustar preparation). The pretreatment of raw juice-based worts with pasteurization, sterilization or ozonisation had no significant effect on fermentation dynamics, sugar intake and ethanol yield in comparison with reference worts. Advisable action is only correct pH of raw juice-based worts from ca 5.9 to 4.8 which ensure high productivity of ethanol.

Summing up, sugar beet and raw juice are attractive raw materials for ethanol production without the need of additional technological operations increasing costs of biosynthesis.

Key words: sugar beet, sugar beet juice, bioethanol, fermentation

The study was financed by the Polish Ministry of Science and Higher Education under R&D Grant No N R12 0062 06.

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Beszterda M.¹, Waśkiewicz A.¹, Szulc P.², Bocianowski J.³, Goliński P.¹

**THE DIFFERENTIATION THE LEVEL OF ERGOSTEROL
AS A COEFFICIENT OF FUNGAL BIOMASS IN THE VARIOUS
MAIZE CULTIVARS**

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Fungal growth can lead to spoilage of food and animals feeds and to the formation of mycotoxins and potentially allergenic spores. Analysis of chemical markers like ergosterol (ERG) in samples of food and animal feed can provide information on microbiological contamination quickly. Ergosterol is the principal sterol playing an essential role as a component of fungal cell membranes, while it is absent in vascular plants.

The aim of this work was to monitor ergosterol synthesis in sixteen cultivars maize grain samples in four replication. A field experiment was carried out in Department of Agronomy at University of Life Science in Poznań on field of Didactic-Experimental Institute in Swadzim, in 2010 year. A high-performance liquid chromatography (HPLC) with a PDA detector was used. Ergosterol content was estimated by comparing peak areas with those of the external standard. The presence of ergosterol was confirmed by a comparison of retention times with those of the external standard and/or by co-injection with a standard solution. Microbiological tests estimating mould contamination of the examined plant materials showed high contamination levels. In all sixteen samples the ergosterol was present ranged from 4.45 $\mu\text{g g}^{-1}$ to 15.98 $\mu\text{g g}^{-1}$. The ergosterol content described in the literature as the maximum safe level allowed level for human consumption is 7 $\mu\text{g g}^{-1}$ and eleven of all analyzed milling maize samples had amount exceeding this limit. The high level of ergosterol can come from both pre-existing fungal communities and post-harvest fungi.

Fungi play a major role in the reduction in the nutritional value of food products and ergosterol appears to be a sensitive early indicator of low levels of fungal activity in grains.

Key words: ergosterol, maize, mould contamination

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Biazik E., Kopec W., Pudlo A., Skiba T.

**BIOLOGICALLY ACTIVE HISTIDINE DIPEPTIDES – FUNCTIONAL
COMPONENT OF POULTRY MEAT**

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Wrocław University of Environmental and Life Science, Wrocław, Poland*

Anserine and carnosine – histidine containing dipeptides are known to be biologically active compounds. They are widely distributed in mammalian tissues. They have antioxidant, free-radical and metal ion-scavenging properties. Moreover, they can react with simple sugars and block the glycation process. Carnosine and anserine have been suggested to have potential therapeutic applications in individuals with metabolic and cardiovascular disease, as well as potential effects against the pathogenesis of Parkinson's disease and related disorders.

Carnosine and anserine were quantified by HPLC method. For sample preparation, muscles were homogenized and hydrophilic fraction was separated using a centrifuge. Then the samples were deproteinised with methanol (1v:3v). A sample solution was reacted with O-phthalaldehyde (OPA pre-column derivation method) before being injected into HPLC. The separation was monitored by a fluorescent detector.

Poultry meat was characterized by higher anserine content and lower level of carnosine. The highest concentration of both dipeptides we can notice in turkey breast muscle. Also mechanically deboned poultry meat can be also source of histidine dipeptides but level of both dipeptides is lower compared to muscle tissue. It can be concluded that poultry meat is rich source of bioactive histidine dipeptides occurring in the muscle tissue.

Key words: poultry meat, histidine dipeptides, carnosine, anserine

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Bilyk O.¹, Dronyk G.¹, Slyvka N.¹, Górecka J.², Szmańko T.²

**SCIENTIFIC AND PRACTICAL ASPECTS OF MAKING ALBUMIN
CHEESE URDA**

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One of the priority lines of the food industry is to improve existing and develop new technologies of food functionality. The use of whey is a prospective direction in the production of these products. Urda – albumin cheese is produced from sheep whey. Such a product that is made exclusively from sheep whey is expensive. However, if to use a mixture of sheep and cow whey, it possible to reduce significantly the cost price of the finished product, and in addition, to use efficiently secondary raw materials.

The aim of the research was to develop technology of albumin cheese Urda and to choose the optimal ratio of sheep and cow whey for its production.

Technology of albumin cheese consists of the following operations: accepting raw material and its quality assessment → whey purification → heat treatment of whey (85–90°C with 30 minutes holding) → separation of proteins → self-pressing of the cheese mass → pickling of cheese → packaging, storage.

Organoleptic, physicochemical, biochemical and rheological parameters of albumin cheese made from a mixture of sheep and cow whey in different proportions were studied. It was revealed that Urda cheese made from sheep whey and a mixture of sheep and cow whey in different ratios have a similar taste, smell and colour. The cheese made from a mixture of sheep and cow whey at a ratio 1:1 is characterized by rich consistency and the best indices. Also, this cheese at a ratio 1:1 has higher biological value indices as compared with other researched albumin cheeses.

As a result of research the best option for the production of albumin cheese Urda is a mixture of sheep and cow whey at a ratio of 1:1.

Key words: sheep whey, cow whey, albumin cheese, Urda

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Błażewicz J., Kawa-Rygielska J., Szwed Ł., Zembold-Guła A.

**INFLUENCE OF HIGH CONTRIBUTION OF MILLED MAIZE
PRODUCTS ON QUALITY OF WORTS**

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Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

Economical aspects of market stimulate need of substitution of expensive material with cheaper modulus. In brew house the most expensive material is malt, which with acceptable quality loss can be replaced with other source of extract.

The aim of this work was the estimation how varying factors are influencing quality of worts produced from composition of malt with high quantity of milled maize products, which is continuation of work published in "Food Technology Operations, New Vistas".

Varying factors were: dose of fine maize grits or maize grits in range from 40 to 80% of composition, granulation level of raw materials – maize grits: 750 μm – 1250 μm ; fine maize grits: <750 μm , type of malt used: Pilsner type or caramel light. Milled corn products originated from two independent suppliers, from which one supplied both fine maize grits and maize grits, and the second supplied only maize grits, which was additionally milled for comparison.

In the course of experiment the following parameters were determined: time of mash saccharification, time of flow, final volume of worts, extract content and pH of worts. The data was compared to analogous parameters of 100% malt worts, and malt worts obtained with Ceremix Plus supplementation.

Addition of raw materials in amount 40 and 60% of grist gives worts with normative saccharification time and final volume. The difference in level of granulation of maize grits, and fine maize grits in large degree influences all investigated parameters. Fine maize grits produced in laboratory conditions (with high share of fine fractions) were characterized by high extract content despite prolonged time of saccharification and lowest final volume. Statistical analysis showed significant differences in pH values.

Key words: Unmalted materials, maize, enzymes, gelatinization, extract content

This work was financially supported by the Ministry of Science and High Education. Project N N312 077038.

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Błażewicz J.¹, Liszewski M.², Zembold-Guła A.¹, Kozłowska K.², Szwed Ł.¹

**THE EFFECT OF NITROGEN FERTILIZATION OF BREWING
BARLEY PLANTS ON THE MALTING PRODUCTIVITY**

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Wrocław University of Environmental and Life Sciences, Wrocław, Poland

The purpose of this study was to determine the effect of growing season, cultivar characteristic and the six variants of nitrogen fertilization on economic usefulness of brewing barley grain cultivars. Economic suitability of brewing barley 'Mauritia' and 'Sebastian' cultivars was defined on the basis of plump grains yield, malting productivity and malt weight, which are obtainable from 1 hectare of cultivation.

A strict field experiment was conducted during the growing seasons 2008–2010, in Agricultural Research Station in Pawłowice near Wrocław, on different nitrogen fertilization levels (kg N·ha⁻¹): 0, 20, 40, 60, 60 (40+20I), 60 (40+20II). Nitrogen fertilization was prosecuted preplant and top-dressing (divided doses) in two stages of growth: I – at the end of tillering, II – in the stage of second node. From barley grain of thickness over 2.5 mm, Pilsner type malts and congress worts were obtained in laboratory conditions.

The results of investigations show that the weather was the strongest factor influencing economic usefulness of the grain. It was affirmed that regardless of the year of the investigation, fertilization with nitrogen had influenced the growth of the yield of plump grains and simultaneously the increase of the malts weight from unit area. It was found that highest economic usefulness, determined on the basis of malting productivity and extractivity was characterized by brewing barley from the year 2009.

Key words: nitrogen fertilization, brewing barley, malting productivity, malt extractivity

This work was financially supported by the Ministry of Science and High Education. Project N N312 199035.

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**Bodkowski R.¹, Pękala J.², Patkowska-Sokoła B.², Jamroz D.²,
Steininger M.¹, Lochyński S.¹, Dobrzański Z.², Nowakowski P.²**

**APPLICATION OF ENZYMATIC METHODS AND LIQUID
CHROMATOGRAPHY (HPLC) FOR DETERMINATION
OF CARNITINE CONTENT IN MILK AND MEAT**

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Recently L-carnitine has gained increased interest as a natural compound of animal origin that has a beneficial effect on humans health. The primary function of L-carnitine is to permit the entry of esterified fatty acids (the source of ATP synthesis) into the mitochondrial matrix, where β -oxidation occurs.

The aim of the study was an estimation of genetic factor influence carnitine content in animal products (milk and meat) according to different analytical methods: two spectroscopic procedures (spectrophotometric and spectrofluorometric) based on enzymatic reactions and HPLC separation followed by UV detection. Material (raw milk and fresh meat) were obtained from 3 different ruminant species: cows, goats and sheep. The samples from all animals of each species were collected twice, then prepared for determination of total and free L-carnitine.

The highest level of both carnitine forms was noted in sheep milk, medium in cow, and the lowest one was found in goat milk. In sheep milk total carnitine concentration was about 38% higher than in cow milk, and when compared to goat about 94%, respectively. The most profitable free:total L-carnitine proportion was characteristic to sheep milk and it amounted to 0.32, while in cow milk 0.28 and goat 0.19. In meat, likewise in milk, interspecies diversities of free and total L-carnitine level were found. The highest concentration was found in lamb, consecutively in beef and goat meat. Total L-carnitine content in lamb was higher about 12% than in goat meat. Lamb was also characterized by about 7% content of that compound. Some differences were therefore established between beef and goat meat. Beef contained about 5% more total L-carnitine than goat meat. The most profitable free: total L-carnitine proportion was characteristic to lamb meat 0.82, while in beef 0.77 and goat 0.75.

All of the applied methods have given comparable and reproducible results which confirmed that the content of quantified carnitine forms was significantly diversified in milk and meat samples from the three domestic ruminant species. The highest concentration of L-carnitine in was found in sheep milk (11.5 mg of total carnitine/100 ml; 3.8 mg of free L-carnitine/100 ml) and in lamb (109 mg of total carnitine/100 mg; 90 mg free L-carnitine/100 mg). In general, it has been proved that muscles are a good source of L-carnitine, moreover dairy product are able to provide meaningful quantities of the important isomer in human diet as well.

Key words: carnitine, meat, milk, HPLC, spectrophotometric, spectrofluorometric

The study was conducted within the framework no N N311 019537.

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**Boruckowska H.¹, Boruckowski T.¹, Żolnierczyk A.²,
Tomaszewska-Ciosk E.¹**

**ENZYMATIC ESTERIFICATION OF STARCH PHOSPHATE
BY OLEIC ACID**

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² Department of Chemistry,

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The subject of the present work was to obtain the ester of monostarch phosphate and oleic acid in the reaction of enzymatic esterification with the use of the lipase of the microbial origin.

The trade preparation of the monostarch phosphate was subjected the reaction of enzymatic esterification by the oleic acid with use of the immobilized lipase from the *Candida antarctica* yeast in the environment of tert-butanol. The analyze of properties of the received product and the substance of the subjected modification – the starch phosphate was made after the reaction process. Chemical bonds in the received product were interpreted by the magnetical resonance method (HNMR). The analysis of absorptive spectroscopy FTIR was performed in order to determine the functional groups. The characteristics of the thermal profiles of preparations were done using the differential scanning calorimeter DSC, and also rheological properties of preparations was measured using Haake Rheostress rhometer.

In the result of the process of the enzymatic esterification of the starch phosphate by oleic acid with use of the microbial origin lipase, in the time of 10 days, the new compound was obtained – the ester differing the properties from the parent substance. Keeping the starch phosphate with the fatty acid in the environment of tert-butanol without lipase, caused the phosphate will come into being the complex starch – oleic acid.

Modificates produced by enzymatic esterification exhibit features of non-newton liquids and they differed physical properties from products from which they was obtained.

Key words: starch, monostarch phosphate, enzymatic esterification, oleic acid

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**Boruckowski T.¹, Boruckowska H.¹, Bienkiewicz M.¹, Żołnierczyk A.²,
Drożdż W.¹**

**ATTACHING OLEIC ACID INTO ACETYLATED STARCH
BY ENZYMATIC TRANSESTERIFICATION**

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Modification of the native starch changing its physicochemical and functional properties can be a good way to find the wider use of this material.

The main method of receiving starch modificates is to use chemical factors. The enzymatic synthesis is alternative solution. The reactions of the esterification of the natural potato starch, and also reaction of the transesterification of high acetylated potato starch by oleic acid with use as the catalyst the trade preparation of lipaze isolated from the *Candida antarctica* yeast (Novozymes 435) and also with use of fraction A and B of that enzyme were conducted in the present work. Natural potato starch and high acetylated potato starch was drying in the temperature 60° C and 105°C at the atmospheric pressure. Proper reactions were conducted in two variants, differing the composition of the reaction mixture and the reaction time. In first case the reaction time was 10 days and every enzyme addition amount to 1 g. In second case reactions were led in the excess of the enzyme (3 g) by the 72 h. The samples in first and second variant were kept in the temperature 60°C in the environment of the solvent: tert-butanolu.

The thermal profile of gelification and burning was measured in obtained modificates on the differential scanning calorimeter DSC 822e of the Mettler Toledo firm. Moreover the analysis of chemical bonds present was executed in modificates by the magnetical resonance ¹HNMR method on Brucker ADVANCE AMX 300. The degree of substitution of the starch by oleic acid (DS) was counted on the basis of ¹HNMR spectrum. The analysis of functional groups was executed for confirmation of the presence of esters bonds in samples by FTIR spectroscopy.

It was affirmed in the result of conducted investigations, that there is possible to execute the reaction of esterification and transesterification using the enzymes. In the case of the natural potato starch, the highest degree of the substitution (DS = 2.11) was obtained in the reaction of esterification leaded by 72 h with the use of the A fraction of enzyme. Natural starch kept 10 days with the addition of Novozymes 435 lipaze did not undergo the substitution.

In the case of the high acetylated potato starch, the highest substitution (DS = 1.24) was obtained in the reaction leaded by 72 h with the addition of the B fraction of enzyme. The lowest degree of substitution (DS = 0.21) was obtained in the case of 10 days reaction with the addition of enzyme Novozymes 435. Received preparations differ their properties from the natural starch.

Key words: starch, modificates, *Candida antarctica*, esterification, DSC, HNMR

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Brodacki A., Batkowska J.

**PHYSICO-CHEMICAL MEAT TRAITS OF SLOW GROWING
SLAUGHTER CHICKEN**

The University of Life Sciences in Lublin, Poland

Hybrid chicken of both sex were subjected to evaluation. They were obtained with the use of Cornish, Sussex (Sx) and Greenleg Partridge (GP) hens, which constituted the component of slow growing meat type chicken. These hybrids were compared to fast-growing Cobb chicken. Birds were kept in two systems of rearing: extensive with the use farm fodders and free access to grass runs and in intensive one.

The chicken were slaughtered twice, in 9th or 12th week of their age. During the dissection analysis the samples of breast and thigh muscles were collected for physico-chemical evaluation. The evaluation covered: pH measurement in 15, 60 minutes and 24 hours after slaughter, conductivity measurement 1 and 24 hour after slaughter, water holding capacity and natural drip from muscle tissue, as well as meat brittleness after thermal process.

Regardless of age in all groups of chicken the pH value in both muscles fluctuated from 5.9 to 6.2, this indicates that it was not abnormal meat, without PSE symptoms. The pH decrease in subsequent measurements could pointed to the proper glycolysis process.

The values of electrical conductivity after 1, as well as after 24 hours after slaughter, were analogous to the growth rate of birds, the biggest values of this parameter characterized the fastest growing chicken. It was stated, that the conductivity of meat derived from younger birds, 9-week old, is smaller 60 minutes after slaughter and grows by 50 to 70% of its initial value during next 24 hours. In 12-week old chicken meat divergences observed were considerably smaller. However, bigger conductivity values were not connected with bigger thermal drip loss or higher pH. Because this parameter is directly connected with meat abnormalities, it seemed that birds are better matured for slaughter in 12th than in 9th week of age.

In meat type hybrids thermal drip loss was significantly influenced by the rearing system, higher losses, by about 25% were recorded for birds reared intensively. Other kinds of hybrids did not influence this trait. Additionally, bigger percentage loss of water was noted in thigh than in breast muscle, as well as in younger than in older birds. This fact may indicate better technological usefulness of meat from chicken slaughtered in older age.

The smaller share force values characterized breast in comparison to thigh muscles in hybrid chicken of all types, as well as in older birds, slaughtered in the second term. Thigh muscles, obtained from chicken slaughter earlier, in 9th week of age, were more tender. Both breast and thigh muscles in birds derived from extensive system of rearing were less tender

with relation to those derived from chicken reared intensively. The exception of this regularity were Cobb hybrids, in these birds the tenderness of breast and thigh muscles was slightly higher in birds reared extensively. These birds were characterized by the smallest shear force value necessary to cut both breast and thigh muscles in comparison to other groups. The influence of chicken sex on whichever analyzed parameters was not affirmed.

Key words: slaughter chicken, sex, hybrids, meat, physico-chemical traits

Research was realised within the project "BIOŻYWNOŚĆ – innowacyjne, funkcjonalne produkty pochodzenia zwierzęcego" ("BIOFOOD – innovative, functional products of animal origin") no. POIG.01.01.02-014-090/09 co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007 – 2013.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Brodacki A., Batkowska J., Florek M.

**THE COLOUR AS A MARKER OF SKIN AND MEAT
OF SLOW GROWING SLAUGHTER CHICKEN**

The University of Life Sciences in Lublin, Poland

The aim of the study was to determine the possibility of carcasses differentiation of slow growing chicken derived from Dominant White Cornish (DWC) cocks and Greenleg Partridge (GP) or Sussex (Sx) hens, on the basis of skin and meat colour. These hybrids were compared to fast-growing Cobb chicken.

The choice of Greenleg Partridge as a component of slow growing chicken was imposed by the fact that they possess genetically conditioned melatonin in dermis which causes dark colour of carcasses together with the xanthophyll present in epidermis. This feature could be used as a natural marker of carcasses of birds reared extensively.

The chicken were slaughtered in 9th and 12th week of rearing. The colour parameters (L^* , a^* , b^*) were determined with the use of color measurement instrument Minolta CR-200. The colour of skin was analysed just after the slaughter, and the colour of muscle was estimated two times, 24 hours after slaughter and after thermal processing.

On the basis of skin colour estimation it could be stated, that in both terms of slaughter, significantly darker skin characterized carcasses of chicken derived from GP hens, however the darkest one was characteristic for carcasses of Sx birds. Simultaneously, the skin of GP birds demonstrated considerably bigger saturation in red (a^*). The smallest blue-yellow coordinate (b^*) characterized the skin of Sx birds as well as the biggest Cobb birds in both terms of slaughter. It was also noted, that the skin of fast growing birds as well as Sx became lighter with bird's age. The L coordinate in PG carcasses did not change.

The percentage of light reflection for muscles changed slightly with the age of birds, with exception to broilers group reared intensively, in this group the increase of L value was noted. In Sx and GP groups a^* coordinate growth in the direction of green was observed in breast muscle and in the direction of red in thigh muscles. The values of b^* coordinate in both muscles were appreciably influenced by the system of rearing, and was statistically higher in chicken reared intensively. However, this parameter did not change with birds' age and only slightly differed because of chicken's origin.

The increase of lightness as a result of thermal process fluctuated between specific groups from 27 to 33% in breast muscle and from 25 to 30% in thigh muscles. The differences of ΔL^* values were not influenced by the term of slaughter, but only the muscle type. The distinctions in skin or muscle colour between birds of different sex were not noticed

in any term of slaughter or hybrid type. The diversified colour of carcass skin or muscles allowed to distinction particular genetic and aged groups using optical measurement instruments. The distinction was not possible without the use of these instruments, therefore, this feature cannot be used as a simple marker, which allows consumers identify carcasses of birds reared extensively.

Key words: slaughter chicken, sex, hybrids, meat colour¹

Research was realised within the project "BIOŻYWNOŚĆ – innowacyjne, funkcjonalne produkty pochodzenia zwierzęcego" ("BIOFOOD – innovative, functional products of animal origin") no. POIG.01.01.02-014-090/09 co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007–2013.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Brychcy E.¹, Gancarz R.²

**THE IMPACT OF DOG ROSE AND HIBISCUS EXTRACTS
ON CALCIUM OXALATE SOLUBILITY**

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Many people suffered from kidney stone disease. The most common cause is possibility of their creation from calcium oxalate. The aim of this study was to check the possibility of dissolving kidney stones by extracts from hibiscus and dog rose. A correlation between the structure of experimental extracts and their capabilities to dissolving of model kidney stones was examined. Effects of plant extracts from dog rose (*Rosa canina L.*) and hibiscus petals (*Hibiscus rosa-sinensis*) on crystals morphology were tested *in vitro*. Petals of dog rose were very hard to achieve and because of that hibiscus petals were used instead of them in the experiment.

Extracts of dog rose and hibiscus were tested as potential solvent for products. They were also tested for their calcium binding capabilities via atomic emission spectroscopy (analytical method based on measuring emitted radiation from inducted atoms in samples). Effects were confirmed using microscopy techniques.

During the research it was confirmed that both dog rose and hibiscus extracts contained large amounts of carbohydrates, which are the main reason of their calcium binding abilities. Negative value of emission percentage suggests that calcium ions concentration was lowered. To adequately compare solutions of calcium oxalate before and after adding the extract calcium oxalate crystals of size 100 µm – 125 µm were used. Samples contained *Rosa canina L.* extracts presented smaller calcium oxalate crystals, what suggest the possibility of their dissolution by compounds from plant extract. Partial reduction of calcium oxalate crystals in hibiscus extract sample was observed under the microscope. While, dense concentrations of calcium oxalate crystals were created in a softer form, which makes them easier to be passed out by urinary system. Extracts from dog rose (*Rosa canina L.*) and hibiscus (*Hibiscus rosa-sinensis*) may be potentially used in medicines to dissolve kidney stones.

Key words: calcium oxalate, dog rose, hibiscus

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Bryła M.^{1,2}, Jędrzejczak R.², Obiedziński M.W.¹

**DETERMINATION OF SELECTED MYCOTOXINS
IN CEREAL PRODUCTS USING LC-ESI-MS/MS
AND SOLID PHASE EXTRACTION**

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Mycotoxins are metabolites of several species of fungus out of the *Aspergillus*, *Penicillium* and *Fusarium* genus. Mycotoxins are commonly found in various types of food products of plant origin, due to fungal growth at various environmental conditions during plant field growth or storage and processing. Mycotoxins are regarded as dangerous food chemical contaminants possessing mutagenic and teratogenic properties. Due to toxicological profile combined with its thermal stability mycotoxins are serious threat for human health and animal welfare. Maximum permitted residual levels of mycotoxins in food (afaltoksyna B1, sum of aflatoxins B1, B2, G1 and G2, aflatoxin M1, ochratoxin A, patulin, deoxynivalenol, zearalenon, and sum of fumonizynes B1 i B2) are defined in the suitable European Commission regulation (1881/2006, 1126/2007 and 165/2010).

The purpose of the study was to develop an analytical procedure suitable for simultaneous determination of several kinds of mycotoxins with the use of LC-MS/MS technique and ion-trap detection (Finnigan LCQ Advantage Max, Thermo) in cereals and cereal products. The compounds as: deoxynivalenol (DON), aflatoxins (B1, B2, G1, G2), toxins HT-2 and T-2, ochratoxin A (OTA), zearalenon (ZEA), and fumonizins B1 and B2 were under investigation. Chromatographic separations were performed on a Kinetex 2.6 μ PFP, 100x2.1 mm (Phenomenex) column with gradient mobile phase composed of A: H₂O/CH₃OH/CH₃COOH (79:19:1) and B: H₂O/CH₃OH/CH₃COOH (19:79:1). Detector was operated in the ESI-MS/MS mode with the following molecular ion adducts as precursors: aflatoxin B1- 313.0 m/z [M+H]⁺, aflatoxin B2- 315.0 m/z [M+H]⁺, aflatoxin G1- 329.0 m/z [M+H]⁺, aflatoxin B2- 331.0 m/z [M+H]⁺, DON-355.0 m/z [M+Ac]⁻, OTA – 404.0 m/z [M+H]⁺, ZEA – 317.0 m/z [M-H]⁻, HT-2 – 447.4 m/z [M+Na]⁺, T-2 – 489.0 m/z [M+Na]⁺, fumonizin B1 – 722,5 m/z [M+H]⁺, oraz fumonizin B1 – 706.0 m/z [M+H]⁺. 10g of the well grounded sample was extracted with 50 ml acetonitrile : water mixture (80:20). Sample was centrifuged at 8000 rpm for 8 minutes, and after that 10 ml of supernatant was transferred into a round bottom flask and evaporated on a rotary evaporator operated 30°C until acetonitrile was fully eliminated from the solution. Residue was dissolved with 10 ml of 0.1M phosphate buffer (pH 5.5)

and passed through a SPE Strata Screen C 500 mg/6 ml (Phenomenex) column, preconditioned with 4 ml of methanol and 2 ml of phosphate buffer. Column was first washed with 8 ml of phosphate buffer and subsequently eluted with 35 ml of ethyl acetate. Fumonisin B1, B2 and Ochratoxin A were eluted with 30 ml of methanol : water solution (1:4) containing 1% NH₃, and passed through an anhydrous sodium sulfate.

After evaporation to dryness, both fractions were combined and re-dissolved in HPLC mobile phase and injected into LC-MS/MS. The method performance was evaluated by determination of spiked cereals samples at 0.4 µg/g level. The recoveries for individual compounds were as follows: 80–90% for DON, 50–70% for aflatoxin B1, 80–90% for aflatoxin B2, 60–70% for aflatoxin G1, 85–90% for aflatoxin G2, 80–90% for toxin HT-2, 75–80% for toxin T-2, 75–90% for OTA, 30–50% for ZEA, 50–65% for fumonizin B1, 65–75% for fumonizin B2.

The developed analytical procedure may be satisfactory used for simultaneous determination of several micotoxins in cereals and cereal products.

Key words: mycotoxins, cereals and cereals products, LC-MS/MS

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Brzozowski B., Bednarski W.

**DEGRADATION OF IMMUNOGENIC GLUTEN EPITOPES
BY PROLYL ENDOPEPTIDASES**

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The synthesis of selected proteolytic enzymes determines the capacity of lactic acid bacteria for the hydrolysis of potentially-detrimental peptides released from food during the digestion process in the human gastrointestinal tract. Upon ingestion, proteases in the gastrointestinal tract degrade proteins like wheat gluten into peptides. Recent studies by Shan et al. demonstrated that during digestion of gluten proteins precisely from α -gliadin are released, among others, 33-meric peptide resistant for hydrolysis by the human gastrointestinal enzymes. The resistance of peptide for hydrolysis comes from high content of proline residues. This 33-meric peptide is also composed of 10 glutamine residues. The enzyme tissue transglutaminase modifies these peptides by deamidating glutamine residue into glutamic acid which introduces the negative charges in gluten peptides and increase affinity to HLA-DQ2 and HLA-DQ8 molecules. Subsequently, these peptides bind to either human leukocyte antigen HLA-DQ2 or HLA-DQ8 molecules and evoke T cells responses leading to inflammation in the small intestine, ultimately leading to the typical symptoms associated with celiac disease.

It seems crucial, therefore, to search for enzymes capable to hydrolysis the peptide bonds between proline residues in allergenic peptides or for microorganisms capable of synthesizing selected enzymes during food processing or in the human gastrointestinal tract. Lactic acid bacteria are able to synthesis proteolytic enzymes that hydrolyze bonds formed by proline residues, e.g. prolyl endopeptidase (PEP, EC 3.4.21.26) decreasing the immunogenicity of storage proteins of cereals.

Prolyl endopeptidases are a family of proteases with the unique ability to hydrolyze the peptide bond on the carboxyl side of an internal proline residue. Although these enzymes are expressed in several mammalian tissues, their absence from gastric or pancreatic secretions, or from the intestinal brush border membrane, highlights the lack of a role for PEP activity in the assimilation of dietary proteins in mammals. The immunogenic gliadin peptides, which are rich in proline residue, can be readily cleaved by bacterial PEPs suggesting a strategy for detoxifying gluten.

The aim of this work was application of prolyl endopeptidases synthesized by *Lb. acidophilus* 5e2 (LB PEP) and *A. niger* (AN PEP) to degradation of immunoreactive peptide of α -gliadin 31–43 with sequence LGQQQPFPPQQPY in condition mimic dough fermentation.

The contents of toxic peptide with sequence QQFP were analyzed in gluten modified by PEPs by competitive ELISA. We also analyzed the resistance of PEPs to *in vitro* digestion by pepsin and pH optimum of PEPs.

The content of epitopes reacted with R5 antibodies which recognize sequence QQFP was influenced by the source of PEP, pH and temperature. The lowest content of toxic peptide (10,4 µg/mL) was obtained after gliadin treatment by LB PEP in pH 6.5 at 37°C. There wasn't any correlations between gliadin hydrolysis ratio and content of toxic peptide. Both enzymes hydrolyzed α-gliadin 31–43 peptide. The highest hydrolysis ratio of α31–43 peptide was obtained in pH 4.0 at 37°C for LB PEP.

The *in vitro* digestion of prolyl endopeptidase synthesized by *Lb. acidophilus* 5e2 and *A. niger* demonstrated that both enzymes were inhibited in simulating gut-conditions. AN PEP and LB PEP activity was detected at pH 2–9. The pH optimum of AN PEP is about pH 3. In contrast the LB PEP showed 2 optimums at pH 4 and pH 7.

In conclusion, the prolyl endopeptidases obtained from *A. niger* is more resistance for pepsin digestion, then *Lb. acidophilus* 5e2 ones. Both enzymes were able to hydrolyze gliadin decreasing their immunoreactivity and to degrade a(31–43)-gliadin peptide during conditions mimic dough fermentation.

Key words: dough, prolyl endopeptidases, gliadin degradation

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Bulla J.¹, Trziszka T.², Golian J.¹, Židek R.¹, Bienek J.³

**SUSTAINABLE AGRICULTURE AND GENETICALLY
MODIFIED FOOD**

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Sustainable agriculture is used term to represent everything from organic agriculture to agriculture maximizing economic yields. Sustainability is based on a holistic philosophy a set values and principles, but may also involve a specific set of practices. Environmental and economical aspects were also considered here in addition to biodiversity, feed and food safety and ethical aspects. The new idea in the term sustainability is that the diversity of views on sustainable agriculture can lead to move discussion and progress towards improved plant and animal breeding. The diversity of new traits that can be introduced into food using biotechnology has challenged our traditional approach to food safety. Novel foods produced using biotechnology has challenged our traditional approach to food safety. Modern biotechnology broadens the scope of genetic changes that can be introduced into organisms used for food, it does not inherently result in foods that are less safe than those produced by more conventional techniques. The principle has important consequences for the safety assessment of genetically engineered and novel foods. It means that a new or different standard of safety is not required, and that previously established principles for assessing food safety still apply. More over, the inherent precision of molecular biology methods for introducing specific genetic changes should enable a more direct and focused assessment of safety. From sustainability point of view is very important concept of substantial equivalence. The main conclusion is that, if a new food or food component is found to be substantially equivalent to an existing food or food component, it can be treated in the same manner with respect to safety. Under this concept the traditional food serves a basis for comparison with new product.

Key words: sustainability, GMO, food safety

This work was financially supported by the VEGA 1/0790/11 and VEGA 1/0619/10.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Bystrická J., Vollmannová A., Čičová I., Bojňanská T.

**CADMIUM AND LEAD INFLUENCE ON POLYPHENOLS
CONTENT AND ANTIOXIDANT ACTIVITY OF MILLET**

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Heavy metals such as Pb and Cd rank among substantial environmental pollutants that are very phytotoxic in environment. Higher amount of heavy metals in soil could be manifested by increased accumulation in plants. The rate of accumulation of cadmium and lead by millet grain and following influence of these risky elements on the content of total polyphenols and antioxidant activity was studied. Statistically significant positive correlation ($P=2.89 \times 10^{-4}$, $P=1.55 \times 10^{-6}$) was evaluated between applied amount of Cd and Pb into soil and their content in millet grain.

Intentional applying of heavy metals did not affect definitely the contents of TPC and AOA. The highest content of TP was recorded in variant where Cd was added in doses 9.1 mg.kg^{-1} and it presents the value $1269 \text{ mg.kg}^{-1} \text{ DM}$. With increasing concentration of lead in millet grain content of polyphenolic substances declined, while the most remarkable decline was recorded by dose of Pb $1092 \text{ mg Pb.kg}^{-1}$ (by 8.25% when compared to control variant). Slight increase of AOA was recorded in millet grain by lowest burden with cadmium ($4.6 \text{ mg Cd kg}^{-1} \text{ pôdy}$)

Statistically significant negative relation ($P\text{-value} = 2.36 \times 10^{-5}$) was assessed between lead content in millet and antioxidant activity.

Key words: cadmium, lead, millet, polyphenols, antioxidant activity

This work was supported by grant VEGA 1-0030-09.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Cegielska-Radziejewska R., Szablewski T., Leśniewski G., Kijowski J.

**THE EFFECT OF MODIFIED LYSOZYME ON MICROFLORA
OF COLD-STORED COMMINUTED FRESH
AND HEAT PORK MEAT**

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Lysozyme is a low-molecular enzyme found in a body secretions, systemic fluids and tissues of humans and animals. Antibacterial activity of this enzyme is limited first of all to Gram-positive bacteria. The spectrum of antibacterial activity of lysozyme may be extended due to its modification. The antibacterial activity of modified lysozyme is connected not only to its enzymatic function, but also catalytically-independent activity. Studies conducted to date have concerned only the use of lysozyme monomer to preserve food. No study were conducted on the effect of modified lysozyme on microflora of meat and meat products.

The aim of the study was to evaluate the antibacterial action of different forms of lysozyme on microflora of comminuted pork, cold-stored at $4\pm 1^{\circ}\text{C}$. Thermo-chemical modification of lysozyme was performed and analyses were conducted on the effect of lysozyme monomer and modified lysozyme on growth of aerobic bacteria, bacteria from the family *Enterobacteriaceae*, from the genus *Pseudomonas* and lactic acid bacteria. The microbiological analyses of samples were conducted after 1, 6, 24, 48, 72, 96 and 144 hours of storage. In the produced lysozyme preparation the proportions of polymeric forms, hydrolytic activity and hydrophobicity were determined.

It was indicated that modified lysozyme was characterized by higher hydrophobicity and lower hydrolytic activity in comparison with lysozyme monomer. It may be stated that the antibacterial action of modified lysozyme in relation to Gram (-) bacteria is independent of its hydrolytic activity. It was shown that modified lysozyme, in comparison to monomer, exhibited a more effective antibacterial action against analysed group of bacteria, especially *Pseudomonas* and bacteria from the family *Enterobacteriaceae*. Heat treatment increased bacteriostatic effect of modified lysozyme on gram-negative bacteria. No effective antibacterial action of lysozyme monomer was found against bacteria from the group *Enterobacteriaceae*, including gram-negative bacteria, causing food spoilage.

Key words: lysozyme, lysozyme modificates, antibacterial activity

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Chmiel M., Słowiński M., Dasiewicz K., Florowski T.

**AN ATTEMPT TO USE COMPUTER VISION SYSTEMS
TO DETECT DFD DEFECT IN BEEF**

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One of the basic criteria for assessing the quality of beef are the pH and colour. Deviations from the typical course of pH changes causes the occurrence of meat defects. At present, in Poland, meat obtained from about 30% young bulls has DFD defect. Such meat is characterized by a darker colour, higher pH values and it can not be used for culinary meat due to very limited shelf life.

The aim of this study was to use computer vision systems (CVS) to detect DFD defect in beef obtained from the carcasses of young bulls.

Material for the study was samples obtained from top round from 40 carcasses of young bulls aged from 13 to 24 months. The live body weight of animals before slaughter ranged from 220 to 510 kg. The samples were mainly from carcasses classified in class O (82%). After chilling, the carcasses were divided into basic cuts and, samples were prepared for the test. Based on pH measurement, 48 hours *post mortem*, raw material was classified into normal (pH <5.8) and DFD (pH ≥5.8) meat. In addition, drip loss, water holding capacity and thermal drip were determined. The colour of the meat samples was determined by colorimetric method (in CIELab system) and by using computer vision systems (in three colour models: RGB, HSV, HSL).

Based on the pH measurement 20% of samples were classified as DFD meat. The average pH value was 5.6 for normal meat, while 5.9 in DFD meat. DFD meat was characterized by a significant lower drip loss and thermal drip (respectively 0.2 and 5.9%) compared with normal meat (respectively 0.6 and 9.2 %). Meat samples with pH ≥ 5.8 were characterized by a lower L* color value (30.6 units) compared to the meat with pH <5.8 (34.2 units). Significant differences in the lightness (determined by CVS method) in the DFD compared to normal meat were found. The results showed that computer vision systems method can be used to detect the DFD defect in beef.

Key words: beef, DFD, computer vision systems, color

This work was financially supported from the budget for science in 2010–2011, project Iuventus Plus No. 2010 004970.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Coma V.

NEW TRENDS IN FOOD PACKAGING

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It is becoming more evident that the ecosystem is considerably disturbed and damaged as a result of the non-degradable plastic materials for disposable items. So there is an urgent need to develop materials from renewable resources, which would be of great importance to the material domain, not only as a solution to growing environmental threat but also as a solution to the uncertainty of petroleum supply.

For food preservation applications, biopolymer-based films and coatings, which act as a barrier to external elements (bacteria, moisture, oil, gases, volatile organic compounds...) and, thus, protect the product and extend its shelf-life, are generally made from biological materials such as polysaccharides, proteins, lipids, and derivatives.

On the other hand, contamination by pathogenic microorganisms and oxidative reactions have one of the greatest impact on limiting the shelf life of perishable foods. During the past several years, consumer demand for 'fresh', preservative-free foods has been growing, leading to growing interest in active packaging that reduce or eliminate consumption of preservatives. Thus, the most investigated are non-thermal inactivation processes, where active packaging holds a considerable place. Because of the microbial foodstuffs contamination occurs primarily at the surface, due to post-processing handling, the use of packaging films containing antimicrobial agents could be more efficient, by slowing migration to the food surface, thus helping to maintain high concentrations where they are needed. Combining bioactive agents directly with a material could provide several advantages, discussed with respect to the type of active matrices. Moreover, if materials were made of a biopolymer, there would be environmental advantages.

Polysaccharide-based matrices can reduce the widespread reliance on petroleum because of their attractive properties from both environmental and economic point of view. In addition, blending polymers may offer a simple and inexpensive method to develop new materials with a number of valuable applications. In this context, there is a substantial interest regarding both comprehension of cellulose properties and its application as renewable and biodegradable packaging matrices. Chitosan is also a promising biodegradable aminopolysaccharide, which exhibits film-forming and antimicrobial properties. It consists of a biopolymer of glucosamine and N-acetylglucosamine units linked by β -1,4 glycosidic bonds. An association between chitosan and cellulose would be of great interest in terms of food preservation.

Key words: food packaging, biopolymer-based films, coatings, chitosan

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Czarniecka-Skubina E., Godlewska K.

**EVALUATION OF THE HYGIENIC LEVEL OF MEAT
PROCESSING PLANT BASIS ON THE MICROBIOLOGICAL
RESEARCH OF RAW MEAT PRODUCT**

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In order to ensure food safety to the final consumer, risk assessment throughout the food chain is necessary. At all stages of the food chain it is very important to prevent contamination, mainly microbiological, due to the possibility of rapid growth of microorganisms and direct hazard to the consumer. Food production requires adequate hygiene and sanitary conditions. Fulfillment of these requirements prevent cross-contamination during processing and distribution, thus preventing food poisoning consumers. The production cycle of animal origin food is longer than production food of plant origin and contains more links. In these products zoonotic pathogens that directly threaten to human health may be found. In addition, the characteristic of this chain is that the manufactured product requires specific storage conditions, i.e. maintenance of the cooling chain since the slaughter of animals until consumption of meat by the consumer.

The aim of the work is evaluation of the hygienic level of meat processing plant as an example of microbiological analysis of raw meat product. The study was conducted over the years 2005–2010, in a meat processing plant as an example of one group of products. In the plant was implemented HACCP system. The research material was a raw meat product from minced meat, which consisted in part of pork and/or beef or poultry meat, spice mixture and ice. Microbiological analysis concerned determining the level of bacteria: *Salmonella spp.*, *Escherichia coli*, mesophilic aerobic bacteria. Analysis specific types of microorganisms were carried out according to the methodology contained in PN-EN ISO 6579:2003 (*Salmonella spp.*), PN-ISO 16649-2:2004 (*Escherichia coli*), PN-EN ISO 4833-22004+Ap 1: 2005 (mesophilic aerobic bacteria).

Based on monitoring of meat microbiological condition a significant variation of the microbiological quality between research periods and between years were observed. There were not found *Salmonella spp.* in any sample of meat. *Escherichia coli* was found in a few meat samples and in amounts which do not threaten the health of the consumer in the proper treatment of meat. The number of aerobic mesophilic bacteria ranged from 4×10^3 – 2.2×10^5 .

Despite the fact, that in any sample it was not found meat threatening the health of the consumer, that conduct microbiological analysis is a necessity. This is result from Regulation

(EC) No 2703/2005 amended by Regulation (EC) No 1441/2007. The second reason is that, if such a hazard existed, there would have to recall the whole production batch of product from the market. Systematically carried out microbiological monitoring of meat also allows for evaluation of the hygienic condition of the plant. In the case of deterioration of the hygienic condition of the plant, e.g. caused by failures of staff would also result in low quality of meat produced.

Key words: hygiene, raw meat product, *Salmonella spp.*, *Escherichia coli*, meat processing plant

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**INFLUENCE OF NANOSILVER BASED PREPARATION
ON THE CONTENT OF SILVER AND ANTAGONISTIC ELEMENTS
IN BROILER MEAT**

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The aim of the study was to determine an influence of the preparation based on water nanosilver suspension and mineral sorbent (vermiculite) used in order to improve hygienic conditions in broiler house (ammonia content, physical features of bedding and air) on the content of silver and antagonistic elements (Se, Cu, Zn) in breast and leg muscles of broiler chickens.

The study was conducted on broiler chickens of Ross 308 line divided into 3 groups (84 birds in each group): control (C), group I where the preparation was given once below the bedding surface at the beginning of the experiment, and group II where the preparation was mixed with bedding and applied with each bedding complementing, i.e. 4 times during the experimental period. The experiment lasted 4 weeks, and at the end the birds were decapitated and breast and leg muscle samples were collected from 8 birds from each group for the laboratory analyses. The content of Ag, Zn and Cu was determined using atomic absorption spectrometry method on AAS-1N apparatus (Carl-Zeiss Jena), while Se content was analysed using atomic absorption spectrophotometry method with hydrides generation (HG AAS) on Varian SpectrAA 220 FS apparatus. The analyses were conducted in the laboratory of Department of Hydrobiology and Aquaculture, Wrocław University of Environmental and Life Sciences. The data obtained were worked out statistically using Statistica 8.0 software (StatSoft).

The content of silver in analysed samples ranged from 0.173 ppm (group I, leg muscle) to 0.198 ppm (control group, leg muscle). In the case of breast muscles the level of silver increased with an increase of preparation applied, however the differences were not significant statistically. Copper concentration was the lowest in breast muscles of group II (0.780 ppm) and the highest in leg muscles of the control group (1.236 ppm). Significant differences ($P < 0.05$) were noted in the case of breast muscles between group I and II. Zinc level was within the range of 4.32 ppm in breast muscles of group I to 9.37 ppm in leg muscles of group II. Statistically significant differences were noted between groups C and I and group II ($P < 0.05$). The concentration of selenium was from 34.77 ppb in breast muscles of the

control group to 88.98 ppb in leg muscles of group I. Significant differences were observed between group C and groups I and II in the case of breast muscles, and between group C and I, and the group II in the case of leg muscles ($P<0.05$). The calculated Pearson's correlations between the content of particular elements in analysed muscles did not confirm the assumed antagonistic activity of copper, zinc and selenium against silver. It may be also concluded that the preparation applied did not unprofitably influenced the elemental composition of selected muscles as regards the content of silver. It may be thus supposed that at this range the application of nanosilver based preparations for disinfection and sanitization purposes seems to be quite safe and beneficial procedure.

Key words: nanosilver, chicken meat, silver, selenium, copper, zinc, disinfection

The study was conducted within the framework of the research project no N N205 018634 financed by Ministry of Science and Higher Education.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**ATTITUDE OF THE LITHUANIAN CONSUMERS TOWARDS
HEALTH FOOD**

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In order to find out how the Lithuanian population perceives "What are safe nutrition and food safety", we have carried out a written inquiry of residents. Therefore, the objective of our paper was to find out how the Lithuanian population understands and assesses health nutrition and food safety. In the inquiry, 466 respondents including 290 women and 176 men agreed to take part. At the biggest shopping centres of various Lithuanian cities and towns, people were given questionnaires. Data of questionnaires were entered into a database and processed by the SPSS data package. To carry out computations, respondents were split into groups by age: ≤18–20 years old; 21–30 years old; 31–40 years old; 41–50 years old; 51–60 years old; 61 years and older. Results of the survey were grouped by age and sex. Greater consumption of health food is observed among men in the ≤18–20 years old and 61 years and older age groups, and among women in 21–30 years old, 31–40 years old and 41–50 years old age groups. Most respondents representing all age groups answered that "organic food is not necessarily safe", the letter E usually marks preservatives. The greater percentage of respondents mentioned that information received on health food is not sufficient, whereas information on food and additives thereof usually is received from the press or via the Internet. The majority of male and female respondents though that the main food safety risks are micro-organisms, pesticides and chemicals, as well as many of the respondents felt that *Bovine spongiform encephalopathy* (BSE) is also significant risk factors for food. Genetically modified organisms, acrylamide and irradiation of male respondents identified as lower risk factors for food. These results are based on the fact that acrylamide, irradiation and genetically modified organisms are less known to the Lithuanian people, because they are more recent. Most women of all ages felt that the biggest food safety risks are pesticides and chemicals.

Key words: Lithuanian consumer, survey, food safety

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

De Meulenaer B., Cucu T., Devreese B.

**ANALYSIS TO SUPPORT FOOD ALLERGEN RISK
MANAGEMENT: WHICH WAY TO GO?**

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Quantitative analysis of food allergens is a key element to enforce EU Directive 2006/142/EC specifying 14 different foods or their ingredients which should be labeled as allergens if they are used in the production of a particular prepacked food product. In parallel, quantitative allergen analysis is a key component of managing the food allergen risk both on the level of the industry and the government. Food allergens are typically proteins which may provoke in some cases life threatening reactions in an allergic individual upon digestion of even very small amounts of the allergic food.

Currently used methods for quantitative allergen analysis are typically receptor based analytical assays, such as immunosorbent assays which are based upon the molecular recognition between the target analyte (typically one or several (allergic) proteins). Alternatively PCR assays are used as well, which in contrast to the receptor based assays do not aim to detect the protein as such, but merely the DNA of the allergenic commodity. Since the latter one is merely an indirect indicator of allergen presence and does not allow the estimation of risk, since no direct link with the amount of allergic protein is present, analytical strategies aiming at measuring the amount of (allergic) protein are preferentially used however.

Thorough evaluation of the robustness of these receptor based analytical assays however for hazelnut and soy revealed that commercial assays are typically leading to erroneous results due to both false positive and false negative results. Indeed due to food processing, protein undergo a number of chemical changes which in several cases leads to a deterioration of the molecular recognition with the receptor used. It was shown however that despite these changes, proteins retained their allergenicity or became even more allergic. Therefore alternative analytical approaches were evaluated in order to enable to develop a more robust analytical approach. These consisted of the use of MALDI-TOF-MS which enabled the qualitative detection of stable peptides present in the allergenic commodities evaluated (whey proteins, soy and hazelnut). Alternatively, the use of antibodies towards a chemically modified hazelnut protein extract proved to be more robust compared, but no satisfactory results were obtained however. The use of antibodies towards a hazelnut protein which proved to be remarkably stable upon processing however improved the robustness of the receptor based analytical methodology drastically, but still about 50% of the present proteins remained undetected in a cookie matrix.

In view of the presented results, reflections will be made if indeed the development of reliable analytical approaches for quantitative allergen detection are realistic or not. Potential alternative approaches will be presented.

Key words: food allergen, immunosorbent assay, PCR, MALDI-TOF-MS

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Doktor J., Połtowicz K.

**EFFECT OF AGE AT SLAUGHTER ON NUTRITIVE VALUE
OF MEAT FROM FAST- AND SLOW-GROWING
BROILER CHICKENS**

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Subjects were fast- and slow-growing broiler chickens assigned to 4 groups according to age at slaughter: Group I – Hubbard Flex, reared to 42 days of age; Group II – Hubbard Flex, reared to 56 days of age; Group III – Hubbard JA 957, reared to 42 days of age; and Group IV – Hubbard JA 957, reared to 56 days of age. Birds were kept on litter in a broiler house. All chickens were fed *ad libitum* complete starter, grower and finisher diets containing 21, 19 and 18.5% CP and 3075, 3200 and 3300 ME/kg, respectively. Birds were slaughtered on the last day of rearing and their breast and leg muscles were assessed for basic chemical composition of water (dry matter), crude protein, fat and ash.

The aim of the study was to determine the effect of slaughter age on chemical composition of breast and leg muscles from fast- and slow-growing broiler chickens.

The percentage of breast muscles in the carcasses of Hubbard Flex chickens did not differ significantly according to slaughter age and was 22.8 (42 days of age) and 24.8% (56 days of age), with body weight of 2074 and 3296 g, respectively ($P \leq 0.01$). In 42- and 56-day-old Hubbard JA 957 birds, the proportion of breast muscles in the carcass was similar (20.18% on average), with body weight of 1632 and 2457 g in younger and older birds, respectively. Fast- and slow-growing chickens reared to 56 days of age differed significantly in the meatiness of the breast portion of the carcass ($P \leq 0.01$). Regardless of the genetic group and slaughter age, proportion of the leg muscles of the chickens showed similar values (19.2% on average).

Breast muscles of 42-day-old Flex chickens were characterized by a significantly higher (by 3.2%) level of protein compared to birds reared 2 weeks longer, in which this parameter was 22.9% ($P \leq 0.01$). Water percentage in the breast muscles of younger, fast-growing chickens was 1.2% lower than in 56-day-old Flex birds and averaged 73.6% ($P \leq 0.01$). At the same time, the muscles of older, fast-growing chickens were found to contain significantly more water (by 1.3%) compared to the muscles of their slow-growing contemporaries ($P \leq 0.01$). In addition, 56-day-old Flex and JA 957 chickens differed significantly in chemical composition of breast muscles, in particular in protein and ash percentage ($P \leq 0.01$ and $P \leq 0.05$). The muscles of fast-growing chickens were characterized by a significantly lower proportion of protein (by 3.7%) and lower content of ash (by 4.3%) compared to their fast-growing contemporaries, in which these parameters were 23.8 and 1.2%, respectively. There

was no effect of age at slaughter on chemical composition of breast muscles from Hubbard JA 957 chickens.

For leg muscles, only significant differences were found in their fat content resulting from the slaughter age of slow-growing chickens. Younger Hubbard JA 957 birds were characterized by significantly ($P \leq 0.05$) lower content of fat in leg muscles (4.9%) compared to chickens reared 2 weeks longer (6.1%). Other than that, no significant differences were found in the chemical composition of leg muscles from fast- and slow-growing birds regardless of their slaughter age.

Key words: fast and slow growing chickens, chemical composition of meat, slaughter age

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on the
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Drotleff A.M., Büsing A., Ternes W.

**BREWER'S SPENT GRAIN AS A LOW-COST SOURCE
FOR EFFECTIVE TOCOTRIENOL (VITAMIN E) EXTRACTION
AND QUALITY ASPECTS OF TOCOTRIENOL RICH
FUNCTIONAL FOOD**

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Vitamin E comprises of four tocopherols (α -, β -, γ -, δ -T) and four tocotrienols (α -, β -, γ -, δ -T3). T3 have been reported to exhibit unique health benefits such as hypocholesterolemic, anticancer or neuroprotective effects and to prevent lipid oxidation in food. Barley (*Hordeum vulgare* L.) is one of the richest European sources of α -tocotrienol (α -T3). Dried brewer's spent grain (DBSG), a barley by-product from the beer brewing industry, is particularly enriched in T3, and sieving fraction of milled DBSG with particle sizes $<500 \mu\text{m}$ have been identified to be the most suitable for T3 extraction. Oil yields of DBSG sieving fractions $<500 \mu\text{m}$ are high (up to 14.4% after Soxhlet extraction with 96% ethanol), as are the concentrations of T (up to $256.8 \text{ mg}\cdot\text{kg}^{-1}$ of extracted oil) and T3 (up to $647.0 \text{ mg}\cdot\text{kg}^{-1}$ of extracted oil), promising an economic plant-scale extraction. However, T3 and T are unstable and undergo degradation mainly because of oxidation processes. In DBSG, we observed a drastic decrease (93%) of α -T3 levels within a storage period of 11 months. Degradation of T3 (about 75%) also occurred during large-scale solvent extraction (maceration with 96% ethanol) of a DBSG sieving fraction. Therefore, storage and processing of T3 rich matter needs special attention in order to prevent degradation. On investigating autoxidation of α -T3 in the model system n-hexan, we found as yet unknown oxidation products (5-formyl- γ -tocotrienol, 7-formyl- β -tocotrienol, and α -tocotrienolquinone) by means of a newly developed HPLC method and spectroscopic structure elucidation. Oxidation products may be important with regard to the quality of T3 rich food; they are the subject of our present research.

Key words: dried brewer's spent grain, tocotrienols, milling, sieving, solvent extraction, degradation, α tocotrienol oxidation products

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**Drożdż W., Boruckowska H., Boruckowski T., Paślawska M.,
Tomaszewska-Ciosk E.**

**PROPERTIES OF EXTRUDATES PRODUCED FROM POTATO
WASTE PULP**

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This study was aimed at determining the effect of initial moisture content of potato waste pulp and temperature of the extrusion process on selected properties of extrudates produced.

Frozen potato waste pulp was defrosted and dried in a fountain dryer, next ground in a rotating laboratory mill to a grain size of <1 mm. Afterwards, the pulp was moistened to a moisture content of 20, 24 or 28% and extruded in a single-screw laboratory extruder at the following temperatures: 60–70–90°C, 90–100–120°C or 130–150–180°C.

An INSTRON 5544 apparatus with a measuring device Bend Fixture was used to determine mechanical properties of the resultant extrudates, i.e: the maximum cutting force, work needed to cut the extrudate, and extrudate expansion at which the maximum cutting force was recorded. The comminuted extrudates were additionally determined for water absorption index and water solubility index at a temperature of 80°C.

The extrudates differed in both the appearance and properties. The extent of these differences was found to depend on the initial moisture content of the waste pulp and temperature of the process. An increase in the initial moisture content of the raw material resulted in an increase in the maximum cutting force, work needed to cut the extrudates and water absorption, as well as in decreasing values of the extension at which the maximum cutting force was recorded and extrudates solubility. Higher temperatures of extrusion were observed to increase solubility of the preparations and to decrease their water absorption. A decrease was also observed in the maximum force and in the work needed to cut the extrudate.

Key words: potato starch extrudates, textural properties

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Drzewicka M., Grajewa H.

**FATTY ACID COMPOSITION OF READY TO COOK
FROZEN PRODUCTS**

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The aim of this study was to assess the fat content and fatty acid composition of selected ready to cook frozen products belonging to convenience food. Material for analysis comprised of 30 following food products: fish and seafood products, pizza, casseroles and meat products.

The fat content was determined using Folch method and the fatty acids composition using gas chromatography. The fat and fatty acid contents showed large differences in products depending on their composition and preparation techniques declared by the producer. The analyzed products contained from 1.17 to 26.86% of fat. The saturated fatty acids (SFA) content ranged from 8.72 to 53.16%, while the monounsaturated fatty acids (MUFA) – from 23.98 to 63.57% of total fatty acids. The polyunsaturated fatty acids (PUFA) percentage accounted for 8.07 to 48.82% and trans isomers – for 0.23 to 6.07% of total fatty acids.

Most of the analyzed fish and seafood products were characterized by the high fat content with the high percentage of fatty acids favorable from nutritional point of view, MUFA and PUFA. The composition of fat from pizza and casseroles was less favorable, due to high proportion of SFA and also trans isomers.

Key words: ready to cook frozen products, fat, fatty acids

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Dukalska L., Murniece I., Muizniece-Brasava S., Sarvi S.

**THE INFLUENCE OF ACTIVE PACKAGING
ON THE HARDNESS CHANGES OF THE SOFT CHEESE *KLEO*
DURING STORAGE TIME**

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Kleo cheese is a soft, white fresh cheese produced in a local cheese factory and is available in local markets in Latvia. *Kleo* cheese is made from pasteurized (78–82°C) and normalized cow's milk. The consistency of the cheese is mild with homogenous slightly grainy texture. Textural characteristics of this cheese depends on its structural characteristics, composition, cheese-making process, fat distribution and the type of packaging used during storage.

The aim of this study was to investigate the effect of packaging materials and the technology on textural hardness in connection to moisture content and water activity during storage.

Kleo cheese was analyzed before packaging (control sample – vacuum packaging (VP)) and afterwards when it was packed in different materials in modified atmosphere (MAP). The following packaging materials were used: OPP, PE/PA, Multibarrier 60. Iron based oxygen scavenger sachets of 50 cc obtained from Packaging Solutions OÜ were used. Cheese samples of 100±10 g were packaged in polymer pouches (110×120 mm). A modified atmosphere consisting of CO₂ (E 290) 30% and N₂ (E 941) 70% was used while VP was selected as the control packaging. Pouches were hermetically sealed by the MULTIVAC C300 vacuum chamber machine, stored in the Commercial Freezer/Cooler 'Elcold' at 4.0±0.5°C for 32 days. The cheese samples were analyzed for hardness before packaging (0 day) and the 5, 11, 15, 18, 22, 25, 29 and 32 storage day. Texture analyses were conducted on the Texture Analyzer, TA-XT2i Texture Analyzer; Stable Micro Systems, NY. Moisture content was determined by ISO 6496:1999, water activity by ISO 21807: 2004 AquaLab LITE device and pH by LVS 1132:2001 – Jenway 3510.

The results show that the hardness of the cheese varied per type of packaging material. At the beginning of the research, the hardness of the control sample was 19.731±2.168 N. But during the storage period, in the middle of the research, it decreased and afterwards increased. Changes of the hardness depend on the moisture content, pH level as well as water activity during storage time.

Key words: *Kleo* cheese, packaging, modified atmosphere, texture

Authors acknowledge financial support from the project Latvian State Research Program No 08-VP-9-9 and the ESF Project "Formation of the Research Group in Food Science", contract nr. 2009/0232/1DP/1.1.1.2.0/09/APIA/VIAA/122.

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Eckert E., Zambrowicz A., Siepka E., Chrzanowska J., Trziszka T.

**ENZYMATIC PROTEIN HYDROLYSATES AND THEIR USE
IN FOOD AND NON- FOOD ITEMS**

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The enzymatic hydrolysis of proteins is a process of protein decomposition into individual amino acids and/or peptides that takes place with the participation of enzymes. The benefits of hydrolyzed proteins in the human diet have been known for a long time, and food products based on protein hydrolysates have been widely available since the 1950s. Protein hydrolysates are derived from products such as milk whey, casein, fish, meat, collagen, egg, peas, soybeans, rice or potatoes. By using a specific enzyme to increase the degree of hydrolysis (% DH) it is possible to obtain hydrolysates with better functional properties than the original protein, such as a better ability to create foam, solubility, emulsifying capacity and gelling. The valuable properties of hydrolysates result in their widespread use in the production of specialty beverages, foods for pregnant women, cosmetics and food supplements. They can also be found in foods for people with an impaired ability to digest, for athletes or hypoallergenic products.

One of the most important features of hydrolysates is the presence of bioactive peptides. Bioactive peptides are absorbed in the intestine and penetrate into the blood intact and exert systemic or local beneficial effects in the gastrointestinal tract. They cause various beneficial health effects in circulatory, nervous and immune systems. Bioactive peptides include opioid peptides, peptides lowering high blood pressure, inhibiting platelet aggregation, carriers of metal ions and peptides with immunostimulatory, antimicrobial and antioxidant activity.

Key words: bioactive peptides, hydrolysis, functional, antioxidant, antimicrobial

Project "Innovative technologies of production of biopreparations based on new generation eggs" Innovative Economy Operational Programme Priority 1.3.1, thematic area "Bio" Co-financed by European Union through European Regional Development Fund within the Innovative Economy Operational Programme, 2007–2013.

**5th International Conference
on the
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**THE EFFECT OF A VACUUM-MICROWAVE DRYING AFTER
OSMOTIC PRE-TREATMENT IN SODIUM CHLORIDE
SOLUTIONS ON THE QUALITY OF PUMPKIN SLICES**

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Pumpkin (*Cucurbita pepo*) is a valuable source of vitamins (C, E, B₆) tannins, and riboflavin, as well as minerals, e.g. potassium, phosphorus, magnesium, iron and selenium. Pumpkin flesh is a delicious and fully appreciated additive in diverse products for children and adults. Pumpkin fruits are being processed to obtain juice, pomace, pickles and dried products. The dried products can be obtained by a vacuum-microwave (VM) drying. A large vapour pressure forming in the centre of the material during vacuum-microwaving allows the rapid transfer of moisture to the surrounding spaces and thus prevents structural collapse. An osmotic dehydration can be used as a pre-treatment to VM drying.

The work was carried out to determine the effect of sodium chloride (NaCl) concentration on the drying kinetics of pumpkin slices dehydrated by the osmotic pre-treatment and VM finish drying, as well as quality of the finish product in terms of shrinkage, colour, texture and sensory attributes.

Pumpkin (*Cucurbita pepo*) of "Hokkaido" variety was used in the experiment. Pumpkin fruit was cut into slices with 18 mm diameter and 5 mm thickness, and then exposed to an osmotic dehydration and VM drying. The osmotic pre-treatment of the samples was carried out in 5, 10 and 15% NaCl solution at temperature 40°C. Pumpkin slices were soaked in an osmotic solution in the 3:1 ratio. After 0.5, 1, 2, 4 and 6 hours of the osmotic dehydration the weight of the slices was recorded. A 360 W at microwave wattage was applied during VM finish drying. The temperature of pumpkin slices was measured with an infrared camera immediately after taking them out of the VM dryer. The effect of the experimental treatments on the quality of the product was determined by analysing shrinkage, density, colour and texture parameters (TPA – Texture Profile Analysis), as well as by the sensory assessment by trained panel in order to discriminate the intensities of the main characteristics of dried product in terms of colour, flavour, taste and texture.

The obtained results revealed that the mass of samples during osmotic pre-treatment was rapidly decreasing in the first hour of the process and then was slightly increasing. This was because at the beginning of the osmotic pre-treatment the intensive water flux from the

raw material to the osmotic solution was much higher than the NaCl solids transfer from the solution to the raw material. Afterwards, water loss was getting smaller than the NaCl gain. However, the increase in NaCl concentration decreased the final moisture content of the pre-treated samples. It was found that the decrease in moisture content of the pumpkin slices during VM finish drying could be described with an exponential equation. While VM finish drying the temperature of samples was increasing until the certain moisture content and then was decreasing as the result of the balance of energy generated within the dried material by dipoles of water and the energy necessary for water evaporation. The increase in NaCl concentration decreased shrinkage, cohesiveness and springiness but in the same time increased hardness and the brightness of the finish-dried product. There was a correlation between hardness determined in sensory evaluation and TPA test. It was also found, that the increased crispiness evaluated in sensory assessment was associated with decreased cohesiveness determined in TPA test. The study revealed that the best product in terms of taste does not require the pre-treatment in NaCl solution but in terms of texture involves pre-drying at NaCl concentration amounted to 15%. The optimal quality of the VM dried pumpkin slices can be obtained by the osmotic pre-drying in NaCl solution with concentration of 10%.

Key words: vacuum-microvawe drying, osmotic pretreatment, pumpkin, sensory properties

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**Gabrielska J.¹, Dudra A.¹, Kucharska A.Z², Sokół-Lętowska A.²,
Bąkowska-Barczak A.², Włoch A.¹**

**ANTIOXIDANT ACTIVITY, PHENOL AND ANTHOCYANIN
CONTENT IN BLACK CURRANT, RASPBERRIES,
CHOKEBERRIES AND BLACKBERRIES**

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Small fruits constitute a good source of natural antioxidant substances. Extracts of fruits from berry species including black current (BC), raspberries (RB), chokeberries (CB) and blackberries (BB) act effectively as free radical inhibitors. Polyphenols comprise a wide variety of compounds, divided into several classes i.e. hydroxybenzoic acid, hydroxycinnamic acid, anthocyanins, proanthocyanidins, flavonols, flavones, flavanols, flavanones, isoflavones, stilbenes and ligands, that occur in fruit and vegetables. Particularly, phenols contribute substantially to the antioxidant complement of many small fruit species, having potential health effects.

The purpose of this work was to study the antioxidant activity of phenolic compounds in the form of the fruits extracts of four berries (BC, RB, CB, BB) using autoxidation and UV-induced lecithin liposome oxidation systems. These oxidation model were chosen since liposome membrane oxidation is relevant to oxidation processes in living organisms and in food systems. Different organic solvents (methanol-WA, diethyl ether-WB, ethyl acetate-WC and water-WD) were tested for the efficient extraction of phenolic compounds from fruits.

The membrane oxidation, total polyphenol (TP) and anthocyanin content (AC) were estimated spectrophotometrically. The lipid peroxidation level in the liposomes was measured as the thiobarbituric acid reactive substance (TBARS). The antioxidant activity measured as IC₅₀ [in milligram of extract per 1 ml of sample] ranged: from a low 0.480 to 0.910 mg/ml for the WA extracts (TP ranged from 22.64 to 45.79 mg of GA equiv/g); from a low 0.033 to 0.129 mg/ml for WB extracts (TP ranged from 79.20 to 331.00 mg of GA equiv/g); from 0.093 to 0.316 mg/ml for WC extracts (TP ranged from 86.91 to 197.34 mg of GA equiv/g) and from 0.263 to 0.779 mg/ml for WD extracts (TP ranged from 19.77 to 64.78 mg of GA equiv/g). Rich in anthocyanins were only WA and WD extracts. AC ranged from 2.32 to 9.46 mg of C3G equiv/g for WA and from 0.96 to 14.35 mg C3G equiv/g for WD extracts. These results suggest on the following sequences of antioxidative efficiency of studied extracts:

WB>WC>WD>WA and BC>CB≈BB>RB. The antioxidant activity of WB, WC and WA (except for BC) from the studied extracts was correlated with total phenolic level. No correlation are between highest antioxidative efficiency of BC and TP and AC. Therefore, more detailed studies are necessary to evaluate the contribution of each phenolics to the antioxidant activity of extracts studied.

Key words: antioxidant activity, polyphenols, anthocyanin, oxidation, TBARS, berries

This work was financially supported by Ministry of Sciences and High Education. Project no N N312 263638.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Gajewska-Szczerbal H., Perek A.

**DYNAMICS OF CHANGES IN THE THERMAL RESISTANCE
OF THE PIGS' INTRAMUSCULAR COLLAGEN
AND IN THE FRAGILITY OF *M. SEMIMEMBRANOSUS* DURING
THE PRODUCTION OF CANNED MODELS**

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Poznań University of Life Sciences, Poznań, Poland*

The aim of this study was to assess the dynamics of changes in the pigs' thermal intramuscular collagen resistance and in the fragility of the pickled and pasteurized pig muscle during the production of canned models. The experimental material comprised muscles which were collected from 'U' class porkers (according to EUROP classification). After cutting them out from chilled half-carcasses, the experimental muscles were divided into parts. One of them was treated as control. The remaining muscle parts were injected with the pickling brine causing their 150% weight increase. Two multi-needle injectors characterized by different numbers of needles were used: Single head, adding brine during movement in the meat injecting head up and down, and two-head, injecting only the head movement down. The brine contained, among others, the following constituents: sodium chloride, polyphosphates and collagen protein. One piece of the brine-injected muscle was taken from each sample for further investigations, while the remaining part was massaged. Next, muscle parts were collected for investigations from the massaged samples, while the remaining muscle was placed in steel cans and pasteurized at the temperature of 72°C (measured at the least heated place) and then chilled. In this way, the 7 following basic experimental samples were obtained: one control, two samples injected with brine using different techniques as well as two samples of each massaged and pasteurized muscles.

The amount and degree of thermal resistance of the intramuscular collagen using the Zajdes and Michajłow's version of Neuman and Logan's method were also estimated. Fragility was estimated using the WBSF (Warner-Bratzler Shear Force) index. To determine this index, shear tests were carried out, using for this purpose an Instron 1140 device equipped in a Warner-Bratzler attachment. In addition, the content of dry matter was determined using drying method, fat content by petroleum ether extraction using Soxtec machine and total protein by the Kjeldahl method. All analysis was performed in each phase of the experiment.

On the basis of the performed experiments, a statistically significant influence of the consecutive phases of the experiment on the dynamics of changes of collagen content and

its thermal resistance was found. The presence of thermally hydrolyzed collagen in the brine increased in the muscle after injection and massaging in comparison with the untreated muscle, whereas lower values were observed after the pasteurization of the canned model which indicates the presence of the collagen highly resistant to the thermal treatment. In the course of massaging and pasteurization, a gradual loss of crude protein, dry matter and collagen from the muscle was observed. Of the two compared injectors, use of the single-headed injector turned out to reduce the amount of the thermo-resistant collagen and lower the WBSF index.

Key words: intramuscular collagen resistance, canned pork products

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Gawrysiak-Witulska M.¹, Siger A.², Wawrzyniak J.¹, Nogala-Kałucka M.²

**EFFECT OF TEMPERATURE AND SEED MOISTURE CONTENT
ON THE RATE OF BIOACTIVE COMPONENTS DEGRADATION
DURING RAPESEED STORAGE**

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Rapeseed oil is considered to be one of the most valuable plant fats. It is a rich source of mono- and polyenoic acids and natural antioxidants – tocopherols, plastochromanol-8 (PC-8), phenolic compounds and sterols. Tocochromanols determine lipid stability in stored seeds. Oxidation of edible oils containing polyenoic fatty acids is a considerable problem for the food industry due to the direct relationship with economic, nutritional, flavor and storage factors. Generally in Poland, seeds after harvest are dried to a moisture content of 7%, which is considered safe in terms of storage conditions. However, there are cases where during storage of seeds moisture migrates in silos or from the heating of warehouse walls. As a consequence, warmer seed layers are slightly dried, while colder layers are repeatedly wetted. The moisture level and temperature of the product will influence events that occur during storage and may sometimes lead to spoilage and self-heating.

The aim of the research was to examine the influence of temperature and seed moisture content on the rate of degradation of native tocochromanols, contained in rapeseed. The experimental material used in the study was rapeseed of cv. *Californium*. Seed samples of 10.2, 12.4 and 15.4 moisture content were stored in a thermostatic chamber, equipped with apparatus that enable to maintain the moisture content of seed on the constant level, in temperature of 25 and 30°C. Rapeseed was stored in constant humidity and temperature conditions up to the decrease of germination energy below 75%. Changes in tocochromanols contents in stored rapeseed were studied in every 6 days. The results of the study pointed out that temperature and moisture content of stored rapeseed have a significant influence on the rate of tocochromanols degradation.

Key words: tocochromanols, rapeseed, moisture content, temperature

This work was partly financially supported by the Polish Ministry of Science and High Education. Project No. N N313 209938.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**Gil Z.¹, Wojciechowicz A.¹, Spychaj R.¹, Kościelak N.¹, Mularczyk A.¹,
Nita Z²**

**QUALITY CHARACTERISTIC OF NEW HULL-LESS BARLEY
GENOTYPES WITH HIGH LEVEL BETA-GLUCAN**

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The aim of this work was investigation of new lines of hull-less barley grain physical properties (1 000 grain weight, hectoliter weight, grain filling, vitreousity and falling number) and chemical composition (total protein, starch, β -glucans, pentosans and fiber contents).

Physical properties of all barley lines were rather equal, which was indicated by quite low variation coefficient, lower than 10%. The exceptions were grain vitreousity and falling number values. Also grain chemical composition, especially starch content, was equal in all lines. Only fiber content, especially its insoluble fraction, was varied by genotype factor.

Grain was big, well formed, and very low falling number values indicate high α -amylase activity. Total protein, β -glucans and fiber contents were quite high. Besides, fiber was consisted of two equal fractions: soluble and insoluble ones. Meanwhile soluble fraction of pentosans was only around 15% of total pentosans.

It also came out, that high protein content and vitreousity lowered starch content. Grain vitreousity was also positively correlated with 1 000 grain weight. It was observed, that the higher total pentosans content, the higher its insoluble fraction content.

Key words: hull-less barley, physical properties, chemical composition, beta-glucan

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Godlewska K., Bednarek A.

**VALIDATION OF THE LABELING OF MEAT
AND MEAT PRODUCTS DISTRIBUTED BY A NETWORK
OF WHOLESALERS**

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All food products permitted marketed in prepackaged bulk or without packaging must be marked. The information contained on the label eases handling of the product distributor, because it shall determine the conditions of storage and durability. They also enable the identification of the manufacturer and identify the correct product. Correct, do not mislead the consumer introducing marking, is the basis for consumer information, which is an element of food safety.

The aim of the study was to validate the labeling of products distributed by a network of wholesalers of meat and meat products nationwide to satisfy the requirements contained in the Polish and EU legislation on labeling.

The scope of research conducted on all providers of wholesale network, providing each range, ie: sausages, meat, frozen foods, delicatessen products, and more. Check-list compiled by the estimated labels placed on products.

According to the applied research methodology established by the Quality Department, the majority of companies whose products are distributed by a network of wholesalers network labeled their products correctly and in accordance with the requirements of food law.

The studies confirm the presence of frequent non-compliance ascertained by the Food Authority. Studies assessing the situation can be described as good.

Key words: meat, meat products, labeling

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Golian J., Bajzík P., Belej L.

**FOOD SAFETY AND FOOD CONTROL SYSTEM
IN THE SLOVAK REPUBLIC IN 2010**

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Food safety in the Slovak Republic is guaranteed by legislation, official food control systems and is included in the National Plan of official control of foodstuffs. In 2010, were in line with the national control plan provided for the number of inspections (frequency and intensity of controls) and number of samples on the basis of risk assessment.

In 2010 were carried out 107,190 inspections, most inspections were carried out in the retail sector and producers and packers. Shortcomings were found in 11,590 from 38,005 objects controlled, which is 30.50% of objects. Totally was carried out 107, 190 inspections. Most deficiencies were detected in overall hygiene – in 8 128 objects, which is 51.01%. Weaknesses were also identified in the application of HACCP system in 3761 objects, which is 32.45% in food labeling in 2,853 objects, which is 24.62% and sales of end-consumption / minimum durability was established in 3,566 objects, which is 30.78%.

In terms of individual sectors was most deficiencies identified in the retail trade up to 5,873 objects, which is 50.67% in the services sector for 3,727 objects, which is 32.16%.

Overall, in 2010, official control authorities collected 36,677 samples, of which 1,722 samples were unsatisfactory, which is 4.7%, with most samples did not comply with the microbiological point of view, labeling and physicochemical properties. In 2010 it was examined at 38,005 objects, which in 3,761 the facility was disagreement in the application of good manufacturing practice. Most breaches were identified in the service sector in 1,321 buildings and retail premises in 1,243. The highest number of deficiencies were found in the retail sector, where the 15, 932 examined at objects to the 8,128 objects were found in the application of non-compliance with hygiene establishments.

Key words: food safety, food control systems, Slovak Republic

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Golian J., Židek R., Revák O., Bulla J.

FOOD SAFETY AND CONTROL – A NEW STUDY PROGRAM

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Faculty of Biotechnology and Food Sciences has bachelor and master degree program which are accredited named Food safety and control. The study program was based on the requirements of practice, inspection bodies and laboratories to train well-prepared students for domestic and foreign markets. Profile of this study program is broadly aimed to enforce the state and the private sphere, in food chain, in trade and a common canteen. Bachelor's theoretical basis is measured to obtain a general knowledge of chemistry, physics, matematicky, biology, plant and animal production, information technology and public health and food production. In follow-up post-secondary subjects such as biochemistry, microbiology, analytical chemistry, biophysical chemistry and the first training courses profiling - General Food Hygiene, Epidemiology and Food allergies, Microbiological methods, Food risks in food production and Sensory analysis of food.

The profile subjects of this program are Food Hygiene, Sanitation in Food, Predictive microbiology in the food science, Good hygiene practice in food processing, Food technology basics, Hygiene distribution and sale of food. On the master degree program is the study designed to manage security systems and food control. On this program are taught subject as Counterfeiting and authentication of food, Food chemistry, Food microbiology, Sensorimetrics and food informatics, Food safety, Food toxicology, Food safety health, Risk assessment, Technology of food animal and vegetable origin, Food control and legislation, Food mycology, GM Foods and Food Safety Authority. The graduates is the official food control, corporate control of food, corporate labs, audit firms, education and research.

Key words: food safety, food control, study program

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Gornowicz E.¹, Węglarzy K.², Lewko L.¹, Bereza M.²

**EFFECT OF ORGANIC FARMING OF HENS ON PHYSICAL
CHARACTERISTICS OF EGGS**

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Organic agriculture is an alternative system to conventional farming. Its purpose is to improve the quality and healthiness of food products and farm produce; it is sustainable and limits human interference in the farm ecosystem, thus inhibiting degradation of the agricultural habitat.

The research objective was to evaluate the physical characteristics of eggs from laying hens of four heritage breeds: Sussex (S-66), Rhode Island Red (R-11), Yellowleg Partridge (Ż-33) and Greenleg Partridge (Z-11) raised under organic conditions. The choice of breeds was based on the principles of organic livestock production. Chickens were selected with regard to their capacity to adapt to local conditions, vitality and resistance to disease. Four breeds were chosen to encourage a wide biological diversity (Commission Regulation (EC) No 889/2008 of 5 September 2008).

Hens were assigned to four experimental groups with 100 birds per group. At 26 weeks of age, 20 eggs were randomly selected from each group and analysed for physical quality characteristics. The heaviest eggs were laid by S-66 hens (48.37 g) and this value was significantly ($p \leq 0.05$) higher than for eggs from Z-11 hens (45.41 g). Egg weight averaged 47.07 g and was comparable to the weight of eggs from the same heritage breeds raised in the conventional system. In comparison with consumption eggs produced under standard conditions, this weight is lower by 25%. The yolks of eggs from all experimental groups had intensive colour (from 12.00 to 12.55 points on the Roche scale). Significantly ($p \leq 0.05$) better results were obtained for the eggs from Ż-33 chickens. Poorer yolk colour (by about 3.0 points) was found for eggs by layers from the conventional system which were unable to use free range and its diverse vegetation. It should be noted that the organic feeds given to the birds had no synthetic colouring agents, which means that the layers in this group owe good yolk colour to the xanthophylls they ingested through free-range vegetation only. The shells of eggs from the organic farming system were thick (340–356 mm) and dense (89.58–93.25 mg/cm²), egg albumen had very high parameters demanded by the consumers (height from 7.74 to 9.03 mm, Haugh units from 91.83 to 97.40).

Key words: organic eggs, physical traits, Haugh units

This work was financially supported by the Ministry of Agriculture and Rural Development RRRE-029-24-3042/10.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Górecka J., Szmańko T., Bilyk O.¹, Kęsy Z., Świątkowski G.

**PHYSICAL PROPERTIES OF GRILL SAUSAGES DEPENDING
ON PACKAGING AND STORAGE CONDITIONS**

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The aim of this study was to determine the effect on the physicochemical properties of grill sausage in vacuum packaging or in the inert gases atmosphere (MAP) and cold storage or at near cryoscopic temperature.

The experimental material was the medium ground grill sausage, produced in industrial conditions packaged in foil bags in a nitrogen atmosphere and carbon dioxide or vacuum. The material was stored at $3\pm 1^{\circ}\text{C}$ or $-3\pm 1^{\circ}\text{C}$ temperature for 0, 7, 14, 21 and 28 days.

There was no significantly effect on dry matter content in the sausages of both: technology used packaging as well as temperature and time of storage. There was also no impact on experimental conditions in fat and sodium chloride in grill sausages. During the time of storage, the content of grill sausages nitrates was showed at higher levels in cured meat products stored at temperature of -3°C than in cold conditions. There was not any effect on the packaging of the technology level of these relationships. The applied experimental conditions did not affect on the water holding capacity examined grill sausages. Experimental conditions have not effect on changes of color parameters L^* , a^* , b^* , hue and chroma of the color, marked immediately after time of storage of grill sausages. However there was significant influence the storage conditions on color stability. The meat products stored at -3°C characterized with a tendency to more dynamic changes in color parameters during the exposure tests.

Key words: grill sausages, physical properties, packaging, storage, cryoscopic temperature

**5th International Conference
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"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Górecka J.², Szmańko T.², Bilyk O.¹, Kęsy Z.², Świątkowski G.²

**SENSORY AND RHEOLOGICAL PROPERTIES
OF MEDIUM GROUND SAUSAGES, PACKED IN VACUUM
OR MODIFIED ATMOSPHERE AND COOL STORAGE OR
AT NEAR CRYOSCOPIC TEMPERATURE**

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Lviv, Ukraine*

In this study it was to determine sensory and rheological properties of grill sausage depending on the packaging and the storage conditions. The medium ground meats (grill sausages) produced in industrial conditions, packed in vacuum or in carbon dioxide and nitrogen atmosphere of stored in the refrigerator ($3\pm 1^\circ\text{C}$), or at near cryoscopic temperature ($-3\pm 1^\circ\text{C}$).

Sensory evaluation of grill sausages was carried out by a 5-point scale immediately after storing as well as after heating them in a microwave oven to a temperature 71°C in geometrical centre. Appearance, color, aroma, juiciness, texture, flavor, salinity, and the general assessment were analyzed. Rheological measurements were showed using an equipment to test strength Zwick/Roell Z010. Rheological analysis included hardness, springiness, cohesiveness, gumminess and chewiness.

The grill sausage were stored in vacuum packs at near cryoscopic temperature compared with other experimental meat products were characterized by higher evaluation of appearance, color, aroma, juiciness, texture, flavor, and higher overall evaluation. The grill sausages of this group were also characterized with higher hardness. However, grill sausages was kept in an inert gases atmosphere, in cold conditions were characterized by higher chewiness. On the other examined properties rheological experimental factors had not any effect. .

Key word: grill sausages, vacuum packed, cyroscopic temperature, sensory and rheological properties

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Górna J.

**THE IMPORTANCE OF LEGAL REUIREMENTS
AND STANDARDS OF FOOD SAFETY MANAGEMENT
FOR THE EFFECTIVENES OF THE TRACEABILITY SYSTEM**

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The article presents the influence of legal requirements and standards of food safety management on the effectiveness of the traceability system. For this purpose, an analysis of the requirements of food law and food safety management standards such as ISO 22000, BRC and IFS in the area of traceability was conducted. Furthermore, the article presents the factors which influence the effectiveness of traceability. The importance of these factors was assessed by the companies of the meat industry.

Key words: standards of food safety systems, ISO 22000, BRC, IFS, traceability

This work was financially supported by the Ministry of Science and High Education. Project N N112 174137.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Grashorn M.A.

HEALTH PROMOTING INGREDIENTS OF THE CHICKEN EGG

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Since ancient times the chicken egg is a valuable food for humans. On the one hand it contains many nutrients which can cover human requirements and on the other hand it contains many ingredients with health-promoting effects. Protein content and amino acids profile correspond directly to human requirements. Egg white and yolk proteins function as antioxidants and show anti-microbial properties. Several proteins of egg white act as antidotes by counteracting some toxins and irritants. By this the mucous membranes in the stomach and in the intestine are protected. Due to the high water holding capacity of egg white proteins eggs are good in treating gastritis, enteritis, diarrhea, dysentery and dehydration. Vitamins, trace elements and fatty acids of egg yolk play important roles in human metabolism and may be easily enriched during egg production. Lecithin has a positive effect in the treatment of Alzheimer patients. Immunglobulins may enhance the immune response in humans. In contrast, the egg also contains some substances with probable health risks like egg white proteins with allergenic properties and yolk cholesterol. Despite these negative aspects, the 'normal' and the 'functional' (enriched) chicken egg can be assessed as a rich source of nutrients and of health-promoting substances for human nutrition. Some ingredients also have remedy effects which predestined the chicken eggs to be incorporated in the Ayurveda concept. The use of eggs as bioreactor for producing health-promoting substances to be used in medicine and feed processing is a future issue which will gain further interest.

Key words: chicken egg, health, immunglobulins, omega fatty acids

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Grądział-Krukowska K., Michalski M.

**DYNAMICS OF CHANGES OF L-LACTIC ACID
AND 3-OH-BUTYRIC ACID IN FRESH EGGS DURING THEIR
STORAGE**

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The rate of penetration of microorganisms and decay depends on the hygienic condition of the eggs and the surrounding environment. From the point of view of specific hygiene rules for food of animal origin, parameters of quality and food safety is the concentration of 3-OH-butyric acid in the dry matter (dm) of the unmodified egg product (can not exceed 10 mg/kg dm) and L-lactic acid, which content can not exceed 1 g/kg dry matter. In stored eggs during a longer period of time, the content of 3-OH-butyric acid in fertilized eggs increases significantly.

The research was carry out with fresh eggs purchased in a supermarket. Eggs were stored at temperatures: 2–8°C, 21–24°C and 30±1°C. For the determination of L-lactic acid and 3-OH-hydroxybutyric acid enzyme tests were used (R-ratiopharm). The eggs were stored in the refrigerator (recommended temperature), rapid growth of L-lactic acid and 3-OH-butyric acid occurred after the second week of storage. After five weeks of storage the content of L-lactic acid was 357 mg/kg dm and not exceeded the legal limit of 1 000 mg/kg dm. The rapid increase in 3-OH-butyric acid content were observed after the second week of storage, and after five weeks of the border limit was exceeded more than tripled.

Eggs stored at room temperature retained its quality for two weeks, in terms of content of 3-OH-butyric acid. The lactic acid content after five weeks does not exceed maximum level of 1 000 mg/kg dm. As expected, the fastest increasing of content of organic acids in examined eggs stored at high temperature (30±1°C). Almost doubles the increase of contents of L-lactic acid was found after two weeks of storage. After five weeks, rising was up to 1 169 mg/kg dm, and thus exceeded the admissible (legal) limit of 1 000 mg/kg dm. After three weeks of storage the contents of 3-OH-butyric acid increased 46-fold, which means almost 20-fold excess over the allowable content. The dynamics of changes in the content of L-lactic acid in eggs is less than for 3-OH-hydroxybutyric acid.

Key words: eggs, 3-hydroxy-butyric acid, lactic acid, storage temperature

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Grenda T., Kwiatek K., Kukier E., Goldsztejn M.

**USING OF MULTIPLEX PCR METHOD FOR DETECTION
OF *CLOSTRIDIUM BOTULINUM* IN FOOD AND FEED**

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The aim of this study was *in house* validation of mPCR method for detection of *Clostridium botulinum*. This study was carried out on fish salad and feed matrixes which were contaminated by spores of reference *C. botulinum* strains, that is: *C. botulinum* NCTC 887 (type A), *C. botulinum* NCTC 3815, *C. botulinum* NCTC 8266, *C. botulinum* NCTC 10281.

The experiments were conducted after incubation process of contaminated matrixes in TPGY broth, under anaerobic conditions. The DNA was extracted from 1 ml of liquid culture of samples by using commercial kit – Genomic Mini AX Bacteria (A&A Biotechnology, Gdynia). The validated mPCR method enabled detection of *bont* genes specific for each toxinotype of *C. botulinum*. The obtained results were displayed on agarose gels. The characteristic parameters for qualitative detection were estimated, that is: specificity, limit of detection expressed as LOD₅₀ according to the Spearman – Karber formula, sensitivity and accuracy according to the PN-EN ISO 16140:2004. The specificity were estimated by experiments with DNA obtained from 20 samples of each matrix (not contaminated). For the assaying of LOD₅₀, sensitivity and accuracy – 20 samples of each matrix at 3 levels of contamination were examined.

The validated method shown high specificity. The specific products of PCR were observed only for DNA obtained from samples contaminated with *C. botulinum* spores. For the examined food samples – LOD₅₀ ranged between 0.034 (0.021–0.056) spore/g and 0.102 (0.62–168) spore/g. The highest level of sensitivity and accuracy was estimated for detection of *C. botulinum* NCTC 887 spores (type A). The results for contaminated feed showed that detection could be limited by inhibitory effect which has influence in higher limit of detection. The calculated LOD₅₀ ranged between 0.191 (0.139–0.262) spore/g and 0.891 (0.592–1.464) spore/g and was nearly 10 times higher than for food samples. The highest level of sensitivity and accuracy, alike in the case of the food matrix, was estimated for *C. botulinum* NCTC 887 spores (type A).

Key words: Clostridium, mPCR, validation, fish salad, feed matrixes

This work was financially supported by the Polish Ministry of Science and High Education. Project No N N308 563639 (2010 – 2012).

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Hallmann E.¹, Rembiałkowska E¹., Lipowski J.², Jasińska T.²

**THE LEVEL OF CAROTENOIDS AND POLYPHENOLS
IN PICKLED RED PEPPER FROM ORGANIC
AND CONVENTIONAL PRODUCTION BEFORE
AND AFTER PASTEURIZATION PROCESS**

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Organic agriculture is recognized by consumer as safer than conventional one. Also vegetables and their preserves from organic production are favored because of their taste and wholesomeness. This opinion is based on knowledge about the production system used in organic farms and processing plants. In organic agriculture use of fertilizers and pesticides is forbidden, only the natural fertilizers as manure, compost, also green manure are widely used. The plant protection is based on natural insect predators and different plants extracts. The sweet red pepper is the best source of vitamin C, polyphenols, also carotenoids: capsorubin, capsantin, beta-carotene and lutein. Some experiments indicated that fruit and vegetable from organic production contained more antioxidant compounds as polyphenols, carotenoids also vitamin C, but some not. In Poland vegetable processing has a long tradition and it is a good method to enhance the keeping quality as well as diet diversity. However, every method of vegetable processing has a negative impact on the bioactive substances content. The organic vegetables contained more such compounds in comparison to the conventional ones, therefore it could be assumed that pickled vegetables would also contain more antioxidant compounds despite the processing. The aim of this study was to prove this hypothesis.

Two cultivars of sweet red pepper (Roberta and Berceo) from organic and conventional cultivation have been used in the experiment. The red pepper fruits were cultivated in certified organic and conventional private farms located in Mazovia region. The red pepper fruits were collected in the same stage of maturity in the organic and conventional farms. The processing was the first step of the work (preparing the pickled red pepper) and after that the pieces of pickled red peppers were freeze-dried (to keep their quality) and chemically analyzed. The quantity and quality analysis of polyphenols and carotenoids has been determined in both fresh and pickled red pepper fruits. The collected data indicated that organic red pepper contained significantly more total flavonoids, also individual compounds as: myricetin, quercetin, beta-carotene and alpha-carotene. On the other hand conventional red pepper contained significantly more total phenolic acids, chlorogenic and gallic acids, kaempferol,

apigenin, cryptoxantin and cryptoflavin. The examined red pepper cultivars were different. The fruits of Berceo cultivar contained significantly more total phenolic acids, chlorogenic and gallic acids, apigenin and cryptoxantin in comparison to the second examined cultivar Roberta. The pasteurization process changed the level of polyphenols and carotenoids in both red pepper samples. After pasteurization red pepper samples contained significantly less of total phenolic aids, total flavonoids, also chlorogenic acid, D-quercitine glukoside, myricetin, cryptoxantin, cryptoflavin, alpha-cryptoflavin and lutein in comparison to the fresh pickled red pepper.

Key words: organic food, carotenoids, polyphenols, pickled red pepper

This work was financially supported by the Ministry of Agriculture and Rural Development. Project no. RR-re-401-334 / 08 (261).

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Iwanowska A.¹, Smulka M.¹, Pospiech E.^{1,2}

**DEGRADATION OF GLYCERALDEHYDE-3-PHOSPHATE
DEHYDROGENASE IN CONDITIONED BEEF DURING 21 DAYS
OF COLD STORAGE**

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A glyceraldehyde-3-phosphate dehydrogenase (GAPDH) is proposed as a useful indicator of tenderization process in meat during its storage in a cold room.

The aim of this study was to observe changes of GAPDH share in proteins of muscles during 21 days cold storage in control and conditioned conditions. The analyses were performed on *longissimus lumborum* (LL) muscles from Polish Holstein-Friesian (PHF) Black-and-White variety bulls slaughtered at the age of 18 to 24 months. The control carcasses were chilled directly after slaughter in the cooled room. The conditioning was performed directly after slaughter at 10°C for 12 h, then it carcasses were chilled at 2°C up to the next day. The samples were excised 2 days after slaughter from the LL muscle, vacuum-packed and stored in a cold room at 2°C for 21 days *post mortem*.

Changes in the proportion of GAPDH in the muscle tissue proteins were evaluated 45 minutes, 3, 10, 14, 17 and 21 days *post mortem* using the polyacrylamide gel electrophoresis (15% acrylamide, pH 8.8 of resolving gel and 8 M urea). The ratio of acrylamide to bis-acrylamide in the gel was 199:1. The identification of GAPDH followed by the use of western blotting method. As a primary antibody was used anti-GAPDH monoclonal.

The content of GAPDH decreased during 21 days of cold storage in control and conditioned meat. Beginning with the 45 min. until the 21 days, the share of this protein decreased from 7.80 to 3.25% in the control and from 9.22 to 2.95% in the conditioned neat. The process of GAPDH degradation was more dynamic (decline in proportions of about 70%) in meat from the conditioned carcasses in comparison to the control (decline of about 42%). It means that conditioning of carcasses speed up the proteolysis process of GAPDH in bovine muscles.

Key words: beef, GAPDH degradation, longissimus lumborum, tenderization

This work was financially supported by Grant N N312 253439 from Polish Ministry of Science and Higher Education.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Jalosińska M., Kołożyn-Krajewska D.

**COMPARISON OF *SALMONELLA ENTERITIDIS* SURVIVAL
IN PROBIOTIC RIPENING SOFT CHEESE WITH THE GROWTH
CURVES PREDICTED BY THE PATHOGEN MODELING
PROGRAM V. 6.0**

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Salmonella spp. belonging to the family *Enterobacteriaceae* are classified as strictly pathogenic. All serotypes of *Salmonella* spp., even zoonoses, are dangerous to humans – causes gastroenteritis, ie. food poisoning. From the standpoint of their pathogenicity in humans, the rods belonging to the serotypes of *Salmonella typhi* cause typhoid, belonging to serotypes of *S. paratyphi* A, B or C cause paratyphoid, and the remaining serotypes (about 2500 according to the scheme of antigenic construction of Kauffman White) are the cause of infectious diseases, known generically referred to as salmonellosis. For many years in Poland and the world's major cause of salmonellosis is the species of *S. enteritidis*.

Many scientific reports indicate the sensitivity of *Salmonella* spp. in the presence of lactic acid bacteria, including probiotic strains. *Salmonella* spp. is growing much more slowly in the presence of these strains, and farming tends to decline.

The Pathogen Modeling Program is predictive computer program to model the growth of various pathogenic bacteria, including *Salmonella* spp., but the data collected to construct the program were based on bacterial growth in liquid media, rather than in real food products. Growth of bacteria in food is subject to many factors that cannot be taken into account during the application of microbiological culture media.

The aim of this study was to compare the survival of a mixture of three reference strains of *Salmonella enteritidis* (ATCC 1592, ATCC 13076, ATCC 2419) in the probiotic ripening soft cheese (Lazur cheese with the addition of probiotic strain *Lactobacillus acidophilus* LA5) stored at a temperature of 10°C and 15°C with the growth curves predicted by the Pathogen Modeling Program v. 6.0 .

Microbiological analysis were carried out according to standard microbiological PN-EN ISO 6785:2009 and performed for 5 research series in every temperature.

To estimate the growth of *Salmonella* spp. were used the Pathogen Modeling Program v. 6.0, and own experimental data of the product (initial pH, storage temperatures and the initial contamination of the product of tested strains).

Curves of the pathogen growth received on the basis of own microbiological examinations were compared with curves obtained from computer simulation.

Survival curves of *Salmonella* spp. estimated on the basis of the Pathogen Modeling Program v. 6.0 differ significantly from obtained in the food product (probiotic ripening cheese). The presence of probiotic strains in the cheese caused a decrease in the number of *Salmonella* since the beginning of storage in both, checked temperatures, which didn't take prediction curves into consideration. These results confirm the thesis that the microbiological tests carried out in order to obtain prediction models should be done with model food product, not with synthetic liquid media.

Key words: *Salmonella enteritidis*, survival, soft cheese, Pathogen Modeling Program

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Jaworska D., Przybylski W., Bednarek A.

**EVALUATION OF SMOKED MEAT PRODUCTS QUALITY BASED
ON THE EXAMPLE OF "SOPOCKA" LOINS**

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The aim of the study was to characterize and evaluate the quality of selected Polish pork loins available on the local market. All tested products were vacuum packed and characterized by comparable shelf life.

For sensory assessment, the sensory QDA method (ISO 13299.2:1998) was applied. Descriptors were chosen, defined and verified in a preliminary session. Finally, 13 sensory attributes were measured to quantify the quality of the tested products (5 attributes of odour, 3 attributes of visual quality and texture as well as 5 attributes of flavor).

The microbiological analysis consisted of determination total bacteria count (TBC) and total viable count (TVC) using pure plate method (deep inoculating method). The results were presented as cfu/cm³ e.g. colony forming units par cm³.

The scope of chemical analysis included evaluation of protein, fat and water content as well as sodium natrium, nitrates and nitrites content.

The analysis of the obtained results in this study showed that the studied pork loins differ significantly in overall sensory quality especially in the intensity of colour as well as the intensity of smoked meat odour and flavour and juicines s.

The microbiological study showed that among the tested five pieces of loin only two samples were characterized by the overall number of bacteria colony below the level of 10⁻⁵. The tested samples were significantly different regarding protein, fat and water content. The obtained protein content in the studied samples was from 12.5 to 26.1%. The tested loins were characterized by different fat content (from 0.62 to 3.39%) and water content (70.7–80.6%). The excess of salt as well as nitrates and nitrites content was not observed in any samples

Key words: smoked pork loins, quality, sensory, microbiological quality

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Jukna V., Jukna C., Pečiulaitienė N., Meskinytė-Kaušilienė E.

**THE EFFECT OF GENOTYPE ON PORK INTERMUSCULAR FAT
AMOUNT AND CALORIC VALUE**

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Lithuanian University of Health Science*

In this abstract represented analysis data about the effect of breed pigs and sex on intramuscular fat amount and caloric value. Researches were pursued with 96 of English Large White, Yorkshire, Landrace and Lithuanian White pigs. These pigs had grown in the same keeping conditions in the state pig breeding station. The control slaughters and meat quality of pigs performed according commonly accredited methods. Caloric value of meat was counted according Watt, Mersil (1975) formula. It has been concluded that breed and sex had influence on intramuscular fat amount ($p < 0.05$). Intramuscular fat amount was estimated major in meat of castrates compared with meat of gilts. All studied pig breeds differences of meat chemical consist were estimated inconsiderable, therefore theirs similar caloric value of meat. The biggest correlation coefficients were estimated between dry matter of meat and protein amount in all studied pig breeds ($p < 0.001$). Between dry matter of meat and intramuscular fat amount the lesser correlation coefficients were estimated ($p < 0.05 - < 0.001$). Intramuscular fat and protein amount had the most influence on caloric value of meat. Caloric value of meat increased that intramuscular fat amount increased in the meat.

To sum up the research data can draw the following conclusions: pigs breed and sex had affected on the intramuscular fat content in the meat ($P < 0.05$). Castrates meat had more intramuscular fat than gilts. All investigated pig breeds of meat chemical composition differences were inconsiderable, therefore their of the meat calorific value was similar. All tested pig breeds the highest correlation coefficients were determined between meat dry matter and protein content ($p < 0.001$). Between the dry matter and meat fat content of the correlation coefficients were lower ($P < 0.05 - < 0.001$). Meat intramuscular fat and protein content the most had influenced meat calorific value, when increasing of meat intramuscular fat content was noticed that meat calorific value increasing trend.

Key words: genotype, intramuscular fat, pork, caloric value

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Karwowska M.

ANTIOXIDANT ACTIVITY OF SPICES IN MEAT PRODUCTS

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Many spices are excellent source of phenolic compounds which have been reported to show good antioxidant activity. The addition of natural antioxidants is a major way to inhibit lipid and myoglobin oxidation in meat products. The literature contains limited information regarding antioxidant activity of mustard seed in meat products.

The aim of the study was to evaluate the influence of ground mustard seed on myoglobin and lipid oxidation of meat products made of pork during storage.

Investigations were carried out on cooked meat products produced from organic pork meat (*m. biceps femoris*). Three variants of cured stuffed meat products samples (in collagen casings) were obtained: 1 – control, 2 – experimental containing 0.2% of ground mustard seed and 3 – experimental containing 0.5% of ground mustard seed. The cooking of the stuffed product was carried out to an internal temperature of 72°C. Chilled meat product samples were packed into the HDPE bags and stored at 4°C until assessed. The measurements of the meat products quality were carried out 1, 5, 10 day after production and included: pH values, water activity, CIE L*a*b* color parameters and lipid oxidation.

Obtained results pointed out that the addition of mustard seed to the composition of cooked sausage had little effect on TBARS values and water activity in examined samples. Analysis of L*a*b* parameters showed slight influence of mustard seed addition on color of cooked meat products.

Key words: meat products, pork, mustard seeds, myoglobin, lipid oxidation

This work was financially supported by the Ministry of Science and High Education. Project IP2010 017170.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Kazimierczak R., Hallmann E., Bąbała J., Rembiałkowska M.E.

**COMPARISON OF THE BIOACTIVE SUBSTANCES' CONTENT
IN THE SELECTED SPECIES OF BERRIES FROM ORGANIC
AND CONVENTIONAL CULTIVATION**

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Berries are rich in vitamin C, anthocyanins and phenolic compounds. Having antioxidant properties, all of these compounds are very important for human health. There is scientific evidence that allows to assume that organic fruit and vegetable contain more bioactive compounds with antioxidant properties than plant crops from the conventional farming. The aim of the presented studies was to compare a nutritional value of different berries. Four species were chosen to the study: blueberry (*Vaccinium corymbosum* L.), raspberry (*Rubus idaeus* L.), strawberry (*Fragaria × ananassa* Duchesne) and blackberry (*Rubus sp.* L.). Fruits came from the certified organic and conventional production. The following nutritive compounds were analyzed in berries: vitamin C, flavonoids, phenolic acids, antocyanins and dry matter. The results showed that organic berries contained more flavonoids, phenolic acids and antocyanins in comparison to the conventional ones. However, berries from conventional production contained more vitamin C. The applied method of cultivation did not impact the content of dry matter. The results indicate the potential beneficial health properties of the organic berries.

Key words: blueberry, raspberry, strawberry, blackberry, nutritive value, organic fruits

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Kikut-Ligaj D.

**SIMPLE PHARMACOPHORE MODELS FOR PREDICTION
OF BITTER TASTE OF SOME NATURAL COMPOUNDS**

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The problem of interactions between a taste receptor and a taste-active compound has been of great importance for investigation of the quality of taste. For the last decade much attention in the area of the taste study has been devoted to biochemical analysis of receptor proteins. It has been shown that a *family* of 25 G protein-coupled receptors, (TAS2Rs family), mediates *bitter taste* in humans. TAS2Rs belong to the super family of receptors that possess seven transmembrane helices and interact with intracellular G proteins and are therefore referred to as heptahelical or G protein-coupled receptors (GPCRs). For this reason our study has concentrated exclusively on lowmolecular bitter ligands that could have similar regions of taste recognition. The intermolecular interactions ligand-receptor and their influence on the bitter taste were analysed on the basis of two methods e.g. 3D pharmacophore-based techniques and molecular docking in which the structure of ligands is docked into the molecular mould (MM). The success of a combination of 3D pharmacophore techniques with the molecular docking method is largely based on intuitive interpretation and formulation of pharmacophore models and precise ligands docking into molecular mould (MM). In the experiment on prediction of the bitter taste we used such groups of natural ligands such as methylxanthines, chromones, furochromones and flavonoids. All proposed by us three-dimensional geometric pharmacophore models consist of nucleophilic and electrophilic active areas. Computer analysis confirmed the bitter taste stimulation by ligand not only at nucleophilic active sites ($Nu_1-Nu_2-Nu_3$ or $Nu_3-Nu_2-Nu_1$) but also at nucleophilic and electrophilic active sites ($Nu_1-E_2-Nu_3$ or $Nu_3-E_2-Nu_1$).

Key words: chemoreception, bitter taste, bitter ligands, pharmacophore, molecular mould, flavonoids, chromones, furochromones, methylxanthines

This research has been supported by Ministry of Science and Higher Education of Poland in the years 2008–2011 within the project No. NN312 187835.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Kirezieva K.K., Luning P.A.

**AN INSTRUMENT TO DIAGNOSE PERFORMANCE OF FOOD
SAFETY MANAGEMENT SYSTEMS IN FRESH PRODUCE**

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In the last years lots of efforts have been put in the implementation of Food Safety Management Systems (FSMS), especially in animal product processing industries. Nevertheless, foodborne outbreaks appear to increase, and there is a tendency for a shift from traditional problems with foods from animal origin to fresh foods such as produce. Fresh produce is an important part of a healthy diet, and consumption of fresh, fresh-cut and minimally processed produce, including raw fruits or vegetables, has increased markedly in the last decade. The sourcing is global, often associated with inadequate sanitation, hygiene deficiencies and improper production practices. Furthermore, in fresh-cut and minimally processed produce there is no further processing that would be expected to eliminate any pathogen, pesticide residue or mycotoxin contamination. The risk of contamination is inherited since the output of one chain actor is the input for the next. However, performance of currently implemented FSMS along the fresh produce chain proved to be unsatisfactory, often lacking scientific base and prone to systemic failures. Therefore, there is a need to diagnose the implemented FSMS in order to know their constraints and bottlenecks in assuring food safety.

Recently, an instrument was developed for food business operators to diagnose their implemented FSMS, considering the context in which they are operating. The instrument is aimed primarily on microbial food safety performance of animal product processing industries and is not covering the primary production. In this study the instrument is further elaborated and adapted to the specificity of fresh produce. It is extended to assess different chain actors, including primary production and trade, and to consider chemical hazards such as pesticides and mycotoxins.

The instrument is a useful tool that provides a picture of current state of a FSMS in the specific circumstances in which a company operates. It enables mapping of FSMS at different actors along a chain and comparison between supply chains.

Key words: Food Safety Management System, fresh produce, food safety, diagnostic tool

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on the
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Kołożyn-Krajewska D., Rosiak E., Trząskowska M., Jałosińska M.

**MICROBIOLOGICAL RISK ASSESSMENT IN SELECTED
MEAT PRODUCT**

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Meat pates are popular and widely consumed products. They are made from meat and giblets subjected to pre-heat treatment which ensures the inactivation of sporulating microorganisms. Because of the composition and degree of fragmentation, these products are an excellent medium for microflora growth during storage, distribution and slicing.

Purpose of the study was to assess the microbial risks associated with the production and distribution of meat pates (pork).

The three most frequent food poisoning microorganisms in the meat pates i.e.: *Listeria monocytogenes*, *Salmonella* spp., *Staphylococcus aureus* were selected.

Minimal Infection Dose (MID) in the case of *L. monocytogenes* is individual, depending on the ontogenic resistance, but the number 10^3 cfu/g is taken as the dose causing the disease. In the case of *Salmonella* that cause the gastro-intestinal infections (salmonellosis) the MID is 10^5 cfu/g, while for the species causing the typhi and paratyphi MID is 10^3 cfu/g product. Vegetative cells of *S. aureus* in general are not relevant in the course of poisoning, the gastrointestinal tract is not a good environment for their development due to the antagonistic action of the normal intestinal flora. The main cause of illness is enterotoxin formed only in food. This process depends on environmental factors such as substrate composition and temperature. The dose of enterotoxin causing disease is estimated at 0.1–1.0 μ g/kg body mass. Some authors indicate that the toxic dose is for enterotoxin A - 0.2 μ g/kg body mass that is 10–15 μ g for a man of average weight, and for enterotoxin B, about 0.3 μ g/kg body mass.

Key words: pork pates, *Listeria monocytogenes*, *Salmonella* spp., *Staphylococcus aureus*, MID

This work was financially supported by the Ministry of Science and High Education. Project N R12 0097 06/2009 managed by prof. Stefan Ziajka.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Kołożyn-Krajewska D., Trafialek J., Rzeźnik R.

**BENEFITS OF SAFETY SYSTEMS IMPLEMENTATION
IN PRODUCTION AND DISTRIBUTION OF FOOD**

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Food safety is of paramount importance not only for consumers and food industry, but also for economics. The health safety of food corresponds to the producer in processing plants or the person who places the product on sale in stores. Food safety is ensured, if the food plants and grocery stores will implement and apply the principles of Good Manufacturing Practice, Good Hygiene Practice and HACCP system. Implementation of these systems is a legal obligation arising from EC Regulation 852/2004.

It is appropriate to check whether the application of the safety system in practice poses food enterprises and shops of any benefit, whether it is just meeting the requirements of food law. The question is whether compliance with legal requirements actually affect the safety of foods in the food production and distribution, and that allows users to reach other benefits. The aim of the paper is to present the documented benefits achieved in manufacturing and distributing of foodstuffs after the implementation of the safety system (Good Hygiene and Manufacturing Practices and the HACCP system).

The study was conducted using a questionnaire. Questionnaires sent to small and medium food enterprises – processing plants (SMEs) and shops were different and takes into account the specificity of their business. The study was carried out in processing plants shortly after the introduction of the national obligation to implement the system in 2005. The subsequent studies in the shops were 4 years later i.e. in 2009, after the entry into force of the European Union obligation to apply the procedures based on HACCP.

Research shows that the implementation of Good Manufacturing Practice, Good Hygienic Practices and HACCP in food shops and plants are at a similar level. Principles of Good Practices have been implemented among the approximately 80% of respondents, and this is a good result. The HACCP system was implemented approximately by 40–50% of food enterprises and shops. It should be noted that studies were conducted in plants 4 years earlier than in the shops. It must be assumed that at present a much greater proportion of plants than the shops have implemented the HACCP system. There is no current data on the degree of international implementation of the HACCP system. Most likely it was that, since the system is mandatory in EU and other countries, all companies have implemented it and apply, so there is no need to verify degree of implementation.

Benefits after the implementation of the safety system in processing plants were analyzed in much broader terms than in grocery stores. The benefits were divided into three categories: to improve health safety, economic and non-economic aspects. Issues concerning the benefits were contained in three different questions of the questionnaire survey. In grocery stores, only one question was devoted to benefits after the implementation of the system to ensure health safety.

Both in the evaluated food plants and grocery stores, a number of different benefits after the implementation of the safety system were declared. However, processing plants and grocery stores differently perceive the positive aspects of system implementation. The main difference concerns the aspect of food safety, which is usually declared as the benefit after the food safety system implementation, both in grocery stores and processing plants. However, in the case of shops much less of the respondents, i.e. about 30%, showed this advantage.

However about 70% of food SMEs cited the improvement of food safety as the main benefit after the implementation of the system. Differences in perception of the benefits can be due to different characteristics of the enterprises and the various determinants of achievement. In the case of plants, important factor was to train staff and implement the principles of GMP / GHP. Conducting training was important for grocery stores too, but other factors as the type and nature of the business, shop location, education, and training schedules of the respondents, were also important.

Research shows that the case of system documentation, which according to the seventh HACCP principle must be conducted and maintained, is viewed very differently in shops and processing plants. In grocery stores, only about 15% of respondents expressed the view that the implementation of the system affected the arrangement of the documentation. Contrast to approximately 50% of SMEs have noted the positive impact of the system implementation for plant documentation.

Other declared benefits after implementing the system in both types of enterprises concerned, among others, increase accountability of employees for the work and increase the competitiveness of the company/store. These benefits were claimed by more respondents from food plants than shops. Despite the differences in indications, implementation of the safety system, in addition to meeting mandatory legal requirements, is resulting in positive consequences for the current operation of the enterprises.

In conclusion, it should be noted that the most important declared benefit of implementing the food safety system is to ensure the safety of manufactured or offered for sale food products, although other aspects beneficial to plants are also noticed in both processing plants and grocery stores.

Key words: food safety systems, survey, HACCP, GMP, GHP

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Kondratowicz-Pietruszka E.

ACID PROFILE OF CANNED FISH OIL

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Fish are still an underrated and rarely consumed food product in Poland. They are a source of protein of high nutritional value and fat of high bioavailability of ca. 97%. Fish are divided into two categories based on their fat content: lean and fat. Fat fish, like, among others, halibut, salmon, eel, tuna, herring, mackerel, pilchard, deserve particular attention. They appear on the market as fresh, frozen, smoked fish or, e.g., in canned form. Among many sorts of canned fish, the canned pilchard range is particularly rich. They should be considered to be a part of the human diet.

The fat is one of the basic nutrients. Fats have multiple important functions in the human body. Fats are an energy source, enhance the tastiness of food, are building materials for cell membranes, provide EFA, are carriers of fat soluble vitamins. The fish, particularly sea fish, such as pilchard, contain polyunsaturated fatty acids of n-3 group that are important in the prevention of atherosclerosis.

The goal of this work was to determine the fatty acid profile of oil contained in canned fish. For the studies, 16 cans of various producers were chosen. The determination of fatty acid content was carried out by gas chromatography. It was found that all oils contain saturated fatty acids, C 16:0 and 18:0. Their total percentage in the SFA profile was from 10.33 to 22.77%. The investigated oils had diverse SFA contents, from 11.64% to 30.99%. The MUFA content was strongly diverse depending on the oil type. For all the studied oils, a common acid in the MUFA group is C 18:1 (cis-9), occurring in the amount from 16.08 to 76.91%. The total amount of remaining acids is ca. 5%. In eight samples, the trans form of C 18:2 (trans-9, 12) acid occurred. The total content of (n-6) family of fatty acids, depending on the sample type, ranged between 5.40% and 62.28%. The $\Sigma \text{FA}(n-3) / \Sigma \text{FA}(n-6)$ ratio for the studied oils was from 0.01 to 0.35. The ratio of $\Sigma \text{UFA} / \Sigma \text{SFA}$ in the oils was from 2.23 to 7.59.

Key words: oil from canned fish, fatty acids

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

**Kopec W., Pudlo A., Ziembowska K., Korzeniowska M., Biazik E.,
Skiba T.**

**CHARACTERISTICS OF MECHANICALLY DEBONED TURKEY
MEAT AS A RAW MATERIAL FOR SURIMI LIKE ISOLATE
PRODUCTION**

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Mechanically deboned meat (MDM/MRM) described the product recovered from animal bones or poultry carcasses by the application of pressure or shear forces. Such products are characterized by a high content of haeme pigments, connective tissue, calcium and fat, usually dark in colour, with undesired texture and easily prone to oxidation processes. However, it can be a good material for further productions.

The aim of the study was to verify the functional properties of different type of poultry meat raw materials, including various kinds of MDM, to be predicted as a raw material for further meat products processing and also for an isolation of myofibrillar proteins.

The experimental material consisted of different kinds of turkey meats: fillet from breast muscle (white meat) and meat from wing with or without skin (control), as well as bone elements (frame and cut off trunk, wing bones, leg bones) separated from meat and deboned. The following analyses were performed:- basic chemical composition including dry matter, nitrogen, crude protein, hydroxyproline. Moreover, pH value, water binding capacity and colour parameters were measured.

The results of the study showed that type of raw materials significantly influenced the content of dry matter, protein, fat and slightly collagen. The lowest amount of dry matter was noticed in breast and wings muscle (26%), whereas the highest value was observed in mechanically deboned meat from wings, thighs and mix type of meats. In mechanically deboned meat from trunk and sternum dry matter content amounted between 34.6–34.8%. Protein content varied from 13.5% for mechanically deboned meat mixed type to 23.6% for turkey hens breast muscles. Whereas, the collagen content amounted about 1% for MMDM and about 0.5% for breast muscle tissues.

Meat from wings and MDM from trunk were characterized by the highest lightness. Slightly lower L* value (but statistically significant) was observed for MDM mix type and MDM from sternum and breast muscles. MDM from thighs and MDM from wings had the lowest L* value. The highest redness (a) was stated for all studied mechanically deboned meat, while much lower values were observed for breasts and wings muscles. The b* value indicated contribution of yellow color. MDM from legs, sternum, wings bones and mix type

were characterized by the highest value of b^* parameter. The lowest contribution of yellow color was observed in breasts and wings muscles.

The highest water binding capacity was observed in control samples (breasts and wings muscles). In case of deboned raw materials high value of WBC was noticed for MDM from legs and wings bones, but no significant differences among mechanically deboned meats were observed. The highest amount of myofibrillar proteins (19–23%) was isolated from breast and wings muscles. Whilst the lowest yield of recovered proteins was stated for mechanically recovered meats (5–8%).

Summing up, the potential technological suitability of mechanically deboned turkey meat for further product processing assessed by functional properties and myofibrillar protein extractability depends on the bone raw materials used for separation process.

Key words: mechanically deboned poultry meat, surimi-like products, color, WHC

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Korzeniowska M.¹, Lech K.², Figiel A.², Szarycz M.², Oziębłowski M.¹

**SENSORY PROPERTIES OF PUMPKIN TREATED WITH
SUCROSE OSMOTIC SOLUTIONS FOLLOWED
BY A VACUUM-MICROWAVE DRYING**

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Sensory characteristic is one of the main factors in food products choice. High quality dried food, including fruits and vegetables, should be characterized by high crispiness, uniform colour and distinctive taste. Pumpkin is rich in vitamins, especially ascorbic acid, riboflavin and tocopherols, carotenoids, tannins and also minerals like magnesium, potassium, iron, phosphorus and selenium. The fruit is widely consumed by humans and it also has some cultural aspects, especially in North America. Thanks to its specific flavour, taste and texture, pumpkin fruit can be manufactured for jam, juice, pomace, pickles and dried products. Food industry applies many drying methods including a vacuum-microwave (VM), which is an advanced technology, fast, safe and economic. In microwave drying, heat is generated by direct transformation the electromagnetic energy into kinetic molecular energy, thus the heat is formed deep within the dried material. A large vapour pressure created in the centre of the product allows the rapid transfer of moisture to the surrounding vacuum and saves structure. In order to enhance the sensory quality of the products, as well as to shorten VM drying an osmotic dehydration as a pre-treatment can be used.

The aim of the study was to evaluate the sensory properties and the drying kinetics of a vacuum-microwave drying of pumpkin slices preceded by dehydration in sucrose solutions. The experiment was performed on fresh pumpkin (*Cucurbita pepo*) of "Hokkaido" variety. The fruit was cut into round pieces 18 mm in diameter and thick for 5 mm, and soaked in 20, 40 and 60% sucrose solutions (1:3 pumpkin to osmotic solution) at 40°C. After 0.5, 1, 2, 4 and 6 hours of the osmotic dehydration pumpkin pieces were weighted and vacuum-microwaved (360 W). Temperature of pumpkin slices was controlled with an infrared camera immediately after removing from the VM dryer. The final product quality analyses consisted of shrinkage, colour and texture parameters (TPA). Moreover, the intensities of the main sensory traits typical for dried product i.e. colour, flavour, taste and texture, were evaluated by trained panel.

A correlation between the results for hardness of dried pumpkin slices evaluated by the sensory panel and a texture profile analysis performed by the Instron machine was found.

The increased crispiness revealed by the sensory assessment was associated with decreased cohesiveness and springiness determined by TPA analysis. The results collected in the study showed also that the best product in terms of taste and flavour was made when 20% sucrose solution was applied. However, the best texture of pumpkin slices required pre-drying in 40% sucrose solution. The increase in sucrose concentration decreased shrinkage, cohesiveness and springiness, but at the same time increased hardness and brightness of the final product. Analysis of the kinetics of drying process revealed that the weight of pumpkin samples during osmotic pre-treatment was decreasing until the equilibrium stage. Higher concentration of sucrose caused a decrease in the final moisture content of the pre-treated samples. An exponential equation can be used for describing the decrease in moisture content of the pumpkin slices during VM drying. The temperature of the samples during VM drying was rising until the certain moisture content followed by dropping down as the result of the energy balance generated within the dried material by water dipoles and the energy necessary for water evaporation.

It can be concluded that the optimum sensory quality of the dried beetroot slices can be reached by application of the osmotic pre-drying in 20–40% sucrose solutions followed by a vacuum-microwave drying.

Key words: pumpkin, sensory properties, vacuum-microwave drying, sucrose pretreatment

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Kosmalski B.¹, Kaźmierska M.¹, Jarosz B.², Siepka E.¹, Trziszka T.¹

**BIOLOGICAL PROPERTIES OF LUTEIN AND ZEAXANTHIN
AND THEIR ROLE IN PROTECTING HUMAN HEALTH**

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Lutein and zeaxanthin belong to a large class of plant pigments referred to as carotenoids. They consist of 40-carbon compounds with nine conjugated double bonds in the polyene chain. Although man is capable of modifying some carotenoids to some extent, he is not capable of synthesizing them *de novo*. Thus, their presence in human body is entirely of dietary origin. Lutein and zeaxanthin are present in a wide variety of fruit and vegetables. Their concentration is particularly high in leafy green vegetables, such as spinach, collards and kale. Furthermore, lutein and zeaxanthin are also present in some animal products, such as egg yolk. Using modern methods of egg design, we can find possibility for egg yolk enrichment on carotenoids, especially lutein, which play a very important role for human health. At present, the most effective prevention method is increasing our intake of lutein and zeaxanthin which accumulate in the macular region of the eye and seem to help in preventing such blindness. Furthermore, lutein and zeaxanthin may enhance monocyte function by increasing the number of surface molecules expressed by monocytes and decrease cancer risk by their ability to scavenge free radicals. This paper is focused on potential role of lutein and zeaxanthin in disease prevention in the context of human health. The effect of this study is a summary containing important information about biological properties of lutein and zeaxanthin.

Key words: lutein, zeaxanthin, egg yolk, age-related macular degeneration, supplements

Project "Innovative technologies of production of biopreparations based on new generation eggs" Innovative Economy Operational Programme Priority 1.3.1, thematic area "Bio" co-financed by European Union through European Regional Development Fund within the Innovative Economy Operational Programme, 2007–2013.

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Kowalik J., Łobacz A., Ziajka S.

**APPLICATION OF IMPEDIMETRIC METHOD
TO QUANTITATIVE EVALUATION OF LISTERIA
MONOCYTOGENES CELLS IN FETA CHEESE**

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The aim of present work was adjustment of monitoring system Bactometer M64 (Biomérieux) based on impedance to evaluate the growth of foodborne pathogen from *Listeria monocytogenes* species in defined dairy products.

Available media with electric properties used in Bactometer are not appropriate for selective evaluation of the number of *Listeria monocytogenes*. In order to make it possible, the composition of BHI media (Brain Heart Infusion – Biomérieux) was modified by addition of selective supplement from Fraser (Merck), is used in identification of *Listeria monocytogenes* according to EN-ISO 11290-2:1998.

To determine the number of *Listeria monocytogenes* cells in feta cheese, the calibration of Bactometer was performed in relation to traditional plate counts method according to producer recommendations. Modification of BHI media was used in Bactometer, by addition of selective Fraser supplement, whereas in traditional plate counts method the Chromocult Agar for *Listeria* according to Ottaviani and Agosti (ISO 11290-2:1998/Amd 1:2004) was used. The calibration curve for feta cheese, bought in local supermarket, was done. Samples were contaminated with *Listeria monocytogenes* inoculum. Cheese samples without addition of *Listeria monocytogenes* were also analysed using the modified BHI broth. Bactometer did not show the detection of *Listeria monocytogenes* or any other microorganisms, which confirmed the satisfactory selective properties of modified media. Cheese samples before calibration were tested for presence of *Listeria monocytogenes* according to ISO 11290-2:1998.

Bactometer calibration showed a high correlation with plate counts method ($r=0.98$). The impedimetric system after calibration performed for many dairy products and different species of foodborne pathogens, with proper selection of selective supplements, can be a useful tool enabling rapid, quantitative microbiological analyses. That kind of dairy products analyses pose an important issue in production and distribution of safe food, as well as it can find application in predictive microbiology.

Key words: feta cheese, *Listeria monocytogenes*, Bactometer, predictive microbiology

This work was financially supported by the Ministry of Science and High Education. Project N N312 296935.

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Krasnowska G., Tril U., Salejda A.M.

**COMMODITY EVALUATION OF POPULAR MEAT PRODUCTS
OFFERED ON LOCAL MARKET**

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In the popular meat products manufactured from fine comminuted raw materials can be expected variability of its quality. This effect is crucial to guarantee the stable features of these products. In this study selected quality factors of the popular meat products were examined in order to verify their compatibility with the criteria of commodity evaluation, nutritional value and sensory attributes.

The experimental material was range of three meat products available on local market in the city of Wrocław: pork frankfurters in unit packages, sterilized chicken pates in aluminum cans, and sterilized pork luncheon meat in metal tins. The evaluation of meat products was carried out on the following attributes: correctness of labeling and packages quality, basic chemical composition (content of water, protein, collagen and fat), amount of sodium chloride and nitrate (III). Besides, color measurement in CIElab system and the sensory evaluation were performed.

The analysis of results leads to the conclusion that the quality of popular meat products, under evaluation, does not get negative feedback. The consumer obtained all necessary and required information of the packages of these products. There were no significant deficiencies that may mislead. It should also be noted that the packages had an esthetic appearance.

Net mass of products sometimes was incompatible with the declaration, but these omission were not significant and mostly connected to the pork tinned meat products.

The analysis of chemical composition has confirmed that the popular meat products comminuted and/or homogenized were produced from raw materials of different quality. It caused variability of products in different production batches. However, evaluated meat products were within generally accepted qualitative criteria. Moreover sensory evaluation confirmed the good quality of these products.

Key words: meat products, consumer, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Krawczyk J.¹, Sokołowicz Z.²

**EFFECT OF FEEDING MAIZE DDGS DIETS TO LAYING HENS
ON FATTY ACID CONTENT OF EGG YOLKS¹**

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Eggs from Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11) included in the biodiversity conservation programme in Poland were studied. Within each breed, the control group (60 hens and 6 cockerels) was kept in a confinement poultry house on a litter floor and fed *ad libitum* complete diet for breeder hens. The experimental group (60 hens and 6 cockerels) was raised in a confinement poultry house on a litter floor; throughout the egg production cycle (to 20 weeks of age) fed *ad libitum* diet containing 10% dried distillers grains with solubles (DDGS).

The material used in this study consisted of 32 eggs (8 eggs from each group) collected at 33 weeks of age (after 12 weeks of feeding DDGS diet to layers). Eggs were evaluated after 24-hour refrigerated storage at 4°C and 55% humidity. The content of higher fatty acids in egg yolks was determined by gas chromatography.

The study showed that the main fatty acids in yolks of eggs from Greenleg Partridge (Z-11) and Rhode Island Red hens (R-11) receiving a 10% DDGS diet (experimental group) and no DDGS supplement (control group) were oleic (C18:1, 44.57–45.23%), palmitic (C16:0; 27.41–29.02%) as well as linoleic (C18:2; 10.06–12.38) and stearic acids (C18:0; 7.39–7.950%). Saturated fatty acid content was similar in all the groups and ranged from 35.49 to 37.32%. DDGS supplementation had no effect on the proportion of saturated fatty acids, the content of which in egg yolk ranged in individual groups from 47.38 to 48.59% for monounsaturated fatty acids and from 47.38 to 48.59% for polyunsaturated fatty acids.

It was found that maize DDGS can be used in the feeding of laying hens of the native breeds as a partial replacement of imported soybean meal in imported feeds. A 10% DDGS supplement has no adverse effect on layer performance nor does it change the fatty acid profile of egg yolk and the n-6:n-3 PUFA ratio while making profitable use of the distilling industry by-products, which otherwise could be a nuisance waste product.

Key words: eggs, Greenleg Partridge, Rhode Island Red, DGGs, fatty acids

¹ Supported by grant no N R12 0083 10 financed by the National Centre for Research and Development.

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on the
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Kronberga M., Straumite E., Karklina D., Murniece I., Galoburda R.

**EVALUATION OF SENSORY PROPERTIES OF NEW TYPE
AGAR JELLIES**

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A lot of research has been carried out to substitute the sugar in food products by other sweeteners since sugar consumption is directly related to diabetes and other illnesses such as obesity. Traditionally, sugar has been the sweetener of choice. Apart from its sweetening action, sugar performs a variety of functions: formation of crust colour, flavour enhancement, texture modification, development of structure, and shelf-life improvement.

Therefore the aim of the research work was to evaluate the effect of inulin syrup and malt extract on the sensory properties of agar-based jellies. Standard agar-based jelly is prepared using the following ingredients: agar powder, glucose syrup, sucrose, citric acid and water. Experimental samples were prepared substituting sugar by inulin syrup or malt extract in the following proportions: 20, 40, 60, 80 and 100%. For taste improving cacao powder was added to agar-based jelly samples. In sensory evaluation of experimental jellies a 9-point hedonic scale and ranking tests were used to determine degree of acceptance. The intensity of sensory properties (appearance, colour, hardness, odour, sour taste, and aftertaste) was evaluated using line scale. The obtained results of sensory evaluation of the samples showed that the agar-based jelly with 20% of sugar substituted by inulin syrup and 40% – by malt extract have a good score. The obtained results show that different kinds of carbohydrates containing syrups can be used as sugar substitute for the production of new type jellies. Evaluation of intensity of sensory properties of jellies with inulin syrup shows that there is no significant difference ($p > 0.05$) in appearance, colour and odour, but there is significant difference in intensity of sour taste, aftertaste and hardness ($p < 0.05$). Evaluation of intensity of sensory properties of jellies with malt extract shows that there is no significant difference ($p > 0.05$) in appearance, odour, sour taste aftertaste and colour, but there is significant difference in intensity of aftertaste ($p < 0.05$).

Key words: sensory properties, agar-based jellies, inulin syrup, malt extract

The research has been done within the National Research Programme "Sustainable use of local resources (earth, food, and transport) – new products and technologies (Nat Res)" (2010–2013) Project no. 3. "Sustainable use of local agricultural resources for development of high nutritive value food products (Food)".

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Król J., Litwińczuk A., Marczewska S., Grodzicki T.

**EVALUATION OF THE EFFICACY OF INTERNAL AUDITS
IN SELECTED MEAT INDUSTRY PLANT**

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The main aim of the study was to analyze the reports from internal audits conducted in 2008–2009 in one of the plant of meat industry. The audits were carried out in accordance with the annual program of internal audits in all organizational units of the plant (Slaughter and Split Unit, Commodities Section, Technical Section, Magazine of Finished Goods, Quality Systems Section, Technical Magazine and Human Resources) compliance with the PN-EN ISO 9001: 2001 norm.

The discordances identified in the audits were not distributed equally between the various divisions of the company. In the case of the Quality Systems Section and Technical Magazine the discordances in the functioning of the QMS were not stated. In the Magazine of Finished Goods and Commodities Section the irregularities, discovered in 2008, were not be repeated in the next year, what reflecting the effective completion of the corrective actions. The worst situation was in the Technical Section, where not only in the 2008 but also in 2009 the discordances in relation to 5.1 and 5.3 point of ISO 9001 norm were found. That situation was connected with the lack of quality objectives and quality policy content knowledge among workers. The quality management system in the reported area therefore requires the constant control and greater involvement of managers and employees in the realization of their assigned tasks.

As a result of the internal audits the valuable suggestions for the improvement of the quality management system were obtained. The introduction of a range of activities after audits (staff training, job instructions, introduction of additional supervision or internal controls and improving quality management system documentation) allowed for the gradual elimination and reduction of discordances which emerged in the certain areas of the plant. Therefore, the results analysis showed that in 2009 the number of discordances decreased by 12% compared to 2008.

Key words: internal audit 2008-2009, meat industry, ISO 9001

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**Kruma Z., Galoburda R., Gramatina I., Muizniece-Brasava S.,
Kozlinskis E., Tomsone L.**

**EFFECT OF DRYING METHOD ON THE CONTENT OF PHENOLIC
COMPOUNDS AND ANTIRADICAL ACTIVITY OF DILL**

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The use of herbs and spices for their flavouring, preservative and health promoting properties has been known since ancient times. Dill is popular herb widely used in many regions, including Baltic countries. Drying is a popular preservation method of dills and the aim of current research was to investigate influence of drying method on the content of phenolic compounds and antiradical activity of dill.

Dill variety '*Superdukat*' was grown in the test fields of the Latvia University of Agriculture. In experimental design three harvest times were chosen to compare total phenol content and antiradical activity of fresh dills and to evaluate their changes during drying. After harvest dills were separated in two fractions: leaves and stems. Drying methods used were as follows: microwave vacuum drying, air drying and freeze drying. For comparison frozen dills were analysed. Additionally, total phenols of fresh and dried dill stems were analysed. Total phenol content (TPC) of plant extracts was determined according to the Folin-Ciocalteu method (Singleton et al., 1999) with some modifications and results were expressed as gallic acid equivalents. Antioxidant activity of the dills were measured on the basis of scavenging activities of the stable 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical.

The highest TPC was detected in microwave vacuum dried samples, followed by freeze dried dills, whereas the lowest in air-dried dill. Blanching was tested for inactivation of enzymes, and process mainly helped to maintain total phenols in dill. Ethanolic extracts of dill showed significant antiradical activity, and it was influenced by used drying method and conditions. Comparing dills dried by various microwave vacuum drying methods, higher antiradical activity showed samples dried using lower pressure and shorter drying time.

Microwave vacuum drying and *freeze* drying better preserves the polyphenolic compounds of dills in comparison to air drying. Blanching is suitable pretreatment for dills that also helps to retain more polyphenols in dried dills.

Key words: dill, drying, freezing, phenol content, antiradical activity

The research has been done within the framework of the ESF Project "Formation of the Research Group in Food Science", contract nr. 2009/0232/1DP/1.1.1.2.0/09/APIA/VIAA/122.

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Kruma Z., Sturmovica E., Ozola S., Kreicbergs V.

**EVALUATION OF RAPESEED MEAL CHEMICAL COMPOSITION
FOR FURTHER USE IN FOOD STUFFS**

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Rapeseed (*Brassica napus L.*) is the most significant oilseed crop in Latvia and it has high nutritive value – high content of oleic, linoleic and linolenic acids, and also it contains other biologically active compounds as polyphenols. Part of valuable substances remains in rapeseed meal.

The aim of current research was to investigate composition of rapeseed meal, and to evaluate their further use in food stuff production.

Rapeseeds were harvested in autumn 2010, dried till moisture content 6% and stored at 20°C temperature. Part of rapeseeds before extraction was treated with ultrasounds. Oil content of seeds were 42% and they could be considered as good quality oilseeds. Oil was obtained using mechanical press. For rapeseeds and rapeseed meal following parameters were analysed: amino acid (LVS ISO 13903:2005), fatty acid profile (methyl esters by gas chromatography), total phenol content (using Folin – Ciocalteu assay). All experiments were performed in triplicate.

The main fatty acids found in rapeseeds and rapeseed meal were oleic acid, followed by linolic acid and linoleic acid. Compared to rapeseeds, in meal lower percentage of oleic acid, but higher percentage of linolic acid were identified. Main amino acids in rapeseeds were leucine (6.22 g kg⁻¹), glutaminic acid (4.99 g kg⁻¹) and lysine (3.83 g kg⁻¹). Rapeseed meal also contained essential amino acids as leucine (4.1 g kg⁻¹), and lysine (3.28 g kg⁻¹). After the extraction of oil rapeseed meal contained phenolic compounds. The phenolic compounds contribute to the dark colour, bitter taste and astringency of rapeseed or mustard meals.

Rapeseed meal could be as a valuable source of natural antioxidants and further experiments will be focused on development of polyphenols extraction method from rapeseed meal.

Key words: rapeseed meal, total phenols, amino acids, fatty acids

The research has been done within the National Research Programme "Sustainable use of local resources (earth, food, and transport) – new products and technologies (Nat Res)" (2010–2013) Project no. 3. "Sustainable use of local agricultural resources for development of high nutritive value food products (Food)".

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Kukier E., Goldsztejn M., Grenda T., Kwiatek K.

***CLOSTRIDIUM PERFRINGENS* OCCURRENCE IN PARTICULAR
LINKS OF FOOD CHAIN**

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Clostridium perfringens is recognized as most important animal pathogen among anaerobic sporulating bacteria responsible for enterotoxemia of many warm-blooded organisms (birds and mammals). Animal morbidity ranges from 15 to 50% and mortality may come up to 100%. Significance of the anaerobe for food animal morbidity increased following the termination of antimicrobial growth promoters, effectively decreasing the morbidity caused by opportunistic bacteria. *C. perfringens* is also recognized as third etiologic factor of human food poisoning and food infections both in USA and in countries belonging to OECD. The production of the major toxins is a base for classification criterion into one of the five toxotypes (A–E). Toxin production ability and level of produced toxins decide about pathogenicity of the bacterium. Not less important than gene activity is immune decreasing of host, which may lead to disease. Taking into account that pathogenicity of *C. perfringens* is conditioned by presence of toxin genes the study were undertaken for assessment of toxin genes occurrence in strains isolated from particular food chain links. Toxin genes were detected from feed, swine faeces, pork meat and ready-to-eat food prepared from pork and human faeces isolates by mPCR. All feed isolates represented type A strains. Fifty five percent of isolates possessed only *cpa* gene and 40% isolates contained both *cpa* and *cpb2* genes. Three isolates (5%) type A subtype beta2 contained additionally enterotoxin gene. Toxin type and its subtype identification revealed that 51.1% of the swine isolates belong to type A, 48.8 isolates belong to type A subtype beta2. Enterotoxin gene was detected in 0.6% strains. Additionally, both isolates possessed *cpb2* gene. Among food of animal origin samples, the presence of the anaerobes was detected in 8.1% of them. Contamination level of samples classified as positive ranged from 1.0×10^1 cfu/g to 3.2×10^1 cfu/g. Isolated *C. perfringens* strains classified like type A. Any of them contained enterotoxin gene. Toxic type and subtype identification of human isolates revealed that 96.5% of the isolates belong to type A and the other belong to subtype beta2 (*cpb2* gene only). Among strains type A 60.5% isolates possessed only *cpa* gene and 30.7% isolates contained *cpa* and *cpb2* genes. *Cpe* occurred in 4.8% isolates. Two of them contained both *cpa*, *cpe* and *cpb2* genes. Any of analysed isolate in both feed, swine faeces and human faeces was classified like strain belonging to type B - E. Obtained results confirmed type A *C. perfringens* dominance in environment.

Key words: *Clostridium perfringens*, mPCR, toxin genes, pork, food, feed, swine faeces¹

This work was supported by The Ministry of Science and Higher Education research program number R1202302.

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**Kusznierewicz B.¹, Piekarska A.², Buszewska M.¹, Namieśnik J.²,
Bartoszek A.¹**

**THE INFLUENCE OF DIFFERENT METHODS
OF PRESERVATION ON THE CONTENT OF BIOACTIVE
COMPOUNDS IN ARONIA AND BLUEBERRY
HONEYSUCKLE JUICE**

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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.

Our study was carried out for juices obtained from blueberry honeysuckle (*Lonicera caerulea* L. var. *edulis*) and aronia (*Aronia melanocarpa* [Mich.] Elliot), the fruits regarded as containing components particularly beneficial for human health. Juices were exposed to different types of processing – typical pasteurization and sterilization, long- or short-term heating, microwave and high pressure operation.

The chemical properties verified embraced determinations of anthocyanins and other polyphenols by HPLC-DAD-MS, total antioxidant activity, as well as chromatographic profiling of antioxidants by TLC and HPLC post-column derivatization. Obtained results indicate that typical sterilization and long-term heating caused the highest loss of anthocyanins in both juices. The antioxidant activity for some of the phenolic degradation products formed during processing was observed. Our studies could be of use in selection of a proper technology of preservation to maximize stability of berry fruits' phytochemicals and thereby to enhance the healthiness of diet for human populations.

Key words: blueberry honeysuckle and aronia juices, processing, polyphenols, antioxidant activity

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on the
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Wrocław 19–20 September 2011**

Lech K.¹, Figiel A.¹, Korzeniowska M.², Oziembłowski M.²

**APPLICATION OF SUCROSE OSMOTIC SOLUTIONS
AND A VACUUM-MICROWAVES AS A DRYING METHODS
FOR BEETROOT SLICES**

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Beetroot intake can be considered as a factor in cancer prevention due to the content of valuable, active compounds such as carotenoids, glycine betaine, saponins, betacyanines, folates, betanin, polyphenols and flavonoids. Though, beetroot is characterised by relatively high moisture content, which exposed it to the physicochemical and microbiological changes leading to the spoilage. One of the methods of vegetal preservation is a vacuum-microwave (VM) drying. During this method a large vapour pressure in the centre of the material allows the rapid transfer of moisture to the surrounding vacuum and thus prevents structural collapse. An osmotic dehydration can be used as a pre-treatment to VM drying.

The objective of presented study was to determine the effect of sucrose concentration on the drying kinetics of beetroot slices dehydrated by the osmotic pre-treatment and VM finish drying as well as quality of the finish product in terms of shrinkage, colour, texture and sensory attributes.

An experimental material consisted root of beetroot (*Beta vulgaris*) var. "Alto F1". Beetroots were cut into slices with 18 mm diameter and 5 mm thickness then dried by the combination of an osmotic dehydration and vacuum-microwaves. The osmotic pre-treatment of the samples was performed by soaking in sucrose solution with concentrations 20, 40 and 60 at 40°C. The ratio of an osmotic solution to beetroot was maintained as 3 to 1. The weight of the samples was measured after 0.5, 1, 2, 4 and 6 hours of the osmotic procedure. VM finish drying was performed at microwave wattage of 360 W. The temperature of beetroot slices was measured with an infrared camera immediately after removing them from the VM dryer. The quality of the products was determined by measuring of shrinkage, colour and selected texture parameters (TPA i.e. Texture Profile Analysis). The sensory evaluation was performed by trained panel to discriminate the intensity of the main traits of dried product such as colour, flavour, taste and texture.

Results collected in the study showed that during osmotic pre-treatment the weight of beetroot samples was decreasing until the equilibrium stage. The increase of sucrose concentration decreased the final moisture content of the pre-treated samples. It was found that the

decrease in moisture content of the beetroot slices during VM finish drying could be described with an exponential equation. Vacuum-microwave finish drying caused an increase of the samples temperature until the certain level of the moisture content followed by a decrease as the result of the balance of energy generated within the dried material by dipoles of water and energy necessary for water evaporation. Shrinkage, cohesiveness and springiness of the beetroot decreased along with an increase in sucrose concentration. However, at the same time increased hardness and colour parameters of the finish-dried product were observed. A correlation between hardness determined by the sensory evaluation and TPA test was found. Moreover, the results of the study showed that increased crispiness evaluated by sensory assessors was associated with decreased cohesiveness and springiness determined by TPA test. According to the sensory analysis of beetroot slices the best flavour does not require pre-treatment in sucrose solution, however in terms of appearance, taste and texture involves pre-drying at sucrose concentration amounted to 60%.

Key words: beetroot, osmotic pretreatment, vacuum-microwave drying, sensory properties

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Lech K.¹, Figiel A.¹, Spychaj R.², Gil Z.², Bojarczuk J.³, Urbanek P.¹

**SOME MECHANICAL, PHYSICAL AND CHEMICAL PROPERTIES
OF POLISH DURUM WHEAT GRAIN**

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The excellent raw material for the production of pasta is semolina, which is obtained by milling of durum wheat grain. The quality of the grain can be defined in terms of the mechanical, physical and chemical properties. Pasta production in Poland is based largely on foreign hard wheat. The necessity of importing this wheat increases the costs of pasta production, but also leads to growing interest in cultivation of Polish durum wheat.

The aim of this study was to determine some mechanical, physical and technological properties of new lines of winter durum wheat obtained from Polish breeding by Plant Breeding in Smolice (IHAR Group), harvested in 2008.

The mechanical properties were determined by a cutting test. During this test a single grain was cut in the middle of its length by a special knife. The results of this test were expressed as the maximal cutting force and the work of cutting. The physical properties were natural slope angle, external coefficient of friction, porosity, density, weight of 1000 kernels, uniformity of grain and particle size index. The chemical parameters were considered in terms of ash, wet gluten and starch contents.

The results obtained in the study were subjected to statistical analysis. Standard deviations were estimated by means of Microsoft Excel. Table Curve 2D Windows v2.03 enabled mathematical modelling with the best determination coefficient. The results obtained were evaluated by statistical analysis with the use of the Statistica v. 9.0. Homogeneous groups were determined with the Duncan's multiple range test at significance level $\alpha = 0.05$. The one-way analysis of variance was applied in order to find out if the differences in the mean values estimated were significant.

The durum wheat grains of the studied breeding lines were characterised by the maximal cutting force and cutting work in the ranges from 74 to 82 N and from 20 to 38 mJ respectively. The natural slope angle was from 14 to 21°, while the external coefficient of friction was from 17 to 25° despite of the kind of surface used in the test. The weight of 1000 kernels was varied from 40.1 to 49.9 g, while uniformity of grain and particle size index were from

80.5 to 88.5 and from 15.8 to 21.1% respectively. The contents of ash, wet gluten and starch were from 0.63 to 0.70, from 25.1 to 30.8 and from 67.1 to 69.3% respectively.

The study revealed that there are many correlations between the determined properties of durum wheat grain. For example the increase in the external coefficient of friction increased the natural slope angle and increasing of the maximal cutting force increased the work of cutting. On the other hand, the increase in the weight of 1000 kernels decreased the maximal cutting force as well as the work of cutting.

Key words: winter durum wheat, mechanical, physical, technological properties

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Lewko L., Gornowicz E.

**EVALUATION OF PHYSICOCHEMICAL TRAITS OF EGGS
FROM SELECTED POLISH BREEDING STRAINS OF LAYING HENS**

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Due to globalization and concentration of poultry breeding, the scale of Polish breeding units of laying hen strains has been reduced and at the present moment there are only three pedigree farms, *i.e.*: Rszew Laying Hen Breeding Farm Ltd. Co., Experimental Station Rossocha Ltd. Co. – National Research Institute of Animal Production and Messa Poultry Breeding Station Ltd. Co, located in Mienia. In 2005 in the units specified above 15 breeding strains and gene pools were used as a basis for the development of breeding stock and commercial hybrids distributed throughout Poland. It was estimated that the domestic breeding strains of laying hens account only for 7 to 10% of the total commercial farm population of layers producing table eggs in Poland.

The effect of bird genome on egg quality was investigated. The study comprised eggs from five Polish layer breeding strains, namely: A-22; K-44; M-55, V-44 and S-55. The determined basic physical parameters of eggs were followed by an extensive chemical analysis of egg content. The concentration and hydrolytic activity of egg white lysozyme was also examined. The experiments were conducted on eggs laid by hens at 36 weeks of age. It was found that eggs from S-55 layers demonstrated the most desirable traits *i.e.* the highest weight of: egg (68.36 g), albumen (41.15 g) and yolk (18.16 g) accompanied by the highest weight (6.16 g) and thickness (372.17 μm) of egg shell. The albumen of A-22 laying hens demonstrated the highest total protein (10.58%) and ash content (0.97%). The yolk of S-55 eggs exhibited the highest water content (49.34%) and the lowest lipid content (30.60%). The greatest lysozyme concentration and activity were noted in the egg albumen of A-22. Significant differences ($p \leq 0.05$) were observed in numerous physicochemical traits of eggs from the investigated Polish breeding strains of laying hens. The results of this study were distributed among breeders of laying hens in Poland. Thus they will be able to take decisions to reduce possible errors in the direction and intensity of stock performance trait selection to improve quality traits in the consumption eggs produced.

The experimental findings demonstrated that bird origin is an important factor affecting egg quality traits.

Key words: eggs, physical traits, lysozyme, Polish hen strains¹

This work was funded by the National Research Institute of Animal Production. Project 5129.1.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Ligaj M., Tichoniuk M., Gwiazdowska D., Filipiak M.

**MOLECULAR METHODS
FOR *AEROMONAS HYDROPHILA* DETECTION**

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Bacteria *Aeromonas hydrophila* are significant human pathogens that cause both gastrointestinal and non-intestinal diseases in children and adults. This bacterium is included on the Contaminant Candidate List of the Environmental Protection Agency and was isolated from freshwater and variety of foods, also stored in refrigerating conditions. Identification of *Aeromonas* species is difficult, requires a series of biochemical tests implementation, because this pathogen presents a broad metabolic capabilities.

For rapid *A. hydrophila* detection we developed the molecular biology methods that were used for specific DNA fragments identification. The key component in determining of potential pathogenicity of this bacterium is aerolysin (*aerA*) gene, basic hemolysin produced by *A. hydrophila*. For the detection of this virulence factor a polymerase chain reaction (PCR) was used. To verify an expression of *aerA* gene in *A. hydrophila* cells the reverse transcriptase-polymerase chain reaction (RT-PCR) was applied. The PCR amplified fragment molecular weight was 156 bp with the use of primers at the sequence of 5'CTGCGAGG-GTTATCGTTGTG (forward) and 5'GTGTCGCTGTCGTTGATCG (reverse). Confirmation that the PCR product is *aerA* gene fragment relied on the application of radioactively labeled DNA probe at the sequence 5'GTCAAGACGGTGGTGGGCTG in Southern blot method. The probe was also utilized for construction of electrochemical DNA biosensor for *aerA* gene detection in real DNA samples isolated from bacteria.

In this work we presented the broad spectrum of modern molecular methods that would help to ensure rapid and accurate detection of pathogenic strains of *A. hydrophila*.

Key words: *Aeromonas hydrophila*, molecular methods, PCR

This work was financially supported by the Polish Ministry of Science and High Education. Grant No. N N312 206736.

5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011

Ligor M.¹, Maruška A.², Trziszka T.³, Buszewski B.¹

**INFLUENCE OF THE CONCENTRATION OF POLYPHENOLS
AND XANTHOPHYLLS IN PLANT LEAVES ON THEIR
ANTIOXIDANT ACTIVITY BY MEANS OF HPLC-UV-VIS
AND SPECTROPHOTOMETRY TECHNIQUES**

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Antioxidant activity of gallic acid, catechin, rutin and total antioxidant activity were evaluated. For total antioxidant activity determination all peaks of the mirror chromatogram were integrated and expressed in RE. For the antioxidant activity evaluation in methanolic extracts of black and green tea (*Camellia sinensis*) and rooibos (*Aspalathus linearis*) a novel convenient on-line reaction detection assay with DPPH[•] requires HPLC instrumentation was applied. The main compounds such as: gallic acid, theobromine, epigallocatechin, catechin, caffeine and rutin, were identified in black, green teas and rooibos plant.

In general, antioxidant activity of green tea has been found superior to black tea. In terms of green tea owing to the higher catechins content the value (approximately 30% higher). Rooibos tea showed the lowest antioxidant activity. Catechin related compounds provide a higher radical scavenging activity than gallic acid in it. The amount of rutin and gallic acid in black tea is approximately 20% higher comparing to green tea.

Leaves of green vegetables like spinach (*Spinacia l.*) are a rich source of carotenoids including xanthophylls. The increased colouration in vegetable and fruit tissues associated with maturity is often indicative of increases in especially carotenoids concentrations. Carotenoids indicate the antioxidant actions based on their singled oxygen quenching properties and ability to trap peroxy radicals. For that reason the total antioxidant activity of extracts from raw and cooked spinach leaves was evaluated. 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 (belongs to xanthophylls) 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 spinach extracts.

Key words: polyphenols, xanthophylls, tea, rooibos, spinach, DPPH, lutein

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on the
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Łopatek M., Pomykała R., Michalski M.

**OCCURRENCE OF PATHOGENIC BACTERIA IN RAW BIVALVE
MOLLUSCS COMMERCIALY AVAILABLE IN POLAND**

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Microbiological infections arising from the consumption of seafood are becoming a serious problem in European Union. Epidemiologic data reported that the number of food poisonings after eating raw or undercooked shellfish is increasing from year to year. In countries as France, Italy, Spain or United Kingdom, which possess many shellfish production areas, monitoring of bacteriological and viral contamination of bivalve molluscs is carried out. In the recent years, a significant increase of seafood consumption is also observed in Poland. With regard to European Union directive, each membership country is obliged to supervise microbiological contamination of bivalve molluscs to ensure consumer health protection.

The aim of this study was to evaluate the prevalence of human pathogenic bacteria in seafood commercially available in Poland.

A total of one hundred samples of raw bivalve molluscs were analyzed. All kind of shellfish used to investigation were imported from EU countries and were available in Polish market. The examined material consisted of different species of seafood: oysters (*Crassostrea gigas*), mussels (*Mytilus edulis*), clams (*Mercenaria mercenaria*), Vongola verace (*Tapes semidecussatus*), scallops (*Pecten maximus*), amande (*Glyceria glycymeria*) and palourde (*Tapes philippinarum*). The samples were analyzed for the presence of pathogenic bacteria such as *Salmonella* spp., *Listeria monocytogenes*, *Campylobacter* spp., enteropathogenic *Vibrio*, koagulase-positive *Staphylococcus* and potentially pathogenic anaerobic bacteria. The scope of study included also the markings of: total plate count, mould and yeasts count, most probable number of *Enterobacteriaceae* and *E. coli*, which are indicators of microbiological contamination of bivalve molluscs. These examinations were performed according to ISO standard methods with some modifications. All suspected *Salmonella* spp. and *Vibrio* spp. colonies were identified using biochemical analyser ID 32 E, whereas isolates of *Listeria monocytogenes*, koagulase-positive *Staphylococcus* and anaerobe were confirmed by API Listeria, ID 32 Staph and ID 32 A, respectively.

The study showed that *Salmonella* spp. was identified in three samples, whereas *Listeria monocytogenes* and *Campylobacter* spp. were not found in tested shellfish. *Vibrio parahaemolyticus* was isolated from 27 samples and Vongola verace were mostly contaminated by this food-borne pathogen (14 samples, 51.8%). Moreover, 22 samples were confirmed by

API system as positive for *Staphylococcus aureus*. It is surprisingly, that the most prevalent bacteria were observed in anaerobic spore-forming (55.0%) and sulfite reducing bacteria (60.0%). The number of *Escherichia coli* established by MPN method in 13 samples exceeded acceptable level 230 MPN/100g of meat and shell liquid. Maximum level of *E. coli* was 9.2×10^4 MPN/100 g. In 61 samples this number was less than 20 MPN/100 g. It was noted that total bacteria count fluctuated between 2.9×10^2 cfu/g and 2.8×10^7 cfu/g and in 15 of all samples this amount was more than 1.0×10^5 cfu/g. In the case of *Enterobacteriaceae* or mould and yeasts maximum level of contamination was determined as 1.1×10^4 cfu/g and 1.1×10^5 cfu/g, respectively.

The results indicate that seafood constitute the potential risk of human food infection. The microbiological criteria relating to bivalve shellfish destined for consumption are included in Regulations (EC) No 1441/2007 of 5 December 2007. It is seems to be also necessary to develop and implement system for monitoring other pathogenic bacteria, which quite frequently occurrence in raw shellfish and which may be a source of food-borne diseases.

Key words: seafood, pathogenic bacteria

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Mazur R.¹, Korzeniowska M.², Górecki J.³, Macherzyński M.³

**MERCURY CONCENTRATION IN SELECTED FISH
FROM POGORIA LAKES LOCATED
IN DĄBROWA GÓRNICZA REGION**

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Monitoring of the mercury compounds in fish meat is now obligatory in the European Union. The mercury compounds belong to group of high risk chemicals for consumer health. Meat quality control of the farmed fish is an essential criteria for permitting food to be consumed by humans. However, such a strict control is not required for fish collected by rod-fishing (WE 78/2005). Because of high level of mercury emission in Poland, especially in the Upper Silesia region i.e. in Dąbrowa Górnicza, lack of this kind of analysis and informative bulletins could be dangerous for anglers and others consumers of caught fish. Therefore, the objective of the study was to analyze mercury concentration in meat and organs of the most popular fish species in Pogoria lakes. The results of the study revealed that the total mercury content in analyzed fish samples did not exceed the permissible level. Presented study was carried out as a screening research, thus the collected results are preliminary and can be a good base for further studies. Therefore, it is necessary to continuously monitor the mercury concentration in fish in order to eliminate any risk of negative impact of this compound connected with fish consumption on human health.

Key words: mercury, heavy metal monitoring, fresh water fish

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Michalczyk M., Banaś J.

**EFFECT OF ADDING ESSENTIAL OILS ON THE SHELF LIFE
OF STORED LARD**

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University of Agriculture in Kraków, Poland*

Essential oils from spice plants form a very large group of substances intensively analysed for their antimicrobial properties in the search for alternative substances to replace traditionally used chemical preservatives in food. Apart from their antimicrobial properties, some also show antioxidant properties.

The aim of this paper was to investigate the effect on the shelf life of stored lard of essential oils of commonly used spice plants such as salvia, hyssop, ocimum, thyme, rosmarinus, coriander, marjoram, and oregano.

Essential oils were added to lard at a concentration of 0.1% (v/w). Samples were then stored in darkness at 20±2°C for 6 months in tightly closed containers. Fresh and stored samples were analyzed for acid number, peroxide value, and TBARS value.

After storage, a slight increase in acid number was observed in samples without additives, accompanied by a more than 5-fold rise in peroxide values and a three-fold increase in TBARS values. The oils applied did not significantly affect acid number except for oils of oregano and marjoram.

Adding essential oils of thyme and oregano caused a marked reduction in peroxide values. The effect of marjoram was noticeably weaker, while adding hyssop resulted in a distinct increase in this indicator of fat rancidity. Oils of thyme, oregano and marjoram also had the strongest effect on reducing TBARS values.

Of the essential oils tested, only those of thyme, oregano and, to a lesser extent, marjoram had sufficient antioxidant activity to positively affect the quality of stored lard. The remaining oils examined had no beneficial effect on the shelf life of the product.

Key words: lard, shelf life, spices, TBARS, essential oils

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Michalczyk M., Macura R., Banaś J., Tesarowicz I.

**PRESERVATION OF GROUND PORK WITH SELECTED
SEASONINGS**

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The aim of this study was to investigate the effect of the seasonings applied on the ground pork quality during storage. The additives were essential oil of oregano (0.02% v/w), freeze-dried garlic (1%), tomato concentrate (15%), and a mixture of the three. A control sample was free of additives. The vacuum packed samples were stored in darkness at $6\pm 1^{\circ}\text{C}$ for 16 days. Sensory, microbial and biochemical analyses were conducted on fresh meat and later on the stored meat every 4 days over the whole storage period.

In sensory evaluation, all samples were sensory acceptable up to the 8th day, on the 12th day – only those with oregano, garlic and a mixture of the three; and on the last day of storage it was the mixture only.

Essential oil of oregano, known for relatively high antimicrobial properties *in vitro*, only insignificantly reduced the growth the microorganisms investigated. Also, the addition of freeze-dried garlic did not led to a noticeable decrease in the amount of detected bacteria in all examined bacteria groups. Tomato concentrate had a greater inhibiting effect on the growth of the microorganisms, probably due to a fall in pH value. Despite of the fact that the above additives, used separately, have no clear beneficial effect on the stored meat, they application in one mixture strongly reduced the rate of growth of all microorganisms investigated.

The addition of the essential oil of oregano positively affected an peroxide value, while the presence of tomato concentrated intensified undesirable changes in fats. The addition of tomato concentrate resulted in a visible increase in protease activity. Due to such additive the share of oxymyoglobin in the stored samples considerably fell with a simultaneous rise in metmyoglobin. The electrophoregrams of proteins from the stored meat showed that only the samples with tomato concentrate, showed a significant differences, chiefly manifested by a lower share of the fractions of heavy chain myosin and myoglobin that was accompanied by a rising amounts of low molecular peptide fraction.

Generally these seasonings, applied together in ground meat, allow to obtain a culinary attractive product with longer shelf life but when used separately in concentrations acceptable, did not show a strong preservative properties.

Key words: ground pork, seasonings, sensory properties, quality, essential oils

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Michalski M.

**PROFICIENCY TESTING (PT) FOR LABORATORIES
PERFORMING CHEMICAL ANALYSIS OF MEAT
AND MEAT PRODUCTS ORGANISED BY THE NATIONAL
VETERINARY RESEARCH INSTITUTE IN PULAWY IN 2009**

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The aim of this study is the qualification of laboratories with help of interlaboratory proficiency testing (PT) in range of analyzed substances. Results of analyses should be credible with previously determined standard uncertainty of measurement. The harmonization of correct results of chemical analysis is secure by the validation of analytic methods, standard uncertainty for individual measurement or for the method of analysis, using certified reference materials of and participation in proficiency testing (PT). Information on the precision and accuracy of the results are to be taken into consideration in the design of the assay. In case of lack of reference materials or reference certified materials, participation in PT is the only method for confirming the technical competences of the laboratory.

Meat sterilized cans "Luncheon meat" were used for analysis. Every participant received sample together with instruction of transportation and document allows to introduce the sample in a quality system of laboratory. In this sample laboratory personnel should analyze at least one of parameters as sodium nitrate, salt (NaCl) by Mohr method, water, fat, phosphorus, proteins, ash, hydroxyproline, and starch. Deadline of realization of analyses was appointed by organizer. The homogeneity of material was estimated on the basis investigation of eight random chosen samples/cans from designed to analysis, applying the criterion of the homogeneity. In the proficiency test 31 laboratories participated and 43 analysts. Laboratory code numbers were known only for laboratory and organizer. The participants of PT applied the standardized method or such, which they use during normal analysis, after their validation.

Reference values for each analyzed parameter were calculated according to Standard PN-ISO 57255: 2000, based on results from participating laboratories. The calculated reference values as well as standard deviations made it possible to calculate z-score according to the formula:

$$z = \frac{x - X^*}{s^*}$$

where,

s* – standard deviation for proficiency assessment

X* – assigned value

x – participant result

The z-score for the majority of analyses was situated in range of $|z| \leq 2.00$ and only in few cases the z value offends $|z| \geq 3.00$. Among sent 270 results of analysis, 252 results had z-score below $|2|$ and nine results were classified as unsatisfactory with z-score above 3,00

In a case of receiving questionable results ($2.00 < |z|$ and < 3.00), laboratory should start with preventive action. Responsible person should tracing the analytic procedure, review analytical records, the state used reagents or discuss with analyst executing analysis to aim at detection and the elimination of analytic shortcomings or mistakes. Obtainment $z \geq 3.00$ is effective with nonconformities and introducing corrective action. The procedure of corrective action should start with an investigation to determine root cause(s) f the problem. Corrective action shall be to a degree appropriate to the magnitude and the risk of the problem. After introduction and the realising of corrective actions additional audit and/or participating in the next PT should confirm in this way "practical" effectiveness of these procedures is recommend.

Key words: proficiency testing, laboratories, meat products, chemical composition

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Murniece I.¹, Kruma Z.¹, Skrabule I.², Sturmovica E.¹

**THE CONTENT OF CAROTENOIDS AND THE COLOR
OF ORGANICALLY AND CONVENTIONALLY CULTIVATED
POTATOES BEFORE AND AFTER STORAGE**

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A renewed concern by communities about the condition of soil's health in agricultural systems has increased interest in organic farming. Organic systems rely almost exclusively on nutrient transformations in the soil since the use of synthetic chemicals, fertilizers and pesticides are limited to permitted substances.

The objective of this study was to investigate the content of carotenoids and the color of organically and conventionally cultivated potatoes before and after storage.

In the research six potato genotypes ('S 03135-10, S 99108-8, S 01063-5, 'Agrie dzeltenie', 'Prelma' and 'Imanta') were used. The potatoes were cultivated in organic and conventional conditions. The relationships between the content of carotenoids and color were investigated before potatoes were stored and after seven months of storage. The content of carotenoids was determined by using Jenway 6300 spectrophotometer and color in the Lab system – by using Color Tec-PCM device. For statistical analysis the data were processed using the S-PLUS 6.1 Professional Edition software.

The results show that the content of carotenoids is higher in organic potatoes both after harvesting and after storage. When the potatoes were stored, the content of carotenoids increased. A significant difference in the content of carotenoids was found between the potatoes which were analysed before and after storage ($p < 0.05$). The same tendency was found in the color L^* of the potatoes ($p < 0.05$).

Key words: carotenoids, color, organic potatoes

The authors acknowledge financial support from the State Research Programme "Sustainable use of local resources (earth, food, and (transport) – new products and technologies (NatRes)" (2010.–2013.) Project no. 3. "Sustainable use of local agricultural resources for development of high nutritive value food products (Food)" (the number of the project: 2010.10-4/VPP-5/4 (VP27)).

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Musilová J., Jónášová D., Tomáš J., Tóth T.

**INFLUENCE OF CADMIUM AND ZINC ACCUMULATION
IN POTATO TUBERS ON THEIR CONTENT
IN DIFFERENT FRACTIONS OF SACCHARIDES**

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Soil samples as well as samples of plant material (potatoes *Solanum tuberosum*) were taken from four sampling sites (Terany, Hontianske Nemce, Prenčöv-1, Prenčöv-2) of Hontiansky and Bansko-štiavnický region. Soil in this region is naturally contaminated by weathering of rocks containing heavy metals (cadmium, lead, copper, zinc) and contamination is caused also by mining of ores and their processing, whereas river Štiavnica is important transport medium of heavy metals.

Soil contents of Cd and Zn assessed in extracts of *aqua regia* exceeded legislatively given limit values for Cd (0.7 mg.kg⁻¹) and for Zn (150.0 mg.kg⁻¹) on all sampling sites. Content of zinc assessed in extract of NH₄NO₃ presented more than 1.5-fold higher value in soil samples from sampling sites Prenčöv-1 and Prenčöv-2 (critical value for Zn: 2.0 mg.kg⁻¹) (Law no. 220/2004) in comparison to critical value. Increased contents of Cd (0.106–0.357 mg.kg⁻¹ FW) were confirmed only in potatoes from sampling sites Hontianske Nemce, Prenčöv-1, Prenčöv-2.

Besides total contents of Cd and Zn in potato tubers these heavy metals were assessed also in fraction of water-soluble saccharides (SS) and insoluble saccharides (IS). Content of SS was in range from 0.32 to 2.33% and the content of IS from 12.74 to 16.56% in potatoes from all 4 sampling sites. Increased contents of Cd and Zn in fresh matter were in consistency with increased contents of these heavy metals in saccharides fractions (Cd SS: 0.020–0.067; IS: 0.017–0.039 mg.kg⁻¹ FW, Zn SS: 1.429–2.999; IS: 0.404–0.750 mg.kg⁻¹ FW). Strong statistical significance between content of Cd in FW and in both saccharides fractions was evaluated (SS: R = 0.878; P-value < 0.01, IS: R = 0.956; P-value < 0.01). Statistical significance between accumulation of Zn in FW and in fraction SS was not confirmed and between content of Zn in FW and in IS there was weak negative correlation (P-value < 0.05).

Key words: cadmium, zinc, potato, soil, saccharides

This work was supported by grant VEGA 1-0030-09.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Nechiporenko U., Orehova S., Vasileva I., Nechiporenko A.

**SHORT-TIME ETHANOL PRETREATMENT INFLUENCE
THE RADIOLYSIS IN BEEF MUSCLE TISSUE**

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In this investigation we study beef forcemeat and beef muscle fiber after mincing full-piece sample of muscle tissue pretreated for 2 min by 96% ethanol. Airproofed forcemeat samples exposed to electron-beam radiation (absorbed dose varied from 12.5 to 50.0 kGy). Methods of pH-metry, EDRS (electronic diffuse reflectance spectroscopy) in wave range 200–750 nm were used to investigate acidity and electronic spectra of surface of beef forcemeat samples during storage (+4°C) in post-radiation period. Microbiological control was performed by microscopy of replicas taken from samples surface dyed by Gram method. Using of two methods of sterilization of beef muscle samples let us to stabilize the interval of pH-changing in normal range during storage period; to differentiate on time scale microbial processes, autolysis and radiolysis; to distinguish characteristics individual for beef forcemeat pH-changing dynamics, electronic spectrum of surface, condition and composition of microflora in post-radiation period.

Key words: electron-beam radiation, muscle tissue, the radiolysis

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

**Niedbalska J., Szoltyś M., Dąbrowska A., Pokora M., Drozdowska K.,
Chrzanowska J.**

**THE OPTIMALIZATION OF AROMA PREPARATIONS
PRODUCTION BY HYDROLYTIC DEGRADATION
OF MILK PROTEINS AND FAT WITH ENZYMES ISOLATED
FROM YEAST *YARROWIA LIPOLYTICA***

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Aroma preparations are one of the most important among functional additives used in food industry. According to their origin they can be classified as natural, synthetic and identical as natural. The last ones are widely applied in food industry as, in contrary to the other groups, they are cheaper and their composition or chemical structure do not differ from their natural counterparts. Common method for obtaining aroma preparations is the use of microorganisms or their enzymes. An interesting group of such microbes are yeast *Y. lipolytica* isolated from ripening cheeses. Their ability for biosynthesis of extra- and intracellular hydrolytic enzymes makes them an interesting tool for creating new, functional additives for food industry.

The aim of the study was the optimalization of aroma preparations production by hydrolytic degradation of milk proteins and fat with enzymes isolated from yeast *Y. lipolytica*.

The aroma preparations were obtained from 3.2 and 6% fat milk. The extracts of *Y. lipolytica* enzymes were isolated from yeast cultured in basic pH and introduced separately or as "coctail" to the paracasein curd. The enzymatic degradation of paracasein was performed at 25 and 35°C for 48h. During incubation the proteolytic degradation was monitored by the increase of soluble nitrogen level, content of free amino groups soluble in water and in PTA, also by the RP-HPLC and electrophoretically. Lipids degradation was evaluated by the determination of free fatty acids content with the use of GC-MS. The obtained hydrolyzates were subjected to sensoric analysis.

It was shown that the level of hydrolytic changes of milk fat and proteins was higher in preparations produced in 35°C. Introduction of the extracellular protease isolated from yeast cultured in basic pH caused the increase in amount of free amino groups soluble in water (28.04%) in comparison to control, whereas in preparations obtained with enzymatic "coctail" the values were about 8.62% lower.

The use of enzymatic "coctail" composed of intracellular endopeptidases with high amino- and carboxypeptidase activities resulted in the increase in concentration of low molecular

fraction soluble in PTA. In those samples, the free amino groups content soluble in PTA, expressed as the % of total free amino groups content, amounted 72.8 to 82.1%, whereas in samples obtained only with extracellular protease, it reached the level 26 to 39.9%.

The analyzed aroma preparations were also characterized by different levels of free fatty acids content. The highest concentration, 9463mg/kg was determined in samples produced with 6% fat milk.

Key words: aroma, hydrolysis, milk protein, fat, *Yarrowia lipolytica*

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Nowicki P., Sikora T.

**HACCP SYSTEM FUNCTIONING EVALUATION MODEL BASED
ON BISTRO BARS IN POLAND**

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With the growing importance of food safety, there can be noticed an increasing interest of food safety management in food production, trade and services companies. For several years, in Poland, there has been noticed a growing trend for eating outside. Currently, consumers have a catering service not only to meet their basic nutritional needs, but offered services include a wider scope, as well as a growing group of customers. Catering companies, including bistros at petrol stations, in order to succeed in the market, in the company's strategy must take into account customer requirements and needs as well as implement a quality assurance system. Proper quality is a guarantee of regular customers and the ability to grow and profit. This article presents analysis of the four synthetic variables vs. selected categories and also shows a functioning evaluation model of the HACCP system based on an example of selected fuel concern bistros. The study covered bistros of selected network of petrol stations (210 stations). The study subjects were employees of petrol stations and it was conducted in 2008 in nine provinces, using the survey method with a questionnaire developed for this testing. The results obtained in the study were analyzed statistically using multiple methods of analysis of variables, both qualitative and quantitative, including descriptive statistics, statistical inference, and multivariate analysis methods.

The conducted researches developed a model describing the degree of the system functioning with two variables: the level of knowledge about the hazards Z_i and self-esteem evaluation of knowledge level W_i . The model is as follows:

$$Y_i = -0,562 * Z_i + 0,813 * W_i$$

Statistical analysis showed that the employees have more knowledge about the hazards in food production, the lower they estimate the system functioning. There has also been proved relationship that the employees estimate higher their knowledge and preparation to work, the HACCP system functioning is being estimated higher. In the bistro bars, which have undergone the rebranding process, the evaluation of the system, the level of knowledge about the risks in food production and self-knowledge and preparation for work is much higher than in the bistros before the changes. Statistical verification showed significant relationships among the two groups with regard to individual bistros' synthetic variables.

Key words: HACCP system, food safety, bistro bars

The research presented in this paper was founded from the Ministry of Science and Higher Education grants no: N N112 054034 in the year 2008–2010.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Orehova S., Nechiporenko U., Vasileva I., Nechiporenko A.

**ETHANOL CONCENTRATION EFFECT ON THE RADIOLYSIS
IN PORK MUSCLE TISSUE**

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Methods of pH-metry, EDRS (electronic diffuse reflectance spectroscopy) and microscopy were used to investigate the influence of ethanol pretreatment of the surface of full-piece samples of muscle tissue and on radiolysis in forcemeat from this samples after the exposure of this forcemeat samples to the fast electrons (absorbed dose range 12.5–50.0 kGy). It is shown that the ethanol concentration (20–96%) exhibited in dynamics of changes of acidity and electronic spectrum of surface of forcemeats during sample storage (+4°C) in the post-radiation period. According to the conditions of ethanol pretreatment and absorbed dose of electron-beam radiation in forcemeat samples generated different selective mediums which predetermines the absence or presence of microorganisms and also their morphology and quantitative ratio.

Key words: electron-beam radiation, muscle tissue, radiolysis

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Orkusz A., Haraf G.

**INFLUENCE OF PACKAGING MATERIALS ON pH,
WATER BINDING CAPACITY, DRIP LOSS AND COOKING LOSS
OF TURKEY THIGH MUSCLES PACKED AND STORED
UNDER MODIFIED ATMOSPHERE**

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The objective of the work was to investigate the effect of packaging material with different barrier properties to pH values, water binding capacity, drip loss and cooking loss of turkey thigh muscles packed and stored in modified atmosphere.

Three packaging materials with different gas and moisture vapour transmission rates (PA/PE, PA/PE+AF, PA/ARE/PE) and four periods of storage (4, 8, 12, 15 days) were studied. The experimental material covered thigh muscles (without skin and bones, average mass \pm 0.5 kg) cut out 24 h after slaughter from the 18-week-old industrially slaughtered turkeys. The experiments were repeated five times for each types of polyamide – polyethylene film pouches. Twenty thigh muscles were placed in the polypropylene (PP) container with an absorption pad, and put in one of three types of film pouches. The thigh portions were packed using the Tepro packaging machine type PP5 (Tepro SA, Koszalin, Poland) in the modified atmosphere (MA) with three compositions: 75% CO₂, 20% N₂, 5% O₂. The samples were stored in a refrigerator at +1°C and examined at 24 h after slaughter (unpacked muscles) and after in the 4, 8, 12, 15 day of storage (muscles packed in MA). The remaining five muscles were used for fresh sample analysis carried out 24 h after slaughter and were used as initial values for all three films.

The storage time and barrier properties of the investigated films had a significant effect on pH values, water binding capacity, drip loss and cooking loss. From 8 day of storage, samples packed in PA/ARE/PE film had the highest pH values, water binding capacity and the lowest concentration of drip loss and cooking loss in comparison to the samples packed in PA/PE and PA/PE+AF bags. Concurrently, significant differences in all these parameters in muscles packed in PA/PE and PA/PE+AF bags, were not observed during cold storage. Significant differences in pH values, water binding capacity, drip and cooking loss between samples packed in PA/ARE/PE film and PA/PE and PA/PE+AF bags can be explained by a clear influence of the oxygen transmission rate on these parameters.

Turkey thigh muscles kept in the film PA/ARE/PE proved to be best suited for consumption and processing, as compared to PA/PE and PA/PE+AF films.

Key words: packaging material, turkey thigh muscles, modified atmosphere, storage

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Ostasz L.

**THE EFFECT OF MICROWAVE HEATING AT 600 W POWER
ON THE CHANGES IN CHEMICAL PARAMETERS
AND THE COMPOSITION OF FATTY ACIDS IN REFINED OILS**

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Heating food in microwave ovens offers many advantages. The product is rapidly and evenly heated, since the thermal energy is distributed from the inside of the product in every direction. When heated conventionally, thermal energy is moved from the outside of the product to its centre and, consequently, it takes much longer time to heat it. Moreover, microwave ovens are simple to use and find increasingly wider application, not only to heat up or defrost food, to cook or stew. Microwave ovens equipped with a grid iron, grill and convection are also used to fry and roast.

Thermal treatment of oils, results in the changes in the chemical composition and physical parameters of fats, e.g., viscosity and density. The type and intensity of changes occurring in oils depends on the acid composition of triacylglycerols, the temperature and heating conditions. Heating at higher temperatures leads to its gradual chemical decomposition, which is the effect of oxidative and hydrolytic transformations. Oxidation being the dominant process during heating affects the nutrition value of fat products. Oxidation products are harmful to health, and may promote the development of atherosclerosis and tumour lesions. The compounds formed affect adversely also taste and olfactory properties of the product.

The aim of the studies was to analyse the qualitative changes in refined maize and peanut oils occurring upon microwave heating at 600 W. The oils were heated in a microwave RM 800 reactor. The heating time of oil samples was: 6, 12, 18, 24, 30 and 40 minutes. To assess qualitative changes occurring in fresh and heated oils, quality indices determined in accordance with PN/ISO standards were used: peroxide value, anisidine value and Totox value. In fresh oils, and during the heating, the fatty acid composition was also determined.

Microwave heating of oil samples at 600 W resulted in an increase of oil temperature to 187–215°C. The highest temperatures were observed during 24–30 min heating. Oxidative and hydrolytic changes in oils were found, demonstrated by an increase in: anisidine, peroxide and acid values. Maximum values of peroxide number of 12.95–15.16 mEq O₂/kg were noticed after 12 min heating. The highest anisidine values 139.93 for maize oil and 133.18 for peanut oil after 24–30 min heating.

Key words: fatty acids, refined maize, peanut oils, microwave heating, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Oziembłowski M.¹, Lech K.², Figiel A.², Korzeniowska M.¹

**QUALITY OF BEETROOT SLICES DRIED
BY A VACUUM-MICROWAVES AFTER OSMOTIC
PRE-TREATMENT IN SODIUM CHLORIDE SOLUTIONS**

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Beetroot is rich in valuable, active compounds such as carotenoids, glycine betaine, saponins, betacyanines, folates, betanin, polyphenols and flavonoids. Therefore, beetroot ingestion can be considered a factor in cancer prevention. However, due to the high moisture content beetroot is exposed to the spoilage. One of the preservation methods for plant material is a vacuum-microwave (VM) drying. During this method energy of the microwaves is absorbed by water located in the whole volume of the material being dried. This creates a large vapour pressure in the centre of the material, allowing rapid transfer of moisture to the surrounding vacuum and preventing structural collapse. On the other hand, an osmotic dehydration can be applied as a pre-treatment to the VM drying.

The aim of this work was to determine the effect of sodium chloride (NaCl) concentration on the drying kinetics of beetroot slices dehydrated by the osmotic pre-treatment and VM finish drying, as well as on the quality of the products in terms of shrinkage, colour, texture and sensory attributes.

The material studied was beetroot (*Beta vulgaris*) of "Alto F1" variety. Beetroot slices with 18 mm diameter and 5 mm thickness were dried by the combination of an osmotic dehydration and VM drying. The osmotic pre-treatment of the samples was performed by soaking in NaCl solution with concentrations 5, 10 and 15% at temperature 40°C. The ratio of osmotic solution to beetroot was maintained at 3:1. The weight of the samples was measured after 0.5, 1, 2, 4 and 6 hours of the osmotic dehydration. VM finish drying was performed at microwave wattage of 360 W. The temperature of beetroot slices was measured with an infrared camera immediately after taking them out of the VM dryer. The quality of the product was determined by measuring of shrinkage, density, colour and the Texture Profile Analysis (TPA) parameters, as well as by the sensory assessment by trained panel in order to discriminate the intensities of the main characteristics of dried product in terms of colour, flavour, taste and texture.

The results of the study revealed that the weight of the samples during osmotic pre-treatment was rapidly decreasing in the first hour of the process and then was slightly increasing.

This happened because at the beginning of the osmotic pre-treatment the intensive water flux from the raw material to the osmotic solution was much higher than the NaCl solids transfer from the solution to the raw material. Afterwards, water loss was getting smaller than the NaCl gain. However, the increase in NaCl concentration decreased the final moisture content of the pre-treated samples. It was found that the decrease in moisture content of beetroot slices during VM finish drying could be described with an exponential equation. During VM finish drying the temperature of samples was increasing until the certain moisture content and then it was decreasing as the result of the balance of energy generated within the dried material by dipoles of water and the energy necessary for water evaporation. The increase in NaCl concentration decreased density, shrinkage, cohesiveness and springiness but at the same time it increased hardness and colour parameters of the finish-dried product. It was found that the increased crispiness evaluated in sensory assessment was associated with decreased cohesiveness and springiness determined by TPA test. The study revealed that the best product in terms of taste and flavour does not require the pre-treatment in NaCl solution, but in terms of texture involves pre-drying at NaCl concentration amounted to 15%. The optimal quality of the VM finish dried beetroot slices can be obtained by the osmotic pre-drying in NaCl solution with concentration of 5%.

Key words: beetroot slices, vacuum drying, osmotic dehydration, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Oziemblowski M.¹, Lesiow T.²

**CORRELATIONS BETWEEN QUALITY INDICATORS
AND CHEMICAL COMPOSITION FOR CHICKEN BREAST
MUSCLE DEPENDING ON SEASON OF THE YEAR
AND TRANSPORTATION DISTANCE**

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The study was carried out on breast muscles of birds from Ross 508 strain. In sixteen separate experiments (4 different suppliers for each of four season) from 50 randomly chosen breast muscles (*pectoralis major*) after 24 h p.m. and in sixteen another experiments measurements after 3 h p.m. were chosen 4 muscles within three groups: lighter than normal (PSE), normal (N), and darker than normal (DFD). The muscles were chosen on the basis of lightness (L*), pH and color subjective assessment from each 50 muscles. After measurements of color parameters (lightness L*, redness a*, and yellowness b*) and pH muscles separately for each group were placed in Cryovac bags for subsequent analysis i.e. chemical composition and water holding capacity. Then packed muscles were transported in cooler to University laboratory.

The aim of the present paper was to evaluate the relationship between lightness (L*), pH, WHC and chemical composition (water, protein, fat) for PSE, N and DFD breast chicken muscles after 24h and 3 h p.m. in relation to seasons of the year and the distance for which birds are transported to poultry company.

On the basis of obtained correlation coefficients results that for individual seasons in three selected muscle groups (PSE, normal and DFD) there were more significant correlations between quality indicators and chemical composition for particular muscle groups than those observed without isolation of the seasons. The found correlations between quality indicators and chemical composition for breast muscles at 24 and 3 h p.m. are generally similar in particular seasons. There were found some more correlations in seasons with muscle groups at 24 h than at 3 h p.m. except of correlation between a* and b* and a* and pH which were found only in muscle 3 h p.m. Moreover for short distance more correlations were found for PSE muscles after 24 h and DFD muscles after 3 h p.m. in comparison with remain muscle groups. For short and long distances there were found more correlations for muscles after 24 than 3 p.m. (23 versus 16).

The found tendency of breast meat to show a lower pH when L* increase is commonly known. It was not found in this study significant relationship between L* and a* as well as between WHC and pH or water-moisture. Additionally, WHC had significant reverse correlation with a* that is not in accordance with results of other authors. The discrepancy may results from the fact that in present paper correlations were counted not for all muscles but in muscles selected into PSE, N and DFD color groups. Paler breast muscle (L*) is associated with higher b* values and this finding is supported by previous research and is inconsistent with other studies.

Key words: breast chicken muscles, chemical composition, quality

This work was financially supported by the Ministry of Science and High Education in the years 2007–2009, as a scientific development project No N312 033 32/2206.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pakulski T.

**MICROBIOLOGICAL QUALITY OF MATURING SEMI-HARD
SHEEP CHEESE**

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Janikowo, Poland*

The goal of the research activity was to assess the microbiological quality of maturing semi-hard sheep cheese, manufactured locally using three different technologies. The reference cheese (I) was manufactured in a conventional way: the cheese-making bacteria cultures were added to freshly pasteurized milk, then kept for 30 minutes at temperature 32–34°C, after that time the rennet was added to curdle the milk. The cheese from all milk proteins (II) manufacturing method consisted of precipitation with the help of calcium chloride of some of the proteins from the milk heated to 92–94°C. Then the partly curdled milk was cooled down to the temperature 32–34°C, the cheese-making bacteria cultures were added, and after acidification the remaining milk proteins were coagulated using rennet. The third type of cheese (III) was manufactured as follows: pasteurized milk was cooled to the temperature 30°C, then pasteurized water having the same temperature was added in quantity equal to 10% of the milk volume, then the cheese-making bacteria cultures were added. The acidification of the milk was conducted for 2 hours at lowered temperature (25–30°C). Then the acidified milk was warmed to the temperature 32–34°C, the rennet was added and the curd was left to form for 30–60 minutes. The further processing of the raw curd was the same for all three types of cheese. The coagulated milk was cut into pieced, the curd was mixed, part of the whey was removed (equivalent to 20% of milk volume) and identical quantity of water was added on its place, then again part of the remaining whey was strained. The raw cheese was slightly heated and dried, and then cheese was pressed into molds and left for 24 hours. Then the formed cheese was put into the brine for the next 24 hours, and after this step the cheese was put away for 6–10 weeks for maturation, which took place at the temperature 10–14°C. The cheese was made from the milk of two different breeds of sheep: from February to April from Polish Color Merino, and from June to August from prolific-dairy Kołuda sheep. Each type of cheese was manufactured in four batches from milk of both breeds. The matured cheeses were sampled to perform laboratory tests to detect the presence of the following pathogens: *Listeria monocytogenes*, *Salmonella spp.*, coagulase positive *Staphylococcus*, bacteria *E.coli*, yeasts and molds. No traces of *Listeria monocytogenes* and *Salmonella spp.* were detected in 25 g of investigated cheeses. The levels of contamination with the *E.coli* and coagulase positive *Staphylococcus* were low, below $1/10^{-1}$ jtk/g, with the exception of one sample of cheese type (I) from prolific-dairy Kołuda sheep, where an increased *E.coli* contamination

level was detected, at $1,7 \times 10^4$ jtk/g. The arithmetic mean of the number of yeast and mold colonies for the cheeses from Color Merino milk was, respectively for each cheese type, in thousands: (I) – 35.32, (II) – 4292.45 and (III) – 7513.61. The corresponding results for the cheeses from prolific-dairy Kołuda sheep, also in thousands: (I) – 51.48, (II) – 7.40 and (III) – 10.29. The differences were not significant. No dependency was found between the cheese manufacturing method, type of used milk and the resulting microbiological quality of obtained cheese.

Key words: microbiological quality, maturing semi-hard sheep cheese, local manufacture



**INNOWACYJNA
GOSPODARKA**
NARODOWA STRATEGIA SPÓJNOŚCI



UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ
ROZWOJU REGIONALNEGO



Projekt "BIOŻYWNOŚĆ - innowacyjne, funkcjonalne produkty pochodzenia zwierzęcego" współfinansowany przez Unię Europejską ze środków Europejskiego Funduszu Rozwoju Regionalnego w ramach Programu Operacyjnego Innowacyjna Gospodarka

Research was realised within the project "BIOŻYWNOŚĆ – innowacyjne, funkcjonalne produkty pochodzenia zwierzęcego" (BIOFOOD – innovative, functional products of animal origin) no. POIG.01.01.02-014-090/09, co-financed by the European Union from the European Regional Development Fund within the Innovative Economy Operational Programme 2007–2013".

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Wrocław 19–20 September 2011**

Patelski P., Balcerek M., Pielech-Przybylska K., Nowak A.

**OBTAINING OF SACCHAROMYCES CEREVISIAE HYBRIDS
FOR FERMENTATION OF SUGAR BEET THICK JUICE WORTS**

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Ethanol is expected to be one of the dominating renewable biofuels in 20–30 years. It can be easily obtained from sugar beet juices. Production of ethanol from sugar beet is not only easy way to obtain the sustainable transport fuel but also enables to activate local sugar beet growers and gives work in sugar factories. Industrial ethanol production is strongly dependent on yeast activity. *Saccharomyces cerevisiae* is one of the first domesticated organisms, and many centuries of use resulted in selection of strains optimized for specific applications, although technologist still are looking for new strains with improved technological properties. For over 50 years of breeding with use of mass mating of haploid cells with subsequent zygote selection, hybridization is often used as a tool to obtain a new yeast's strains. This method is quite labour – intensive but still in use due to the lack of disadvantages of the modern methods of yeast improving resulting in creating strains with new DNA not verified in nature.

In this work crucial steps toward obtaining and selection of new *Saccharomyces cerevisiae* hybrids for fermentation of sugar beet thick juice worts were described. 12 diploid distillery yeasts from Pure Cultures Collection of the Institute of Fermentation Technology and Microbiology (Lodz Technical University) and their 65 haploid clones of were used as a biological material. First step was to select parental haploid strains possessing desired features of distillery yeast, with the most important: ability to conduct vigorous fermentation of high density worts with high ethanol yields. Fermentations of thick juice diluted to 25°Blg enriched with mineral salts and nitrogen were carried out for 5 days at 30°C. Worts were inoculated with 2 g d.m./L of yeast cream. Initial phase of fermentations lasted for approximately 48–72 hours and ethanol yield approached 55–86% of the theoretical. 12 best fermenting haploids with desired features were selected to obtain fusants. Hybrid strains were obtained with use of "mass mating" method and zygotes were isolated with use of micromanipulator equipped with glass needle. Hybrids were then selected during fermentations of 25°Blg thick juice based worts. Growth on the surface of YPG medium, sporulation ability and assimilation, fermentation, nitrogen patterns were also tested. 8 hybrids were distinguished by initial fermentation phase shorter than 40 hours and over 75% of total ethanol yield after 5 days fermentation of 25°Blg worts prepared from sugar beet thick juice. These strains were selected for detailed investigations during larger-scale fermentations.

Key words: *Saccharomyces cerevisiae*, sugar beet, worts, fermentation

This work was financed from funds for Polish Science in 2009–2011 years as a part of project: R&D N312 301037.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Patelski P., Dziekońska U., Pielech-Przybylska K., Balcerek M.

**INFLUENCE OF BIOTIN DEFICIENCY ON BIOMASS GROWTH,
RISING POWER AND CHEMICAL COMPOSITION
OF SELECTED STRAINS OF BAKER'S YEAST**

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Biotin (vitamin H) is a cofactor for a few essential enzymes of the carboxylase family (EC 6.4.1.-). Biotin is required for the biosynthesis of fatty acids and the metabolism of amino acids and carbohydrates. Higher plants, most fungi and bacteria, are prototrophic for biotin. Most vertebrates are biotin auxotrophs. One of more desirable features of baker's yeast, is low requirement for growth factors, including B-group vitamins. Industrial *Saccharomyces cerevisiae* strains are predominantly auxotrophic for biotin, and a lot of researches on vitamin biosynthesis and technological features of *S. cerevisiae* strains improvement were made.

The influence of biotin deficiency on growth, chemical composition and rising power of selected strains of baker's yeast was evaluated. Biological materials were *Saccharomyces cerevisiae* strains: Y biotin-independent strain of *S. cerevisiae* v. *sake*; R, D, W, B, P – 5 strains of industrial baker's yeast and *S. cerevisiae* "225" – auxotrophic for biotin used for its microbiological determination. All strains were obtained from Pure Cultures Collection of the Institute of Fermentation Technology and Microbiology (Technical University of Lodz). Propagation of strains in biotin-free medium was evaluated. As a reference, cultivations in molasses medium with/without biotin addition were also made. Examination if any of tested baker's yeast strains has a reduced requirement for biotin was performed. Biomass after separation was investigated for rising power, total protein, ash and total phosphorus content. Strains Y and 225 were tested as a reference.

None of tested industrial baker's strains had ability to biotin synthesis. Biomass yield after 48 h of cultivation in biotin-free medium ranged from 0.49 g d.m./L (strain W) to 0.76 g d.m./L (strain R), while for reference strain "225" 0.52 g d.m./L. Strain Y was distinguished by sevenfold higher biomass gain as obtained after cultivations of industrial strains in biotin-free medium. After cultivation in molasses medium biomass yields for tested strains were less differentiated and varied from 7.67 g d.m./L to 13.3 g d.m./L. Rising time of the dough prepared with yeast cultivated with biotin was two time shorter than for biomass without biotin addition.

Results confirmed that biotin is necessary for proper propagation of baker's *Saccharomyces cerevisiae* and helped to chose the strains of biotin-independent hybrids of baker's yeast.

Key words: biotin, strains yeast, baker's yeast

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pawlak-Lemańska K., Mikucka K., Sikorska E.

FLUORESCENCE ANALYSIS OF CANE BROWN SUGAR

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Sugar is an important foodstuff and their nutritional, gustative and preservative properties make it an essential nutrient in the diet. Brown sugars are traditionally composed of 88–93% of sucrose, whereas white sugars consist > 99% of sucrose. The color of brown sugars resulted from the inclusion of substances present in cane syrup as an phenolic acids, polyphenolics, Millard reaction products and also heterocyclic aromatic hydrocarbons.

Commercial cane sugars exhibit characteristic fluorescence, which can be used to obtain information about constituents in and the origin of sugar.

The present study demonstrates the use of fluorescence spectroscopy for observed the differences in commercial brown cane sugar distributed in Poland. Total luminescence and synchronous scanning fluorescence spectroscopy techniques were tested to identified the color generated constituents in brown sugars which can differentiate the type of sugars.

Two – way principal component analysis (PCA) of the fluorescence spectra was used to find the principal direction of variation in the sample's fluorescence data.

Total luminescence spectra were done for the aqua solutions of brown sugar samples (conc. 9.5 mg/ml). Bands attributed to amino acids, catechols formed in the base-catalysed of glucose and fructose and those tentatively ascribed to phenolic compounds were observed in the synchronous scanning fluorescence spectra.

The results presented confirm the capability of the fluorescence techniques to monitor the quality of brown sugars distributed on Polish market.

Key words: cane brown sugar, fluorescens spectroscopy

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Perek A.¹, Waśkiewicz A. ², Kowalski R.¹, Dolata W.¹

**ADDITION OF RED WINE TO STEAKS AFFECTS
THE FORMATION OF HETEROCYCLIC AROMATIC AMINES
DURING GRILLING**

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Heterocyclic aromatic amines (HCA) are considered the main food mutagens in cooked meat products. Their formation depends greatly on several factors. Research has shown that the non-meat additives applied in meat products during the process of production and thermal treatment conditions play a major role in HCA's synthesis. Some studies have shown that the concentration of HCAs can be reduced addition of compounds with antioxidant potential. However, antioxidants are known to exert both anti- and pro-oxidative effects depending on their concentrations and interactions with other food components during thermal treatment.

The aim of the study was to find the influence of red wine on speeding up or inhibition of HCA's formation in meat during grilling.

The study was carried out on steaks obtained from beefs musculus longissimus dorsi and from pork loin (musculus lumborum). Marinated muscles and a control sample were put to thermal treatment and then they were analyzed. Isolation and purification of HCA's fraction were carried out using solid-phase extraction. The sample were analyzed by UPLC with TQ Detector.

Four different heterocyclic aromatic amines (2-amino-3-methylimidazo [4,5-f]-quinoline (IQ), 2-amino-3,4-dimethylimidazo[4,5-f]-quinoline (MeIQ), 2-amino-3,4,8-trimethylimidazo[4,5-f]quinoxaline (DiMeIQx) and 2-amino-1-methyl-6-phenylimidazo [4,5-b]pyridine (PhIP)) were found in meat extract.

The results proved that the red wine had differential influence on the amount of HCA's formation depending of muscles. PhIP was determinate in the most amount in both kinds of meat. Red wine influenced on inhibition of HCA's formation in beef but increased the number of IQ, 4,8-DiMeIQx and PhIP in pork compared with the control sample.

Key words: red wine, heterocyclic aromatic amines, meat, grilling

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Pérez-Alvarez J.A., Viuda-Martos M., Fernández-López, J.

SPICE: A NEW SCOPE

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Spices and aromatic herbs have been used since antiquity as preservatives, colorants and flavour enhancers. Thus spices reduce the need for salt and fatty condiments, improve digestion and provide the organism with extra antioxidants that prevent the appearance of physiological and metabolic alterations. Spices, which have long been the basis of traditional medicine in many countries, have also been the subject of study, particularly by the chemical, pharmaceutical and food industries, because of their potential use to improve health. In last years have seen increased interest on the part of consumers, researchers and the food industry into how food products, in general, and specific foods particularly, can help maintain the health. The positive effect of a functional food may include the maintenance of health or wellbeing, or a reduction in the risk of suffering a given illness. To improve spice health benefits it is necessary to identifying the spices bioactive compounds. The role played by these spice minor compounds is very important since evidence suggests that they may contribute significantly to the functional properties in which they sometimes act synergically. The specifications for spice health claims are still relatively unclear and so industry could claim that there is a certain amount of inherited cultural knowledge and little scientific evidence. At the same time, there is a growing interest in the use of bioactive compounds that act as natural additives to replace the synthetic antioxidants, whose use is increasingly restricted due to the secondary effects they may produce. The determination of the antioxidant capacity of spices and their derivatives in foods is being given greater importance by researchers and those involved in the agro-food industry. By this way, *in vitro* and *in vivo* studies have demonstrated how these substances act as antioxidants, digestive stimulants and hypolipidemics and show antibacterial, anti-inflammatory, antiviral and anti-cancerogenic activities. These beneficial physiological effects may also have possible preventative applications in a variety of pathologies. In the composition of culinary herb and a spice can be found proteins, fibre, sugars, essential oils, minerals and pigments besides bioactive compounds such as phenolic acids, flavonoids, sterols and cumarins. Many of the functional properties presented by spices are associated with the presence, type and concentration of phenolic compounds, although the exact composition will depend on several factors, such as the part of the plant used, its vegetative state, environmental conditions, harvesting technique, etc. Other compounds present in spices are the essential oils (EOs), which, in general terms, are composed of more

than seventy components some of which may represent more than 85% of the total content, while others may only be present in trace amounts. However, the role played by these minor compounds is very important since evidence suggests that they may contribute significantly to the functional properties of EOs, in which they sometimes act synergically. This essential oil are composed by terpenes, monoterpenes and sesquiterpenes (as hydrocarbons, alcohols, ketones, etc., which may be acyclic, monocyclic, bicyclics, tricyclics). The essential oil and their components have been demonstrated to possess multiple functional properties, including antioxidants, digestive stimulants and hypolipidemics and show antibacterial, anti-inflammatory, antiviral and anti-cancerigenic activities. However, they are extremely volatile, the organoleptic impact, in the food, would be important and also that issues of safety and toxicity will need to be addressed.

Key words: spices, aromatic herbs, functional properties

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**THE EFFECT OF EXTRUSION TEMPERATURE
ON THE QUALITY CREATION OF CORN SNACKS
WITH DIFFERENT ADDITIVES**

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The aim of the study was the effect of food-by products of distillery and brewery utilization in corn snacks extruded in different temperatures on physicochemical properties of final products.

For corn snacks production dried granules of distillery decoction, brewer's by-yeast and brewer's spent grain have been used. Four levels of additives have been applied: 0, 10, 15 and 20% of dry components mass. Obtained mixtures underwent extrusion in the one screw cooking extruder in the following head temperatures: 160, 170 and 180°C. There were determined physical properties of the snacks, like: expansion index, volume weight, density and colour objectively as Hunter L, a, b values as well as total phenolic compounds content by Folin-Ciocalteu reagent in samples being the extracts in pure methanol.

The properties of corn snacks fortified with used food-by products have been affected by the type of additive applied and also by the level of snacks' fortification and extrusion temperature adapted. All additives utilized in corn snacks production improved their texture but decreased expansion index - in the lowest degree in products fortified with yeast, independently on the extrusion temperature. The higher doses of by-products, like 15 and 20% occurred not profitable. Snacks manufactured in lower temperature (160°C) were of higher hardness than other samples. Profitable effect of higher extrusion temperature (180°C) on the product texture was stated for snacks with brewer's spent grain and brewer's by-yeast as the additives. Corn snacks fortified with yeast characterized suitable crunchy texture and high expansion index independently on the extrusion temperature and the additive quantity used. There were not found significant differences in the snacks density independently on the extrusion condition and the type of additives applied. Independently on the extrusion temperature the lightness of snacks decreased with by products addition, particularly with distillery decoction, the redness increased in the highest degree in snacks with yeast and the yellowness decreased mostly in samples with brewer's spent grain. The fortification of snacks with brewer's spent grain and yeast affected 2.5–3.0 as much increase of total polyphenols contents in ready products. Alongside with an increase of the temperature from 160 to 180°C an increase of phenolic compounds content was observed.

Key words: corn snacks, extrusion, additives, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**PHYSICOCHEMICAL PROPERTIES OF COOKED TUBERS
OF PURPLE AND RED POTATO**

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The aims of this study were to investigate the sensory properties, volatiles, discoloration and a texture of cooked purple and red potatoes compared with yellow potatoes to establish whether they could possess suitable material for human diet.

Five purple, four red and one yellow coloured fleshed potato cultivars grown at the testing station of the Central Institute for Supervising and Testing in Agriculture at Přerov nad Labem in Czech Republic were taken for the experiment. There were determined in potato tubers the physicochemical features, like the volatile components, colour by Hunter lab method, texture as well as sensory properties and the tendency for discoloration of raw and cooked potatoes. The volatiles were obtained using steam distillation extraction methodology.

On the base of the results obtained it was stated that violet fleshed coloured cultivars characterized typical strong potato flavour, intense violet colour before cooking and navy-blue after cooking. Red coloured cultivars occurred increased share of blue colour after cooking and weak declined potato flavour. Tubers of all studied cultivars were hard or quite hard, little or medium floury of optimal or quite dry texture. More than 30 compounds were identified. The most important impact on the flavour of investigated potatoes had medley linear alcohols and aldehydes. In our opinion, the sesquiterpenes, thought predominated volatiles, had no significant influence on the aroma properties. The amount of volatiles ranges from 580 to 114 µg/100g respectively.

Key words: purple potatoe, red potatoe, yellow potatoes, diet, physicochemical properties

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pieczyńska J.¹, Szoltyś M.², Grajewa H.¹, Biernat J.¹

**THE EFFECT OF CULTIVATION INTENSITY ON FATTY ACID
COMPOSITION IN GRAIN, FLAKES AND BRAN OF WINTER
WHEAT (*TRITICUM AESTIVUM* L.) – PRELIMINARY STUDY**

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Three new wheat (*Triticum aestivum* L.) varieties, Sukces, Kobiera and Rapsodia were used to study the effect of cultivation intensity and place on fatty acid composition in grain, flakes and bran .

The varieties were from two strain testing stations located in Lower Silesia, Zybiszów and Tomaszów Bolesławiecki in 2007 year. The cultivation was conducted on two intensity levels: lower and higher. The higher level differed from the lower firstly in higher nitrogen dose by 40 kg, secondly in application of fungicide, growth regulator and foliage dressing. The fatty acid composition was determined by gas chromatography method.

The investigation showed that in the initial study material polyunsaturated fatty acid, especially linoleic acid, were predominant. The SFA, MUFA and PUFA mean contents in wheat grain were mg/100g, in flakes and in bran ,respectively. The higher level of tillage caused PUFA's content decrease, with coincident MUFA and SFA contents increase. The fatty acid composition of grain, flakes and bran was affected mainly by winter wheat variety.

Key words: fatty acid composition, grain, flakes, bran, cultivation

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**PARTIAL CHARACTERIZATION OF DIFFERENT CULTIVARS
OF WHITE CABBAGE BY TOTAL ANTIOXIDANT ACTIVITY
AND GLUCOSINOLATE CONTENT**

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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. The wider application of *Brassica* vegetables in dietary prevention of civilization diseases as well as in support of therapeutic measures relies on the knowledge of factors influencing the content of these bio-active phytochemicals.

The study was carried out for seven cultivars of white cabbage (*Brassica oleracea* var. *capitata*) grown in different regions of Poland. The content of the individual and total glucosinolates, antioxidant activity and cytotoxicity towards human cancer cells was compared. The obtained results show that both cabbage variety and growing conditions have the impact on the content of bioactive compounds. The results of our studies could help in selection of proper cabbage cultivar and specific environmental conditions in order to maximize phytochemical content in *Brassica* vegetables and thereby to enhance the chemopreventive potential of the diet for human populations.

Key words: antioxidant activity, glucosinolate content, white cabbage, cultivation

This research was carried out as part of the project "Utilizing white cabbage for the phytoremediation and biofumigation of soils (AGROBIOKAP)", co-financed by the European Union from the European Fund for Regional Development within the framework of the Operational Program for an Innovative Economy 2007–2013.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pielech-Przybylska K.¹, Balcerek M.¹, Patelski P.¹

**SYNTHESIS OF HIGHER ALCOHOLS DURING ETHANOL
FERMENTATION OF RYE MASHES AS EFFECT
OF YEAST STRAIN AND METHOD OF STARCH LIBERATION**

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Formation of by-products during alcoholic fermentation is a complex process. Particular attention should be paid to higher alcohols because of complexity of their synthesis. Higher alcohols are formed through two routes: catabolic pathway – as products of amino acid catabolism (as was found by Ehrlich) or anabolic pathway – as by-products of amino acid synthesis from pyruvate. Moreover Genevois and Lafon proved that higher alcohols could be the products of carbohydrate metabolism and may be formed from acetic acid and acetaldehyde.

Synthesis of higher alcohols depends on yeast (quantity of inoculum, cellular growth phase, enzymatic activity, rate of sugar fermenting), oxygen concentration and composition of fermented media (mashes obtained by the PLS method contain more of important for yeast growth nutrients than those obtained by pressure cooking).

The aim of the work was to study the effect of various *Saccharomyces cerevisiae* strains and method of starch liberation on dynamics of higher alcohols synthesis during rye mashes fermentation. The study was carried out by using three winter rye varieties: Dańkowskie Diament, Amilo and Dańkowskie Złote. Mashes were prepared by pressureless and pressure cooking method of starch liberation. During starch liquefaction and saccharification processes enzyme preparations were used: Termamyl S.C. (alpha-amylase), SAN Extra L (glucoamylase) and Shearzyme (xylanase - only for PLS method). Fermentations were conducted by using commercial preparations of dried distillery yeast strains: I-7-43, D-2 and As-4 (in dose 0.3 g d.m./L). After 0, 17, 21, 25, 41, 45, 49, 65 and 72 h of fermentation determination of the concentration of higher alcohols (expressed as sum of n-propanol, 2-methyl-1-propanol, n-butanol, 2-methyl-1-butanol and 3-methyl-1-butanol) was performed according to the static headspace analyses method (SHS-GC). Extract, pH, ethanol and sugar content were determined by methods applied in distillery industry.

The method of starch liberation has affected the concentration of higher alcohols in fermented mashes. The lower concentration of higher alcohols (an average of 35%) was noted in mashes prepared by pressure-cooking method in comparison with PLS method. Also yeast

strain has impact on higher alcohols concentration. The lowest concentrations were observed in mashes fermented by yeast strain I-7-43, irrespective of the method of starch liberation. Mashes fermented by strain I-7-43 contained over 30% less higher alcohols as compared to mashes fermented by strains D-2 and As-4. In two cases this difference exceeded 45% (mashes prepared by pressure-cooking method, obtained from Dańkowskie Złote and Dańkowskie Diament, fermented by strain D-2). The dynamics of fermentation of mashes by strains D-2 and I-7-43 was similar – the initial phase of fermentation in some cases lasted 20 hours. In mashes fermented by strain As-4 ethanol production started before 10 hours.

Key words: *Saccharomyces cerevisiae* strains, starch liberation, higher alcohols

This work was financially supported by the Ministry of Science and High Education. Project N N312 205936.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**IMMUNOLOGICAL AND OXIDATIVE STATUS
AND LIPID PROFILE OF BLOOD SERUM OF RATS FED
WITH ADDITION OF RAPESEED, RASPBERRY SEED
AND STRAWBERRY SEED OILS**

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Oils produced from raspberry, strawberry and rapeseeds contain apart from fatty acids also number of substances with anti-oxidative, anti-inflammatory, anti-arteriosclerotic, anti-carcinogenic and immunosuppressant properties such as tocochromanoles, carotenoides, flavonoides, phytosterols, phenol acids etc.

The aim of this study was to evaluate the changes in lipid profile, anti-oxidative enzymes activity and indicators of immunological answer in blood and tissues of rats obtaining the diet with addition of oils produced from rapeseed, raspberry seed and strawberry seed oils.

Experimental animals were male rats of Wistar breed weighting initially about 300 g in the age of four months. The animals were randomly divided into four feeding groups, 7 rats in each group. The animals were fed with restrictive diet (15 g per day per rat) enriched with rape seed, raspberry seed and strawberry seed oils in amount of 5% of the mixture. The oils used in the study were produced by Mega-Sort Company Ltd. (Poland). At the beginning of the experiment and after 6 weeks of feeding test samples of blood were collected from each rat and the activity of superoxide dismutase (SOD) and cellular glutathione peroxidase (cGPX) was evaluated. Lipid indicators TG, total cholesterol, HDL and LDL were also evaluated in the rats' blood. After that all rats were killed by decapitation and the internal organs such as spleen, liver, thymus and adrenal glands were collected for the study. The relative weight of all internal organs was estimated as the percent of body weight. Immunological studies were carried out on macrophages isolated from peritoneal cavity. The coloration with the use of crystal violet (CV) was performed together with evaluation of nitric oxide (NO), activity of arginase and lactate dehydrogenase (LDH). The results of blood tests were

statistically evaluated with one-factor variance ANOVA, for evaluation of difference significance the Tukey's test was applied with the use of Statgraphic Plus 4.0 program.

The oils added to rats' diet were characterised by diverse content of tocopherols. The oil from raspberry seeds was found as the richest source of vitamin E, and then rapeseed oil and strawberry seed oil (respectively 301.9; 76.3 and 58.4 mg/100 g). The phytosterols content in studied oils was between 4.62 mg/g in strawberry seed oil to 7.25 mg/g in rapeseed oil. The oils served in rats' diet during 6 weeks did not influence significantly on the level of TG, total cholesterol or HDL and LDL fractions. In the group obtaining rapeseed oil and also in control group (without the oil additions) lower level of LDL fraction was observed comparing to other groups but any statistical differences were not found. The significant decrease of anti-oxidative enzymes SOD and cGPX in red blood cells of rats obtaining the raspberry oil in their diet was observed, the highest indicators were observed in the group obtaining rapeseed oil and in control group ($P \leq 0.01$). Any significant differences between studied groups of rats in macrophages activity were not found. The macrophages activity was similar in all studied groups so the oil addition has not influenced the general immunological condition of studied rats.

Key words: lipid profile, anti-oxidative enzymes activity, immunological answer, rats diet, rapeseed oil, raspberry seed oil, strawberry seed oil

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pilipczuk T.², Kusznierewicz B.¹, Piekarska A.², Namieśnik J.², Bartoszek A.¹

**INFLUENCE OF CULTIVATION CONDITIONS ON THE CONTENT
OF ISOTHIOCYANATES IN WHITE CABBAGE**

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Epidemiological studies indicated that frequent consumption of cruciferous vegetables, such as cabbage or broccoli, can lower the risk of several types of cancer. This protective effect is associated with the health-promoting phytochemicals, which in *Brassica* vegetables include glucosinolates (GLS) and their breakdown products, mainly isothiocyanates (ITC). When plant tissues are ground or chopped, the enzyme myrosinase and sequestered GLS come into contact and hydrolysis of the latter is started. Depending upon GLS structure and reaction conditions isothiocyanates, indoles, or other less desirable products are obtained. Content of GLS, hence chemopreventive properties depend on cultivar, location and growing conditions. In Europe *Brassica* vegetables may represent the most important foods implicated in prevention of civilization diseases.

The study was carried out for seven varieties of white cabbage (*Brassica oleracea* var. *capitata*) grown in different regions of Poland. Places of cultivation varied as regards agricultural aspects: organic vs. industrial cultivation, soil class, intensity of sunlight and risk of pest attack. The content of the isothiocyanates was determined using Zhang's method. This method depends on the facile and quantitative reaction of the highly electrophilic central carbon atom of the $-N=C=S$ group with vicinal sulfhydryl groups located on adjacent carbon atoms of a suitable reagent. A cyclic thiocarbonyl product is formed and the nitrogen atom as a primary amine is released. The assay utilizes 1,2-benzenedithiol as the vicinal dithiol reagent and measures the concentration of the reaction product – 1,3-benzodithiole-2-thione – by HPLC.

The obtained results show that both cabbage variety and growing conditions influence the content of isothiocyanates.

Key words: isothiocyanates, white cabbage, cultivation

This research was carried out as part of the project "Utilizing white cabbage for the phytoremediation and biofumigation of soils (AGROBIOKAP)", co-financed by the European Union from the European Fund for Regional Development within the framework of the Operational Program for an Innovative Economy 2007–2013.

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Platta A.

THE QUALITY OF SELECTED CARROT VARIETIES

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The object of those researches was the qualification of mineral components, heavy metals, nitrates (V) and (III), total carotenoids, total saccharides and contents in fresh carrot samples and to determine the influence of carrot converting degree (freezing process) and cooking methods on the retention of analyzed compounds. The retention of above mentioned compounds analyzed in selected raw and frozen carrot varieties. The examined raw carrot samples were cooked in traditional way (starting from boiling water), in the pressure cooker and in the steam cooker. The frozen carrot samples were cooked only in traditional way. The aim of this work was to define the sensory quality of the carrot of selected varieties after cooking it with various methods. Sensory characteristics of cooked carrots were established with the use of a 5-point scale (1-minimum value; 5-maximum value). Quality factors were taken into consideration: general appearance, smell, consistency and taste.

The statistical evaluation indicated substantial influence of cooking methods on trends in Ca, Mg, Pb, total carotenoids and total saccharides concentrations in researched fresh carrot samples. The results of researches showed that the concentration of nitrates (V) and (III) in all varieties of frozen carrot were much lower in the fresh carrot after freezing process at -22°C . Freezing storage process caused the decrease in content of nitrates (V) but a rise in concentration of nitrates (III). In all analysed samples of carrots, mean nitrate levels were found to be below $400\text{ mg NaNO}_3/\text{kg}$ raw materials.

The results showed that the sensory characteristics depended on the cooking methods used. The Nigel carrot variety and the Nipomo carrot variety gained the highest sensory evaluation scores with regard to the cooking methods used. The frozen Nandrin carrot variety had the lowest sensory estimation after cooking it in the traditional way. In addition, the storage period influenced the quality characteristics of the cooked vegetables. The frozen Niagara carrot variety had the lowest sensory estimation after three and six months of the storage period.

Key words: carrot of varieties, freezing process, storage period, cooking methods, mineral compounds, carotenoids, saccharides, heavy metals, nitrates (V) and (III), sensory quality

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Platek M., Jarmoluk A.

**THE EFFECTS OF THERMAL PROCESSING AND ADDITION
OF ALGINATE ON FUNCTIONAL PROPERTIES
OF RESTRUCTURED MEAT PRODUCTS**

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Influence of functional additives (alginate, xanthan, guar gum, hydroxypropylmethylcellulose) and scalded meat on textural (hardness, gumminess and chewiness) and functional properties (water-holding capacity, WHC) of restructured meat products was studied. Model meat products were prepared with addition of scalded meat at three levels (100, 50 and 0%) and alginate also at three levels (0.5, 0.75 and 1%), and with using microbial transglutaminase (MTG) (0.3%), calcium sulfate (1%). Final products were stored in chilling conditions (4°C) for 24 hours – variant I. The variant II was prepared according to the same procedure, but with 2 more steps, which included heating of sample to the final internal temperature 72°C and cooling its to 14°C in ice bath.

The results showed that dry matter of the restructured products increased with increasing alginate content. Whereas protein content was depended on the scalded meat concentration. The measurements of free fat content in meat products showed that the highest content had a sample with addition of 100% scalded meat. Water holding capacity (WHC) depends on the scalded meat level and alginate level. The highest value of WHC was recorded in meat samples with addition of 1% alginate. Statistical analyze proved significant differences in value on textural properties of restructured meat products. The hardness, gumminess and chewiness of the restructured products increased with an increasing scalded meat content. Heating process in variant II was deteriorated textural properties of analyzed sample. Increased of hardness, gumminess, chewiness was caused by alginate addition.

Key words: alginate, xanthan, guar gum, hydroxypropylmethylcellulose, restructured meat products

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on the
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Wrocław 19–20 September 2011**

Podlaski S.

**PROBLEMS AND CHALLENGES OF HIGHER AGRICULTURAL
EDUCATION IN POLAND**

General Council for Higher Education, Poland

There are about 151 million students in the world today. This number has increased by 53% since 2000. There is no doubt that education on such a large scale may often be of bad quality. We are currently entering the second phase of this process, in which the quality of education begins to play progressively a bigger role. In Poland the number of students increased from 403.000 in 1990 and 1991 to 1.953,000 in 2005 and 2006. Since 2006 we have been witnessing slow decrease in these numbers. Among 461 universities and colleges (including the institutions under the direction of the Ministry of National Defence and the Ministry of Interior and Administration), 131 were public ones with 1.266.900 students (66.7% of the total) of which 324.000 were undergraduate students during the first year of study.

At the beginning of academic year 2009–2010 there were 330 private third-level institutions with 633.100 students (33.3% of the total) of which 163.700 were undergraduate students during the first year of study. Poland (before USA) is a world leader in the number of students attending private universities and colleges. In 2009 there were 64.000 teachers employed by public third-level institutions compared to only 18.000 in private ones. The private third-level institution is the primary place of work for 900 people. In-breeding of employees is a typical phenomenon within Polish universities and colleges. The University of Warsaw and the Jagiellonian University in Krakow appear in the Academic Ranking of World Universities and employ 90% of academic staff that received PhDs from these universities, for which they occupy the first position in the world.

The rapid decrease of student numbers in the last few years constitutes a feature of Polish agricultural education. The total number of students between 2006 and 2009 decreased by 52.5–54.1% for Fishery and Agricultural Engineering, and by 41.7% for Agriculture. Such fields as Horticulture, Wood Technology and Animal Sciences saw decreases in the student numbers by 15.1–16.7% between 2006 and 2009. The situation is different for Landscape Architecture with an increase by 37%, while Food Technology, Human Nutrition and Veterinary Medicine increased by 1–2%. Studies offered in Food Technology and Human Nutrition ceased completely in private institutions.

In Poland, as well as in the world, students of agricultural specialisations are not the most satisfied with their choice of studies. The research of the Polish Agency for Enterprise Development carried out on 33.000 students and graduates has shown that many students would choose a different type of third-level institutions, especially institutes of technology – 52%, universities – 20%, and agricultural institutions – only 11%.

New conditions for the functioning of third-level institutions were laid down by the Higher Education Act. The act guarantees that the best institutions can shape study curricula based on an efficiently operating internal system whose tools evaluate the quality of education. Good teaching methods and a relatively high level of research will increase the chances of particular faculties in the competition with regard to students, resources, employees and their reputation. We will shortly see how faculties and third-level institutions avail of this opportunity.

The experience of American universities shows that any change is only beneficial when employees are informed why the change was introduced and if university authorities are determined to introduce the reforms.

Key words: agricultural education, Pole, university

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on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Połtowicz K.¹, Kozłowska J.², Wężyk S., Doktor J.¹

**EFFECT OF LINSEED OIL SUPPLEMENT IN LAYING HEN DIETS
ON FATTY ACID PROFILE OF EGG YOLK**

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WHO recommendations on daily human diet concerns the increased intake of polyunsaturated fatty acids (n-3 PUFA), including α -linoleic acid. Linseeds are a rich source of this acid, but they reduce production results of laying hens when fed in high doses. Linseed oil, provides up to 40% flax seed, contains over 90% unsaturated fatty acids, over 50% are acids n-3.

The aim of the study was to determine the possibility of modifying the composition of egg yolk fat by feeding linseed oil to layers. Forty-week-old Astra S hens were randomly assigned to two groups and fed a control diet (group I) or a diet with 3% linseed oil supplement (group II). Both diets contained 16.5% crude protein and 5.8% (group I) or 7.8% crude fat (group II). Eggs laid by hens at 1, 10, 20 and 30 days of the experiment were examined. On each of these days, 6 eggs were randomly selected from each group to determine the profile of higher fatty acids in egg yolk. Fatty acid profile of the feed mixtures and fat oxidation were also determined.

Feeding the experimental diet with 3% linseed oil to laying hens caused a significant ($P \leq 0.01$) increase in the proportion of n-3 PUFA, including α -linoleic acid (ALA), eicosapentanoic acid (EPA), dipicolinic acid (DPA) and docosahexaenoic acid (DHA) in egg yolk. The highest ALA increase was noted after 20 days of using the diet. The proportion of these acids was the highest on day 10 of the experiment. On day 30, the proportion of PUFA in egg yolk in group II decreased comparing to an earlier study, but it still was higher than in the control group ($P > 0.05$). The n-3 PUFA content of egg yolk increased at the cost of decreases in the proportion of saturated and monounsaturated fatty acids in yolk. Analysis of fat oxidation parameters in the feeds at 1 and 30 days of the study showed an increase in peroxide value and epihydrine aldehyde in the experimental feed, which is evidence of considerable oxidative instability of linseed oil.

The results showed that the use of 3% linseed oil supplement in layer diets enables egg yolk to be enriched with n-3 PUFA, especially α -linoleic acid. Because of high oxidative instability, proper antioxidants have to be added to these feeds.

Key words: egg yolk, fat, modification, feeding, linseed oil

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pomykała R., Wieczorek K, Osek J.

**PROFICIENCY TESTS IN FOOD MICROBIOLOGY AMONG
OFFICIAL CONTROL LABORATORIES OF THE VETERINARY
INSPECTION IN POLAND**

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According to the Act of 29 January 2004 on the Veterinary Inspection its operations include prevention and fight against animal diseases and supervision of health and quality aspects of foodstuffs of animal origin. Proper realization of the tasks is assured by analytical activities Inspection's laboratories: Veterinary Hygiene Laboratories, National Reference Laboratory (NRL) localized in Pulawy and laboratories approved by the Chief Veterinary Officer. In accordance with the EU Regulation (EC) No. 882/2004 the NRL organizes comparative tests between official control laboratories and ensure an appropriate follow-up of such testing. Laboratories undertaking official controls should participate in a relevant PT organized by appropriate NRL.

The purpose of this study was to evaluate the proficiency of official control laboratories of the Veterinary Inspection in Poland, performing microbiological tests of food of animal origin.

Proficiency tests were organized by the NRL according to the ILAC-G13:08/2007 and ISO/IEC 43-1:1997 Standards. In the years 2006–2010 a total of 21 rounds of PTs were organized with over 1,200 participants. Matrices used for sample's preparation were: pork, bovine and chicken raw meat, raw and smoked fish, sausages and surface sponge swabs. Samples were naturally or artificially contaminated with the target microorganism. Parameters tested included qualitative and quantitative microbiological tests listed in food safety criteria and control of hygiene process (Regulation (EC) No. 2073/2005), i.e. detection of *Salmonella* spp. and *L. monocytogenes*; enumeration of aerobic plate count, *Enterobacteriaceae*, coagulase-positive *Staphylococcus* spp. and *L. monocytogenes*. Prepared samples were tested for the sufficient homogeneity and stability (ISO 13528:2005 Standard). Assigned values for enumeration parameters were determined by ISO 13528:2005 Standard. A z or z' -score parameters were used for evaluation of the participant's proficiency. Criteria of results acceptance were: $|z| \leq 2$ – satisfactory, $2 < |z| < 3$ – doubtful, $|z| \geq 3$ – unsatisfactory.

The average percentage of the correct results was over 85 for the qualitative tests. Only in few cases participants were not able to properly detect target microorganisms. In the quantitative tests over 88% of participants achieved satisfactory result. These high numbers of satisfied results in PT indicate that safety and quality of food is under appropriate supervision. Furthermore, proficiency tests are an effective tool used by NRL in the supervision of a national network of the Veterinary Inspection's official food control laboratories.

Key words: microbiological tests, controlling, food of animal origin

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Pudło A., Kopec W., Korzeniowska M., Biazik E., Skiba T.

**CHICKEN BONES AS AN ALTERNATIVE RAW MATERIAL
IN ACIDIC-ENZYMATIC PROCESS OF COLLAGEN EXTRACTION**

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The objective of the study was to compare collagen extraction in hydrochloric acid solution from pig and chicken bones and the method of acidic-enzymatic extraction using citric acid and pepsin.

Materials used in the study were poultry and pigs bones. Acidic and enzymatic methods were applied for collagen isolation from raw pigs skin and bones, as well as pigs and poultry bones after thermal treatment. Acidic hydrolysis was performed in citric and HCl at pH 2.0, an enzymatic hydrolysis by proteolytic enzyme pepsin in citric and HCl (pH 2.0), whilst thermally treated material was processed in 6% HCl. Collagen extraction was carried out for seven days at room temperature. Samples were analyzed for dry matter, total protein, ash, fat and hydroxyproline content.

The collected results revealed significant effects of hydrolysis conditions applied in raw pigs bones on dry matter, collagen and ash content. No influence on total protein and fat content in the hydrolyzed pig bones was noticed. The highest collagen content was found in pigs bones after hydrolysis in HCl (pH 2.0). Enzymatic hydrolysis in citric acid was stated the most effective. The lowest collagen content was analyzed in poultry bones when enzymatic process in acids were performed. Acidic hydrolysis of poultry bones in HCl (pH 2.0) was characterized by the highest collagen loss. Collagen content and recovery in thermally treated pigs bones were dependent on used hydrolysis method. The highest recovery of collagen (14%) from bones was stated, when enzymatic process in HCl was applied. It was found that pepsin used for hydrolyzing bones in HCl was almost four times more effective than process carried out without the enzyme. When citric acid was applied for 7 days hydrolysis around 9% of collagen was obtained, whereas pepsin addition to resulted in 14% of collagen recovery. All post-hydrolysis solutions were characterized by lower than 50% collagen content in the total protein, that caused low purity of analyzed solutions.

Processing of thermally treated poultry bones effected in different results in relation to pigs bones. The most effective collagen recovery (17%) was found in solutions from enzymatic hydrolysis either in hydrochloric or citric acids, whereas the lowest yield of protein was stated for hydrochloric acid (pH 2.0). In all analyzed solutions an increase of collagen concentration was measured. An important disadvantage of the hydrolysis of thermally treated poultry bones was relatively low purity of obtained collagen solutions.

Application of 6% hydrochloric acid resulted in high effectiveness of the total protein dissolution. Collagen recovery equaled 0.23% for raw pigs bones, whereas 0.9 and 2.9% for thermally treated pigs and poultry bones. When hydrolysis was carried out in citric acid on previously heated pigs and poultry bones 9 and 5% of the fibrous proteins were recovered. Higher amount of collagen obtained during enzymatic hydrolysis in relation to acidic process showed that pepsin cut the netting bonds in telopeptides without disruption of the triple helical structure of the molecule.

Poultry bones are, as good raw material for collagen extraction, as pig bones when strong acidic or enzymatic extraction with pepsin is applied for the process.

Key words: collagen, extraction, pig bones, chicken bones

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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PHYTOSTEROL CONTENTS IN COLD PRESSED OILS

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Phytosterols exert beneficial effects on human body, among them the main recognized is hypocholesterolemic effect, and furthermore anticancerogenic, antioxidant and anti-inflammatory activity. These compounds inhibit also benign prostatic hyperplasia. The most important food sources of phytosterols are plant oils, nuts and cereals.

The aim of this study was to assess the content of total phytosterols and their composition in selected commercial cold pressed oils purchased in health food stores and hypermarkets in Wrocław.

The material for the study comprised of 13 types of cold pressed oils from 15 producers: safflower oil, poppy seed oil, sesame oil, hemp oil, milk thistle oil, walnut oil, avocado oil, macadamia nut oil, apricot kernel oil, rosehip oil, camelina oil, high linolenic and low linolenic linseed oils. In total 44 oil samples were analyzed. The phytosterol contents were determined using gas chromatography method with flame ionization detection.

It was shown that the total phytosterol contents in the analyzed oils ranged from 128,8 to 644,1 mg/100 g. The highest phytosterol contents were found in sesame, camelina and rose hip oils, while poppy seed and walnut oils were the poorest sources of these compounds. β -sitosterol predominated in the sterol fraction of all studied oils and accounted for 41% (linseed oils) to 84% (apricot kernel oils) of the total sterol content. Kampestanol was present in oils in the smallest amounts of the identified sterols. Camelina and milk thistle oils distinguished by the presence of cholesterol amounting to 4,5–7,1%. Camelina oils also contained brassicasterol, which accumulates in plants of Brassicaceae family. Some types of analyzed oils, for example avocado and walnut oils, varied considerably in sterol contents between samples from different producers.

Key words: phytosterols, cold pressed oils purchased

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Radzimiński A.

**AT THE TABLE OF THE CLERGY AND KNIGHTS
OF THE TEUTONIC ORDER IN PRUSSIA**

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The paper will present the results of research on certain aspects of food and dining among members of the Teutonic Order in Prussia in the Middle Ages. The study was based on very diverse sources, but mainly different types of accounts from the 14th and 15th centuries. Of note are the ledger of the Malbork treasurer for the years 1399–1405, the ledger of the convent of the Teutonic Knights in Malbork from the years 1399–1412, ledgers of offices of the convent of the Teutonic Knights in Malbork, the expenses ledger of the commander of Malbork castle from the years 1410–1420, and commercial accounts of the Teutonic Order. Also of importance are accounts of Prussian towns for expenses relating to food in connection with visits of the Grand Masters.

Of great importance are accounts of Teutonic clergy, though these are unusual. One such account, kept by Johann von Ast, comes from the years 1445–1446 and is preserved in the original in the Archives of the Teutonic Order in Berlin. Several years ago it was prepared for print and published by me. It contains a great deal of information on shopping, including for food items which then appeared on the table of the aforementioned cleric.

One unique source is a Teutonic cookery book dating from the second half of the 15th century, which contains numerous interesting recipes for different types of dishes, from meat and fish, through poultry, to desserts. The rules of the Teutonic Order in the 13th century placed emphasis, on the one hand, on the necessity of restraint during fast days, but clearly indicated, on the other, that the Teutonic knights' abstinence was nothing out of the ordinary. It is understandable that the Teutonic knights had to be in constant readiness for armed struggle.

Studies have shown that the food of the Grand Masters of the Teutonic Order differed fundamentally from what the ordinary brother knights ate. Meat dishes that were placed on the table of the Grand Masters differed substantially from dishes eaten in conventual castles. Teutonic knights ate a comparatively large amount of pork, beef and mutton. In this respect the cuisine of the Grand Masters was far more sophisticated. There veal, lamb and piglet prevailed, and although these also appeared on the tables of knights in conventual castles, it was in much smaller quantities. Relatively frequently dishes of wild birds appeared on the table of the Grand Masters – large quantities of starlings, a true delicacy of the Grand Masters, as well as wild duck and partridge. Exceptionally, even cranes were eaten. A favourite delicacy of the

Grand Masters was game. We quite frequently find information about purchasing venison, wild boar, hares, and even aurochs.

The range of fish eaten by the Grand Masters and the Teutonic knights was indeed impressive. At the forefront is the consumption of cod, although it was purchased primarily in connection with meetings of the General Chapters, which took place on 14th September, the Feast of the Elevation of the Cross. Other fish that found their way on to the table of the Grand Masters were eel, salmon, pike, lamprey, sturgeon, and bream. A special fish, which Grand Masters often received as a gift, was sturgeon.

In the cuisine of the Grand Masters foreign spices such as pepper, saffron, ginger, cloves and cinnamon were used fairly frequently. It is worth mentioning that this type of condiment, like tropical fruits, were widely commercially available in large Prussian cities. In a sense, the great popularity of tropical fruit in the cuisine of the Grand Masters is surprising, as it was – as already mentioned – widely available commercially.

Teutonic inventories mention large stores of such fruits as figs, almonds, raisins and dates. The table of the Grand Masters, of course, could not be without all kinds of beverages. We find local and imported wines from the Rhine, Alsace, Greece, Portugal, Spain and Hungary, as well as beer and mead. Beer from Gdańsk and Elbląg was drunk, as well as favourites from Bydgoszcz and from Wismar.

The accounts of Johann von Ast, parish priest of the church of Sts John in Toruń, show the different types of food and drink purchased as well as their prices. On the basis of these, it is possible to study what was eaten, and thus try to determine who the guests invited to the table of the aforementioned clergyman were.

I shall also mention some examples of dishes and recipes from the Teutonic cookery book coming from the second half of the 15th century. First of all, what draws attention is the great variety of recipes described there, with in some cases even the quantities of the ingredients being given and the exact method of preparation of the dishes being presented. This 15th century Teutonic cookery book may well be a good basis for preparing tasty dishes even in the present day.

Key words: food, tutonic order, Prussia, dinning habits

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

**Riekstina-Dolge R.¹, Kruma Z.¹, Augšpole I.¹, Ungure E., Karklina D.¹,
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**PHENOLIC COMPOUNDS IN FERMENTED APPLE JUICE:
EFFECT OF APPLE VARIETY AND APPLE RIPENING INDEX**

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This paper reports the influence of apple variety and apple ripening index on the total phenolic compounds to fermented apple juice. Five apples variety juices were fermented using the three different processing times, depending on the apples storage period. The aim of current research was to evaluate phenolic compounds of fresh and fermented juice, depending on used apple variety and apple ripening index. Apples juice was fermented with *Saccharomyces bayanus* yeast EC-1118 (Lalvin, Canada). Phenolic compounds were detected for apple juice and fermented juice. Total phenol content (TPC) was determined according to the Folin-Ciocalteu spectrophotometric method and results were expressed as gallic acid equivalents. The highest TPC was detected in juice and fermented drinks made from 'Kerr' variety apples. In juices stabilized with 'Tannisol' higher content of TPC were detected. In fermented drinks mainly TPC is lower compared to corresponding apple juice.

Key words: phenolic compounds, fresh and fermented juice, apple variety, apple ripening index

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Rola J.G., Korpysa-Dzirba W., Ostrowska M.

**STAPHYLOCOCCI AS ONE OF THE PARAMETERS
OF THE HYGIENE OF CHEESE PRODUCTION IN MILK FARMS**

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Department of Hygiene of Food of Animal Origin of national veterinary research institute in Puławy performs research on presence of coagulase-positive staphylococci (CPS) and staphylococcal enterotoxins in different stages of production of milk products.

The aim of this study was to establish the occurrence of staphylococcal enterotoxins in milk products and to estimate the hygienic quality of cheeses produced in milk farms.

Production of cheeses comprises of raw milk heating to 32°C, the rennin added starts the process of cloth formation. Afterwards, the milk curd is cut and the liquid whey is separated. Cheese grains are rinsed with warm water and once again liquid whey is separated. The grains are placed in forms to drain off and formed and the salt is added. After this step, the cheeses are transported to the specially assigned places for ripening.

All collected samples, including the swabs from the production environment, were analyzed according to PN-EN ISO 6888-2 Standard. Samples where coagulase-positive staphylococci were detected and the final products were analyzed for the presence of staphylococcal enterotoxins according to the European Screening Method.

Since the beginning of 2011, 54 samples were collected from 5 milk farms. Samples were taken from each stage of production including raw milk and swabs from the production environment especially from the stages where the highest level of *S. aureus* is expected. These samples were: raw milk; milk after being heated, before adding the rennin; milk curd; grain after rinsing; formed cheese, cheese after adding the spices and salting; mature cheese and also swabs from hands of person involved in production; from milk tank; from the surface of the strainer and from mold for forming the cheese. The contamination with CPS of raw milk, half-products and the final products was between: $<1 \times 10^0$ CFU.mL⁻¹ – 2.1×10^2 CFU.mL⁻¹; $<1 \times 10^0$ CFU.mL⁻¹ – 1.4×10^5 CFU.g⁻¹; $<1 \times 10^1$ CFU.g⁻¹ – 8.2×10^4 CFU.g⁻¹, respectively. Also, hygiene of production was verified by analyzing the swabs from production environment – in all farms the level of *S. aureus* was <1 cfu per swab or cm². Staphylococcal enterotoxins were not detected in any of analyzed samples. From each sample where the presence of CPS was confirmed, CPS were isolated and identified. Among these strains, species like *S. aureus*, *S. sciuri*, *S. capitis*, *S. equorum*, *S. warneri*, *S. chromogenes* were found.

Key words: staphylococcal enterotoxins, hygienic quality, cheeses milk farms

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Rola J.G., Ostrowska M.

**COMPARATIVE STUDY OF DIFFERENT STABILIZATION
PROCEDURES FOR MILK SAMPLES USED
IN PROFICIENCY TESTING FOR *LISTERIA MONOCYTOGENES***

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Risk assessment is a systematic process of identification and evaluation of hazards resulting from microbiological contaminations. *L. monocytogenes* is a widespread pathogen, which can occur in food and is responsible for many outbreaks, with high mortality rate. Commission Regulation (EC) No 2073/2005 lays down the criteria for *L. monocytogenes* detection and enumeration. Regular participation in Proficiency Testing (PT) provides independent verification of the analytical competence of the laboratory. National Veterinary Research Institute, Department of Food Hygiene of Animal Origin acting as National Reference Laboratory and organizes the PTs for official veterinary laboratories as well as commercial laboratories.

To set up these studies, it is necessary to prepare artificially contaminated samples, raw and pasteurized milk, which contamination level is sufficiently stable and homogeneous during transport to the participating laboratories. *L. monocytogenes* is able to grow at refrigeration temperature, that is why temperature is not sufficient to maintain a constant concentration of *L. monocytogenes* during transport.

In this context, we tested several procedures to maintain the concentration of *L. monocytogenes* in raw and pasteurized milk samples: freezing temperature at -23°C and addition of sodium azide (azidiol) at the concentration of 0,02% as a preservative at temperature between $2-8^{\circ}\text{C}$. For enumeration of *L. monocytogenes* samples at two levels of contaminations were used: high level – $1 \times 10^4 \text{ CFU.mL}^{-1}$ and low level – $1 \times 10^3 \text{ CFU.mL}^{-1}$. For detection of *L. monocytogenes* two types of samples were used: uncontaminated and contaminated at low level – $1 \times 10^2 \text{ CFU.mL}^{-1}$. Samples were analyzed at 1st, 3rd, 6th and 8th day after contamination.

Through this study we selected preservation procedures, which could be used to stabilize the bacterial level of artificially contaminated milk samples during time indicated for carrying out the analysis including transportation of the samples. Sodium azide (azidiol) was effective in stabilizing the contamination level of *L. monocytogenes* in milk samples in all used levels. The average values of the results of the samples fixed with this preservative, analyzed in intervals of 3 days for the period 8 days maintained stable. A freezing method was able to stabilize the concentration of *L. monocytogenes* in the artificially contaminated samples. In case of frozen samples the difference among average values of the results between 1 and 8 day from contamination amounted $0.1 \log_{10}$. It proved that the samples were stable. The same results were obtained in case of both raw and pasteurized milk and both preservation methods.

Key words: milk, microbiological contamination, *Listeria monocytogenes*

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Rola J.G., Sosnowski M.

**RELATIONSHIP BETWEEN ROUTINE AND REFERENCE METHOD
OF QUANTITATIVE DETERMINATION
OF BACTERIOLOGICAL QUALITY OF RAW MILK**

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Hygiene, especially bacteriological quality of raw milk, is very important point in dairy industry and technological process. The growth of bacteria in milk depends mainly on temperature and the presence of other bacteria. Bacteria in milk can occur through colonization of the teat canal or infected udder, or as contaminants. The main reasons for spoilage of milk are saprophytic microorganisms.

According to the European Union Legislation the quality of raw milk must be controlled. Food business operators must initiate procedures to ensure that raw cow milk meets the total bacteria count criterium of 100 000 per ml at 30°C. For checking of the total bacteria count the EN-ISO standard 4833 for the plate count at 30°C must be applied as the reference method. The use of alternative analytical methods is acceptable when they are validated against the reference method mentioned in accordance with the protocol set out in EN-ISO standard 16140 or other similar internationally accepted protocols. In particular the conversion relationship between an alternative method and the reference method should be established according to ISO standard 21187.

Conversion in quantitative microbiology means expressing the result of a quantitative determination of the bacteriological status of a test samples as obtained with a routine method in units of the reference method. The main routine method of determination of total bacteria count in raw milk are an instrumental methods: Bactoscan (Foss Electric) and Bactocount (Bentley). The methods based on enumeration by continuous epifluorescent microscopy or the flow cytometry let count individual bacteria cells in much shorter time compared to the reference method.

The establishment of a conversion relationship is based on the examination of test samples with both methods, covering the field of application and the spectrum of the samples as analyzed using the routine method. It should be guaranteed that the obtained conversion relationship is representative of the circumstances under which the routine method is carried out and the resulting conversion relationship is later applied.

The levels of contamination should uniformly cover the range of interest for the routine method concerned. The statistical calculations are made by regression method. After eliminating outliers the average values and standard deviations for both methods, as general as for each level of contamination should be estimated. For defining the linear regression equation in the form $y = ax + b$, the slope of the line – a , and the y -intercept – b , should be calculated on the basis of the general average values and standard deviations of both methods.

The paper describes the particular rules of the establishing of the conversion relationship of the instrumental methods (Bastoscan and Bactocount) and the reference method of determination of total bacteria count in raw cow milk in European Union countries.

Key words: milk, contamination, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Rosiak E., Kołożyn-Krajewska D.

**GROWTH AND SURVIVAL OF *SALMONELLA SPP.* IN MINCED
MEAT PRODUCT STORED IN REFRIGERATOR TEMPERATURES**

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Predictive microbiology is based on repeatable behavior of microbial populations in the same environmental conditions. The usefulness of predictive models is due to several factors, one of them are original data which the characteristics of behavior of microbial populations under specific environmental conditions. It is therefore important to obtain data during the experiment conducted for food products rather than microbiological liquids. Aim of this work was to study the growth and survival of three strains of *Salmonella* in finely minced sausage during storage at 5, 10 and 15°C.

The material consisted of hot dogs purchased at the store of the manufacturer. *Salmonella* strains came from the collections of the National Veterinary Institute and the American Type Culture Collection. Product samples were inoculated with 18–24 hours old mixture of three strains culture in amount of 1000 cells/g. Then the sample was stored under aerobic conditions at temperatures of 5 and 10°C during 18 days and at 15°C during 9 days. For each storage temperature 5 repetitions of storage cycle were performed.

As a result, storage of products infected with *Salmonella* at 5°C was survival of the bacteria. At a temperature of 10°C, the bacteria showed an increase to 8 days of storage, then the population died. In the case of storage of products at 15°C was strong growth to 8 days of storage.

Key words: *Salmonella* strains, minced sausage, storage

This work was financially supported by the Ministry of Science and High Education. Project N R12 0097 06/2009.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Roszko M., Szymczyk K., Jędrzejczak R.

**POLYCHLORINATED BIPHENYLS (PCBS), POLYBROMINATED
DIPHENYL ETHERS (PBDE) AND CHLORINATED PESTICIDES
IN CEREAL PRODUCTS**

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Polychlorinated biphenyls (PCBs), polybrominated biphenyl ethers (PBDEs) and pesticides are regarded as hazardous chemical contaminants of food. These groups of substances are not uniform, they include numerous compounds differing in their chemical structure. PCBs and PBDEs each include 209 so-called congeners possessing different chlorination/bromination level and/or substituent position on the molecule. Pesticides form a very diversified group of chemicals belonging to more than 100 different chemical classes. PCBs, PBDEs and several classes of pesticides exhibit environmental persistence and are regulated under the Stockholm Convention on the persistent organic pollutants.

The aim of this work was to investigate the presence of selected chemical compounds in the cereal products. An analytical method suitable for determination of PCB/PBDE in cereal products was developed for the purpose of this study. Six indicator PCB congener (28, 52, 101, 138, 153, 180), 12 dioxin like PCB (77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169, 189) and 14 PBDE congener (17, 28, 47, 66, 71, 85, 99, 100, 138, 153, 154, 183, 190, 209) concentrations were determined. Method performance was evaluated on laboratory made spiked samples and on the basis of isotope labeled internal standards. Validation experiments showed that statistical parameters of the method were in concordance with the EU Regulation 1883/2003 and EU Commission Decision 2002/657. Selected chlorinated pesticide residues (DDT, HCH, HCB, chlordane, heptachlor, heptachlor-epoxide, aldrin, eldrin, dieldrin, nitrophenene and methoxychlor) were additionally determined in the studied material. Gas chromatography coupled to a low resolution ion trap mass spectrometry was used for all determinations. Preliminary study on the presence of the investigated compounds in cereals was conducted on some market-based samples. Research revealed that both PCBs and PBDEs were present in all of the studied samples. Mean concentration of 6 indicator PCB was in the range of 5–574 pg g⁻¹ (median value 201 pg g⁻¹). Lower chlorinated PCB congeners (28, 52) were the most abundant in studied samples. PCB-TEQ value determined on the basis of the 1998 TEFs was in the range of 0,0002–0,055 pg TEQ g⁻¹ (median value 0,0058 pg g⁻¹). All of the investigated PCB congeners were commonly found in the studied samples. The only exceptions were CB # 81 and # 126 which were found at concentration above limit

of quantification only in 30% of the samples. Mean summary concentration of the investigated PBDE congeners varied from 63 to 348 $\mu\text{g g}^{-1}$ (median value 109 $\mu\text{g g}^{-1}$). BDE # 47 and # 99 were the most abundant, while # 190 and # 209 were not found in any of the investigated sample. In case of the investigated pesticide residues only the DDT isomers were found in the studied samples in relatively higher concentrations, however determined quantities were in $\mu\text{g kg}^{-1}$ range. Several samples had the residues of other pesticides like chlordane, HCH isomers, endrin or dieldrin determined, but in quantities significantly lower comparing to the DDTs. Results of this study suggest that levels of PCB/PBDEs and organochlorine pesticides are low in cereal products. However due to very high importance of cereal as food and feed products, precise determination of chemical contaminants levels in this groups of products is fully justified, and requires further investigation.

Key words: polychlorinated biphenyls, polybrominated biphenyl ethers, chlorinated pesticides, cereal products

This work was financially supported by the Ministry of Science and High Education. Project N N312 102738.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

**Ruiz-Navajas Y., Viuda-Martos M., Perez-Alvarez J.A., Perez-Alvarez J.A.,
Sayas Barbera E., Fernandez-Lopez J., Sendra E.**

**CHEMICAL COMPOSITION AND ANTIBACTERIAL ACTIVITY
OF ESSENTIAL OILS OF TWO AROMATIC HERBS
(*SANTOLINA CHAMAECYPARISSUS* AND *SIDERITIS
ANGUSTIFOLIA*) WIDELY USED IN THE FOLK MEDICINE**

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The aim of this work was to (i) determine the chemical composition and (ii) the effectiveness of the essential oils from *Santolina chamaecyparissus* and *Sideritis angustifolia* on the growth of some bacteria related to food spoilage such as *Alcaligenes faecalis*, *Aeromonas hydrophyla*, *Listeria innocua*, and *Enterobacter gergoviae*.

Essential oils were chemically analysed and identified by GC and GC-MS. The agar disc diffusion method was used to determine the antibacterial activities of the oils. The concentration effect (CE) was also determined.

In the essential oil of *S. chamaecyparissus*, 58 compounds were identified, representing 91.4% of the total oil, the major constituents being artemisia ketone (27.19%), α -guaiene (18.21%), β -phellandrene (7.49%), myrcene (6.94%) and camphor (3.88%).

When the essential oil of *S. angustifolia* was analyzed by GC-MS 77 compounds were identified, representing 94.3% of the total oil, the major constituent being α -pinene (12.71%). Other important compounds were β -phellandrene (11.97%), 1,8-cineole (7.41%) and trans-caryophyllene (6.33%).

The CE values for the bacterial strains can be seen in Table 1. The inhibitory effect of each oil was seen to be proportional to its doses. The agar disc diffusion method indicated that *S. chamaecyparissus* essential oil showed the highest antibacterial activity against the *Listeria innocua* and *Aeromonas hydrophyla*, with inhibition zones of 12.70 and 16.50 mm respectively. *S. angustifolia* Essential oil present the highest antibacterial activity against *Alcaligenes faecalis*. The disks impregnated with 5 and 2 μ L of essential oils of *S. Chamaecyparissus* and *S. angustifolia* did not have inhibitory effects on any of the four tested bacteria. In the case of *Enterobacter gergoviae* the *S. Chamaecyparissus* and *S. Angustifolia* essential oil did not show antibacterial activity.

Table 1. The concentration effect of *S. Chamaecyparissus* and *S. angustifolia* essential oils

Essential oil	Dose (µL)	‡ Diameter of inhibition zone (mm) including disk diameter of 9 mm			
		<i>Alcaligenes faecalis</i>	<i>Listeria innocua</i>	<i>Aeromonas hydrophila</i>	<i>Enterobacter gergoviae</i>
<i>S. chamaecyparissus</i>	2	N.A.	N.A.	N.A.	N.A.
	5	N.A.	N.A.	N.A.	N.A.
	10	11.50±0.71‡	N.A.	N.A.	N.A.
	20	14.00±0.00	N.A.	10.00±0.00	N.A.
	40	16.50±0.71	12.70±0.20	16.50±0.71	N.A.
<i>S. angustifolia</i>	2	N.A.	N.A.	N.A.	N.A.
	5	N.A.	N.A.	N.A.	N.A.
	10	12.00±0.00	N.A.	N.A.	N.A.
	20	14.00±0.00	N.A.	N.A.	N.A.
	40	18.00±0.00	12.10±0.10	11.00±0.00	N.A.

‡ (mean and SD). N.A., non-active

S. Chamaecyparissus and *S. angustifolia* essential oils can be used as antibacterial agents, being the main reason for their suitability, their natural origin, which consumers find comforting.

Key words: essentials oils, *Santolina chamaecyparissus*, *Sideritis angustifolia*, food spoilage, bacteria

This work was financially supported by CajaMurcia.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Salejda A.M., Krasnowska G.

**ANALYSIS OF CONSUMER PREFERENCES
FOR FOOD PRODUCTS AVAILABLE ON THE LOCAL MARKET**

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Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

The objective of the study was to collect data related to consumer preferences in respect of food products available on the local market. Undertaken analysis provided knowledge about most popular groups of foodstuff, places, costs and frequency of purchase.

The research was conducted with the method of questionnaire. To identify any drawbacks that might occurred while it elaborating the pilot study on 20 respondents was conducted. The survey was composed of three parts: first part included title and short instruction, essential part with 7 closed-ended questions and third part with questions about personal details of respondents. On the surveyed population contributed 302 residents of Lower Silesia more than 17 years old (164 women and 138 men).

The analysis of the responses given showed that most of respondents appeared to buy foodstuff daily or 2–3 times a week (34.11%). Only ever twelfth asked person declared to do shopping once a week. In this study gender was the main factor affected frequency of purchase. The most frequently purchased group of food products were baker's goods. Apart from bread the most popular groups of products were: dairy, vegetables and fruits also processed meat products. Respectively 88.08, 80.46 and 68.78% of questioned declared to buy these products. Snacks and spirit beverages were purchased most rarely. The selection and purchase of particular food products was strictly related to consumer's age. In conducted survey respondents marked department store (52.65%) and shops in housing estate area (39.40%) as most frequent places of buying groceries. Most rarely place of purchase were market place (4.97%) and hypermarket (5.63%). Most of respondents supplied with food products daily or 4 to 6 times a week (all 50%) and almost 69% of respondents spent to 30 min daily doing shopping. More than 70% of questioned declared to intended for buying foodstuff more than 100 zł per week. The survey research enabled to collect valuable data about consumer behavior on food market.

Key words: consumer preferences, food market

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Wrocław 19–20 September 2011**

**Sánchez-Zapata E., Zunino V., Fuentes-Zaragoza F., Viuda-Martos M.,
Sayas E., Sendra E., Pérez-Alvarez J.A., Fernández-López, J.**

**EFFECT OF TIGER NUT FIBRE ADDITION ON THE QUALITY
OF A SPANISH DRY-CURED PORK SAUSAGE ("CHORIZO")**

IPOA Research Group (UMH-1 and REVIV-Generalitat Valenciana). AgroFood Technology Department. Escuela Politécnica Superior de Orihuela. Miguel Hernández University. Orihuela, Alicante Spain

There is a growing interest in the revalorization of by-products from the food industry. By-products from tiger nuts (*Cyperus esculentus*) milk production are a suitable fibre source. Tiger nut fibre (TNF) has a high proportion of total dietary fibre (TDF: 59.71g/100g), composed mainly of insoluble dietary fibre (IDF: 99.8%). "Chorizo" is the most popular meat dry-cured product in Spain, which is appreciated for its colour, aroma and flavour. These characteristics are a result of the manufacturing process and, particularly, the addition of paprika, a spice widely used in the Spanish meat industry. The aim of this work was to study the effect of the tiger nut fibre addition (5 and 7.5%) on the quality (composition, physicochemical properties and oxidation) of a Spanish dry-cured sausage. No significant differences ($p < 0.05$) were observed in the protein and ash content of the different sausages. However TNF addition decreased fat and increased moisture content. The addition of 5 and 7.5% TNF significantly increased ($p < 0.05$) the TDF content of "Chorizo" from 1.46 ± 0.03 (control) to 4.56 ± 0.01 (5% TNF) and 6.18 ± 0.07 (7.5% TNF), resulting in a product with high fibre content. Weight loss during dry-curing process was lower in the "Chorizo" containing TNF, probably because the TNF retains water. TBARS showed no differences ($p > 0.05$) for TNF concentration. TNF addition increased the water activity, while decreased pH. Lightness (L^*), yellowness (b^*) and redness index (a^*/b^*) were significantly ($p < 0.05$) affected by the fibre content, but redness (a^*) wasn't. The addition of 5% and 7.5% TNF to "Chorizo" provides a rich fibre and healthier product, without significant changes in the physicochemical properties which allow maintaining its traditional characteristics and quality.

Key words: tiger nut fiber, pork sausage, quality

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Sanny M.^{1,2}, Jinap S.², Bakker E.J.³, van Boekel M.A.J.S.¹, Luning, P.A.¹

**ASSESSMENT OF VARIATION IN ACRYLAMIDE CONCENTRATION
IN FRENCH FRIES PREPARED
IN FOOD SERVICE ESTABLISHMENTS USING
THE TECHNO-MANAGERIAL APPROACH**

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Dietary intake studies observe significant variations in acrylamide concentrations, a probable human carcinogen. The objectives of this research were to identify the technological and people related factors as well as to quantify their contribution to the variation in acrylamide concentration in French fries prepared under typical conditions in food service establishment (FSE). A techno-managerial approach was used to support a systematic analysis of literature that gave both qualitatively and quantitatively insight in the mechanisms, factors and conditions affecting the variation in acrylamide concentration. In an observational study, besides acrylamide, frying time, frying temperature, and reducing sugars were measured and the actual practices at receiving, thawing and frying during the preparation of French fries were observed and recorded. The literature study identified the variation in initial concentrations of reducing sugars and the variable frying conditions (time-temperature) as the major technological factors influencing the variation in acrylamide concentration. Food handler's inadequate control on these factors in their daily practice could lead to the large variation and high acrylamide concentrations in French fries. The observational study found that the variation in actual frying temperature contributed most to the variation in acrylamide concentrations, followed by the variation in actual frying time; no obvious effect for reducing sugars. The lack of standardised control of frying temperature and frying time (due to inadequate frying equipment) and the variable practices of food handlers seem to contribute most to the large variation and high acrylamide concentrations in French fries prepared in the restaurant type of FSE as compared to the chain fast-food services, and the institutional caterers. The obtained insights can be used for the development of dedicated quality control measures at FSE, which may contribute to a sustainable reduction in acrylamide intake.

Key words: A techno-managerial approach, Acrylamide, Variation, French fries, Food service establishments, Control measures

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Wrocław 19–20 September 2011**

Semeriak K., Ambrozik-Haba J., Platek M., Zimoch A., Jarmoluk A.

**THE EFFECT OF SELECTED PLASTICIZERS
ON STRENGTH PROPERTIES OF EDIBLE FILMS**

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Wrocław University of Environmental and Life Sciences, Wrocław, Poland*

The aim of this work was to determine the influence of plasticizers (glycerol, polyethylene glycol, sorbitol) on mechanical properties of hydrocolloid – based protective coatings.

Experiment was executed according to bifactor model, by assumption: three different concentrations hydroxypropyl methyl cellulose 100 (HPMC 100), carrageen (0, 1, 2%) and plasticizer (1, 1.4, 2%). Mechanical properties were analyzed on samples, which were 15 mm long and 7 mm wide. Film penetration and tensile strength tests were investigated using Zwick Roel Z010. Results were statistically analysed using Statistica 6.0.

Research showed that increase concentration of HPMC reduces max value of force puncture (F_{maxp}) and tensile strength (F_{maxw}). Protective coating containing hydrocolloids and PEG 400 is presented the lowest puncture force as well as the highest elongation in tensile strength test. Films with 1% of glycerol without HPMC had the best mechanical properties.

Key words: glycerol, polyethylene glycol, sorbitol, mechanical properties, hydrocolloid coating

This work was financially supported by development project No. N R12 0079 06/2009 "Opracowanie metody poprawy jakości i bezpieczeństwa żywnościowego chłodniczo przechowywanego mięsa", funded by NCBiR.

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Semeriak K., Jarmoluk A., Ambrozik-Haba J., Zimoch A.

**USES OF COLOUR DISPERSION PRODUCED
WITH CARBOXYHEMOGLOBIN ADDITION**

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Colour stability of meat covered with hydrosols based on haemolysis erythrocytes treated with carbon monoxide (CO) and antioxidants: BHA (100, 150 and 200 ppm) and rosemary extract (250, 500 and 1000 ppm) was studied. Storage stability, emulsion stability, emulsifying activity, viscosity and pH were determined in hydrosols after 0, 5, 10 and 15 days of storage. Samples of loin were covered by hydrozoles, vacuum packed and stored in 4°C. Instrumental evaluation of colour parameters (CIE L*a*b*), haem pigments content (all myoglobin form - OxyMb, COMb, DeoMb, MetMb; Warris's method) and depth penetration of carbon monoxide in meat was conducted after 0, 5, 10 and 15 days of storage. Antioxidant activity was measured as thiobarbituric acid reactive substances (TBARS). Meat covered by experimental hydrozols presented a redder color and lower values of lightness L* during 15 days of storage time. The penetration depth of hydrosols in experimental meat reached 13.69 mm after 5 days of storage. The mean concentration of carboxymyoglobin in sample with 150 ppm BHA and 1000 ppm rosemary extract was 0.81 mg/g.

Key words: colour stability of meat, hydrosols, carbon monoxide, BHA, rosemary extract

This work was financially supported by research project No N N312 214536 "Wykorzystanie tlenku węgla i antyoksydantów do stabilizacji barwy chłodniczo przechowywanego mięsa" funded by MNiSW.

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**Sieпка E.¹, Bobak Ł.¹, Gładkowski W.², Kosmalski B.¹, Eckert E.¹,
Trziszka T.¹**

**EGG YOLK OF GREENLEG PARTRIDGE LAYERS
AS A SOURCE OF PHOSPHOLIPIDS**

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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 could be used as diet supplements and for biomedical applications.

The egg yolk contains several lipid fractions showing health-promoting effects. Fatty acids have to be mentioned as important class of nutrients for human consumption. Phospholipids fraction, especially lecithin derived from egg yolk, has a very high nutritional and medical value and is also a good emulsifier.

The chemical extraction of phospholipids from egg yolk using ethanol and purification of the obtained extracts using acetone have been well known for several years. In this study, the application of optimized parameters of the purification of extracts obtained from egg yolk was connected with using cold acetone.

The aim of the study was to characterize and compare the content of basic groups of phospholipids and fatty acids composition of phospholipids of egg yolk (obtained from Greenleg Partridge egg yolk), as well as phospholipids fraction content assay and acid value of this fraction in experimental and control fractions.

The phospholipids extracted from enriched eggs were characterized by a high content of omega – 3 (7.3%) and omega – 6 fatty acids (14.25%) as well as preferred ratio of omega – 6 to omega – 3 fatty acids at the level of 1.9.

Proper feeding of layers significantly affects the profile of fatty acids in the phospholipid fraction.

Key words: phospholipids, fatty acids, egg yolk

Project "Innovative technologies of production of biopreparations based on new generation eggs" Innovative Economy Operational Programme Priority 1.3.1, thematic area "Bio" co-financed by European Union through European Regional Development Fund within the Innovative Economy Operational Programme, 2007–2013.

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on the
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Skiba M.¹, Oziemblowski M.², Skiba T.²

**ANALYSES OF BIOLOGICALLY ACTIVE COMPONENTS
IN ECOLOGICAL EGGS**

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Activity of biological components of egg white from hens breeding in ecological and farm conditions was examined. These ingredients in egg white are enzymes and other substances which inhibit microorganisms development. The most important are: cystatine (cysteine proteinase inhibitor), ovomucoid (serine protease inhibitor) and lysozyme as enzyme responsible for breaking down the polysaccharide walls of many kinds of bacteria and thus it provides some protection against infection. In the literature it is often point out the lithical ability of lysozyme depending on environmental and genetically conditions, as well as breeding system (litter or free range).

The research showed that the antipapin activity of cystatine was significantly higher in egg white from native race hens Greenleg Pertrage (GP) in relation to conventionally breed Lohmann Brown (LB) birds. Value of cystatine inhibitor activity in ecological eggs was 11–12 units/3mg of egg white. The activity of lysozyme was statistically significant and varied from 678 units in LB to 1252 units in GP egg-white group. In own studies also better ability to inhibit enzymes of trypsin was presented in eggs from ecological farm. Antitrypsin activity of ovomucoids in GP (17,7 units/mg of egg white) was almost twice as high as examined in LB eggs (9.2 units/mg of egg white).

Egg white from native race hens Greenleg Pertrage has a great beneficial activity. Own studies showed that the genetic diversity and the system of the breeding influenced significantly on biological activity of lysozyme, cystatine and ovomucoid.

Key words: cystatine, ovomucoid, lysozyme, biological activity, eggs

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"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Skolik A.

ASSESSMENT OF THE TASTE OF SELECTED COMPOUNDS

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The study was aimed to assess selected compounds by means of taste senses applied as measurement means, with observance of appropriate conditions of assessment and requirements, concerning the persons conducting it and use of methods adequate to the task determined in the assessment.

In order to determine sensory sensitivity of the candidates the tests were conducted on the assessing persons: with respect to taste daltonism; the thresholds of taste sensitivity and thresholds of variance were determined.

The group of 15 persons was selected to tests, of which appropriate group was selected, so called "chosen assessing persons", that is the team of 10 persons, who in consideration of their special abilities within the scope of conducting organoleptic assessments created so called sensory panel, distinguishing itself with appropriate constancy of assessments and taste memory.

On the basis of this professional team of persons, the organoleptic assessment of selected compounds was conducted with respect to intensity of bitter taste.

Various compounds were used for tests, of the same concentration over the threshold level, which were appropriately numbered and coded. The task of selected assessing persons was to place examined samples in accordance with the increasing degree of bitterness.

The obtained results of assessment presented initially, which compounds among those selected distinguished themselves with intensity of bitter taste and allowed to use them to further tests on chemoreception of bitter taste and shaping of molecular matrix of the bitter taste receptor.

Key words: organoleptic assessment, taste, bitterness

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Sokolowicz Z.¹, Krawczyk J.²

**QUALITY OF EGG FROM HERITAGE BREED HENS KEPT
UNDER FREE-RANGE CONDITIONS**

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The aim of this study was to test the hypothesis that similarly to hens of the native Greenleg Partridge and Yellowleg Partridge hens, Leghorn (G-99), Rhode Island Red (R-11) and Sussex (S-66) layers are suited for free-range systems and lay better quality eggs under free-range compared to indoor conditions.

This study analysed eggs obtained from Leghorn (G-99), Rhode Island Red (R-11) and Sussex (S-66) laying hens, which are kept *in situ* as a gene bank at an Experimental Farm of the National Research Institute of Animal Production in Poland.

At 18 weeks of age, 120 layers of each breed/line were assigned to 2 groups, which were kept in different systems. Sixty layers of each breed were kept on litter in a windowless poultry house without outdoor access (LF) at a stocking density of 5 birds/m², and 60 layers of each breed were kept on litter with outdoor access (FR) at a stocking density of 9 m² per hen. The lighting programme was 16 h light and 8 h dark (16L: 8D). Hens received a complete diet *ad libitum* in the indoor system and a farm-produced feed in the free-range system.

The material used in this study consisted of 180 eggs (30 eggs from each group) collected when laying hens were 44 weeks old. Eggshell strength was determined using an Instron tensile tester. Egg quality traits, i.e. egg weight, shell colour, density and thickness, yolk weight, albumen height, Haugh units and yolk colour (Roche scale points) were measured using the EQM system (TSS).

Compared to the litter system with outdoor access, the egg production of free-range hens of the analysed breeds (during the period from 20 to 56 weeks of age) was lower at 56.3% for Leghorn (G-99), 58.3% for Rhode Island Red (R-11), and 49.5% for Sussex hens (S-66). The smallest difference in the course of egg production between litter-reared hens without outdoor access and free-range hens was noted in Rhode Island Red hens.

In the present study, free-range hens of all breeds tended to produce eggs with lower weight. The decrease in egg weight under the free-range system was not paralleled by a decrease in yolk weight, which caused egg yolk percentage to be higher in the free-range system.

In G99 free-range hens, eggshell weight was lower than in hens raised in confinement. Free-range hens of the other breeds laid eggs with similar shell thickness, shell density and breaking strength.

Hens raised with outdoor access produced eggs with more intensive yolk colour, which was confirmed statistically for the R-11 line.

In our opinion, of the analysed breeds/lines R-11 hens are best suited for free-range rearing because they reduce their productivity to a lower extent than other breeds when exposed to free-range conditions. Under the free-range system, the physical characteristics of their eggs did not change for the worse.

Key words: eggs, hens, quality

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on the
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Wrocław 19–20 September 2011**

Spychaj A.¹, Szalata M.^{2,3}, Słomski R.^{2,3}, Pospiech E.^{1,4}

**IDENTIFICATION OF PORK FROM MEAT OF OTHER SPECIES
EMPLOYING THE CYTOCHROME OXIDASE SUBUNIT I**

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The purpose of the study was to examine the utility of the cytochrome oxidase subunit I for identification of pork and to distinguish it from meat of other species, which are often offered on the market. Nucleotide sequences of the cytochrome oxidase subunits I (COI) are well known and available in GenBank. Moreover, cytochrome oxidase subunit I is used for examination of global biodiversity in DNA barcoding method.

The fragment of the cytochrome oxidase subunit I (mtDNA) was employed to design species specific primers, which as a set were used to detect pork. This primers set was tested on DNA not only from pig (*Sus scrofa f. domestica*) but also from cattle (*Bos taurus*) chicken (*Gallus Gallus*), duck (*Anas platyrhynchos f. domestica*) and turkey (*Meleagris gallopavo*) to exclude any cross reactions. DNA for the experiment was extracted from raw muscle tissue using the proteinase K method. Species specific primers for detection of pork (SSCOIF11: GGAGCAGTGTTCGCCATTAT and SSCOIR11: TTCTCGTTTTGATGCGAATG) were designed on the base of the sequence from GenBank (AF 034253) with the help of the program located at http://biotools.umassmed.edu/bioapps/primer3_www.cgi website and synthesized by TIB MOLBIOL. PCR was performed in total volume of 20 µl. The reaction mixture contained 100 ng of DNA, 10x PCR Buffer, 1 µM each primers, 0.25 mM dNTP and 0.03 units of Taq DNA Polimerase. Following conditions for PCR were used: initial denaturation at 95°C for 9 min, denaturation at 94°C for 60 s, annealing at 59°C for 60 s, extension at 72°C for 180 s. 30 cycles of amplification were carried out followed by final extension for 10 min at 72°C. The obtained PCR products were separated in 1.5% agarose gel (13x15 cm) with 0,003% ethidium bromide for 45 min at 100 V. To identify PCR product size, the size marker 100 bp Low Ladder was used, and the results were observed on transilluminator G – Box.

The obtained data indicate that primers pair designed on the basis of the cytochrome oxidase subunit I yielded 294 bp PCR products in reaction with pig DNA and as a rule no reaction with DNA from the other species.

Key words: cytochrome oxidase subunit I, pork meat, identification, DNA

This work was financially supported by Grant N N312 205636 from Polish Ministry of Science and Higher Education.

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on the
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Spychaj R.¹, Gil Z.¹, Kaluza B.¹, Bojarczuk J.², Figiel A.³

**POLISH DURUM WHEAT AS A RAW MATERIAL
FOR PASTA PRODUCTION**

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The aim of this research was to estimate the technological value of 19 new lines of winter durum wheat obtained from Polish breeding by Plant Breeding in Smolice (IHAR Group), harvested in 2008.

The grain was evaluated with regard to its physical and milling properties. Next, chemical features of flour were determined (ash, total protein, carotenoids). The properties of protein complex were determined on the basis of the amount of wet gluten and its deliquescence and farinographic curve. Sedimentation tests (Zeleny, SDS) were also carried out. The properties of amylolytic-starch complex were evaluated by measuring starch content, degree of starch damage and amylographic features. The content of carotenoid pigment and colour of flour and pasta by L* and b* dimension (CIE L*a*b*) was also determined. Pasta was exposed to a three point bending test on Instron 5566 and cooking quality was determined (minimal cooking time, cooking index and cooking loss).

Statistical analysis of the obtained results was carried out in Statistica ver. 9.0. It included calculating the mean, standard deviation, coefficient of variation and correlation coefficient between physical and milling properties of grain, quality features of flour and farinographic and amylographic features, the colour of flour and pasta, the blackening susceptibility of dough and the cooking qualities of pasta.

Durum wheat from Polish breeding characterised with high virtuosity (90%), uniformity (79.1 %) and hardness of grain (16.4%). The milling process gave a little amount of breaking flour (8.6 %) and large amount of middlings (57.5%) with high level of its reduction (89.2%).

The obtained flour contained 0.66% of ash, 10.8% of protein and 30.5% of wet gluten (deliquescence 10 mm). The flour also characterised with a high level of carotenoid pigment (up to 0.559 mg%) and high level of starch damage (reached up to 16.24%).

There was little variability of material with respect to amylographic and farinographic features. The biggest difference was detected in maximal viscosity (400–1400 AU) and softening of dough (90–170 FU).

The flour and pasta obtained from it characterized with little variability of both dimension of colour. The pasta also characterized with little variability in terms of force detected in the three point bending test, and cooking quality excluding minimal cooking time (390–540 s).

Many significant correlations between the features of grain, flour and pasta were noted. Importantly, among the calculated coefficients a negative correlation between cooking loss and content of protein in grain and flour and wet gluten was observed. A negative correlation between both sedimentation tests and softening of dough was also noted. Dimension b^* of flour and pasta was positively correlated with carotenoid pigment and negatively with starch damage and milling properties of grain.

Key words: winter durum wheat, pasta, physical and milling properties

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on the
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Wrocław 19–20 September 2011**

Stachelska M.A., Jakubczak A., Więtczak B., Tyl S.

**APPLICATION OF PHENOLIC ACIDS FOR ELIMINATION
OF *ESCHERICHIA COLI* O157:H7 FROM MEAT**

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Phenolic acids and their salts play a role of antioxidant as well as antimicrobial agents. They appear mainly in fruits, vegetables, wines, teas and cereals. The aim of this research was to assess the antibacterial activity of lithium, sodium and potassium salts of cinnamic, *p*-coumaric, caffeic and ferulic acids against *Escherichia coli* O157:H7 ATCC 8739 as well as to evaluate their lowest minimum inhibitory concentrations (MICs). *E. coli* O157:H7 is known to be a pathogen responsible for production of verotoxins evoking hemorrhagic diarrhea at people. There is a strong requirement to develop the effective natural methods which may eliminate a risk of *E. coli* O157:H7 appearance in food, particularly in meat products. The 1, 2, 3, 4 and 5% solutions of each salt were prepared. Agar-well diffusion method was used for carrying out the experiment. The Columbia agar Petri dishes were incubated at 35°C for 24 h. At the end of the incubation period, inhibition zones were measured in millimeters. The findings showed that lithium, sodium and potassium salts of cinnamic acid possessed the highest inhibitory activity against *E. coli* O157:H7, while sodium and potassium salts of *p*-coumaric acid were less effective, and a lithium salt of *p*-coumaric acid, as well as lithium, sodium and potassium salts of caffeic and ferulic acids did not show any antimicrobial activity. The salts of phenolic acids characterized by different chemical structure possessed various inhibitory features against *E. coli* O157:H7. Such results clearly prove that phenolic acids and their salts may be a potential natural alternative for chemical food preservation.

Key words: *Escherichia coli* O157:H7, antimicrobial activity, phenolic salts

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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Staniewska K.

**DAIRY PRODUCTS PACKAGES SERVING
AS AN INFORMATION TRANSMITTER, SHAPING
THE CONSUMERS' DIETARY BEHAVIOUR**

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The aim of this paper was to analyse the occurrence and correctness of nutrition and health claims found on dairy products packages. The evaluation of dietary labelling the dairy products packages was conducted on the basis of data gathered by means of the forms, which were prepared earlier. The nutrition facts labels provided by the producer were particularly taken into account. The conducted research enabled to assess to what degree nutrition and health claims were placed on the packages, which types of those were used most frequently, whether they were correctly formulated and did not mislead consumers.

The research revealed that many of the dairy products packages available on the market contain nutrition and health claims. Nutrition claims are placed in accordance with binding legal regulations. However, many dairy products packages are labelled with health claims that are not supported by appropriate research due to a dearth of the final list of those. The use of the wrong form of health claims is possible because of the transition period. Another important aspect is to include advertising slogans that suggest the specific characteristics of the products. The usage of such contents and pictures is very often an incorrect procedure, as it does not meet legal requirements and can imply false product characteristics, particularly in terms of their impact on health and well-being.

The situation of food labelling has been improved in the course of time, however, a misuse of certain contents can be easily detected on some packages.

Key words: nutrition, diet, health, dairy products

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on the
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Staniewska K.¹, Panfil-Kuncewicz H.², Mieczkowska M.²

**THE ROLE OF FOOD PRODUCT LABELING
IN SHAPING CONSUMER CHOICES
AND NUTRITIONAL KNOWLEDGE**

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*² Department of Dairy Science and Quality Management,
University of Warmia and Mazury in Olsztyn, Olsztyn, Poland*

The discussed survey investigated the role of food label information in raising the consumers' awareness about nutrition. The objective of the study was to determine the respondents' comprehension of the information printed on food product packaging and to evaluate its effect on consumer awareness and nutritional knowledge.

The described study was a focus group interview. The responders were divided into three groups, and each group attended an hourly interview conducted based on a survey script. The respondents were selected by random purposive sampling.

The results of this study suggest that consumers rely on the following sources of food and nutritional information: television, printed media, the Internet, advertising leaflets, friends and family. According to the majority of respondents, packaging labels are the most comprehensive source of nutritional information for consumers. In addition to the price, the respondents attached the greatest importance to the product's best before/durable life date, brand name, list of ingredients and nutritional value.

Key words: product labeling, consumer choices, nutritional value

This work was financially supported by the Ministry of Science and High Education. Project N 312306135.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Steinka I., Kukulowicz A.

**EFFECT OF A MIXING KIND TEA AND *KALANCHOE*
ON GROWTH OF *STAPHYLOCOCCUS AUREUS***

*Department of Commodity and Cargo Science,
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The aim of the study was to assess the impact of mixing infusion of tea, *Kalanchoe sp* and citrus fruits on the growth of *Staphylococcus faecalis*. The samples included infusions of black, green, red, and white tea with the addition of *Kalanchoe sp*. The study used *Staphylococcus aureus* ATCC 23934. Two types of infusions were prepared: first with the addition of *Kalanchoe*, and second with the addition of *Kalanchoe* and citric acid. Tea infusions and *Kalanchoe sp*. were mixed in the following proportions: 1:1:1:0,25. The results showed that the prepared mixtures had similar degree of biostatic activity of the bacteria tested.

The maximum decrease in the count of *Staphylococcus aureus* by 4.02 log CFU/ml was observed for contact of infusion with bacteria in the ratio of 200:1. The decrease in the count of bacteria depended on the ratio between staph and infusion. Reduction of *Staphylococcus aureus* count ranged from 1.08 log CFU/ml to 4.02 log CFU/ml. The degree of reduction of staphylococci differed only slightly for different contact duration: 30, 60, and 120 minutes. The observed reduction in the count of staphylococci was 0.30–0.57 log CFU ml higher for the longest time of incubation of bacteria with the infusions. Addition of citric acid resulted in lower degree of inhibition of *Staphylococcus aureus* compared to the inhibition by the infusions without the acid. The difference was significant only at the lowest concentration of the infusion.

To conclude, the effects of infusions were more dependent on their concentration than duration of the activity. Citric acid did not stimulate the inhibition of staphylococci.

Key words: tea, *Kalanchoe sp*, citrus fruits, *Staphylococcus faecalis*

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Stuper K., Matysiak A., Perkowski J.

**CONCENTRATION OF MYCOTOXINS
IN WHEAT GRAIN COLLECTED
FROM WIELKOPOLSKA REGION AND DURING STORAGE
IN DIFFERENT CONDITIONS**

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Microscopic fungi are major pathogenic microorganisms affecting quality of cereal products. Their toxic secondary metabolites, called mycotoxins, may have a significant effect on the quality of grain. Wheat is a key factor enabling the emergence of city-based societies, it was one of the first crops that could be easily cultivated on a large scale, and had the additional advantage of yielding a harvest that provides long-term storage of food. The aim of these investigations was to determine level of concentration of ergosterol, count of CFU (colony forming units) and mycotoxins from trichothecenes group in wheat samples collected from Wielkopolska region from individual farms in 2006–2008 and during storage in different conditions of temperature and humidity. Experiments conducted in the years 2006–2008 showed that wheat grain contamination with fungi and their metabolites was slight. In the course of statistical analyses significant differences in ERG, mycotoxins and CFU contents wasn't found between samples collected in several year. The level of DON concentration admissible in the EU in non-processed grain was not exceeded in any analyzed sample. Mean concentration of ERG in wheat samples was 2,79 mg/kg, mean content of total toxins 0,030 mg/kg and mean count of CFU was 1,26 log cfu/g. Based on the conducted analysis of correlations between concentrations of ERG, total toxins and CFU level for all tested objects positive significant correlations were found between all characteristics. Higher correlation coefficients were found for the dependence of ERG concentration on total toxins, in relation to the correlation of CFU on total toxins. The model experiment consisting in the storage of cereals at different relative humidity levels and temperatures showed that growth dynamics of moulds and the formation of their toxic metabolites depend both on storage conditions and initial inoculum concentration.

Key words: ergosterol, CFU, mycotoxins, trichothecenes, wheat grain

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Stuper K.¹, Muzolf-Panek M.², Perkowski J.¹, Nawracala J.³

**COMPARISON OF ANALYTICAL METHODS OF PHENOLIC
COMPOUNDS DETERMINED IN CEREAL GRAINS**

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Increasing interest in phenolic compounds originates mainly from their antioxidant properties. Particular attention has been paid to their role as "free radical scavengers" and has provoked numerous studies into phenolic compounds in many plants, including cereals. Cereals contain a wide range of phenolic compounds, of different chemical structures, of which phenolic acids are of significance. In wheat grains, ferulic acid occurs in the highest amounts. Phenolic acids contribute not only to the sensory properties of cereal products but also to their health benefits such as anticancer or antidiabetes properties. It has been found that phenolic content in cereal products correlate positively with their antioxidant activity. Due to the content of phenolic compounds, including ferulic acid, and their biological activity cereal products may constitute an important part of human daily diet.

There are a great number of analytical methods for the determination of phenolic compounds in fruits, vegetables, and other foods, also in cereal grains. However, taking into account the sample preparation methods and the matrix diversity, this altogether causes some difficulties in the comparison of the final results. Therefore, the objective of this paper is to discuss recent results of studies on the analytical methods for the phenolic determination in food products such as cereal grains. To this end, the authors compare also various methods used for preparing and/or treating samples to determine the phenolic content in cereal grains.

Even though the absolute numbers differed, a reasonably good correlations were obtained when comparing total phenolics determined by the most widely used Folin-Ciocalteu method with the RP-HPLC and the cyclic voltammetry methods. The correlation coefficient was better for the RP-HPLC than for the cyclic voltammetry. The Folin-Ciocalteu method has the advantages of being relatively simple and fast method for phenolic quantitative determinations which basis is well understood. However, since its poor specificity the results could give high variations. Moreover, using Folin-Ciocalteu method or cyclic voltammetry only total phenolics could be determined in the samples without qualitative determination. To get better insight into the phenolic profiles liquid chromatography methods are used. HPLC combined with various detectors like PDA, UV, fluorescence detector enables to isolate, identify and determine individual phenolics in the grain products. When coupled with

mass spectrometry the determination was often made more effective. The disadvantage of the chromatographic methods could be the process of sample preparation which is often time consuming and it requires experience from the analyst. The sample preparation is of great importance in order to diminish the negative effect of the matrix. To this end different techniques are used, such as solid-phase extraction (SPE), microwave-assisted extraction (MAE) and ultrasound-assisted extraction (UAE). When choosing the technique of sample preparation not only the efficiency of extraction is taking into account but also the reduction of the solvents used as well as time and cost of the procedure.

There are a variety of analytical methods for phenolic determination in cereal grains which results in a great discrepancies of the final results comparison. Thus, further detailed research are needed.

Key words: cereal grains, phenolic acids, antioxidant activity

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Szablewski T.¹, Rudzińska M.¹, Cegielska-Radziejewska R.¹, Gornowicz E.²

**COMPARATIVE ANALYSIS OF FATTY ACIDS PROFILE
AND CHOLESTEROL CONTENT OF EGGS YOLKS
OF DIFFERENT BREEDS LAYING HENS HOUSED
IN ECOLOGICAL CONDITIONS**

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The ecological production is growing in popularity, its production system consequently included farming that is why consumers have positive judgment of its products and associate them with health and environmental benefits. However eggs are one of the primary sources of cholesterol and fatty acids in our diet.

The aim of the study was to analyze the content of fatty acids, and cholesterol in eggs collected from different breeds laying hens: Greenleg Partridge (Z-11), Yellowleg Partridge (Ż-33), Sussex (S-66), Rhode Island Red (R-11) maintained in the Rosocha Laying Hen Breeding Farm Ltd. Co., within the Experimental Station Grodziec Śląski of the National Research Institute of Animal Production. The laying birds were kept under uniform environmental and feeding conditions in accordance with ecological requirements (Commission Regulation (EC) No 889/2008 of 5 September 2008). The layers were at 38 weeks of age. The study was carried out on 20 eggs collected from each breed of layers. Lipids were extracted from homogeneous yolk samples with a mixture of methylene chloride:methanol. Fatty acids composition was determined after methylation by gas chromatography (ISO/FDIS 17059). The analysis was performed using gas chromatograph HP 5890 SII equipped in flame ionization detector and capillary column Supelcowax 10 (30 m x 0.32 mm x 0,25 µm). Separation was performed in programmed temperature conditions: from 60°C, rate 12°C/min to 200°C – hold 25 min. Fatty acid methyl esters were identified on comparison to retention times of standards. The content of cholesterol was determined, after saponification and silylation, using gas chromatograph HP 6890 equipped in flame ionization detector and capillary column DB-35MS (25 m x 0.20 mm x 0.33 µm). The oven temperature was programmed: from 100°C hold 5 min, then increased 25°C/min to 250°C and 3°C/min to 290°C hold 10 min. As an internal standard, 5 α -cholestane was used. Cholesterol was identified based on comparison of its retention time with that of authentic standard.

The results of the study showed that percentage composition of saturated fatty acids in lipids extracted from analyzed eggs ranged between 34.32 and 35.57% and monounsaturated fatty acids constituted from 48.62 to 50.38%. Lipids extracted from eggs collected from Rhode Island Red hens were characterized by the highest level of monounsaturated fatty acids. The highest concentration of polyunsaturated fatty acids was observed in lipids from Yellowleg Partridge eggs (16.03%). The highest content of cholesterol was determined in Yellowleg Partridge (14.66 mg/1g yolk) and Rhode Island Red (14.31 mg/1g yolk) egg yolk lipids, whereas the lowest in Greenleg Partridge (13.63 mg/1g yolk) and Sussex (13.90 mg/1g yolk) eggs.

Key words: eggs yolk, fatty acids, cholesterol

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Szmańko T.¹, Górecka J.¹, Malicki A.², Kęsy Z.¹, Świątkowski G.¹

**EFFECT OF PACKAGING AND STORAGE CONDITIONS
ON THE STABILITY OF MEDIUM GROUND SAUSAGES**

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The aim of the study was to evaluate stability of grill sausage, produced in industrial conditions, packed in vacuum (V) and inert gases (M). The grill sausage was kept in low temperature conditions /3°C/ (3V, 3M), or in a state at near cryoscopic temperature /-3°C/ (-3V,-3M) for 7, 14, 21 and 28 days. In the samples which were not stored (control samples) and in stored products it was analyzed: pH, free amino groups, acid value, peroxide value and TBA value. The total microorganism count, the number of lactic acid bacteria, the yeasts and moulds, the presence of *Salmonella* bacteria, the aerobic coli form bacteria, the *Staphylococcus*, the pathogenic bacteria and the presence of spore forming bacteria were analyzed.

Over the time of storage pH of grill sausages has been decreased steadily. These changes, regardless of the type of packaging, were more dynamic in the products stored under refrigeration. From 21 days of the experiment, regardless of the experimental factors, an increase in the content of free amino groups is showed. During the storage time it was observed systematic changes in the fat content of sausages. Despite the fact that the acid value was steadily increasing but was at the safe level. The peroxide value of grill products stored in refrigerated condition has been increasing significantly, while the changes of TBA occurred with similar dynamics over the time of storage, regardless of the conditions of packaging and temperature. During the time of storage of grill sausages it had a tendency to decrease in the total microorganisms' count in experimental groups 3V,-3V,-3M. This trend was not observed in the case of grill sausages group 3M. In experimental grill sausages were not observed the growth of lactic acid bacteria, the yeasts and moulds, the presence of *Salmonella*, the aerobic coli form bacteria, the *Staphylococcus*, the pathogenic bacteria and the presence of spore forming bacteria. The highest quality is showed of grill sausages in vacuum and stored at near cryoscopic temperature.

Key words: grilled sausages, vacuum, modified atmosphere, storage

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Szmańko T., Korzeniowska M., Górecka J., Rzaśa A., Bronkowski R.

THE QUALITY OF BOAR MEAT SMOKED PRODUCTS

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The principal part utility of boars destined to production of smoked products (pork loin, collar and smoked backfat) has been evaluated. The study used meat of boars from wbp x pbz crossbred sows and wbp, pbz and Duroc boars. Fatteners were slaughtered at the age of 170 – 175 days and 85 – 100 kg body weight. The experimental population was divided into 2 groups: boars castrated on the second day of life and boars.

The principal parts used in production were: longissimus dorsi, collar and backfat. The production was carried out in laboratory conditions according to traditional low-efficiency technologies. The following indicators were analyzed: colour (pork loin, collar) determined in L*,a*,b* system. The scores were carried out using of CR 200b Minolta reflectance colorimeter. Organoleptic evaluation was carried out by six person team, according to 5 – degree scale, with use of principles given by Tilguer. Moreover, all products were evaluated with regard to intensity of sex odour and taste. Three levels of the a/m indicators were adopted: B – no boar taint (taste); N – boar taint (taste) at non-disqualifying intensity; D – boar taint (taste) at disqualifying intensity.

The products made from boar and hog parts were characterized by similar organoleptic evaluation results. Boar taint and taste was sporadically presented in smoked products made from both boar and hog meat.

Key words: boars, smoked meat products, quality of processed products

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**Szoltysik M., Dąbrowska A., Pokora M., Niedbalska J., Drozdowska K.,
Chrzanowska J.**

**THE EFFECT OF REFRIDGERATING STOTAGE
ON THE AROMA COMPOUNDS CONTENT IN MILK PROTEINS
AND FAT HYDROLYZATES PRESERVED BY SUBLIMATION**

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The aim of the research was the evaluation of refridgerating storage of aroma preparations on their volatile compounds content.

The analyzed preparations were obtained by hydrolytic degradation of paracasein curd of 3.2 and 6% fat milk. The hydrolysis was performed with non-commercial enzymes – extracellular hydrolazes of yeast *Yarrowia lipolytica*. Enzymatic degradation of paracasein was performed in 25 and 35°C for 48 hours. The obtained preparations were dried by sublimation and stored in 4°C for 4 weeks. In samples, which were taken just after drying (week 0) and on 2nd and 4th week of storage, the level of volatile compounds was analyzed on GS/MS. The extraction of analyzed substances was carried out by the SPME technique. Chromatographic separation was performed using Agilent Technologies column (100m x 0,25µm x 250 µm) with temperature gradient from 40°C for 5 min. to 240°C (4°C/min.) split 1:1 on Agilent Technologies gas chromatograph coupled with mass spectrometer (GC/MS method). The tentative identification of volatile compounds was based on comparative analysis of determined mass spectrum and MS from spectrum commercial library NIST and by comparison with retention time of standards.

It was shown that in all analyzed aroma preparations the main group of detected compounds were short- and medium chain, like butyric, capronic, caprylic, laurylic and mirystic acid. Their content in all identified substances was form 43 to 67% depending on the analyzed hydrolyzate. The highest concentration of those substances was determined in hydrolyzates obtained with the use of 6% fat milk and at incubation temperature of 35°C. The analysis of the influence of refrigerating storage on the content of detected compounds showed, that the their amount was storage-dependent, after 4 weeks of storage their concentration was about 16% lower in comparison to samples taken at week 0. The biggest differences were determined for butyric, capronic and caprylic acids.

Key words: aroma compounds, milk proteins, milk hydrolyzates, sublimation, *Yarrowia lipolytica*

This work was financially supported by the Ministry of Science and High Education. Project N N31221 3036.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Tichoniuk M., Ligaj M., Gwiazdowska D., Filipiak M.

**APPLICATION OF ELECTROCHEMICAL DNA HYBRIDIZATION
BIOSENSORS IN FOOD ANALYSIS**

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DNA hybridization biosensors are devices attempted to apply in identification of nucleic acid fragments typical for selected food components (e.g. genetically modified additives) or indicating food pollution such as microbial or pathogenic one. Recognition event relies on specific interaction between target nucleic acid sequences and complementary DNA probes immobilized in sensor detection layer. Electrochemical systems of hybridization monitoring provide promising attitude in biosensors' development in relation to its abilities in fast, un-complicated and inexpensive application.

Although idea of biosensors' construction is quite simple there are some critical points in these devices preparation and their application in food sample analysis. Crucial role plays a proper selection of DNA probes sequence that must be highly specific for selected nucleic acid fragments. Equally important is construction of biosensor detection layer that should enable effective hybridization with target nucleic acid. Reliable monitoring system of DNA duplex formation is also often connected with application of additional electrochemical, immunological or enzymatic indicators. Detection of specific nucleic acid fragment via hybridization biosensor is as well frequently supported by DNA amplification using polymerase chain reaction techniques.

Most common application of electrochemical DNA hybridization biosensor in food analysis is connected with the identification of nucleic acid fragments typical for genetically modified (GM) organisms. In our work we constructed a sensor for the detection of DNA fragments specific for *bar* gene, P35S promoter or *Tnos* terminator fragments that are widely applied in GM-plants (e.g. RoundupReady soybean, BT-maize). The biosensor recognition layer was performed using chemical modification of working electrode surface (either gold or carbon paste electrodes) and covalent immobilization of DNA probes. Hybridization recognition based on voltammetric measurements of electroactive indicators (cobalt bipyridine complex, methylene blue) that selectively bind to single- and double-stranded DNA.

DNA hybridization biosensors are also employed in detection of nucleic acid fragments typical for foodborne pathogens. Our last research work focused on preparation of electrochemical sensor for identification of DNA fragments specific for aerolysin gene, toxin secreted by *Aeromonas hydrophila* bacteria. This opportunistic pathogen could easily colonize low-proceeded foods stored in refrigerating conditions. The biosensor construction relied on

chemical modification of gold working electrodes with self-assembled monolayer of thiolated DNA probes and 6-mercaptohexanol compounds. Hybridization results were evaluated by voltammetric measurements of methylene blue accumulated in sensor detection layer. The successful differentiation between DNA samples isolated from water contaminated via *A. hydrophila* and other bacteria was accomplished. The further work on application of performed biosensor for determination of microbial contamination by *A. hydrophila* bacteria in food products is now in progress.

Key words: DNA, hybridization, biosensor, nucleic acids

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Timoracká M., Vollmannová A.

**ISOFLAVONS COMPOSITION VARIABILITY OF SOYBEAN
IN RELATION TO THE GROWN LOCALITY
AND STORAGE DURATION UNDER NATURAL CONDITIONS**

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The work goal was the content of two isoflavons (daidzein and genistein) determination in soybean. The legumes samples came from slovak producers from different localities of Slovakia. For information completing the agrochemical characteristics were determined and evaluated within the soil hygiene of soil samples from parcels, on which soybean were cultivated. In many cases, enhanced reference values were defined for background element concentration in soil, not very markedly, but the total contents of all monitored risky elements did not reach in any case indicative limit value for soil contamination.

From quantitative analysis of isoflavons it results that their content is variable dependent from variety. In soybean seeds, isoflavons have the dominant post, whilst daidzein formed the greatest deal of all total polyphenols content. The gained results suggest the variety dependence, as well as the locality influence on these compounds forming. Also the changes in content of chosen isoflavons in material in the dependence on variety and on the period of stored in natural conditions were surveyed. From the results it came out that in period interval 6–9 month the content of all observed isoflavons declined in dry material.

Key words: daidzein, genistein, soybean

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Tomsone L., Kruma Z.

**EVALUATION OF TOTAL PHENOLS AND ANTIRADICAL
ACTIVITY OF GROUND-ELDER, CHICKWEED, GOOSEFOOT
AND DANDELION GROWN IN LATVIA**

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Latvian flora is rich in wide range of medical plants, but some of them are recognized as weed (ground-elder, chickweed). Active compounds of plants have positive effect to both human health and food quality. Phenolic compounds of plant origin have attracted considerable attention due to their beneficial functional and nutritional effects including antioxidant and antimicrobial activity, furthermore polyphenols are present in almost all plants, but in various amounts.

The aim of current research was to determine total phenols and antiradical activity of several weeds (ground-elder, chickweed, goosefoot and dandelion) grown in Latvia.

For experiments four plants – ground-elder (*Aegopodium podagraria* L.), chickweed (*Stellaria media* L.), goosefoot (*Chenopodium album* L.) and dandelion leaves and flowers (*Taraxacum officinale* L.) were used. Plants were collected at different vegetative stages. For analysis fresh plants were extracted with ethanol/water solution (80:20). Total phenol content (TPC) of plant extracts was determined according to the Folin-Ciocalteu spectrophotometric method (Singleton et al., 1999) with some modifications and results were expressed as gallic acid equivalents. Antioxidant activity of the barley and malt extract were measured on the basis of scavenging activities of the stable 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical and the final results were expressed as micromoles of Trolox equivalents.

Total phenols varied among medical plants. The highest phenol content was detected in ground-elder, followed by dandelion leaves and flowers. Whereas the lowest content of TPC in goosefoot were detected. The content of total phenols in plant extracts significantly depends on plant vegetative stage. All plant extracts exhibited DPPH radical scavenging activity, and the highest activity for plants with higher content of total phenols were detected.

Results showed that weeds grown in Latvia contain significant amounts of polyphenolics, show antiradical activity and they could be valorised as natural antioxidants in different food matrixes.

Key words: ground-elder, chickweed, goosefoot, dandelion, total phenols

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
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**Towarek J.¹, Kopec W.², Korzeniowska M.², Oziembłowski M.²,
Chorażyk D.², Pudło A.², Skiba T.², Biazik E.²**

**OMELET WITH STEW – NEW PRODUCT FOR GASTRONOMY –
CONCEPT AND PROTOTYPE DEVELOPMENT**

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Nowadays, gastronomy plays an important role in the nutrition and tourism, especially serving traditional or regional products. However, the most popular kind of the product distributed by gastronomy or food serving chains is fast food, which is controversial from the nutritional point of view. Thus, the innovative concept of the New Product Development (NPD) is now widely applied in searching for a new, interesting, high quality, nutritive, tasty and fast prepared but fresh products.

The aim of the study was to work out a new innovative product being an alternative to typical lunch dishes including combination of the omelet and traditional Polish meal "bigos" i.e. stew. The product should be directed to the young population (students, "yuppies") as an alternative to typical lunch meal, which is most often a kind of fast food. Moreover, it should be of high nutritive value, with middle energy input and interesting taste. Such requirements meet the idea to combine component based on eggs product (omelet) and a traditional Polish stew.

The concept of the new product was created to meet requirements for the combined product of omelet and stew with own appearance and sensory profile different from both main components. The prototype of the product was developed in four stages by the modification of a traditional omelet and stew recipes. Prototypes were then analyzed by a sensory panel consisted of 12 assessors using selected quality traits, i.e. appearance and color, texture and structure, taste as well as smell an overall acceptance of the product, with a 5-points scale. The results were statistically analyzed by using Quantitative Descriptive Analysis including Principal Component Analysis.

Sensory evaluation of the first prototype showed that the product was judged as average with the lowest among all experimental products, overall acceptability, what was connected mainly with non-harmonized taste. Prototype II i.e. omelet with stew inside the product, was characterized by slightly lower than prototype I sensory quality, but good overall appearance. Changing the kind of omelet to sponge cake type did not affect appearance, taste and smell in relation to prototypes I and II, but tendency to better scores for texture was noticed. The addition of tomato paste to the omelet recipe had the highest effect on the quality of the omelet

with stew (prototype IV). The scores exceeded 4.7 and 4.8 points for an overall acceptability and taste of the products, respectively, and they were the highest among all the prototypes. Thus, an omelet with stew as a the newly achieved product can meet the requirements for small and medium gastronomy, as well as it fulfills the concept of culinology®.

Principal component analysis (PCA), which creates clusters from analyzed traits showing a kind of "similarity", revealed that for omelet I and III one cluster was created from appearance and texture, second from taste and overall acceptance, but smell seemed not to have "similarity" to the rest of the variables. Thus, it might not be used in further evaluation of the product. In the evaluation of the prototype II all quality highlights should be applied in further evaluation during a new product development. PCA carried out for the prototype IV revealed that appearance was the only one sensory trait, which had no similarity to the rest of the selected quality highlights evaluated in the study. What can be explained by achieving a high level of appearance acceptance for newly formulated products.

It can be concluded that as the effect of the prototype testing procedure the product, which can be easily implemented to gastronomy practices was developed. The product i.e. omelet with stew was characterized by the combination of the components with own highly accepted taste and appearance, and as well it can be proposed to be introduces as lunch meal in small (bistros, bars) and middle size gastronomy (restaurants).

Key words: omelet, stew, sensory analysis

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Trafialek J., Czarniecka-Skubina E., Kolożyn-Krajewska D.

**AUDIT FOOD DEPARTMENTS BASED
ON SELECTED HEALTH CARE ESTABLISHMENTS**

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Food enterprises, including catering establishments, are obliged to implement procedures based on HACCP rules. The sixth principle of HACCP system relates to necessity of implemented system verification. For this purpose, usually the external audit is used.

The paper presents the results and comparison verification of HACCP system conducted by an external audit in 6 selected enterprises. Three hospitals and three nurseries located in the Mazowia voivodship were audited. The basis of audits were EC Regulation 852/2004 requirements and the Polish Act of food safety and nutrition, from 25 of August 2005 (Official Journal, No. 171, pos. 1225, with changes). Audits for all enterprises were conducted using the same checklists. The study in each establishment covered documentation audit and audit of the production area. During the documentation audit the functioning of the HACCP system with particular compliance of hazard analysis, identify and Critical Control Points monitoring were examined. However, during the audit of the production area, the practical functioning of the system, including the hygienic condition of the establishment, monitoring of CCP, possession and application of procedures and keeping records were assessed.

Collected results stated that the significantly less variances were identified in nurseries than in hospitals. The food department in one of hospitals was very negatively evaluated by auditors. The main variances found in all enterprises were: lack of regular records of Critical Control Points monitoring, lack of regular taking corrective actions and lack of regular reviewing of the HACCP system. Stated variances directly influence on the health safety of meals produced in the enterprises and show a lack of compliance with the requirements covered by the referenced documents. It should be underlined that the customers of these products are small children whose immune system is not fully formed, as well as the sick people with reduced immune system due to a variety of diseases and treatments, which have been treated in hospital. The auditors suggested the appropriate corrective actions, which were accepted by management of audited enterprises. The recipient of meals produced in the surveyed establishments carrying out similar audits in other establishments of this type should be considered.

Key words: HACCP system, audit, hospitals, nurseries

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Trzaskowska M., Kolożyn-Krajewska D.

**GROWTH AND SURVIVAL OF *SALMONELLA* SPP. IN DRY
FERMENTED SAUSAGES STORED UNDER REFRIGERATION**

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Dry fermented sausage used in the experiment was produced in Department of Meat Technology and Quality Management, University of Life Sciences in Lublin, from pork, backfat, and additives such as curing mix (in amount of 2.8% in a ratio of meat, containing sodium nitrate [100 mg/kg] and nitrite [150 mg/kg] for 72 hours in 2°C). The raw batter was inoculated with 2.0 ml/kg of the probiotic bacteria *Lactobacillus casei* LOCK 0900 (about 10⁹ cfu/ml). Maturation of sausages lasted 21 days.

To investigate growth and survival of *Salmonella* spp. in dry fermented sausages, product was inoculated with mixture of three strains of *Salmonella* spp. in the number average of 3.5 log cfu/g. Samples prepared in this way were stored at temperatures of 5 and 10°C. The storage time was 9 days.

The objective of this work was evaluation of survival of *Salmonella* spp. in dry fermented sausage with probiotic strain stored under refrigeration.

The number of *Salmonella* spp. was measured by plate method on Brilliant Green Agar (Merck).

In the sausage samples stored at 5 and 10°C a slow reduction of the number of *Salmonella* spp. cells after about 4 days of storage was observed. However, in the last day of storage the number of assayed microorganisms differed significantly from initial level ($p < 0.05$). This observation indicates adverse conditions for development of *Salmonella* spp.

Key words: *Salmonella* contamination, dry fermented sausage, refrigeration storage

This work was financially supported by the Ministry of Science and High Education. Project N R12 0097 06/2009 managed by prof. Stefan Ziajka.

Acknowledgements

Authors would like to thank mgr Karolina Wójciak and prof. Zbigniew Dolatowski from University of Life Sciences in Lublin for production of dry fermented sausages.

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

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**ANTI-LISTERIA ACTIVITY OF ESSENTIAL OILS OBTAINED
FROM EGYPTIAN AROMATIC PLANTS IN SKIMMED MILK
AND FULL CREAM**

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For many years, a range of different chemical and synthetic compounds have been used as antibacterial and antifungal agents to inhibit microbial food spoilage. Microbial and aroma attributes are within the most decisive factors limiting safety and sensory appealing of foods. As an alternative to synthetic compounds, several plant essential oils (EOs) constituted by volatile active compounds may provide antimicrobial potential and pleasant aroma profile. The aim of this study was to optimize the antimicrobial efficacy of plant EOs for the control of *Listeria* spp. using food model media based on skimmed milk and full cream. The EOs evaluated were obtained from oregano (*Origanum syriacum*), marjoram (*Majorna hortensis*), rosemary (*Rosmarinus officinalis*), black cumin (*Nigella sativa*) and thyme (*Thymus vulgaris*) and their inhibitory concentration effect (CE) were determined against *Listeria innocua* using the agar dilution method.

In skimmed milk the essential oils of thyme, marjoram, rosemary, black cumin, and oregano, showed inhibitory effects on *Listeria innocua*. As regards full cream none of the five EOs assayed showed antibacterial activity. Regarding the concentration effect, the inhibitory effect increased with increasing concentrations of EOs.

Spices essential oils can be used as natural antimicrobials and represent a useful alternative for the food industry to reduce the quantity of synthetic additives used.

Key words: plant essential oils, antilisteria activity, skimmed milk, full cream

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Vollmannová A., Urminská D., Ježo P., Árvay J., Harangozo L.

**SAFETY OF SOIL AND AGRICULTURAL PRODUCTION
IN VICINITY OF INDUSTRIAL ENTERPRISES
IN MIDDLE POVAZIE REGION**

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The evaluation of the soil hygiene and agricultural production from the aspect of Cd, Pb, Cu and Co contents in the chosen locality (Vrchy) of the Middle Povazie region in vicinity of three industrial enterprises (the rubber corporation, the cement mill, glass works) are aims of this work. The values of the soil reaction pH/KCl in the observed locality are in interval 3.63 – 7.06, it means that the soil was extremely acid till neutral. The Cd content (0.60 mg.kg⁻¹ – 1.06 mg.kg⁻¹) and the Co content (13.4 mg.kg⁻¹ – 24.4 mg.kg⁻¹) in soil extract by aqua regia were in both soil horizons by 6–51% and 7–63% higher than hygienic limit values given by Law 220/2004 valid in the Slovak Republic. It means, that soil contamination by Cd and Co was analytically confirmed. The legislative critical value in relationship to grown plant given by the legislative determined in soil extract of NH₄NO₃ was only for Pb soil content by 20–200% exceeded. The values are in interval 0.12 mg.kg⁻¹ – 0.30 mg.kg⁻¹. Flax grown at the observed locality contained higher amounts of Cd and Pb (by 68–100% and 30–130% respectively) in relationship to hygienic limits given by Food Codex of the Slovak Republic. The results confirm the necessity of risk metal monitoring in the soil as well as in the agricultural production in vicinity of potential pollution sources because of food chain safety assurance.

Key words: soil safety, Cd, Pb, Cu, Co content

This contribution is the result of the project implementation: Centre of excellence for white-green biotechnology, ITMS 26220120054, supported by the Research & Development Operational Programme funded by the ERDF.

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Waśkiewicz A.¹, Beszterda M.¹, Wit M.², Wakuliński W.², Goliński P.¹

**BIOSYNTHESIS OF FUMONISINS BY SELECTED ISOLATES
OF *FUSARIUM VERTICILLIOIDES***

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Fungi of the *Fusarium* genus belong to a group of the most severe pathogens of many crops, commonly producing mycotoxins – secondary metabolites with well-documented health hazard, significantly affecting food safety.

Among mycotoxins formed by *F. verticillioides* the most important are fumonisins (FB₁, FB₂, FB₃) – family of polyketide derivatives disrupting sphingolipid metabolism, by the inhibition of ceramide synthase – a process underlying the mechanism of toxicity and pathogenesis of fumonisin-related diseases. They cause different toxicological effects in both humans and animals. The feeds contaminated with fumonisins has been shown to cause a number of mycotoxicoses, including leukoencephalomalacia in horses, pulmonary oedema in swine, altered hepatic and immune function in cattle as well as liver cancer and neural tube defects in experimental rodents. FB₁ is toxic to the liver and kidneys in many species, causing apoptosis followed by mitosis in the affected tissues and it is also toxic to the cardiovascular system in pigs and horses. Epidemiological studies also suggest that fumonisins could be associated with human esophageal cancer in some regions, where maize contaminated with fumonisins is used as food. The aim of this study was to estimate fumonisins biosynthesis yield by selected *F. verticillioides* strains on the rice medium.

Fumonisin (B₁, B₂ and B₃) in purified extracts were quantified using HPLC with fluorescence detection ($\lambda_{\text{Ex}} = 335 \text{ nm}$ and $\lambda_{\text{Em}} = 440 \text{ nm}$) and C18, 3.5 μm XBridge column (3.0 x 100 mm). Fumonisin were formed by all *F. verticillioides* isolates with the highest yield for 3 of 22 isolates and the lowest level for 6 of 22 isolates. Other isolates were characterized by an average capacity of biosynthesis of these mycotoxins.

Key words: fumonisins biosynthesis yield, *Fusarium verticillioides*, rice

This work was financially supported by the Ministry of Science and High Education. Project NN 310 3769 33

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Wick Ch., Harper J.W.

SELECTED ION FLOW TUBE MASS SPECTROMETRY IN FOODS

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The analysis of food is based on identifying compounds that give rise to its functional characteristics of flavor, texture and wholesomeness. The major functional food compounds in foods include proteins and volatile organic compounds (VOCs) derived from lipids. VOC identification and quantification provide information on the organoleptic qualities of food including odors, flavors, rancidity, impacts of processing and, potentially, the source of the food. Classically these analyses have been performed using gas chromatographic separation with downstream analyses by several methods including mass spectrometry. While still valuable, these GC methods require significant sample preparation with potential loss of analytes and introduction of experimental error. Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) is a highly sensitive method, ppb and ppt in the newer models, requiring little or no sample preparation and rapid output, seconds. These attributes make SIFT-MS a desirable technology within the food industry. This presentation will briefly introduce the fundamentals of SIFT-MS and a discussion of current SIFT-MS based research within the Department of Food Science and Technology at The Ohio State University investigating VOCs in foods. Alone or in combination with other analytical techniques, such as FTIR and proteomics, SIFT-MS has the potential to greatly enhance our knowledge of the compounds and mechanisms underlying the quality of food.

Key words: volatile organic compounds, SIFT-MS

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Wrocław 19–20 September 2011**

Wick M.

**PROTEOMICS IN MUSCLE GROWTH, DEVELOPMENT
AND MEAT QUALITY**

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The Ohio State University, Columbus, USA*

The goals of animal agriculture industry are to increase muscle growth and meat quality; predominantly tenderness in fresh meat and water holding and rheological characteristics of processed meats.

Meat, the postmortem product of skeletal muscle, is the end product of meat animal agriculture. In meat animal agriculture ante mortem pressures, including genetics, nutrition and stress, combine with postmortem aging to influence the economic value of meat. Ante mortem mechanisms give rise to muscle growth and development which are important to increasing the amount of meat produced. Through the use of proteomics we are beginning to identify the differential protein expression patterns associated with muscle growth, post mortem aging and meat processing characteristics.

Genome/RNA based techniques are increasing our knowledge of transcriptional events during muscle growth and development. However, it is ultimately the transcribed proteins, the proteome, that give rise to the phenotypes of increased muscle mass and the postmortem mechanisms responsible for meat tenderness, water holding capacity and the rheological properties of processed meats. Over the past 15 years the study of the proteome using proteomics has become a frontline tool to elucidate these mechanisms. This presentation will discuss some of our work using proteomics to investigate skeletal muscle growth and meat quality issues in cattle, poultry and fish.

Key words: proteomics, cattle, poultry, fish, growth of skeletal muscle, meat quality

This work has been funded by the United States Department of Agriculture and The Ohio State Agricultural Research and Development Center research awards.

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on the
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Wieczorek K., Dmowska K., Osek J.

**IDENTIFICATION AND MOLECULAR CHARACTERIZATION
OF *LISTERIA MONOCYTOGENES* ISOLATED FROM BEEF**

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Contamination of beef during slaughter and processing is a major risk of food-borne infection of the consumers. Cattle may be a reservoir of several bacterial pathogens, including *L. monocytogenes*. Infection of humans with these microorganisms may cause severe illness, mainly in infants, the elderly and those with compromised immune system. The aim of this study was to determine the prevalence and characteristics of *L. monocytogenes* in slaughtered cattle in Poland.

A total of 406 bovine cattle hides and 406 bovine carcasses were sampled using a swab method and sponges from the brisket area after exsanguination of animals. Four sites (100cm² each) were rubbed with 4 sterile sponges. Samples from the corresponding bovine carcasses were collected with the same method. The bacteria were isolated using the standard 11290-1 ISO method and identified with API[®] Listeria test (bioMérieux). DNA from the isolates was extracted using the Genomic-Mini kit (A&A Biotechnology). The molecular serotyping was performed with the PCR method. Moreover, 5 putative *L. monocytogenes* virulence genes, including internalin ones (*inlA*, *inlC*, *inlJ*, *lmo2672*, and *lmo2821*) were also identified. Additionally, antimicrobial resistance of the isolated bacteria strains was performed by the microdilution method using GPN3F plates (Trek Diagnostic System). The following drugs were used in the study: ampicilin (AMP), penicilin (PEN), rifampicin (RIF), gentamicin (GEN), vancomycin (VAN), and erythromycin (ERY). These drugs are commonly used in the listeriosis treatment in humans. Furthermore, other 11 antimicrobials were also included in the MIC study.

During March 2007 – September 2009 total 816 samples from 3 slaughterhouses in the eastern part of Poland were tested for the presence of *L. monocytogenes*. It was found that 54 of them (6.6%) were positive. Among them 44 isolates were recovered from the hide (10.8%) whereas 10 positive samples were identified in bovine carcasses (2.5%). The PCR investigation showed that the most of the isolated were of 1/2a serotype (39 strains from hides and 8 from carcasses, respectively). Some strains were also 1/2c (4 isolates), 4b (2 strains), and 1/2b (1 isolate) serotypes.

PCR analysis showed that all *L. monocytogenes* isolates possessed the 3 internalin *inlA*, *inlC*, and *inlJ* genes. Moreover, the transcriptional regulator sequences *lmo2672* and *lmo2821* were also identified in all isolates tested.

The results of antimicrobial resistance profile of the *L. monocytogenes* strains isolated from hides and carcasses revealed that all strains were susceptible to AMP, PEN, RIF, GEN, VAN, and ERY. On the other hand, several strains were resistant to Oxacilin + 2% NaCl, Ceftriaxone or Clindamycin.

In conclusion, *L. monocytogenes* may be isolated from beef chain and the strains possess several putative virulence marker genes that make them potentially pathogenic for humans.

Key words: beef contamination, *Listeria monocytogenes*, characteristic

This work was financially supported by the EU FP6 ProSafeBeef project, Grant No. FOOD-CT2006-36241.

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Wieczorek K., Osek J.

**VIRULENCE MARKERS AND ANTIMICROBIAL RESISTANCE
OF *CAMPYLOBACTER* SPP. ISOLATED
FROM CHICKEN CARCASSES IN POLAND**

*Department of Hygiene of Food of Animal Origin,
National Veterinary Research Institute, Puławy, Poland*

Campylobacteriosis is one of the most common food-borne diseases and it is usually epidemiologically linked to the consumption of poultry products. *C. jejuni* and *C. coli* together account for more than 95% of *Campylobacter* infections in humans. However, not much is known about the prevalence and characteristics of *Campylobacter* recovered from such source in Poland. The aim of the present study was to isolate and characterize *Campylobacter* spp. from chicken carcasses (*Gallus gallus*) sampled at the slaughter level.

A total of 54 *Campylobacter* isolates were used in the study. The samples were collected from chicken carcasses during year 2010 using a swab method. *Campylobacter* spp. were identified with standard 10272-1 method. DNA from the isolated bacteria was extracted using the Genomic-Mini kit (A&A Biotechnology). The species determination was done using multiplex PCR. The following virulence genes were then identified: *cadF*, *flaA*, *cdtA*, *cdtB*, *cdtC*, *virB11*, *iam*. *Campylobacter* were then tested for antimicrobial resistance using the MIC method. The following antimicrobials were used: erythromycin (ERY), ciprofloxacin (CIP), tetracycline (TET), streptomycin (STR), and gentamycin (GEN).

It was found that 31 out of 54 contaminated samples (57.4%) were positive for *C. jejuni*, whereas the remaining 23 isolates (42.6%) were identified as *C. coli*. PCR detection of the virulence marker genes revealed that all isolates had the *cadF* sequence responsible for *Campylobacter* adhesion. Almost all strains (53, 98.1%) were also positive for the *flaA* gene encoding flagella formation. Furthermore, 32 isolates had the *cdt* toxin genes, whereas 37 strains possessed the *iam* marker. None of the *Campylobacter* strains isolated from chicken carcasses was positive for the *virB11* gene. Differences in the presence of these virulence markers were observed between species of *Campylobacter* identified in the study. Analysis of antimicrobial profiles of the isolated *Campylobacter* strains showed that there were differences in the resistance to several drugs between *C. jejuni* and *C. coli*. However, all isolates were sensitive to gentamycin. On the other hand, several strains had the multidrug resistance patterns.

In conclusion, chicken carcasses are often contaminated with *Campylobacter* spp. The isolated bacteria possess several putative virulence marker genes that make them potentially pathogenic. Furthermore, the strains may be resistant for some of the antimicrobials commonly used in campylobacteriosis treatment.

Key words: *Campylobacter*, chicken carcasses, antimicrobial properties

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on the
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Wojciechowicz A.¹, Gil Z.¹, Le Thanh-Blicharz J.²

**QUALITY OF WHEAT BREAD ENRICHED
IN CEREAL AND FRUITY DIETARY FIBER**

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Cereal products and bread are perhaps the most important item in our daily diet. There is a trend to find new sources of dietary fiber as ingredients for the food industry. The most widespread consumed dietary fiber products are those derived from cereals. Dried pomace, a fruit industry by-product, is considered as a potential food ingredient having high dietary fiber content.

The aim of this research was to evaluate the impact of cereal and fruity dietary fiber on the quality properties of wheat bread. The research material was wheat flour type 750 incorporated with oat and apple fiber. The content of dietary fibers in the obtained samples was 5 and 10%. The control sample was wheat flour without the addition of dietary fiber.

In the investigations, the following parameters of wheat breads were determined: volume, overbake, porosity of the crumb, energy value, total dietary fiber content, starch digestibility and sensory evaluation.

The results obtained showed that different type (cereal and fruity) of dietary fiber hasn't had a significant influence on examined characteristics. The increasing content of dietary fiber positively impacted overbake and texture of bread and porosity of the crumb. It was found that the increasing content of dietary fiber caused starch digestibility and bread volume to decrease.

Key words: fruity fiber, dietary fiber, quality of wheat bread

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Wojciechowicz A.¹, Gil Z.¹, Le Thanh-Blicharz J.², Spychaj R.¹

**THE EFFECT OF RESISTANT STARCH ON THE QUALITY
OF WHEAT BREAD**

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Breads and cereal products are a large part of daily human nutrition, thus they may play an important role in the diet of ill people, aiding their treatment, and of healthy human beings, where their role might be preventive. There is a trend to find new sources of dietary fibre as ingredients for the food industry. Using resistant starch (RS), which exhibits similar physiological effects to those of dietary fibre, so called "functional food" can be produced with an enhanced dietary fibre content.

The objective of this research was to evaluate the effect of contribution of resistant starch on the quality of wheat bread. The research material was wheat flour type 750 incorporated with retrograded acetylated starch (RS4 resistant starch). The content of addition in the achieved flour samples was 10 and 20%. The control sample was wheat flour without resistant starch.

In the investigations, the following parameters of wheat breads were determined: volume, overbake, porosity of the crumb, energy value, total dietary fiber content, starch digestibility and sensory evaluation.

The results obtained showed that the increasing content of resistant starch positively impacted overbake of bread and dietary fiber content. It was found that the increasing content of resistant starch caused bread volume, starch digestibility and energy value to decrease. The worst color and texture of the crumb gained control bread. Samples containing 10% of resistant starch showed the highest values of crust color and taste of bread.

Key words: resistant starch, wheat bread, quality parameters

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Wojdyło A., Oszmiański J.

**THE EFFECT OF ADDITION OF VARIOUS FRUITS TO QUINCE
JAMS ON THEIR POLYPHENOL CONTENT, ANTIOXIDANT
ACTIVITY, COLOUR AND ORGANOLEPTIC PROPERTIES**

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The aim of the study was to establish whether the addition of various fruits (flowering quince, sea buckthorn, raspberry, strawberry, red and black currant, chokeberry, rowanberry and hawthorn) during jam processing improves their chemical composition, color and enriches them in polyphenol compounds other than those found in quince fruits.

Jams were prepared from quince cultivars and 20% of fruits. In jam samples fresh was determined a content of dry matter by the weight method (PN-90/A-75101/03), total acidity (PN-90/A- 75101/04). The content of phenolic compounds was determined by the HPLC. Antioxidant activity was determined by the DPPH radical method.

It contained 360 mg/100g polyphenols compounds. Its antioxidant activity against DPPH was 40.5 μ M Trolox/1g. The content of dry matter and total acidity was 39.8 and 1.15%. Depending on the added fruits the chemical composition was different. The content of dry matter and acidity level in the jam with raspberry, black currant and hawthorn added increase compared to the jam of quince, whereas the addition of the rest fruits caused those parameters to comparable or lower than the values obtained for the quince jam. The content of phenolic compounds decreased in the following order: quince with chokeberry > rowanberry > Flowering quince > sea buckthorn > black currant > hawthorn \geq quince jam > strawberry > red currant \geq raspberry. The content of phenolic compounds in mix jams quince with chokeberry was increased by more than 2 times, and its activity against DPPH improved by 1.6 times. Addition of various fruits significantly affected the color of quince jams. Addition of flowering quince did not change color or tested jams. The color of the quince jam with chokeberry and black currant was sensory scored the best, while the flavor and color of the quince jam with rowanberry added was the least acceptable.

Key words: fruits, jams, polyphenol content, antioxidant activity, colour, organoleptic properties

This work was supported by the Polish Ministry of Science and Higher Education, Project No. N N312 199935.

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Wojdyło A.¹, Oszmiański J.¹, Teleszko M.¹, Król K.²

**FRUIT QUALITY, POLYPHENOLIC CONTENT
AND ANTIOXIDANT CAPACITY OF ORGANICALLY
AND CONVENTIONALLY GROWN STRAWBERRIES**

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in Skierniewice, Poland

Polyphenols are an important class of phytochemicals in fruits. Strawberries (*Fragaria x ananassa* Duch.) are an important crop in temperate regions such as Poland in Central Europe. They are widely consumed fresh and in processed forms especially as frozen fruits. These attractive fruits are favored for their excellent taste and can be considered a very potent source of bioactive phenolic compounds including hydroxycinnamic acids, ellagic acid, ellagitannins, flavan-3-ols, flavonols, and anthocyanins. Organic food is an expanding sector of the agricultural industry in many parts of the world, and it is possible to find organically produced food in most supermarkets in Europe and North America. The overall goal of organic farming is to use agricultural methods that have the smallest impact on the environment and provide the greatest benefit to people.

The aim of the study was to estimate whether the effect of cultivation technique on the chemical composition (dry matter, soluble solids, total acidity, sugars and vitamin C) and phenolic profiles of strawberry fruits.

Strawberry fruit came from the Certified Organic Experimental Field of the Research Institute of Pomology and Floriculture in Brzezna. The experiment was conducted in 2010, whereas strawberry fruit were picked in the period from 5 to 20 June. There were selected average samples of four strawberry varieties for studies: Elkat, Kent, Honeoye, Alioth. There were determined dry matter, soluble solids, total acidity, the content of total and reducing sugars as well as ascorbic acid in the fruits. In addition, there was determined a content of phenolic compounds by the high performance liquid chromatography method (HPLC) and antioxidant activity by ABTS method.

Separate analysed chemical determinants were influenced not only by the fruit cultivation system, but also the variety studied. The study results show that conventional fruit included a comparable level of dry matter, but higher total and reducing sugars, and were also characteristic of a higher level of total acidity and soluble solids. In organic fruit, however, there was a higher content of bioactive compounds, including phenolic compounds, but not ascorbic acid. It was reflected in the antioxidant activity. Analysing the results obtained, it

was ascertained that the content of particular groups of phenolic compounds in strawberry fruit was significantly influenced by a production method as well as the examined variety. Organic strawberry included a higher level of proanthocyanidins and anthocyanins but a lower content of phenolic acids and flavonols, comparing to conventional fruits

Therefore, at this stage of the studies, it is difficult to present unequivocal conclusions allowing to state which production system provides fruit of better pro-healthy quality, or which varieties are more advantageous for organic production. Concerning the above mentioned, the studies should be continued to next years to confirm the regularities observed.

Key words: dry matter, soluble solids, total acidity, sugars, vitamin C, strawberries

This work was financially supported by the Ministry of Agricultural and Rural Development RR-re-029-5-2/11(28).

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Zagorska J.¹, Antone U.², Šterna V.², Ciproviča I.¹

**EVALUATION OF IMMUNOGLOBULIN
AND LYSOZYME CONCENTRATION
IN MILK ENRICHED WITH CAROTENOIDS**

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Little attention has been paid to carotenoids influence on concentration of lysozyme and immunoglobulin, therefore the aim of the present study was to evaluate influence of feed with different content of carotenoids on lysozyme and the immunoglobulin concentrations in milk.

3 groups were tested: 2 experimental and 1 control groups. The basic feed was equal in all groups, e.g. silage was fed to add libidum and rapeseed bran – 2 kg cow day. 1 group – rapeseeds oil (100 g cow day); 2 group – rapeseeds oil (100 g cow day), and carrots (7 kg cow day); 3 group – red palm oil "Carotino" (100 g cow day). A total 27 bulk milk samples were analyzed. Collected milk sample were immediately cooled to 4–8 °C and transported to the laboratory. The concentration of immunoglobulin (IgA, IgG, IgM) and lysozyme were determined by turbodimetric method. The somatic cell count was determined by "Somacount 300" to exclude milk obtained from mastitis cows. The concentration of immunoglobulins and lysozyme were determined according the following scheme: no additional supplements were administered to the herd for two week period prior to sampling→35 days after feed supplemented with carotenoids addition→ 7 days after feed supplemented with carotenoids interruption. 7 days after feed supplemented with carotenoids interruption the higher concentration of IgA, IgM and lyzocyme was in experimental groups, comparing with control group.

The research results demonstrate – feed supplemented with carotenoids has influence on immunoglobulin and lysozyme concentration in milk.

Key words: immunoglobulin, lysozyme, carotenoids, cow milk

This work was financially supported by ESF Project "Formation of the Research Group in Food Science", Contract No.2009/0232/1DP/1.1.1.2.0/09/APIA/VIAA/122.

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Zambrowicz A., Eckert E., Trziszka T.

**EGG-YOLK PROTEINS AS A SOURCE
OF PEPTIDES WITH ANTIOXIDANT ACTIVITY**

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Hen eggs are an important source of bioactive substances which may find applications in the prevention and treatment of various medical conditions. ACE-inhibitory, antimicrobial, immunomodulatory and antioxidant activities have been reported for egg protein hydrolysates.

In this study, egg-yolk immunoglobulin and phosvitin were hydrolyzed with bovine trypsin and pork pepsin. The antioxidant properties of these obtained hydrolysates were studied. The progress and kinetics of the hydrolysis were analyzed by monitoring the degree of hydrolysis (DH), free amino group content and the RP-HPLC profiles of resultant peptides. The radical scavenging capacity on DPPH, ferric reducing activity (FRAP) and chelating activity on iron (II) were measured.

The results indicated that pepsin was more effective in protein degradation than trypsin. The degrees (DHs) of hydrolysis for three-hour pepsin hydrolysates were: 37.3 and 25.1%, for immunoglobulin and phosvitin respectively. The greatest increase in the free amino group concentration was also observed for pepsin. The final levels, both for pepsin and trypsin, of the free amino groups determined in the phosvitin hydrolysates were 2 times higher than in the immunoglobulin hydrolysates. The RP-HPLC profiles of the protein hydrolysates showed differences in the hydrophobicity of the generated peptides.

The phosvitin hydrolysate obtained with trypsin after one hour reaction was the most effective as a DPPH free radical scavenger ($0.7 \mu\text{M Trolox mg}^{-1}$). Pepsin hydrolysates of phosvitin exhibited strong ferric reducing activity which significantly increased during hydrolysis, finally reaching $1044.4 \mu\text{g Fe}^{2+} \text{mg}^{-1}$. The trypsin hydrolysates of immunoglobulin showed only weak ferric reducing activity. The hydrolysis products obtained from phosvitin exhibited stronger chelating activity than immunoglobulin hydrolysates.

Key words: bioactive peptides, immunoglobulin, phosvitin, antioxidant

Project "Innovative technologies of production of biopreparations based on new generation eggs" Innovative Economy Operational Programme Priority 1.3.1, thematic area "Bio" Co-financed by European Union through European Regional Development Fund within the Innovative Economy Operational Programme, 2007–2013.

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Wrocław 19–20 September 2011**

**Zdybel E., Tomaszewska-Ciosk E., Drożdż W., Boruczkowska H.,
Romańczuk M.**

**DETERMINE SOME PROPERTIES OF THERMAL INSULATION
PARTITIONS PRODUCED USING POTATO STARCH**

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Constantly growing amount of plastic waste forces to search for biodegradable packaging materials. Starch is a natural polymer, easily degradable and as such found its application as an additive to the polymer material making it easier to biodegradation. At the same time demanding requirements for the packaging materials do not allow for the reduction in the functional properties of biodegradable materials. There are several important functions of packaging but one of the most important is to prolong the life of the packaged product by hedging against changes in temperature reactions.

The aim of this study was to investigate the thermal conductivity of the material obtained from extruded starch.

Natural potato starch, acetylated starch and their mixture were subjected to extrusion at three different temperatures (50, 60, 70, 90, 100, 120 and 140, 150, 170°C). Extruded material was obtained in the form of beads with a diameter of 0.5 cm.

In order to verify the thermal conductivity has been studied the time in which the temperature rise by heating the tested material at a specific thickness. The study was conducted in a layer of natural starch, acetylated and extruded starch. In addition, the extruded starch was formed into rigid shapes with a thickness of 20 mm and afterwards there was tested the time after which the temperature rose in the material divided by earlier shaped extruded starch.

As the results of the experiment it was stated that comparing to the natural starch the acetylated starch is characterized by a lower thermal conductivity. Among the extruded starch the acetylated starch, which was extruded at temperatures 90, 100, 120°C, showed lowest thermal conductivity. Fittings, which were made from extruded starch, had a lower thermal conductivity comparing to the balls of extruded starch, and the lowest thermal conductivity had fittings made of starch extruded at the lowest temperature.

Key words: potato starch, acetylated starch, extruded starch, thermal conductivity

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Židek R., Golian J., Maršálková L., Bulla J.

**COMPARISON OF THREE METHODS USED
FOR MTHFR C677T DETECTION**

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The MTHFR gene provides instructions for making an enzyme called methylenetetrahydrofolate reductase, which plays a role in processing amino acids. Polymorphisms in the MTHFR gene have been studied as possible risk factors for a variety of common conditions. These include heart disease, stroke, hypertension, preeclampsia, psychiatric disorders, and certain types of cancer. Rapid and accurate identification of polymorphisms in the gene MTHFR in position C677T is essential. In this work we have compared three methods based on RFLP and SYBRgreen Realtime PCR methodology. The work shows the necessity of using positive controls and selects the appropriate region for DNA, to ensure quality and repeatability of results. RealTime PCR method provides substantial variability in the melting curve of the same genotypes.

Key words: methylenetetrahydrofolate reductase (MTHFR), RFLP, SYBRgreen, Realtime PCR

**5th International Conference
on the
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Wrocław 19–20 September 2011**

Zimoch A., Ambrozik-Haba J., Jarmoluk A., Semeriak K.

**THE EFFECT OF DEACETYLATION DEGREE
ON THE PROPERTIES OF CHITOSAN**

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The aim of this study was to produce chitosan with different degrees of deacetylation and evaluate selected parameters of rheological and mechanical strength of properly prepared sols and protective films, assuming a constant level of plasticizer. Experiment was performed in different washing times of deacetylation and this process was repeated 1, 2 or 3-fold. Determination of molecular weight by viscometric method, DD by potentiometric titration and calculation of efficiency of DD process were performed for obtained chitosans. Effect of experimental factors on the variability of rheological properties of colloids and films produced from them were evaluated by measuring rheological parameter (dynamic viscosity) and texture properties (tensile strength, puncture). Statistical result has showed that the value of deacetylation degree decreases with increasing washing time (solution of sodium hydroxide). Molecular weight of chitosans was the same for every variant. It was also shown that the efficiency of deacetylation of chitin, a multi-stage process ongoing 11 hours remains at a similar level as the one-step process. The results indicate that the viscosity of sols measured at constant temperature and at constant shear rate decreases with a reduction in the degree of deacetylation of chitosan molecules. Mechanical strength of films on tensile and puncture decreases with increasing time and the repetition of the deacetylation process of chitin.

Key words: chitin, production of chitosan, deacetylation degree, films, rheological and mechanical properties

This work was financially supported by development project No. N R12 0079 06/2009 "Opracowanie metody poprawy jakości i bezpieczeństwa żywnościowego chłodniczo przechowywanego mięsa", funded by NCBiR.

**5th International Conference
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Wrocław 19–20 September 2011**

Zimoch A., Jarmoluk A., Ambrozik-Haba J., Semeriak K.

**THE EFFECT OF HYDROLYSED SILK PROTEIN
ON SELECTED PHYSICAL PROPERTIES OF CHITOSAN FILMS**

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The aim of this study was to determine the effect of hydrolyzed silk proteins on the variability of physical properties (puncture strength, elongation, elongation at destruction, water vapor permeability, WVP) of chitosan edible coatings. Variability factors were: silk protein and glycerol at three levels: 0, 1.5, 3.0 and 0, 15, 30% respectively. Effect of silk proteins on the variability of the mechanical properties of experimental coatings was studied with the use of stress device Zwick / Roell Z010. Water vapor permeability of experimental coatings was also performed. It was found that coatings produced with chitosan were characterized with the greatest strength of extension $F_{\max} = 61.49$ N, destruction $F_{\max} = 59.59$ N and puncture $F_{\max} = 61.13$ N. It was shown that with increasing addition of silk proteins and a dose of glycerol up to 15% the water vapor permeability of coatings increased. The highest water vapor permeability of coatings composed with 3.0% of silk proteins and 15% added glycerol was $1.313 \text{ WVP} \times 10^{-10} \text{ [g / Pa} \cdot \text{m} \cdot \text{s}]$. Interaction between silk protein and glycerol was also confirmed.

Key words: chitosan, silk protein, coatings, mechanical properties, WVP

This work was financially supported by development project No. N R12 0079 06/2009 "Opracowanie metody poprawy jakości i bezpieczeństwa żywnościowego chłodniczo przechowywanego mięsa", funded by NCBiR.

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Wrocław 19–20 September 2011**

Żyngiel W.

HIGH PRESSURE PROCESSED FOOD PRODUCTS

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Consumer's expectation for minimally processed, microbiologically safe, additives free and stable food products with "fresh like" characteristics has stimulated the interest of alternative food preservation technologies.

Development of new technologies and modification of conventional preservation methods is associated with restriction to the thermal processes causing significant changes in the structure and ingredients of raw food product. Modern, alternative technologies of food preservation are mainly based on the concept of minimal processing with retention the high nutritional value and sensory attributes of natural food while maintaining the product quality and ensuring consumers health safety. Nonthermal processing of foods has essentially meant unprecedented opportunities for the industrial sektor in providing better health and wellness for the consumers and unforeseen new food products of excellent quality without compromising safety. The challenges surrounding these emerging technologies are immense, but the long list of interested groups in support of their development is growing in an exponential fashion. Alternative, nonthermal processing technologies are being advanced and making a significant, positive impact in the food sector. Emerging processing facilitates the development of new products never envisioned before as a series of niche markets that will potentially receive wide attention in nearest time. The opportunities for such new products are countless and most will have superb quality and very attractive prices.

These requirements are complied by the high pressure processing technology (HPP) which as one of the emerging technologies in food processing and preservation offers the opportunity of producing food of high quality, greater safety and increased shelf-life. The usefulness of high pressure treatment of food products is the settlement of such compression parameters which do not lower the nutrient value and sensory features of the product and affect directly on his persistence by the elimination or significant reduction unprofitable microbiological and enzymatic processes.

The commercial application of high pressure processing for food preservation generally concerns the highly industrialized countries which communities with relatively high incomes are interested in the acquisition and consumption of minimally processed food products. Food products preserved by high pressure processing in the industrial scale are offered on the consumer market in Japan, USA and some European countries (France, Spain).

Key words: high pressure processing (HPP), pressurized food products, market offer of HPP food products

**5th International Conference
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"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Żyngiel W.

IRRADIATION OF FOOD PRODUCTS

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The irradiation is a physical treatment of food products exposed to the defined dose of ionizing radiation and is used as the preservation method of various food types in about 50 countries worldwide. Food irradiation has potential application for control and improvement the microbial safety of foods as the effect of inactivation or reduction the contamination level of pathogenic and spoilage microorganisms, insect infestation, delay or eliminate natural biological processes in foods such as inhibition of ripening, germinating or sprouting and shelf-life extension of various types of animal and plant origin food products. Among the relatively emerging technologies for food preservation irradiation has gained the widest application in food industry. The effective impact of irradiation treatment depends of several factors as commodity, cultivar, maturity, pre- and postharvest treatments and contamination degree of foods to be processed, the allowed doses of radiation, the conditions during processing as temperature and atmosphere and susceptibility of the microbial load for inactivation.

Irradiation is allowed when there is a reasonable need for the use of ionizing radiation for preservation of food products but should be rather the supplement than replace of good hygiene, handling and practices in food production. The process of irradiation carried out under appropriate conditions is considered as the safe technique of food treatment. The irradiated food products are required to be labeled with the special "radura" symbol for consumers information. Irradiation has received official legislation approval for treatment of various food types by international and national health authorities for commercial application. Consumer's opinion, awareness and receptive toward irradiated foods generally is concerned with low public knowledge, insufficient education and lack of reliable informations about potential benefits and possibilities of food irradiation.

The implementation of ionizing radiation for commercial application in food industry requires the proper infrastructure. The irradiation has high capital costs and requires a critical minimum capacity and food products volume designed for preservation for properly economic operation although irradiating process has low operating cost.

Key words: irradiation, food preservation, legislation, consumer attitudes, processing costs

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Hińcza Ł., Żulewska J.

**QUALITY FUNCTION DEPLOYMENT AS A TOOL TO DEVELOP
NEW PRODUCTS**

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Quality function deployment (QFD) enables both the design of new products and the improvement of an already existing one on the basis of the consumers' demands by incorporating them into development process.

The aim of this work was to specify the consumers' preferences and the factors affecting the process of decision making when purchasing tvarog, and to determine the possibility of QFD application to modify the traditional products such as tvarog.

The study was conducted among the clients of one of the supermarkets in Olsztyn. A group of 100 consumers consisted of 76 women and 24 men. The personal enquiry was carried out using a specially designed questionnaire. The results of this questionnaire were compiled and analyzed in order to specify the consumers' expectations and transfer these demands into "the house of quality". The further part of this research was the construction of "the house of quality" by ascribing the proper technical parameters to the customers' demands, establishing the correlation between them, determining their importance and the degree of difficulty in achieving the intended target value.

The consumers' choice of particular tvarog was motivated by its taste, fat content, price, and best before date. The technical requirements regarding tvarog concerned its taste, fat content, the weight of its package, moderate price, the type of packaging, and the freshness assurance.

The parameters of a special concern during tvarog production, necessary to satisfy the consumers were the package design, the cheese acidity, its fat content and the packaging method ensuring the freshness of the product.

Key words: consumer preferences, tvarog, QFD

**5th International Conference
on the
"QUALITY AND SAFETY IN FOOD PRODUCTION CHAIN"
Wrocław 19–20 September 2011**

Gątorska A.

**THE QUALITY OF BOTTLED WATER IN THE CONTEXT
OF PET PACKAGING**

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Description of the risks related to storage of bottled water in PET packaging, based on available literature data, was the aim of the study.

Manufacturers of bottled water, for the evaluation of the hygienic quality of the end-product in relation to safety, focus their attention mostly on microbiological parameters. Whereas, no evaluation of the hypothetical effect of the packaging itself on the quality of water during storage has been established. In the market, PET packaging dominates in this group of products.

Requirements for packaging material are changing along with the technical development in the food industry and packaging, market development, and increasing competition. The basic criterion of the evaluation of usefulness of packaging, which is intended for contact with food products, results from possibility of migration, i.e. moving of components of packaging into the product. Packaging made of plastic consists mostly of multimolecular polymers, where other substances are used during their production (such as catalytic agents, softening agents, stabilizers). These components can migrate and interact with the packaged food. In addition, the purity of polymers is also important; they should be devoid of so-called free monomers that are hazardous for human health.

Genotoxic compounds, such as formaldehyde and acetic aldehyde and other organic compounds are indicated as risk-inducing factors that originate from PET packaging. Among factors that condition the effects of this type of packaging on products contained in it are time and conditions in which products are stored.

Key words: bottled water, packaging, quality

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