PROCEEDINGS OF THE 6TH 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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Preface

The first International Conference in the cycle of "Quality and Safety in Food Production Chain" was held in Wrocław in the year 2000. The present, sixth conference has been divided into the following five sessions:

1. New technologies and methods for the improvement of food products, nutraceuticals and biomedical preparations
2. New trends in food preservation and technology
3. Food analytics
4. Traditional and functional food
5. Safety systems in food production chain

Production of food is a complex and long chain of biological, chemical, physical, economical and psycho-sociological processes. It is also strongly conditioned by many religions. It is, however, an existential element of mankind and all economical and political activities must be subordinated to the idea of quality of life, sustainable development and, first of all, to the basic needs of the humans. Food science is a wide spectrum of knowledge covering fundamental and applied sciences. The quality of food products depends on all elements of environment, in which production is carried out. Soil, water air and feed contamination decided about the quality of plant and animal raw materials and may limit their use in food production. Methods of food processing, preservation and packaging, as well as food additives, also decided about the pro-health quality of food. Food technologies are based on the latest scientific achievements and are closely integrated with the food legislation. The knowledge of biological principles governing the production of materials to be processed is equally important. Thus, food production requires process monitoring in all production steps "from field to table". All aspects of food production chain are strongly connected with quality of life. The improvement of the quality of life is in focus of many research groups, worldwide. This includes such factors as functional food, natural origin food products, nutraceuticals, diet supplements, as well as biotechnological products.

These goals could be summarized as a transfer of knowledge and technology in the service of humans quality of life. Today in Europe, we are creating new values with the aim to support the economy and individual person by bringing the world of science, business, and education closely together. This goal has been included in the Horizon 2020 programme and is created by Knowledge Innovation Communities (KIC). In 2016, KIC Food for Future will be launched to accelerate the development of the food economy. We are convinced that the conclusions we will arrive at during this conference will support this endeavour and future scientific and economic co-operation not only in Europe but also worldwide.

The Wrocław University of Environmental and Life Sciences is developing very large research in area of the modern technologies including novel food nutraceutical, biomedical products – all for the idea connected with quality of life improvement. First of all Wrocław

University of Environmental and Life Sciences is strongly involved in the activities promoting the quality and safety of food in the whole production chain and it participates in the most of the national and European initiatives. One of the forms of such activity is organization of international conferences.

The organizers of the conference would like to wish all participants fruitful discussions, constructive debate, and a pleasant time during stay at the University and in our beautiful city of Wrocław, the capital of Lower Silesia.

Prof. Tadeusz Trziszka
Chairman of the Conference Organizing Committee

Adamczewski K., Kowalik J., Tarczyńska A.S., Staniewski B.

MICROBIOLOGICAL RISK ASSESSMENT IN THE BUTTER PRODUCTION

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Risk assessment is a complex process made up of several stages. With the management and communication of risk it is pivotal component of risk analysis. Microbiological Risk Assessment (MRA) means in the practice collecting and processing data about the product. Ensure here include all the factors that affect on the microbiological quality of final product, from the quality of raw material, parameters of production technology to physicochemical properties and the storage conditions of final product.

Food products due to differences in chemical composition may constitute "medium" to growth, survival or inactivation of undesirable microflora. A useful tool in predicting the behavior of microorganisms is predictive microbiology. Using commercial software, with appropriate mathematical models can specify the number of microorganisms and / or specify the time after which the product may endanger the health of the consumer.

After identifying the pivotal factors having the largest influence on the behavior of microorganisms in the specific product, and the observations carried out on purposefully contaminated products can predict the reaction of e.g. pathogens in similar environmental conditions.

The aim of this study was to predict the microbiological risks in selected stages of the technology at a hypothetical contamination of substrates and products in the butter production. To the contamination of raw materials, semi-final and final butter product was used strains of *Listeria monocytogenes bacilli*.

The results were compared with predictions obtained from the available programs (ComBase Predictor) and WMP (WaMa Predictor). Analyses showed the possibilities of growth pathogenic microorganisms during the butter production. Also studied the possibilities of using the predictive programs in a microbiological risk assessment. By analyzing the obtained predictions from CP and WMP applications it was observed "the safety margin" arising from the overestimation of pathogen cell growth, which allows for using applications to estimate the microbiological risk.

Aniołowska M., Kita A.

THE EFFECT OF OIL TYPE ON GLYCIDYL ESTERS CONTENT IN OILS USED FOR FRENCH FRIES FRYING

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French fries are one of the most popular potato products in the world. Deep-fat frying is a commonly used method during which fried products obtain unique sensory characteristics, such as flavour, texture and appearance. However oil during frying undergoes different reactions such as hydrolysis, oxidation and polymerization. Products of oil degradation could lead not only to decrease of organoleptic quality of fried products, but also their safety. The ratio of oil degradation depends mainly on the type and quality of oil, especially fatty acid composition.

The aim of the study was to find the effect of oil type and frying time on oil degradation and the content of glycidyl esters.

Material used for the study was refined oils such as rapeseed, palm, palm olein and mixture based on palm olein. The experiment was of five days' duration and entailed the following: French fries were fried for eight hours per day in oils heated to 180°C in 30 minutes cycles. Fresh and after every 8 hours of frying, the oils were analyzed for acid and anisidine values, colour, and refractive index, fatty acid composition by GC and composition of glycidyl esters by LC-MS.

Hydrolytic and oxidative changes depended on oil type. Hydrolysis and polymerization occurred most intensively in palm olein, while oxidation in rapeseed oil. The colour of all oils underwent darkening, with the largest change occurred in rapeseed oil. Degradation of oil caused increased change in the refractive index of frying oils, which occurred to the same extent in all media. The percentage of individual fatty acids changed depending on the time of frying. Fresh palm oil and palm olein were characterized by high percentage (37–51) of saturated fatty acids, while rapeseed oil by less than 9%. There were observed losses of mono- and polyunsaturated fatty acids in all oil samples. With increasing frying time the content of glycidyl esters decreased and was dependent on type of frying medium. The highest content of GE characterized palm olein and the lowest rapeseed oil. The palm oil, palm olein and mixture were dominated by glycidyl esters of palmitic and oleic acids, while rapeseed oil by glicidyl ester of oleic acid.

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Aniołowska M., Kita A.

EFFECT OF FRIED PRODUCTS QUANTITIES ON WATER CONTENT IN OIL USED FOR FRYING IN GASTRONOMY

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Fried foods have become more and more popular, especially in fast-food restaurants. Frying is a fast and convenient technique for production of foods with unique sensory properties such as colour, flavour, texture, and palatability, highly appreciated by consumers. During frying of foods, fat is subjected to high temperatures in the presence of air and water, which results in the formation of a high number of new compounds through thermal, oxidative and hydrolytic reactions. Hydrolysis of frying oil is one of the most important reactions during deep fat frying. It is affected by water present in the fried food. The fried material, usually at room temperature or even refrigerated, comes into contact with frying oil preheated to 130–200°C. Water present in the fried food is quickly heated to the boiling point, and produced steam which enters the frying oil. Under these conditions, triacylglycerols are partially hydrolyzed into free fatty acids, diacylglycerols, monoacylglycerols and even glycerol (Gertz et al. 2000).

The aim of the study was to find the influence of the amount of fried products on water content and hydrolytic changes in oil used for frying in one of the catering point in Wrocław.

The material used for research was palm oil designed for frying (Goldpalm). Samples of fresh and used oil (after finishing of frying) were collected over a period of two months. Oil in the fryer was heated to a temperature of 160°C for 8 hours a day and frying was carried out periodically for 3 days. In the oil were fried fishes and meat in an amount of 5 to 20 kg/day. In fresh and used samples of frying oil was analyzed water content by Karl Fischer method using coulometer with generator electrode without diaphragm and free fatty acids content as acid value.

The fresh oil exhibited low water as well as free fatty acids contents. The water content of the oil increased with increasing amount of fried products. Significant changes in water content were observed when in oil was fried more than 30 kg of food. After frying 44 kg of food, water content reached to the value of 4995 ppm, which was thirty times higher than in fresh oil. Hydrolytic changes occurred most intensively when in the oil were fried small amounts of products (between 20 and 30 kg). Acid value of oil used for frying higher amounts (over 30 kg) was from 1.13 to 1.53 mg KOH/g for 44 kg.

Gertz C., Klostermann S., Kochhar S.P., 2000. Testing and comparing oxidative stability of vegetable oils and fats at frying temperature. Eur. J. Lipid Sci. Technol., 102, 543–551.

HUMAN CAPITAL
NATIONAL COHESION STRATEGY

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Babij K., Dąbrowska A., Szołtysik M., Korzeniowska M., Pokora M., Zambrowicz A., Chrzanowska J.

APPLICATION OF WHEY PROTEIN HYDROLYSATE FRACTION TO THE MODEL MEAT SYSTEM

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The objective of the research was to assess the oxidative changes occurring in the model meat product formed with the added fraction of whey protein hydrolysate with the highest antioxidant activity. In the present study, whey protein concentrate (WPC-80) was hydrolized with serine extracellular protease obtained from yeast *Yarrowia lipolytica*. The hydrolysis of protein solution was carried out at the temp. of 37°C, pH 8.0 for 24 h with the enzyme applied in a dose of 150 U/g of the protein. The course of hydrolysis was monitored by the determination of the hydrolysis degree (DH), increase of free amino group content (FAG), by RP-HPLC and electrophoresis (SDS PAGE). The hydrolysate was further fractionated by ultrafiltration with a membrane of cut off 10 kDa. The antioxidant activity in seperated fractions was determined by the free radicals DPPH scavenging activity, the ability to reduce the Fe (III) ions in FRAP test and chelating Fe (II) activity. The observed free radicals scavenging activity of the peptide fraction >10 kDa was 0.17 μM Trolox/mg, the ability to reduce Fe (III) reached 23.2 μg Fe^{3+}/mg whilst Fe^{2+} chelating activity exceeded 450 μg Fe^{2+}/mg. Model forcemeat, i.e. a raw chicken meat finely ground and emulsified with fat was enriched with soy protein in control sample. In experimental samples the soy protein was substituted with whey protein hydrolysate fraction >10 kDa. Pâté was thermally treated and further cold stored (4°C ± 1°C) for 14 days. The intensity of the ongoing oxidative process during storage was measured by determination of the products that react with a 2-thiobarbituric acid (TBARS). Changes in free fatty acids composition were estimated using a gas chromatography (GC/MS). It was found that during the 14-day storage of the pâté, the additon of whey protein hydrolysate fraction >10 kDa had a significant effect on TBARS values comparing to control samples. Soy protein substitution with 50% and 100% resulted in 5.8% and 12.4% decrease in TBARS respectively.

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Biazik E., Lesiów T., Cichoń M., Popowicz R.

THE CURRENT LEVEL OF CONSUMER KNOWLEDGE IN POLAND ABOUT ACTIVE AND INTELLIGENT PACKAGING SYSTEMS

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Active and intelligent packaging systems are based on interactions between packaging and the food they contain in order to enhance food quality and safety. Such technology includes advances in controlled respiratory rates, moisture migration, microbial growth and delayed oxidation. Intelligent systems monitor the condition of the packaged foods to give information about the quality of the packaged food during transportation and storage.

The aim of the study was to present the latest solutions in active and intelligent packaging and to determine consumer awareness and preferences in purchasing food with these innovative types of packaging systems.

This study summarizes the results of two separate surveys of 100 consumers each from Lower Silesia region (aged 18–77) characterized by different places of residents, levels of education and gender. The research was conducted in 2012 and respondents were interviewed using questionnaires. The questions referred to the consumer expectances with regards to the usefulness of these types of packaging systems and their willingness of purchase such products.

Over 39% of the respondents declared that they had some understanding of active packaging systems. This result was influenced by the level of education and place of residence. In comparison awareness of intelligent packaging is relatively low. 88% of respondents did not have any knowledge of this packaging system. The results were related to education level, while the place of residence did not affect consumer awareness. The highest level of interest to both types of packaging was observed in the female group.

Furthermore, the study showed a willingness to purchase food with active and intelligent packaging systems by the majority of Polish consumers, even if this resulted in a higher price for food products.

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Bilsborough S.

APPLICATION OF MASS SPECTROMETRY IN FOOD PROFILING

Agilent Technologies

The application of mass spectrometry in the screening of food products for contamination with compounds that are detrimental to human health is well documented. For such applications in food safety, targeted techniques are used to determine the presence and quantity of extremely low levels of contaminants, such as pesticides, veterinary drugs and mycotoxins. However, the application of untargeted methods allows for the discovery of unexpected compounds and profiling of food samples. Profiling provides a chemical fingerprint of a sample for comparison with other samples to detect adulteration or degradation of the product. Additionally, profiling provides a useful tool to determine the authenticity and origin of foodstuffs. In this presentation, we discuss the principles of untargeted mass spectrometry applied to the screening and profiling of food.

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Błażewicz J., Kawa-Rygielska J., Pietrzak W.

EFFECT OF MALT SUBSTITUTION WITH CORN GRAIN MILLING PRODUCTS ON SELECTED PROPERTIES OF MALT WORTS

Wrocław University of Environmental and Life Sciences, Department of Food Storage and Technology, Wrocław, Poland

The substitution of malt with large portions of unmalted adjuncts is possible. However, it requires the application of known procedures of adjuncts pretreatment with enzymatic preparations. Often the maximal share of adjunct depends on required technological parameters of the process and properties of obtained worts.

The aim of the study was the assessment of the effect of 40% substitution of pilsner and caramel light Carahell® malts with corn grits of 750–1250 μm granulation or corn groats of 250–750 μm granulation on saccharification time of mashes, filtration time, total volume, pH, extract and content of protein hydrolysis products (FAN – free amino nitrogen and soluble nitrogen) in worts obtained using the congress mashing. The grits and groats were gelatinized with the addition of Termamyl 120 L enzymatic preparation and were mashed with the addition of Ceremix Plus MG preparation.

It was stated that substitution of 40% of pilsner and caramel light malts with corn grits or groats prolonged the mash saccharification time interval to 10–20 min, extended filtration time of wort to 120 min without a decrease in its volume after this time, increased the pH and the extract of worts by ca. 0.05 and 0.2–0.5% respectively. The use of 40% share of corn milling products as malt replacements caused a typical decrease in the content of soluble proteins in worts by even 50% in comparison to all-malt worts mashed with the addition of Ceremix Plus MG preparation. Application of enzymatic preparations (Termamyl 120 L and Ceremix Plus MG) during mashing of malt load with 40% share of corn unmalted adjuncts allowed to at least twofold increase in the content of FAN in obtained worts.

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Błażewicz J., Kawa-Rygielska J., Pietrzak W.

EFFECT OF CORN MILLING PRODUCTS ON THE CONTENT OF CHOSEN ELEMENTS IN MALT CONCENTRATES

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The use of malt replacements in the form of unmalted adjuncts in brewing or production of malt concentrates of comestible type is a common practice. The economical conditions of the market are causing that expensive raw material like malt is substituted with its cheap replacement, most often with the products of corn grain milling.

The aim of the study was the assessment of unmalted adjunt addition, in the form of corn grits and groats, on the content of potassium, sodium, zinc, calcium, iron, magnesium and copper in the comestible type malt concentrates. The malt substitution with unmalted adjunct was 40, 60 and 80%.

The laboratory worts were obtained using the congress mashing method. The primary raw materials were pilsner malt and caramel light Carahell® malt. The shares of unmalted adjuncts in the final loading of raw materials were 40, 60 and 80%. Used unmalted adjuncts were commercial products of corn grain milling in the form of corn grits of 750–1250 μm granulation and corn groats of 250–750 μm granulation.

The malt concentrates were obtained from laboratory worts subjected to preliminary evaporative thickening in the vacuum evaporator Rotavapor R-151 (Bűchi) under 10 kPa pressure and the temperature of the bath of 70°C. Preliminary thickened worts were subjected to spray drying in Mini Spray Dryer B-190 device (Bűchi). The inlet temperature of drying was 140°C and the outlet temperature in the range of 75–80°C.

In the powdered concentrates the content of univalent (potassium, sodium) and divalent (zinc, calcium, iron, magnesium and copper) were determined. For this purpose the "wet" mineralization was conducted in the closed microwave system. Mineralization was performed according to PN-EN 13805:2003. Determination of the content of Ca, Na, K, Mg, Fe, Zn and Cu was performed in acetylene/air flame using atomic emission spectrometry with SpectraAA atomic absorption spectrometer with AA240FS flame adapter produced by Varian. The determination of Ca, Na and K were performed according to PB-01/AAS procedure and Mg, Fe, Zn and Cu according to PB-02/AAS procedure, developed and used in Research Laboratory of Atomic Absorption Spectrometry at Wrocław University of Environmental and Life Sciences.

Obtained results of analyses of worts and concentrates obtained with the addition of unmalted adjuncts were referred to respective results for all-malt worts and concentrates and commercial malt concentrate.

Supplementation of pilsner malt and caramel light Carahell® malt with unmalted adjunts at 40, 60 and 80% loading in the form of corn grits and groats with the addition of Ceremix Plus MG enzymatic preparation caused the decrease in the content of potassium, calcium, and magnesium in the malt concentrates. Only the content of sodium in concentrate was increasing with the increasing share of unmalted adjuncts.

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

THE EFFECT OF NUTRITIONAL STATUS OF NITROGEN ON BARLEY PLANT ON VALUE MALTING GRAIN BY MOLINA-CANO

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The aim of the study was determination the effect of nitrogen fertilization and time of malting barley grain germination on the classification of the suitability of malting barley grain varieties by the method of Molina-Cano.

Field experiments were conducted in 2008–2010 in a split-block in four replications with two variable factors. Factor 1 – fertilization N ($kg^{*}ha^{-1}$): doses – 0, 20, 40, 60, 60 (40 +20 I), 60 (40 +20 II). Factor 2 – variety: Sebastian and Mauritia. Nitrogen fertilization was performed before sowing and top dressing (divided doses) in two development stages: I – at the end of tillering (BBCH 29), the second – in the shooting phase (BBCH 32). In the experiments, nitrogen was used as a 34% ammonium nitrate. In each year of the experiment, in early spring, before the application of nitrogen fertilizers were determined mineral nitrogen content in soil. Agrotechnical (except nitrogen fertilization) were made by intensive cultivation technology of spring barley, taking into account the full protection of plants against weeds, diseases and pests. After the post harvest resting period grain malting was evaluated. Malting grains was carried out in laboratory conditions as in the preparation of pilsner type malts. The steeping and malting of grain samples (250 g) were conducted in a climatic cabinet, with temperature kept at a level of 15–16°C. The steeping cycle spanned for 48 h. The grain was kept in water and air atmosphere according to the following scheme: 8 h – in water /w/, 11 h – in air atmosphere /a/, 5 h – w, 8 h – a, 11 h – w, and 5 h – a. The steeping enabled obtaining the assumed final moisture content of 45%. The time of malting was counted from the termination of the steeping cycles and lasted from 3, 4, 5 and 6 days. After completion of soaking the trials of malt were dried in laboratory wind dryer using the following temperature cycles: 10 h – 30°C, 5 h – 40°C, 3 h – 50°C, 3 h – 65°C, and 2 h – 82°C. Selected results of the evaluation of malt and wort have been used in the technological assessment of barley according to the principles developed by Molina-Cano for the EBC.

The level of nitrogen fertilization of malting barley plants differentiates substantially the amount of quality index Q. The optimal nitrogen fertilization tested cultivars was within the boundaries of 40–60 N kg*ha^{-1}. Splitting doses of nitrogen in the cultivation of malting barley causes the deterioration of the functional characteristics of grain, malts and worts. The level of nitrogen fertilization of barley malting plants and malting time of grain to the greatest extent differentiates malts extractivity. The use of 5-day malting grain tested cultivars barley allows the obtaining of pilsner malts the highest quality.

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Błażewicz J.[1], Liszewski M.[2], Kozłowska K.[2], Kupisz K.[1]

THE EFFECT OF AGRICULTURAL TECHNOLOGY OF SPRING BREWING BARLEY ON PILSNER MALTS QUALITY

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The aim of the study was to determine the influence of diverse agricultural technology used in "Post-registration Variety Testing and Agriculture", taking into account the two levels of nitrogen fertilization of barley plants at doses of 50 (40 +10) kg N·ha^{-1} and 90 (50 + 40) kg N·ha^{-1} on the pilsner malts quality. Main nitrogen fertilization has been used in the phase 2 elbows (BBCH 32).

Barley grain came from the Department of Experimental in Pawłowice, belonging to the Wrocław University of Environmental and Life Sciences, where strict field experiment was carried out in the framework of PDOiR. Barley plants were fertilized with nitrogen in two agronomic systems: the average (level a1), where the dose was 50 (40 +10) N·ha kg^{-1}, a chemical fungicide protection was limited to a seed treatment, and – the intensive with increased nitrogen dose to 90 (50 + 40) kg·h^{-1}, taking into account the full protection of the chemical fungicide (two treatments during the growing barley) and extra application of foliar multicomponent formulations (including fungicides) and retardant.

The material used for this study was barley grain of five varieties (Aliciana, Blask, Conchita, Signora and Stratus) came from the 2012 growing season. Malting barley was carried out in laboratory condition using conventional processes for the production of pilsner malt. From barley grain brewing varieties as a result of 3-, 4- and 5-day malting obtained pilsner malts. An assessment of the suitability of malting grain by Molina-Cano was made by interpretation of the effect of selected agricultural treatments (N fertilization) and malting time on the quality of received malts.

Collected results confirmed the thesis that high doses of nitrogen in the cultivation of malting barley adversely affects on quality of malts and worts. Statement of selected technological features of grain, malts and worts proves negative impact of intensive nitrogen fertilization of barley plants at a dose of 90 kg N·ha^{-1} on the quality of grain and pilsner malts. More preferred technological effects causes fertilization at the dose of 50 kg N·ha^{-1}. Tested barley varieties were characterized by a quality index Q more than the threshold value, eligible for processing grain into malt, regardless of the intensity of cultivation. 3- and 4-day malts showed a tendency to achieve higher values of index Q, after applying an average dose of nitrogen fertilization (a1). Intensive levels of nitrogen fertilization (a2) the most often

deteriorated brewing quality. The extended from 3 to 5 days malting time did not bring substantial improvement of the malts quality, 4-day malts had the best processing properties. Extractivity of examined malts remained at a high level, irrespective of the agrotechnology. Even at high doses of nitrogen (90 $kg \cdot h^{-1}$) exceeds the required minimum for pilsner malts value of 79.5%. This shows small variation of grain quality put into cultivation in Poland new varieties of malting barley, regardless of the applied agricultural technology (fertilizer N).

Bobak Ł.[1], Zambrowicz A. [1], Siepka E. [1], Różański H.[2], Trziszka T. [1]

USE OF SUPERCRITICAL ANTISOLVENT (SAS) TECHNIQUES TO ISOLATION OF PURE PHOSPHOLIPID FRACTION FROM EGG YOLK

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The paper presents the possibility of using the SAS (Supercritical AntiSolvent) techniques for the isolation of pure phospholipid (PL's) fraction of egg yolk. The use of SAS technique allows obtaining a pure phospholipid fraction precipitated from an ethanol solution obtained during classical chemical extraction (CE).

A solution of phospholipid in ethanol is pumped to the extractor through which flows carbon dioxide in the supercritical state (usually under a pressure of 28–36 MPa and a temperature of 40–60°C). Phospholipids in these conditions are not soluble in supercritical carbon dioxide ($scCO_2$) and precipitate from solution and be collected when the system is depressurized down to atmospheric pressure from the walls of the extractor basket. Whole ethanol is received in the separator.

SAS process was carried out under conditions of 28 MPa, 60°C and $scCO_2$ flow of 32 l/h using a high-pressure extractor operating in the range up to 100 MPa and temperatures up to 80°C (Natex Prozesstechnologie GesmbH Ternitz, Austria). The ethanolic solution of phospholipids was pumped at a rate about 5% calculated to the fluid flow by means of a pneumatic HPLC pump (Knauer GmbH, Berlin, Germany) operating pressure up to 75 MPa.

As a result in the optimal SAS process conditions is possible to obtain phospholipids a purity of 99 ± 1% (expressed as a acetone insoluble matter) compared to 67% obtained during CE. Phospholipids in the SAS process was characterized by approximately 10% lower content of saturated fatty acids (SFA) and about 6.5% higher content of polyunsaturated fatty acids (PUFA) including an increase in DHA content of 2.8%.

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PHENOLIC CONTENT AND COMPOSITION ANALYSIS OF REDCURRANT AND CRANBERRY EXTRACTS IN RELATION TO THEIR ANTIOXIDANT ACTIVITY IN ERYTHROCYTE MEMBRANE

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Redcurrant and cranberry fruit is consumed because of its taste and healthy effect. Compounds contained in this fruits are known as agents acting preventively and therapeutically on the organism. Attributed to it is an antioxidant and anti-inflammatory action, helpful in the treatment of tumors and diseases of the nervous, digestive and especially blood systems. Polyphenolic compounds exhibit a variety of medicinal properties, in particular antioxidant properties, if they are provided and assimilated by the body. Knowledge of the mechanisms responsible for their effect on the organism at the molecular level is of vital importance for the point of view human health and nanotechnology in food sciences.

The purpose of our experiments was to investigate the mechanism of the antioxidant properties of extracts of cranberry and red currant fruits in correlation with erythrocyte membranes. The UPLC analysis of the polyphenolic composition was conducted. Polyphenolic content by Folin-Ciocalteu and extract amphiphilicity was determined. The antioxidant study was conducted with erythrocyte membranes, their oxidation being induced with UVC irradiation. Degree of oxidation of lipids was determined with the fluorimetric method on the basis of quenching the probe DPH-PA. Using the Fourier transform infrared spectroscopy (FTIR) method, it was specified the location in the membrane of red blood cells of the phenolic substances contained in the extracts and their impact on its degree of hydration. Also, the protective effect of the extracts towards changes in the membrane of erythrocytes due to its exposure to UVC radiation was determined.

The fruit of these plants, as UPLC analysis showed, are rich in many nutrients, including polyphenols. The HPLC analysis showed they are rich in polyphenols, in particular anthocyanins in red currant fruits and procyanidins and anthocyandins in cranberry. The extract studied show hydrophilic character also.

The FTIR and fluorimetric investigation showed that the extracts modify the erythrocyte membrane and protect it against free radicals induced by UV radiation. The results show

that the extracts protect erythrocytes against the harmful action of UVC radiation. The compounds contained in the extracts do not penetrate into the hydrophobic region, but bind to the membrane surface inducing small changes in the polar head groups of membrane lipids. The extracts have a high antioxidative activity. Their presence on the surface of the erythrocyte membrane entails protection against free radicals.

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Borawska J., Pliszka M., Darewicz M., Iwaniak A.

ANGIOTENSIN I-CONVERTING ENZYME ACTIVITY OF OAT (AVENA SATIVA L.) PROTEINS HYDROLYSATES

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In recent years an increase of interest in food ingredients with specific biological activity and health-related functions has been observed. Biologically active peptides derived from food proteins are considered as regulators of e. g. cardiovascular, immune, and nervous or digestive system.

The best known bioactive peptides with antihypertensive properties are angiotensin I-converting enzyme [EC 3.4.15.1] inhibitors (ACE inhibitors). They play a role in lowering high blood pressure and regulating the cardiovascular system activity. Oats proteins may be the source of ACE inhibitors. Nutritional value of globulins and prolamins from oat seeds is comparable to meat, eggs and milk proteins.

The aim of the study was to examine the angiotensin I-converting enzyme inhibitory activity of oat proteins hydrolysates.

The extracts of oat proteins were the materials taken for the analysis. The samples were subjected to the simulated digestion (*in vitro*) using human gastric and duodenal digestive juices isolated from volunteers. The SDS-PAGE method was used to verify the progress of hydrolysis. The ACE inhibitory activity of obtained hydrolysates was assayed according to method by Jimsheena and Gowda (2009).

It was found that the degree of hydrolysis and ACE inhibition increased during the digestion process. The sample treated with gastric and duodenal juices demonstrated the highest degree of ACE inhibition (84%, IC_{50} = 0.44 mg/ml). The degree of ACE inhibition of this sample was 37 p.p. higher in comparison with the untreated sample (47%, IC50 = 27.62 mg/ml). The proteins are only partially digested with pepsin in the stomach, so the sample hydrolyzed by gastric juice was characterized by a lower degree of inhibition (74%, IC50 = 5.25 mg/ml) in comparison with the 'gastro-duodenal' samples.

The results showed that the oat proteins can be the source of peptides with angiotensin I-converting enzyme inhibitory activity that are released during the simulated digestion.

Jimsheena V.K., Gowda L.R., 2009. Colorimetric, high-throughput assay for screening angiotensin I-converting enzyme inhibitors. Anal. Chem., 81 (22), 9388–9394.

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Boruczkowska H.[1], Figurska-Ciura D.[2], Boruczkowski T.[3], Drożdż W.[1], Tomaszewska-Ciosk E.[1]

INNOVATIVE USE OF WHITE BEET PULP AS AN INGREDIENT OF SHORTCRUST PASTRY

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The aim of the study was to obtain cakes with added white beet pulp and then to determine their physical properties and comparison with the properties of cakes obtained using the traditional method. Biscuits were prepared according to the basic recipe, which is then modified by replacing part of the wheat flour by dried white beet pulp. Pulp additions were respectively: 0, 20, 40, 60, 80 and 100% (without baking flour). Baking was carried out in a laboratory convection-steam oven Rational Self Cooking Center in controlled conditions at a temperature of 210°C and dry air (humidity 0%).

The study assessed the performance of the process and defines the physical characteristics of biscuits before and after baking – the maximum force and the work needed to cut the cake strength measured on an Instron machine and the color measured by Minolta camera. As the amount by weight of white beet pulp growing in cakes, the maximum force needed to cut the dough increase from the value of 3.32 N to the value of 15,1 N and the maximum force required to cut the baked cakes increase from the value of 25.1 N to the value of 91.1 N. At the same time work needed to cut the dough rising from a value of 7 mJ to a value of 23.8 mJ , and the work required to sever the finished baking increase from a value of 11.4 mJ to a value of 126.3 mJ. The addition of beet pulp caused to shift slightly dough color vector (Hue) from the value of 1.272 to 1.342, while lowering the intensity of the color (Chroma) from the value of 35.86 to 22.71. The work was also performed sensory profiles evaluation. Attributes evaluated were shape and size (uniformity, smoothness and color), consistency (crispness, hardness, brittleness, and fragility), structure (porosity, appearance of the fracture and degree of crushing of cakes when breaking), taste and smell (intensity of perceived taste and smell). All attributes were determined using structured scale with a possible range of scores from 1 to 5 where the higher number (5) denoted better attributes of the product and the lowest number (1) the worst.

The results obtained in the work allow us to conclude that it is possible to baking cakes with added white beet pulp.

Boruczkowski T.[3], Boruczkowska H.[1], Tomaszewska-Ciosk E.[1], Drożdż W.[1], Figurska-Ciura D.[2]

APPLICATION OF COMPUTER IMAGE ANALYSIS SOFTWARE TO DETERMINE THE DEGREE OF STARCH HYDROLYSIS

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The aim of the study was to use the computer image analysis software to determine the course of acidic and enzymatic hydrolysis of starch. Starch hydrolysis was carried out on a bench equipped with a webcam. The hydrolysis process was carried out in a glass beaker placed on a magnetic stirrer. An indicator of the process was the iodine dissolved in KI. The process of hydrolysis of starch was controlled by a camera taking pictures of the contents of the beaker in five-second intervals. At the same time every two minutes the small sample was taken from the beaker and assayed for glucose content using a spectrophotometric method with Fehling reagents. The resulting images were analysed in computer analysis program: ImageJ. First it was selected area of beaker and this area was separate into the basic color values (RGB – red, green and blue). Saturation of each color was presented by a computer program using an 8-bit value ranging from 0 to 255 and then the value of each color was correlated with the measured glucose content.

The applied method allows a rapid determination of the degree of hydrolysis of starch using a camera and computer software for image analysis. It also allows you to automatically interrupt the hydrolysis process at any point.

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Brodowska M.[1,2], Kołota A.[3], Guzek D.[2], Głąbska D.[3], Górska-Horczyczak E.[1,2], Wojtasik-Kalinowska I.[2], Pogorzelska E.[1,2], Wierzbicka A.[2]

TOTAL ANTIOXIDANT CAPACITIES OF PORK MEAT ENRICHED IN PUFA

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The study was carried out on two muscles: *Longissimus dorsi* (LD) i *Semimembranosus* (SM), which derived from 3 groups of pork meat. In each group were 6 animals, for 100±15 kg mass slaughter. Feeding scheme of pigs with the use of standard fodder as control (K), standard fodder supplemented in 3% linseed oil (L1) and standard fodder supplemented in linseed oil and antioxidants: 1 mg Se and 100 mg vitamin E (L2) on kg, was applied.

The aim of this study was to find the effects of antioxidant bioactive compounds (omega-3 fatty acids, vitamin E and Selenium) in pork meat on total antioxidant status of meat.

The measurements included total antioxidant activity by kit of Randox (nr kat. NX 2332), colour by Minolta CR-400 in L*a* b* system, pH by electrode Testo 205 and basic composition by spectrophotometer in the near infrared. To appoint differences between the groups, univariate analysis of variance and the Tukey'a test were used. In order to set correlation between factors, correlation matrix was applied. The level of significant statistically was accept (α=0.05).

In the case of *Longissimus dorsi* muscle there was no demonstrate statistically significant differences between the groups (p=0.9299) in antioxidant capacity, which may be due to type and specificity of muscle. In case of the *Semimembranosus* muscle (SM) a statistically significant difference between the groups (0.0053) in antioxidant status was demonstrate, (p= 0.0099 and p= 0.0124 for K vs L1 groups and L1 vs L2 groups respectively) and there was no of statistically significant differences between trials K and trials L2 (p= 0.9934). Data show that addition of polyunsaturated fatty acids to fodder had no influence on the antioxidant properties of meat while applying these doses of vitamin E and Se as an antioxidant substitution. No noticed statistically significant correlation between antioxidant status and component of colour's meat. The colour depends on pH of meat.

The results of this study indicate that diet enriched in bioactive compounds, has an impact on antioxidant status of pork meat. Total antioxidant status of pork meat enriched

in bioactive compounds depends on specificity of muscles and its activity. The presence of polyunsaturated fatty acids in pork meat reduces of amount antioxidant substance, which may be consumed in order to protect the bonds of polyunsaturated fatty acids. In study there is no demonstrating the impact of antioxidant status of meat on colour's meat.

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Brychcy E., Król Ż., Ulbin-Figlewicz N., Kulig D., Jarmoluk A.

THE EFFECTS OF LOW-CONCENTRATED ACIDIC ELECTROLYZED WATER ON SENSORY QUALITY OF FRESH PORK

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Many techniques have been devised to decrease microbial contaminants on raw meat. The treatment with acidic electrolyzed water (AEW) seems to be a promising method. AEW is an alternative with environmentally friendly broad spectrum microbial decontamination. It is produced by membrane electrolysis of a dilute sodium chloride solution in water ionizers. AEW is characterized by its low pH, high oxidation-reduction potential, high dissolved oxygen and free chlorine content. Acidic electrolyzed water has been tested and used as a disinfectant in the food industry and other applications.

It was hypothesized that AEW may be used as a sanitizing agent without causing adverse effects to pork meats. Therefore, the purpose of this study was to examine the effect of AEW treatment on sensory characteristics of pork meat during storage.

The research material was Longissimus dorsi muscle collected from Meat Plant Dworeccy. Material was purchased 48 hours post mortem. The muscle 50 mm thick slices were cut and sprayed with electrolyzed sodium chloride solutions on the meat surface for 120 s (immediately after preparation). Electrolyzed sodium chloride solutions at concentrations of 0.001, 0.01 and 0.1% were used for this study. Samples of fresh meat treated with sodium chloride solutions ((non)electrolyzed solutions) were packaged in foil bags PA/PE using *modified gaseous atmosphere* and stored for 7 days at a 4°C. Raw meat samples were analyzed for their texture, colour, odor and overall acceptability. Sensory qualities of the samples were evaluated using a 5-point hedonic scale. Sensory evaluation was accomplished at day 0 and repeated after 7 days of refrigerated storage at 4°C. Data were analyzed using a 2-way ANOVA. Differences between means were established with Duncan Test with 5% significance.

After 7 days of storage, the AEW-treated pork meat (electrolyzed 0.1% NaCl solution) had better sensory scores than the control. Furthermore, residual sodium chloride content of acidic electrolyzed water gives meat samples freshness color as well. These results indicate that AEW treatment apart from their antimicrobial properties can improve sensory qualities (positively affects the meat colour) and extend shelf life of the pork meat during storage at 4°C.

Brychcy E., Kulig D., Król Ż., Ulbin-Figlewicz N., Jarmoluk A.

LOW-CONCENTRATED ACIDIC ELECTROLYZED WATER AS AN ANTIBACTERIAL AGENT FOR WASHING FRESH PORK MEAT

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Over the last decade, application of acidic electrolyzed water (AEW) in meat sanitation has been studied as an alternative non-thermal method. The application of acidic electrolyzed water is limited because of its lower pH values. At pH<2.7, dissolved Cl_2 gas can be rapidly lost due to volatilization, decreasing the bactericidal activity of the solution by time and adversely affecting human health and the environment. Compared to acidic electrolyzed water, application of low concentrated electrolyzed water can minimize human health and safety issues caused by Cl_2 off-gassing

Acidic electrolyzed water is usually generated by electrolysis of a dilute NaCl solution in a chamber with anode and cathode electrodes separated by a membrane, and obtained from the anode side. AEW water has been proven to exhibit strong bactericidal activity to many pathogens.

The objective of this work was designed to evaluate the effectiveness of low-concentrated acidic electrolyzed water for reducing meat surface microflora on fresh pork.

The research material was *Longissimus dorsi muscle* collected from Meat Plant Dworeccy. Material was purchased 48 hours post mortem. The muscle 50 mm thick slices were cut and sprayed with (non)electrolyzed sodium chloride solutions on the meat surface for 120 s (immediately after preparation) and packaged in foil bags PA/PE using modified gaseous atmosphere and stored for 7 days at a 4°C. Electrolyzed sodium chloride solutions at concentrations of 0.001, 0.01 and 0.1% were used for this study. The control samples were non-electrolyzed sodium chloride solutions at concentrations of 0.001, 0.01 and 0.1%. Raw pork was an additional control sample. The physicochemical properties of low-concentrated AEW and its impact on surface decontamination (at 0 and 7-days of storage) of pork meat were evaluated. The amount of yeasts and moulds, the number of psychrotrophs and the total number of microorganisms were determined according to ISO 21527-1:2008, ISO 17410:2001, ISO 2293:1988, respectively. Data were analyzed using a 2-way ANOVA. Differences between means were established with Duncan Test with 5% significance.

3.1 log reduction of total number of microorganisms was observed after spraying the meat with 0.1% NaCl subjected to electrolysis by 10 minutes. The highest reduction of psychrotrophs (3.11 log) and yeast and moulds (2.7 log) were noted after treatment with electrolyzed 0.1% of sodium chloride solution.

These results suggest that the low-concentrated AEW had a good opportunity to use for protecting pork from bacteria and also may be possibly to apply in food industry.

Brychcy E.[1], Malik M.[2], Kulig D.[1], Król Ż.[1],Ulbin-Figlewicz N.[1], Jarmoluk A.[1]

INFLUENCE OF MEAT SURFACE OF ACIDIC ELECTROLYZED WATER TREATMENT

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Acidic electrolyzed water (AEW), which contains free chlorine, is considered to be effective for disinfection. AEW is generated by the electrolysis of a sodium chloride solution using positive and negative electrodes in chamber separated by a selective membrane, and is obtained from the well of the anode. There are two type of acidic electrolyzed water. Strong acidic electrolyzed water is effective against many human pathogens including *Bacillus cereus* and *Escherichia coli*. However, this type of water has a corrosive activity against food devices. Moreover, strong acidic electrolyzed water contains high concentrations of free chlorine and its byproducts may have cytotoxicity and genotoxicity. To minimize its corrosive activity and toxicities, AEW was prepared by the electrolysis of a solution containing low sodium chloride concentrations and low current of electrolysis (low-concentrated acidic electrolyzed water).

The purpose of the study was to investigate the influence of AEW on meat tissue escpecially on meat protein.

The research material was *Longissimus dorsi muscle* collected from Meat Plant Dworeccy. Material was purchased 48 hours post mortem. The muscle 50 mm thick slices were cut and sprayed with (non)electrolyzed sodium chloride solutions on the meat surface for 120 s (immediately after preparation). Electrolyzed and nonelectrolyzed sodium chloride solutions at concentrations of 0.001%, 0.01% and 0.1% were used for this study. Gel electrophoresis following the method of Davis (1964), the Fourier transform far infrared (FT-FIR), middle-infrared (FT-IR) and the FT-Raman spectra were performed 24 h after treatment meat samples with AEW. The FT-FIR and FT-IR spectra were measured on a Bruker VERTEX 70 V vacuum spectrometer equipped with an ATR accessory and air-cooled DTGS detector. For the FT-IR spectra (in the range 4000–400 cm^{-1}) and the far infrared spectra (in the range 600–50 cm^{-1}) the diamond ATR accessory was used and the spectra were elaborated in the OPUS™ software to convert them from reflectance into absorbance. The instrument was kept under vacuum during measurements, and the spectra were recorded at a resolution of 2 cm^{-1}. The FT-Raman spectra (in the range 3500–50 cm^{-1}) were measured on a Bruker MultiRAM spectrometer equipped with a Nd:YAG laser (emitting radiation at a wavelength of 1064 nm) and a liquid nitrogen cooled germanium detector. The spectra were recorded at a resolution of 4 cm^{-1} with co-addition of 512 scans, and with a max power of 500 mW.

The obtained results show, that composition of the study materials are the same. This demonstrates an absence of formation a new chemical compounds and denaturation of meat protein during the process of sample preparation.

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Brychcy E., Ulbin-Figlewicz N., Kulig D., Król Ż., Jarmoluk A.

INFLUENCE OF LOW-CONCENTRATED ACIDIC ELECTROLYZED WATER ON VARIABILITY OF HAEM PIGMENTS PROCESSES IN FRESH PORK

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Chemical decontamination treatments contain a variety of substances such as organic acids, strong electrolyzed water, or trisodium phosphate. Many of them result in physical changes involving colour, odour, and texture of meat. Therefore, it is crucial to develop a reliable alternative for current methods. Over the last decade, application of strong acidic electrolyzed water in meat sanitation has been studied.

Acidic electrolyzed water (AEW) is a newly recognized disinfecting compound that has the potential to be used for inactivation of pathogenic microorganisms associated with fresh pork. The generation of electrolyzed water involves reactions in a cell containing inert positively charged and negatively charged electrodes, respectively, separated by a membrane, and through which a dilute salt water solution passes. Acidic electrolyzed water is obtained from the anode side.

The purporse of the study was to evaluate the influence of low-concentrated acidic electrolyzed water (which possesses antimicrobial activity) on colour of pork meat.

Electrolyzed sodium chloride solutions at concentrations of 0.001, 0.01 and 0.1% were used for this study. Samples of fresh meat treated with sodium chloride solutions ((non)electrolyzed solutions) were packaged in foil bags PA/PE using *modified gaseous atmosphere* and stored for 7 days at a 4°C. Colour parameters L*, a*, and b* were determined in the international CIE system using a Konica-Minolta CR 400 colorimeter and meat pigments were measured by modified method of Warris (1979). Data were analyzed using a 2-way ANOVA. Differences between means were established with Duncan Test with 5 significance.

It was found that low-concentrated acidic electrolyzed water treatment has an influence on concentration of haem pigments, concentration of myoglobin forms and on CIELAB colour values. The meat sprayed by electrolyzed 0.1% of NaCl solution has more intense red colour in accordance to the control. Other studies proved that these colour changes are not significant for consumers but influenced on more acceptability.

Brychcy E., Ulbin-Figlewicz N., Kulig D., Król Ż., Jarmoluk A.

APPLICATIONS OF ACIDIC ELECTROLYZED WATER IN THE FOOD INDUSTRY

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Acidic electrolyzed water (AEW) is a novel antimicrobial agent which has been used in Japan for several years and which is now gaining popularity in other countries. It has been reported to possess antimicrobial activity against a variety of microorganisms. Little is known about the principle behind its sterilizing effect, but it has been shown to have significant bactericidal, virucidal and moderate fungicidal properties

AEW is produced by membrane electrolysis of a dilute sodium chloride solution in water ionizers where anode and cathode electrodes are separated by a membrane. Acidic electrolyzed water is obtained from the anode side and characterized by its low pH, high oxidation-reduction potential, high dissolved oxygen and free chlorine content.

The purpose of the study was to overview of issues related to the acidic electrolyzed water and its effective in reducing or eliminating foodborne pathogens on kitchen boards and on various food products, such as fish, poultry, fruits, and vegetables, on which it reduced populations of pathogens to undetectable levels.

AE water has gained interest as a disinfectant used in agriculture, dentistry, medicine and food industry. It has been shown as an effective antimicrobial agent for cutting boards, poultry carcasses, eggs, lettuce, alfalfa seeds, sprouts, pears, apples, peaches, tomatoes, strawberry and food processing equipments. It also has the potential to be more effective and inexpensive than traditional cleaning agents.The greatest advantage of anodic water for the inactivation of pathogenic microorganisms relies on its less adverse impact on the environment and it is more effective, less dangerous and less expensive than most traditional preservation methods such as glutaraldehyde, sodium hypochlorite and acetic acid. The use of acidic electrolyzed water is an emerging technology with considerable potential.

Bryła A., Juzwa W., Lewandowicz G.

ENCAPSULATION OF ELDERBERRIES EXTRACTS INTO PHOSPHOLIPIDS NANOPARTICLES

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Elderberry (*Sambucus nigra*) belongs to the Caprifoliacea family. Fructus Sambuci (elderberry fruits) have been used for generations in both home therapy and supplementation. High content of bioactive factors justifies the use of elderberries in treatment of many illnesses. However, application of fresh fruits may be questionable due to the presence of toxic sambunigrin and high susceptibility to degradation of its bioactive compounds. The use of fruits extracts encapsulated in liposomes may be the solution. Liposomes are microspheres made of surfactant bilayers both filled with and suspended in an aqueous solution. The unique structure of the vesicle provides the necessary barrier properties and allows efficient encapsulation process. It allows the inner solution to be released in a specific locations and conditions, and increases bioavailability of bioactive compounds. The aim of the research was to define, which one, among tested lecithin types, would be the most suitable for stable, single-layer, liposomes preparation. Given liposomes are to be used as a potential carriers for elderberry extract, source of bioactive compounds.

Liposomal nanocapsules were prepared from commercially available soya, sunflower and egg yolk lecithins by freezing-thawing technique and hydrated with elderberry extract. Size, stability and zeta potential of the obtained structures and encapsulation process efficiency were investigated. It has been revealed, that soy lecithin is the best material for liposomes preparation among testes once. Soy lecithin liposomes population was characterized by homogenous size, good stability, and relatively high encapsulation efficiency.

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Bryła A., Juzwa W., Lewandowicz G.

PHOSPHOLIPID NANOPARTICLES AS BIOACTIVE COMPOUNDS CARRIERS

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Potato juice is known from its bioactive properties and beneficial influence on gastrointestinal tract. However, it is highly susceptible to degradation and many of its valuable compounds, especially flavonoids are not efficiently absorbed. Therefore, there is a need for encapsulation assays. Microencapsules are usually inconvenient to use in food matrix. However, nanoencapsulation into liposomes is adequate both for hydrophilic and hydrophobic compounds preservation. Liposomes are vesicle-like structures made from phospholipid bilayer filled with and suspended in an aqueous solution.

The aim of the study was to develop a method for a potato juice hydrolisate encapsulation into liposomes and to characterize physicochemics of the obtained nanocarriers.

The encapsulated material was potato juice hydrolisate. Liposomes were prepared from egg yolk, soy and sunflower lecithin by Bangham method. Liposomes population has been characterized by ζ-potential and size determination by Dynamic Light Scattering technique. The obtained results were confirmed by flow cytometry. Finally, encapsulation efficiency was calculated.

As a result of given research, one has proved that a hydrolisate from potato juice can be encapsulated into liposomes. Moreover, it was revealed, that the most suitable shell building material among tested lecithin is a soy one. Vesicles obtained from soy lecithin were relatively stable and homogenous. The encapsulation process itself was characterized by satisfactory efficiency level. For all the above mentioned reasons, it can be assumed, that liposomes are an adequate carrier and, potentially, can increase both stability and intestine absorption rate of potato juice hydrolisate.

The work was financially supported by the grant POIG 01.01.02-00-061/09 "Bioactive food" implemented within the Programme Innovative Economy 2007–2013.

Buda B., Dąbrowska A., Szołtysik M., Pokora M., Babij K., Chrzanowska J.

IMPROVING OF NUTRITIONAL VALUE OF YOGHURT WITH CHELATING BIOPEPTIDES

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Milk proteins are an attractive source of biologically active peptides, which are released from their sequence during hydrolytic processes occurring *in vivo* in digestive tract as well as *in vitro* during fermentation of dairy products or by enzymatic hydrolysis. Those biopeptides may reveal several important properties, such as: metal ions-chelating, antioxidant, antimicrobiological, antydiabetic and antihypertensive activities. Particularly interesting are chelating peptides, which could be applied for improving human health and act as disease preventing factors. Chelating peptides may also increase mineral bioavailability for the organism and inhibit the production of reactive oxygen form. The aim of this study was to obtain more nutritionally attractive yoghurt by introduction to these product metal ions-chelating peptides. The iron-chelating peptides were prepared from casein hydrolyzates obtained after degradation conducted with pepsin. After thermal inactivation of the enzyme the resulted hydrolyzate was dried, subjected to chelation process with 0.05M $FeCl_3$ and, after additional drying, used in yogurt production in amount of 4%. The determined amount of Fe was higher in analyzed yogurt in comparison to control one and proportional to the used dose.

Calin Sanchez A.[1], Lech K.[2], Szumny A.[3], Figiel A.[2], Carbonell-Barrachina A.A.[1]

DRYING KINETICS AND QUALITY OF MARJORAM DEHYDRATED BY DIFFERENT METHODS

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Marjoram (*Origanum majorana* L.) is a perennial herb in the mint family that grows wild in the Mediterranean region. It is used primarily as seasoning in cooked dishes but is also found in beauty and health care products due to its antiseptic and anesthetic properties. This herb is usually preserved by drying.

The aim of the study was to determine the drying kinetics and find the optimal drying conditions ensuring the best quality of the dried marjoram herb in terms of chemical composition and sensory attributes.

The marjoram herb of cultivar Miraż was dehydrated by convective drying CD at three temperatures (40, 50 and 60°C), vacuum-microwave drying VMD at different microwave powers (240, 360 and 480 W) and the combination of CD and VMD. The drying kinetics was determined by a gravimetric method and the temperature of VMD samples was measured with the infrared camera Flir i50.

The influence of different drying methods, described above, on aroma compounds of *Origanum majorama* was evaluated. Volatile compounds of studied samples were obtained by hydrodistillation-extraction process on Deryng apparatus. The chemical composition was established on the basis of analyzed on gas chromatography coupled with mass spectrometer. Sensory evaluation with trained panel was used to discriminate the intensities of the main aromatic characteristics of marjoram samples.

The decrease of moisture ratio in time was described by Page model, which was fit to experimental points at satisfactory statistical coefficients. The time of drying was from 255 to 2100 min for CD and from 14 to 28 min for VMD depending on the drying parameters. The application of VM finish drying significantly decreased the time of CD. The highest temperature of the samples measured during VMD amounted to 48, 51 and 53°C for 240, 360 and 480 W, respectively. This temperature was below 50°C for samples dried by the combined method.

Thirty three volatile compounds were identified. The most important for the flavour were: sabinene hydrates and its acetates, a-terpineole, a-pinene and g-terpinene. Yield of obtained oil in fresh marjoram (790mg $100g^{-1}$ db) in each case was reduced. The high maintenance of essential oil was obtained in case of vacuum-microwave technique (~780mg $100g^{-1}$ db). Opposite to VM method, the most common used technique, convective drying (60°C), yielded the highest loses in volatiles (up to 30% of initial amount). The best sensory profile of plant material obtained, as well as maintenance of essential oil recommended vacuum-microwave technique to *Origanum majorama* drying.

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Carbonell-Barrachina A.A.[1], Figiel A.[2], Calín-Sánchez A.[1], Hernández F.[2], Szumny A.[4], Nuncio-Jáuregui N. [1],Noguera L.[1], Wojdyło A.[5]

POMEGRANATE BASED FOODS AND PRODUCTS: COMPOSITION, CONSUMER ACCEPTANCE, FUNCTIONALITY AND DEVELOPMENT OF NEW PRODUCTS

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Pomegranate (*Punica granatum* L.) is gaining acceptance among international consumers mainly because of its health benefits and attractive appearance and color.

Among pomegranate products, **hydrosustainable products** (obtained after application of deficit irrigation strategies, which save water and are environmental friendly) are among the most popular ones. These products are characterized by dark color, high contents of bioactive compounds and advance optimal harvest time, which is interesting from a commercial point of view (Galindo et al. 2014). Before that, Carbonell-Barrachina et al. (2012) evaluated the potential of sour-sweet pomegranate fruits for the juice industry.

The potential interest of **sour and sour-sweet pomegranate** fruits is being studied. For instance, Vázquez-Araújo et al. (2013) fully described the **sensory profiles** of 13 Spanish cultivars and their **aptitudes for processing or fresh consumption**.

Calín-Sánchez et al. (2013 and 2014) studied the **drying** kinetics, chemical composition, antioxidant capacity, sensory quality and energy consumption in the dehydration of pomegranate arils and rind by different methods. Vacuum-microwave and convective pre-drying and vacuum-microwave finishing drying are good options for food drying industry to simultaneously reduce the drying time and the energy consumption.

Due to the high popularity of pomegranate, new products are being developed. For instance, Andreu-Sevilla et al. (2013) described the volatile composition and the sensory profile of **pomegranate wine**. Besides, full usage of the co-products and wastes generated in the industrialization of pomegranate are the final goal of current research. In this way, immature fruits removed during the farming practice "**thinning**" (reducing fruit load to allow remaining fruits to develop their maximum size and quality) are being characterized and have very high total polyphenol content and antioxidant capacity (Nuncio-Jáuregui et al. 2014a).

Full characterization of polyphenols is being currently conducted by LC-PDA-QTOF/MS and UPLC-PDA, and compounds such as punicalagins and ellagic acid play important roles.

Nowadays **adulteration** of pomegranate juice has been detected owing to high product demand, high price, short harvest season and shortage of production. A simple method to detect adulteration has been implemented using simultaneous analyses of parameters such as volatile compounds, sugars, organic acids, proline, and minerals, especially K (Nuncio--Jáuregui et al. 2014b).

Koppel et al. (2014) studied the **drivers of liking** for pomegranate juice in Estonia, Spain, Thailand and United States. The most important conclusions were: (i) individual consumer variation is greater than country specific variation and (ii) taste sensitivity or prior exposure rather than flavor are important in acceptability of this product.

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Cegielska-Radziejewska R., Szablewski T.

EXTENSION OF THE SHELF-LIFE OF PORK MEAT PACKAGED IN A MODIFIED ATMOSPHERE BY TREATMENT WITH THERMOCHEMICALLY MODIFIED LYSOZYME

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Egg lysozyme has desirable properties as a food preservative and is considered as a safe food ingredient. The antibacterial action of different forms of lysozyme (monomer and thermochemically modified lysozyme) on microflora, physico-chemical and sensory attributes of pork meat packaged in different preservative gases atmospheres (65%O_2, 25%CO_2, 10%N_2, 50%O_2, 40%CO_2, 10%N_2, 80%O_2, 20%CO_2) and stored at a 4±1°C was investigated in this study.

Treatment of the samples included no addition (control), addition of monomer and addition of modified lysozyme. The monitored parameters included: microbiological (TVC, *Enterobacteriaceae*, *Pseudomonas* spp. and lactic acid bacteria) and physico-chemical indexes (pH, color) as well as a sensory attribute, i.c. – aroma. Analyses of samples were conducted during four weeks of storage. The proportions of polymeric forms, hydrolytic activity and hydrophobicity were determined in the produced lysozyme preparation. The content of lysozyme polymeric forms after modification was evaluated by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). Lysozyme hydrolytic activity was determined by spectrophotometry.

The modified lysozyme was characterized by lower hydrolitic activity and higher hydrophobicity than lysozyme monomer. It was shown that modified lysozyme, in comparison to monomer, exhibited a more effective antibacterial action against analyzed groups of bacteria, especially *Pseudomonas* and bacteria from the family *Enterobacteriaceae*. It was indicated that surface application of modified lysozyme allows to retards the appearance of adverse changes in aroma in the meat.

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Chmiel M.[1], Florowski T.[1], Słowiński M.[1], Payne D.S.[2], Powers T.H.[2]

THE CHANGES IN COLOR QUALITY OF BEEF STORED IN MODIFIED ATMOSPHERE (CO_2/N_2) WITH OXYGEN SCAVENGER

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The aim of this study was to characterize the changes in color of beef stored up to 16 days in the master bags with modified atmosphere (CO_2/N_2) and oxygen scavengers and during the further storage in the display case with access to atmospheric oxygen.

The study was conducted on case-ready units of beef (flank). The meat was placed on a polystyrene tray overwrapped with a perforated PVC stretch film. Next, the samples were placed into master bags each made of a barrier film. One O_2 scavenger (FreshPax® CR, Multisorb Technologies®) was loosely placed in the headspace of the master bags in order to absorb residual oxygen after gas mixture filling. The master bags were filled with the gas mixture of CO_2 (30%) and N_2 (70%), sealed and stored in the cooling room (2.0±1.5°C) in the dark. After 1, 6, 13 and 16 days of storage, master bags were measured for residual oxygen (CheckPoint II analyzer). Then, packages were opened and the trays with the meat were placed for up to 48 hours in the display case (6.0±2.5°C, PAROS 1.3, Igloo). The meats were constantly exposed to the light in order to simulate the commercial conditions at retail level.

Immediately after opening master bags and after 0.5, 1, 2, 24 and 48 hours of storage in the display case, the color of meat was evaluated in CIEL*C*h° scale using Minolta CR200 colorimeter.

Based on the obtained results, it was found that the oxygen scavengers (FreshPax® CR, Multisorb Technologies®) within 24 hours after packaging removed the residual oxygen from master bags and maintained this state throughout the whole period of storage i.e. 16 days. Meat packed in master bags was characterized by a dark purple color, typical for meat packed without an oxygen. The sufficient time to return to a pink-red color of the meat and its stabilization was 30 minutes after opening the package and exposing meat to atmospheric oxygen. This preferred color of beef was maintained for 48 h of storage in the display case.

Chorążyk D.[1], Łaba W.[2], Kopeć W.[1], Pudło A.[1]

ENZYMATIC DIGESTION OF PRETREATED CHICKEN FEATHERS WITH CRUDE BACTERIAL KERATINASE

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The purpose of the study was to evaluate the effect of feathers pretreatment with sulfite on the amino acid composition of keratin hydrolysates obtained after digestion with crude keratinase of *B. cereus* B5esz.

Chicken feathers, prior to enzymatic digestion, were subject to a moderate thermo-chemical pretreatment through autoclaving (121°C, 20 min) in sulfite solution (1 mM or 10 mM). After washing and drying, feathers were used in the digestion experiment. Proteolytic digestion of chicken feathers was carried out with concentrated, cell-free culture fluid of keratinolytic *Bacillus cereus* B5esz. The hydrolysis was conducted for 24 hours at 55°C in a reaction mixture containing degreased feathers (1%), enzyme preparation (50U), $CaCl_2$ (1 mM), NaN_3 (0,02%) in Tris-HCl buffer 0,05M, pH 7,5. The influence of sulfite addition in the reaction mixture during digestion of feathers without thermal treatment was also determined.

The amino acid composition of the obtained hydrolysates was analyzed in order to assess the hydrolysis advancement and to estimate their potential value.

The HPLC analysis of amino acid composition was conducted after derivatization with O-phthalaldehyde. Separation was monitored with use a fluorescent detector. Amino acids standards were used for the method validation. The linear relationship between amino acids standards of six different concentrations and peak areas was found.

The reaction efficiency of enzymatic digestion of keratin was expressed as total concentration of amino acids released into the reaction mixture. In the obtained hydrolysates 15 amino acids were identified. The research revealed that thermo-chemical pretreatment (with 1 mM or 10 mM Na_2SO_3) of feathers, prior to enzymatic hydrolysis substantially increased efficiency the of enzymatic keratin degradation ca. 4 – and 5 – times. Feathers pretreatment did not much affect the concentration of tyrosine, lysine, glycine and methionine; however stimulated the liberation of glutamine into the mixture, which was not found in controls. The largest increase in the concentration was observed for branched chain amino acids (BCAA), serine, glutamic acid and histidine. Increasing the concentration of sulfite (from 1 mM to 10 mM) during the pretreatment stage caused beneficial increase in the concentration of the released amino acids by 27%.

Application of 1 mM Na_2SO_3 in the reaction mixture during enzymatic digestion of untreated feathers, resulted in moderate, 17% increase in the amino acid yield, whereas an addition of 10 mM Na_2SO_3 caused enzyme inhibition.

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Chwastowska-Siwiecka I., Skiepko N.

EFFECT OF MARINE ALGAE *(SCHIZOCHYTRIUM SP.)* ADDITION TO FEED MIXTURE ON THE CHEMICAL COMPOSITION AND FRESHNESS OF INTRAMUSCULAR LIPIDS OF RABBIT MEAT

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The experimental material were rabbits of Termond White breed (n=150), that were allocated to 3 analogous feeding groups, 50 rabbits each. The animals (75♀ and 75♂) were fattened at the Experimental Station of the National Research Institute of Animal Production (ZDIZ PIB) in Chorzelów in the autumn-winter season. Since weaning till day 60 of life, the rabbits were fed a complete standard feed mixture, whereas in the last 30 days of fattening, mixtures of two experimental groups (group II and III) were enriched with 20 and 40 g per kg addition of biomass from marine algae *(Schizochytrium sp.)*. Slaughter and post-slaughter handling were conducted in compliance with binding procedures. Carcasses were cooled at a temperature of ca. 4°C for 24 h. The boned thigh muscles were determined for chemical composition, vitamin E, total cholesterol and intramuscular lipid freshness (TBARS and acid value).

The analysis of the chemical composition showed, that the higher content of dry matter (24.81%) and fat (2.19%) characterized thigh muscles of rabbits fed with the addition of 20 g per kg of marine algae, which was confirmed statistically ($P \leq 0.05$). The average participation of total protein in the studied experimental groups was similar. Although the highest level of this component of at 21.98% was found in the muscle of rabbits, which receiving the control diet during the fattening. Relatively high level shaped of the participation of mineral compounds, identified form the ash in the analyzed meat. The muscle samples of animals fed control feed and the addition of 20 g per kg of marine algae content of this component was similar and respectively accounted for: 1.13 and 1.12%.

A higher content of total cholesterol (68.20 mg/100 g) was obtained in the muscle of rabbits fed diet supplemented with 40 g per kg of marine algae. Participation of vitamin E was the lowest (2.06 μg/g) in muscle to derive from animals fed with feed from marine algae in an amount of 40 g per kg, which was confirmed statistically ($P \leq 0.01$). The content of vitamin E in meat samples of rabbits receiving the control mixture and with the addition of 20 g per kg of algae biomass was higher respectively about: 1.43 and 1.07 μg/g, in comparison to the group fed with the highest level of marine algae.

It was found that changes on the freshness of intramuscular lipids were not dependent on fattening rabbits used in feed containing of biomass from marine algae. The analysis showed that the highest acid value was in thigh muscle of rabbit fed with 40 g per kg addition

of marine algae (2.69 mg 0.1n KOH/g). Samples of meat originating from the control feed group were characterized by the lowest acid value, which ranged from 1.38 mg 0.1n KOH/g. In the studies reported, the effect of compound feed mixtures on the level of malonaldehyde in samples of thigh muscle, which was confirmed statistically ($P \leq 0.05$). The highest average content of malonaldehyde (1.37 mg per kg) was found in the muscles of rabbits fed the enriched mixture of 40 g per kg of biomass from marine algae.

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Czaja A., Mizgier P., Wyspiańska D., Sokół-Łętowska A., Kucharska A., Czubaszek A.

COMPARISON OF EXTRACTION METHODS FOR THE DETERMINATION OF BREAD ANTIOXIDANT ACTIVITY

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The bread composition depends on the formula and the fermentation process. During determination of the antioxidant activity due to spectrophotometric measurements a selection of a suitable extractant is necessary. Further prerequisite is reliable and comparable method for the preparation of the bread extract. When selecting a suitable extraction method laboratory practice must be also taken in the account.

The main aim of the study was to compare the effectiveness of two extractants for the determination of antioxidant activity in bread with addition of plant extracts.

Breads were prepared from straight dough as described by Karolini-Skaradzińska et al. (2001). Flour, water, fresh yeast (3% flour weight) salt (1,5% flour weight) and plant extracts (0 or 1% flour weight) were united and mixed until consistency of 300 FU was obtained. The samples for the extraction were obtained from frozen, lyophilized and shredded breads. The antioxidant activity in 80% acetone or 80% methanol bread extracts was determined by ABTS, DPPH and FRAP.

The method of extraction had varying impact on the results of antioxidant activity determined by various methods. In case of wheat bread and bread with addition of microencapsulated red cabbage extract, FRAP and DPPH analysis showed that extraction with 80% methanol was more efficient. Only for breads with onion husk extract, FRAP method showed that extraction with 80% acetone is more effective. When bread with microencapsulated onion husk extract was analyzed there was no difference in antioxidant activity between results obtained with different methods of extraction. It turned out that the type of the extractant had greater significance during the determination of antioxidant activity with FRAP method than with ABTS and DPPH methods. Due to comparability of the results and simplicity, the method of extraction with 80% methanol is recommended.

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Czaja A., Wyspiańska D., Mizgier P., Kucharska A., Sokół-Łętowska A., Czubaszek A.

CHANGES OF ANTIOXIDANT ACTIVITY DURING STORAGE OF WHEAT BREADS ENRICHED WITH ONION HUSK EXTRACT

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Enrichment of bread with diverse supplements has a long tradition among artisan and factory bakers. Various additives were used and are used both for their taste and for health properties. Onion is a popular addition to bread, mainly in a roasted form. Due to its high content of derivatives of quercitin, which possess anti-inflammatory properties, onion provides not only taste qualities but also health promoting appeal. Onion husk is onion processing by-product that also contains quercitin and thus may serve to enhance visual and health properties of bread.

Dry onion husks were united with 80% ethanol with addition of $NaHSO_4$ (0,1ml/l). Then extract was compacted to 30% of previous volume of ethanol and shaken with hexane. The bottom stratum was collected and evaporated. The onion husk extract was obtained by vaccum drying of the residue.

The purpose of the research was to determine changes of antioxidant activity of breads enriched with various onion husks extract content and their stability during storage.

Wheat flour (ca. 0.55% ash content), water, yeast, salt and various quantity of onion husk extract (0; 0.5; 1%) were united in Stephan UMC 5 and mixed at 900 rpm for 3 minutes. Doughs were bulk fermented and degassed twice after 60 and 90 minutes. Proofing took from 50 to 60 minutes. Doughs were divided after second degassing – the weight of pieces varied around 86 grams. Baking took place at a 230°C. After cooling yield and volume of breads were determined. The colour of crumb was determined after 24 hours according to CIELab.

ABTS, DPPH and FRAP methods were used to measure antioxidant activity in fresh bread and bread stored for 24, 48 and 72 hours in room temperature. Total polyphenols quantity was also determined during the storage. Breads were frozen, lyophilized and shredded prior to extraction for the purpose of determination of the antioxidant activity and total polyphenols content.

Bread yield and colour was influenced by the quantity of the extract. Breads with onion husk extract were darker than wheat bread. Onion smell was slightly detectable. The addition of onion husk extract caused a growth of the antioxidant activity and total polyphenol content. The increase was proportional to the addition of the extract. Breads antioxidant activity was stable during the storage. Breads enriched witch onion husk extract had a higher antioxidant activity than wheat bread. The storage had little effect on the antioxidant activity of breads and the onion husk extract might be considered a promising bread additive.

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Czarniecka-Skubina E., Wachowicz I., Rosiak E., Grzesińska W.

EFFECT OF HYGIENE IN THE CATERING ESTABLISHMENTS ON MICROBIOLOGICAL QUALITY OF DISHES PREPARED IN COOK-CHILL TECHNOLOGY

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The aim of the study was to evaluate the hygienic condition of the plant and microbiological safety of selected dishes prepared in cook-chill technology, stored in the refrigerator up to 5 days in catering establishment, representing institutional catering and serving meals intended for 3000 consumers.

The total viable count of bacteria (TVC) and the Total viable count of psychotrophic bacteria (TVPC) were determined in chilled dishes. The study was performed in three series. It was assumpted that the dish is safe when the number of microorganisms does not exceed 10^5 cfu/ 1 g of product. Bioluminescence method, which makes use of a luminometer and the contact method using Petrifilm™ 2000 of company 3M were applied for evaluation of the hygienic condition of catering establishment. *Aerobic Count Plate*, *Selected E. coli Plate*, and *Coliform Count Plate* tests were used.

It was found that there is a lack of reproducibility of microbiological evaluation of meals in different study series. Large discrepancies of results between the series and high values of TVC in first tests on the production day were shown: the poor quality of raw materials or lack of reproducibility of their quality, failure to ensure the necessary parameters of technological processes in the production meals, and failure to provide correct temperature of storage products.

On the basis of evaluation of the hygienic condition of establishment it was found: the lack of appropriate hygiene conditions for the production of dishes in cook-chill technology, resulting from non-compliance with GHP / GMP by personnel. Health risk assessment for people consuming dishes in the evaluated catering establishment was estimated. The necessity of standardisation of technological process and precise monitoring of established technological parameters.

In the initial stage of implementation of the cook-chill system in evaluated catering establishment, due to the problems with ensuring proper of production hygiene, shelf life of produced meals may not exceed three days, assuming that the first day is a day of production, and the third day is the day of consumption.

There is a strict relationship between good hygiene practices and production of safe food. The use of cook-chill technology in meals production in the evaluated establishment, due to the high risk of consumers, requires caution and monitoring of the effectiveness of hygiene treatments performed.

Danaher M.

DEVELOPMENTS IN THE ANALYSIS OF ANTIPARASITIC AGENTS IN FOOD AND THE IMPACT FOR INDUSTRY

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Food producing animals can be exposed to a wide of parasitic infections during their life time. These internal parasites (worms, fluke and coccidia) and external parasites (lice, ticks, mites and flies) can affect animals at various stages of production including during grazing or housing. Parasites can be controlled by a range of antiparasitic agents, whose usage can varies greatly depending on the nature of the production system (extensive or intensive), geographical/climatic factors and national licensing. Antiparasitic agents are one of the most important groups of veterinary drugs and are necessary to maintain animal health and animal productivity. They are also the most widely used veterinary drugs because they are often administered as a blanket herd treatment. In this presentation, analytical methods for analysis of antiparasitic drugs belonging to the anthelmintic, coccidiostat, endectocide and ectoparasitic classes will be discussed. A review of literature has shown a move away from traditional HPLC based methods to LC-MS/MS. Research has shown that the inclusion of a wide range of antiparasitic agents is chromatographically possible but the development of a generic selective sample preparation is difficult. Researchers have explored the application of different sample preparation protocols including generic solvent extraction, dilute and shoot, QuEChERS and cold temperature treatment. However, to date no one sample preparation method has been developed that allows the analysis of a broad range of substances in a single analysis. In summary, technologies are available to detect a wide range of antiparasitic veterinary drug agents in food and are becoming more widely used for residue surveillance purposes. There are still gaps in the analysis, particularly for older drugs that are still widely used outside of the European Union and polar compounds that are difficult to analyse. In conclusion, the application of these technologies is very advantageous in terms of sensitivity and analytical scope of methods. Indeed, implementation of these methods in recent years has resulted in the successful detection of a number of new emerging residue issues in food including, flukicides and emerging coccidiostat drug residues.

Dankowska A., Małecka M., Krupa M.

APLICATION OF SYNCHROMOUS FLUORESCENCE SPECTROSCOPY WITH MULTIVARIATE DATA ANALYSIS FOR THE DETECTION OF BUTTER ADULTERATION WITH COCONUT OIL

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Adulteration of butter is practiced for economical purposes and the detection of foreign fat in milk fat is a real issue of the dairy industry. The most common adulterants of butter are coconut and palm oils .

The aim of the study was to examine the synchronous fluorescence technique to detect adulteration of butter with palm oil. Synchronous fluorescence spectra were collected in the region of 280–700 nm with wavelength intervals (Δλ) of 10, 30, 60 and 80 nm. Successive Projections Algorithm was used to select five most important wavelengths from the spectra collected for each wavelength interval.

Further, regression analysis of synchronous spectra intensities was used to calculate the limits of adulteration of butter with palm oil. Detection limits were calculated as three times the standard deviation of the intercept, divided by the calibration curve slope. According to the data acquired at 10, 30, 60 and 80 nm wavelength intervals, the lowest detection limits of adulteration equaled 6.2, 6.4, 5.5 and 6.0%, respectively.

Moreover, the Multiple Linear Regression models were built to enable the prediction of percentage of soybean oil added to extra virgin olive oil. The lowest root mean square errors of calibration and the root mean square errors of cross validation were acquired for the wavelength intervals 60 and 80 nm. The results obtained for both parameters were comparable and equaled 1.4; 1.8 and 1.5; 2.0 respectively. Synchronous fluorescence spectroscopy together with multiple linear regression analysis can be successfully applied for the quantitative determination of adulteration of butter with coconut oil.

Darewicz M.[1], Borawska J.[1], Minkiewicz P.[1], Vegarud G.E.[2], Iwaniak A.[1]

EVALUATION OF SALMON PROTEIN HYDROLYSATES FOR ACE INHIBITORY AND ANTIOXIDANT ACTIVITIES

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Fish proteins may be the source of bioactive peptides such as angiotensin I-converting enzyme (ACE) inhibitory and antioxidative peptides. Salmon myofibrillar and sarcoplasmic proteins were examined as bioactive peptides precursors after both *in vitro* digestion and hydrolysis.

The method was developed using carp muscle tissue. The *in vitro* digestion method using human digestive juices isolated from the stomach and duodenum of volunteers consisted of the following steps: (1) "chewing" – 3 min, (2) "stomach" with a gradual lowering of pH – 2 hours, the final pH = 2.5, (3) "duodenal "– one hour, pH = 7.0. Then, using the mentioned method, *in vitro* hydrolysis of protein extracts was carried out applying commercial enzyme preparations such as pepsin and Corolase PP.

Hydrolysates of salmon myofibrillar and sarcoplasmic proteins obtained by *in vitro* digestion and *in vitro* hydrolysis showed ACE inhibitory and antioxidant activities. The increase of ACE inhibitory activity and scavenging ABTS+• activity of salmon myofibrillar and sarcoplasmic protein hydrolysates from all stages of both *in vitro* digestion and *in vitro* hydrolysis was observed. The samples after *in vitro* hydrolysis showed greater activity as ACE inhibitors and lower activity as ABTS+• radical scavenger than the samples after digestion by human digestive juices. It was possible to identify 13 and 10 peptides with ACE inhibitory activity and/or antioxidant activity in hydrolysates of myofibrillar and sarcoplasmic proteins of salmon obtained by *in vitro* digestion and *in vitro* hydrolysis, respectively.

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Dymek M.[1], Ingvortova M.[2], Kupczyński R.[1], Dobrzański Z.[1]

INFLUENCE OF HOUSING SYSTEM ON EGG QUALITY AND FATTY ACIDS PROFILE OF YOLK

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All housing systems for laying hens offer a number of potential advantages and disadvantages. Data from a number of studies revealed differences in egg quality depending on the housing system.

The aim of this study was to assess the housing conditions (cage, barn, free range and organic) on selected egg quality parameters of laying hens. Examination included internal and external characteristics of eggs and the profile of fatty acids in the yolk.

Eggs from hens kept in four different housing systems differed significantly (P≤0.05). The heaviest eggs were laid by caged and barn hens (62 g), slightly lighter (59 g) by free-range layers, while the lowest weight were characterized by organic eggs (54 g). The highest egg shape index was noticed in barn system (79%) resulting indirectly in the biggest eggshell area (74 cm^2). Lowering tendency of eggshell strength was obtain for barn>organic>free range>cage. Evaluation of internal egg quality showed significantly higher free range egg yolk weight and its proportion in egg (16.6 g; 28%) in relation to eggs housed in other conditions (14.0–15.5 g; 25–26%). Yolk index ranged from 41 (cage system) to 45% (organic system). Yellow color of yolk was obtain darker in eggs from cage<organic<free range<barn housing conditions. Egg quality measured by the height of thick albumen and Haugh units was the highest in organic farming (7.9 mm, 89 JH), and the lowest in battery cages (6.0 mm, 76 JH).

Fatty acids were determined quantitatively and significant differences were obtained between groups (P≤0.05). Free range eggs contained the highest amount of saturated fatty acids (39.5%) as a result of high content of palmitic (27.3%) and stearic acid (11.4%; P≤0.05). High polyunsaturated fatty acids concentration were evaluated in egg yolks from hens kept in barn system and it was lowering in other farming conditions (barn>cage>free range>organic). Barn eggs were characterized by the highest content of linoleic, alpha-linolenic and arachidonic acids. Cage eggs contained highest amounts of myristic, gamma-linolenic and eicosapentaenoic acid. The greatest content of palmitoleic and oleic acids was obtained in organic eggs. The n-6/n-3 PUFA ratio ranged from 5 (organic and free range) to 9 (barn).

The results obtained in this study present some advatages in producing eggs as a functional food with better quality requared by the final consumer.

Dymkowska-Malesa M.[1], Szparaga A.[2], Czerwińska E.[3]

EVALUATION OF ORGANOCHLORINE COMPOUNDS CONTENT IN CHOSEN VEGETABLES FROM THE AREA OF WARMIA AND MAZURY IN POLAND

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Organochlorine compounds are very persistent compounds. Considering the harmfulness of these substances, the goal of the study presented in this article was to evaluate the content of organochlorine compounds in selected vegetables. The highest content of lindane was detected in carrot. Accumulation of γ-HCH in cauliflower was more than five times lower. The presence of ΣDDT was detected in all tested vegetables at quantities not exceeding the MRL value. The lowest mean content of ΣDDT was observed in broccoli and spinach, while a three times higher quantity of this compound was detected in carrot.

Chlorinated hydrocarbons were detected in all the tested vegetable samples. It was observed that vegetables raised in north-eastern Poland persistently contain numerous foreign chemicals and, as such, should be included in a programme to monitor the levels of harmful chemicals.

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Dymkowska-Malesa M.[1], Szparaga A.[2], Czerwińska E.[3]

EVALUATION OF RADIOCESIUM LEVEL IN CHOSEN VEGETABLES FROM THE AREA OF WARMIA AND MAZURY

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Contamination of environment and food by artificial isotopes cause receiving radiation doses by people, that can be taken by inhalation of isotopes from the air or the oral route. From the point of view of radioactive contamination of the environment, the most dangerous are the isotopes 134Cs and 137Cs, which concentrations are used as an indicator of environmental pollution.

In accordance with the Decree of the Minister of Health of 15.01.2003 year, Cs-137 may be present in various products, seeing that is used for irradiating vegetables to inhibit sprouting (in potatoes, onions, garlic), the elimination or reduction of pathogenic microorganisms (bacteria, mold, fungi) and parasites. Radiation also helps to extend the storage life of fresh fruit and vegetables

The necessity to monitor the content of radiocesium results from its toxicity, therefore the aim of the study was to analyze the content of radiocesium in chosen vegetables (carrots, cauliflower, broccoli, green peas, green beans, spinach) from area of Warmia and Mazury. The content of Cs-137 in investigated vegetables showed that the aboveground parts of plants accumulate considerably more radiocesium compared to the root vegetables.

Fiedorowicz E., Sobotka W., Stanek M., Drażbo A.

THE EFFECT OF DIETARY PROTEIN RESTRICTION IN FINISHING PIGS ON THE CHEMICAL COMPOSITION AND FATTY ACID PROFILE OF PORK

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The objective of this study was to determine the effect of dietary protein restriction in finishing pigs on the chemical composition and functional properties of pork.

At the end of a feeding trial, 45 pigs were slaughtered at the "Warmia" Meat Processing Plant in Biskupiec near Olsztyn (NE Poland). The carcasses were chilled at 2–4°C for 24 hours, and samples were collected from the longissimus dorsi muscle (m. longissimus dorsi). The samples were divided into three groups:

group I – samples collected from the carcasses of finishing pigs fed a diet with standard levels of total protein and essential amino acids (lysine, methionine, threonine and tryptophan);

group II – samples collected from the carcasses of finishing pigs fed a low-protein diet (levels of total protein and essential amino acids reduced by 15%);

group III – samples collected from the carcasses of finishing pigs fed a low-protein diet supplemented with limiting amino acids (lysine, methionine, threonine and tryptophan) to the levels noted in group I.

Meat samples were assayed for the content of dry matter, crude ash, total protein and intramuscular fat. Lipids were extracted by the Peisker method, and fatty acid concentrations were determined by gas chromatography using the VARIAN CP-3800 system with a flame ionization detector (FID).

A decrease in the concentrations of total protein and limiting amino acids in pig diets was accompanied by an increase in the intramuscular fat content of *m. longissimus dorsi.* A low-protein diet supplemented with crystalline essential amino acids contributed to a decrease in intramuscular fat content and an increase in total protein levels in pork. Dietary protein restriction led to a decrease in the concentrations of saturated fatty acids (SFAs), a slight increase in the levels of monounsaturated and polyunsaturated fatty acids (MUFAs and PUFAs) and the narrowing of the n-6/n-3 PUFA ratio in meat. The supplementation of a low-protein diet with crystalline essential amino acids (lysine, methionine, threonine and tryptophan) increased the concentrations of n-6 PUFAs in *m. longissimus dorsi.*

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ELEMENTAL COMPOSITION OF PLANTS SPECIES GENUS *SALVIA*

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Species from genus *Salvia* of *Lamiaceae* family are well known in Ukraine and in the world. It's used as medicinal, food and ornamental horticulture. It is used in food industry for dried spicy mix and as flavoring at canning of vegetables. It's requiring determine an elemental composition of plant material.

The aim of our study was to examine of the composition macro- and microelements and their absorption in the system soil – roots – aboveground part of species genus *Salvia* and to determine their safety under condition introduction and cultivated in Forest-Steppe of Ukraine.

Element content of species genus *Salvia* (*S. patens, S. officinalis, S.verticillata and S. sclarea*) was carried out using by Roentgen-Fluorescent method research. Samples were collected in the phase of full flowering in the National Botanic Garden in Kiev. Physiochemical research elements arrive at the soil-root-aboveground part and cumulativeness in plants was performed.

The analysis showed that the content of a number elements in the system soil-roots-grass (Fe, Pb, Na, P, Al, Mg, Cu). Other elements on the contrary have tended to accumulate in the grass (Mn, K, Sr).

Content of potentially toxic elements Sr in aboveground mass of four species *Salvia* are minor. A small number Pb was found in roots of plants, but in the over-ground parts of plants it was decreases till 0.03 mg/100 g and lies within the RC.

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EFFECT OF RAPESEED STORAGE CONDITIONS ON INCREASE IN FREE FATTY ACID CONTENTS

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Poland's accession to the European Union has contributed to an increased profitability of rapeseed production. This has resulted in a systematic expansion of rape cultivation area and growing yields of this crop.

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 with southern exposure. 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.

While not a chemical compound of fungal biomass, free fatty acid levels measured as fat acidity values (FAV) are a measure of deterioration occurring in seeds during storage. Free fatty acid formation in oilseeds represents a direct loss in oil quality and is usually associated with increased respiration and percentage of seeds infected with storage fungi. The aim of the research was to examine the influence of temperature and seed moisture content on increase in free fatty acid contents.

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 enabled to maintain the moisture content of seed on the constant level, at temperatures of 25 and 30°C. Rapeseed was stored in constant humidity and temperature conditions up to the decrease of germination capacity below 75%. Changes in acid value in stored rapeseed were studied at 6-day intervals. The results of the study showed that temperature and moisture content of stored rapeseed have a significant influence on increase in free fatty acid contents.

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Gornowicz E.

THE USE OF FEED ENZYMES IN BROILER CHICKEN DIETS AS RELATED TO CARCASS MEATINESS

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The objective of the study was to determine the efficiency of a mono component serine protease, alone and in combination with a multi-component carbohydrase, in diets with low levels of protein, essential amino acids and metabolizable energy (ME) for broiler chickens, with particular consideration of dressing percentage and carcass meatiness.

Ross 308 chickens were assigned to four feeding groups, each having 5 subgroups of 200 birds. Group I (control) was fed standard starter, grower and finisher diets containing 21.0, 19.16 and 18.70% protein, respectively. Groups II, III and IV received feeds with 8% lower protein and digestible amino acids (starter 19.32%, grower 18.05%, and finisher 17.65%). ME in the diets was identical in groups I to III, but 5% lower in group IV. All the diets contained phytase and xylanase. The diet for group III was supplanted with a mono component serine protease, produced by submerged fermentation of *Bacillus licheniformis* containing transcribed genes from *Nocardiopsis prasina* (DSM Nutritional Products) (15000 PROT/kg) at 200 mg/kg. In addition to this enzyme, group IV also received 200 mg/kg of a preparation containing β-glucanase (120 FBG/ml), pentosanase, hemicellulose and pectinases, which was produced through fermentation of *Aspergillus aculeatus* (DSM Nutritional Products). The main feed components were maize, wheat, soybean meal, and rapeseed meal and soybean oil. The results obtained for rearing performance, slaughter value and meat yield of broiler chickens were statistically analysed by analysis of variance and estimated using Duncan's test.

As assumed in the experiment, at the end of the rearing period chickens from group II had significantly ($p \leq 0.05$) the lowest body weight (2256 g) and European Efficiency Factor (EEF) (298). For groups III and IV, these parameters were more favourable: body weight by 2.57 and 5.01%, and EEF by 6.38 and 13.76%, respectively. These differences were significant at $p \leq 0.05$. The most advantageous dressing percentage was found for group I (73.48%) and it was significantly ($p \leq 0.05$) different only in relation to group II (71.63%). In the other groups, this parameter was 72.44% (group III) and 73.11% (group IV). Significantly ($p \leq 0.05$) best meatiness was characteristic of carcasses from group III (47.54%), with breast muscle forming as much as 25.25%. Carcass meatiness in groups I and IV was similar: 45.86% (including 23.57% breast muscle) and 45.61% (23.26% breast muscle), respectively. Carcasses from the negative control group (II) contained the least meat (43.52%), including only 21.34% breast muscle.

The use of feed enzymes in broiler chicken diets with 8% lower protein level had a significant effect on carcass meatiness by improving it by around 4 percentage points. After imposing a ban on the use of feed antibiotics in broiler chicken nutrition, due among others to health safety in the food production chain, feed enzymes appear to be a desired supplement that improves production parameters and slaughter value of broiler chickens while safeguarding consumer health.

Gornowicz E., Lewko L.

FACTORS INFLUENCING SENSORY QUALITY OF GOOSE MEAT

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The objective of the study was to perform sensory evaluation of raw and heat-treated meat depending on sex, origin, and rearing system of geese. Six experimental groups were established, three of which contained phylogenetically different geese. They were southern strains of domestic geese included in the genetic resources conservation programme: Lubelska (Lu), Kielecka (Ki) and Podkarpacka (Pd). These birds were raised in free-range system for 140 days in two feeding groups. One group was conventionally fed with a diet based on cereals, green forage and root crops throughout the study. The second group was exclusively fed with whole oat grain (oat fattening) for the last 21 days of rearing, following an adaptation period of 7 days. Each experimental group contained 30 birds (15 males and 15 females), totalling 180 geese.

The sensory quality of meat was evaluated on 16 birds from each group, including 8 ganders and 8 geese. Raw meat was evaluated using chilled carcass parts 24 hours after slaughter. Both raw and heat-treated meat was evaluated on a four-point scale of 2 to 5, with 2 representing lowest quality and 5 representing highest desired quality. Evaluation was performed by a regular panel of 5 tasters.

When analysing the sensory scores for goose meat, statistically significant ($p \leq 0.05$) differences were found between some sensory characteristics depending on bird origin and sex. These concerned parameters such as external appearance and total score for breast muscle, as well as the two above characteristics, colour and fatness for leg muscle. A large difference ($p \leq 0.05$) was observed for the scores of above traits between the muscles of Lu ganders and geese. For the other groups of birds with regard to sex, significant ($p \leq 0.05$) differences were only noted for leg muscle colour. All the scores were high and exceeded 4.00 points, indicating that raw meat from free-range Lu, Ki and Pd geese lived up to consumer expectations. One exception was the score of 3.87 points for the external appearance of raw breast muscle from Lubelska females. No significant differences were found for the total mean scores of sensory traits of raw meat with regard to sex and origin. However, the meat of ganders received slightly higher scores from the panel of experts, ranging from 4.53 (external appearance) to 4.63 points (fatness). The scores for females ranged from 4.19 (external appearance) to 4.43 points (aroma). The total score for raw meat from different groups of geese was 4.46 points for Lu, 4.47 points for Ki, and 4.51 points for Pd. The muscles of oat fattened geese received significantly ($p \leq 0.05$) better scores.

Analysis of the sensory scores for heat-treated meat showed no significant differences in terms of origin, sex and rearing system. The scores were very high and exceeded 4.60 points for all traits. The values for breast muscle ranged from 4.74 (aroma, ♀Ki and ♂Pd) to 4.90 points (tenderness, ♂ and ♀Lu), and those for leg muscle from 4.67 (aroma, ♀Ki) to 4.83 points (tenderness, ♂Lu). The total score for heat-treated muscles was 4.79 points for Ki and Pd, and 4.81 points for Lu.

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FATTY ACID PROFILE OF BREAST MUSCLE IN GEESE

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Geese were subjected to two experimental rearing systems with 90 birds per system. Geese from group I were raised in the Jaworze Organic Farm in accordance with organic farming principles. Under this system, waterfowl have access to water, feed materials originate from the same farm and from organic sources, the farm has sufficient acreage and has been certificated. Geese from group II were raised under the most popular system used in goose farming, i.e. indoors with constant free range access. Over the last 3 weeks, birds were fed exclusively with oat grain (oat fattening). The diets fed to experimental geese were formulated to provide the same level of nutrients. In both groups, birds were fed a diet containing 17.8% crude protein, 11.1 MJ metabolizable energy and 3.9% crude fibre until 5 weeks, and a diet with 10.3% CP, 10.2MJ ME and 6.6% CF from 6 to 17 weeks of age. Organically raised birds received this feed mixture until the termination of the experiment at 140 days of age. The diets of geese from both systems were supplemented with green forage and root crops.

After slaughter and post-slaughter processing, breast muscles were sampled from the right carcass side of 12 males and 12 females from each experimental group to analyse basic chemical composition and the content of some fatty acids.

When analysing the chemical composition of breast muscles, it was found that those from organically raised geese contained from 22.51 to 24.06% crude protein and from 1.59 to 2.20% crude fat. Under the conventional rearing system, the respective values were 21.49 to 22.95 and 2.61 to 2.96%. These values indicate that breast muscle from organically raised geese were richer in crude protein and had a lower crude fat content.

The total content of saturated fatty acids (SFA) in breast muscle ranged from 31.94 to 33.70% in geese from group I and 30.35 to 33.66% in conventionally raised birds. In this group of acids, the most abundant acids were palmitic (from 2.81 to 21.54% and from 17.42 to 20.95%) and stearic (from 9.58 to 11.32% and from 9.27 to 14.82%, respectively). The level of monounsaturated fatty acids (MUFA) in breast muscles varied between 38.73 and 43.91% for organically raised birds and between 28.68 and 43.48% for geese from the second system. Among MUFA, oleic acid was by far most abundant, from 40.32 to 43.95% in the organic group and from 32.31 to 42.75% in the conventional group. In the group of polyunsaturated fatty acids (PUFA), a considerable portion was made up by linoleic acid, the content of which in intramuscular fat averaged between 13.19 and 16.13% in group I and between 16.26 and 18.47% in group II.

In crude fat from the most valuable carcass cut, i.e. breast muscle from organically raised geese, MUFA content was higher by 5.84 percentage points and n-3 PUFA content by 0.58 percentage points. In addition, the n-6 to n-3 PUFA ratio was at a level recommended for the human diet (5.96:1) compared to as much as 9.58:1 in conventionally raised geese fattened with oats.

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COLOUR OF MEAT FROM BROILER DUCKS

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The experiment used fresh meat from Pekin ducks (A-55 male × GL-30 female). A total of 387 hybrids (205 males and 182 females) were reared for 11 weeks on a private duck farm according to standards used on conventional duck farms. Throughout the study, birds were kept indoors without free range access and fed the same diets *ad libitum*. The nutritive value of the diets was 19.8% crude protein and 11.9 MJ metabolizable energy until 5 weeks and 17.6% and 12.6 MJ respectively during the next period. After 11 weeks of rearing, all birds were slaughtered and subjected to post-slaughter processing (3 batches of 129 birds over 3 days), which were carried out in accordance with appropriate technological procedures. After evisceration, cleaning and chilling to 9°C inside breast muscle, carcasses were weighed and placed in cold storage at 4°C. Based on weight, the carcasses were divided into four ranges: from 1567 to 2170 g (I), from 2171 to 2330 g (II), from 2331 to 2508 g (III), and from 2509 to 2949 g (IV). Colour measurements were made 24 h postmortem. Samples for analysis were prepared by cutting the breast muscle from the sternum and ribs and turning them inside out. The slices of breast muscles (*m. pectoralis superficialis* and *m. pectoralis profundus*) served to measure their colour. Leg muscles were prepared from the thigh and lower thigh and homogenized. The colour of leg muscle mass was measured. All the measurements were performed on the left carcass side.

Instrumental evaluation of colour was made using a portable trichromatic colorimeter (Minolta Chroma Meter CR-310).

Breast muscle had the lightest colour (45.25) in heaviest ducks (group IV) and the darkest colour (43.99) in birds from group II, with no statistically significant differences. For leg muscles, the difference in colour was even smaller (0.71). No trends in the colour lightness of meat depending on the weight of broiler duck carcasses were noted.

There were no significant differences in the physical parameters of a^* and b^* colour for meat within particular carcass weight groups.

Despite considerable differences in carcass weight, the meat of broiler ducks from the same rearing system was characterized by only slight and non-significant colour deviations, and provided very good quality material for further use in processing.

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Górecka J., Szmańko T., Kopczacka K.

ATTEMPT TO INCREASE THE STABILITY OF WILD BOAR MEAT TREATED BY DIFFERENT LEVELS OF THE LYSOZYME PREPARATION

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In studies the attempt to enhance the sustainability venison by introducing bacteriostatic substance, i.e. monomeric lysozyme preparation, on the surface stored *muscles longissimus dorsi* of wild boar were investigated. The bacteriostatic agent was applied at three different concentration levels, respectively L1, L2 and L3

The muscle excised from five carcasses of the age app. 2–3 years and the body mass app. 70–90 kg. The vacuum packed in laminate PA/PE attempts, were stored at 2 ± 1°C for 0, 14, 21 and 28 days.

The assessment of durability of raw material was based on the determination: drip loss, meat acidity (pH,) collagen content, dry matter content, the value of free amino groups as well as the value of TBA. The color parameters were measured calorimetrically with L*, a*, b* scale, according to which was calculated hue and chroma of the color. Color (intensity and desirability), aroma (intensity and desirability) as well the overall sensory evolution were analyzed.

Statistical analysis of the results was carried out using STATISTICA 10.0 software. Averages, standard deviations, least significant differences and estimation of differences between mean values at $p < 0.05$ were calculated.

After 28 days of storage of raw material the weight losses of 2.30% were noticed. The most advanced of physicochemical changes in meat were recorded after 28 days of storage, for example the increased the value of malonic aldehyde was noticed. However, after this time, the deterioration of the freshness of venison (evaluated organoleptically) was not found. In the samples L1, L2, L3 on the cross section of muscles hue changes were observed. These changes were associated with: reduced brightness, increased share of red as well as decreased participation of yellow in the reflectance spectrum. After the heat treatment the reducing of brightness meat color and the gradually decreasing of redness share in the spectrum reflectance were noticed. The beneficial effect of storage on the reduction of the cutting force of wild boars meat was recorded. The best results to preservation of venison meat were obtained in case of application on the surface of muscles of wild boars the lysozyme preparation at variants: L2 and L3.

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NUTRITIONAL VALUE OF MUSCLES LIPIDS OF GEESE FROM POLISH CONSERVATIVE FLOCKS

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The evaluation of nutritional value of lipids of geese muscles from conservative flocks and increasing the availability of the obtained results, can help bringing positive aspects of the meat to consumers and poultry producers attention. Fatty acid profile of the goose muscle lipids were the subject of few research, therefore it was recognized as appropriate to undertake studies in this direction. The aim of the work was to determine fat and cholesterol contents as well as fatty acids proportions in goose muscle lipids.

The experimental material was breast and leg muscles of 17-week-old geese of northern varieties: Kartuska (Ka), Suwalska (Su) and southern varieties: Lubelska (Lu) and Kielecka (Ki) from conservative flocks, maintained using the *in situ* method at the Research Station of Waterfowl Genetic Resources in Dworzyska, belonging to the National Research Institute of Animal Production in Kraków. The geese from all flocks were fed *ad libitum* by the same complete feed: In the 17th week of age, from each flock 6 females were taken for analysis (two experiments were made) having body weight close to the arithmetic mean of body weight in a particular flock. The percentage lipids content of muscles was determined via the Soxhlet extraction (AOAC 1990). The fatty acids proportions were determined by Capillary Gas Chromatography technique.

Genotype affected the fat and cholesterol contents as well as fatty acids profile in muscles. Both breast and leg muscles of northern varieties (Ka and Su) contained more lipids than muscles of southern varieties (Lu and Ki) (by 0.52–0.7% and by 0.98–1.24 % respectively). Leg muscles of Ka geese were lower in cholesterol content than other genotypes muscles (57.88 v/s 65.11–72.31 mg/100 g of muscle) but there were no differences in cholesterol content between breast muscles of geese from individual flocks.

The obtained data indicated that lipids of Ki breast muscles in comparison to other genotypes were characterized by the low proportion of PUFA (19.15 v/s 21.68–23.38 %) including PUFA n-3 (1.83 v/s 2.45–2.74 %) and the least favourable value of n-6/n-3 ratio (9.65 v/s 7.56–7.88). Lipids of Ki leg muscles showed the lowest percentage of SFA (27.42 v/s 29.61–30.62 %) and the most favourable value of UFA/SFA ratio (2.46 v/s 2.18–2.23), while leg muscles of Lu geese were lower in PUFA n-3 and higher in n-6/n-3 ratio. The lowest so the most advantageous value of n-6/n-3 ratio (6.62) had leg muscles of Ka geese. Lipids of breast and leg

muscles of all genotypes were characterized by a higher than recommended (0.4) value of PUFA/SFA ratio (0,69–0,75).

To sum up the nutritional value of lipids of Kartuska muscles can be recognized as higher than muscles of geese from other flocks. The reason for that is the lowest cholesterol content, the highest percentage of PUFA n-3 and closed to the recommended value of the n-6/n-3 ratio in leg muscles. However the breast muscles were characterized by high content of UFA including MUFA, low cholesterol content and slightly different than recommended value of the n-6/n-3 ratio in breast muscles. Regarding the cholesterol content, SFA, UFA therein MUFA and PUFA percentages as well as value of the n-6/n-3 ratio, the investigated genotypes can be arranged as follows: Ka>Lu>Ki, Su.

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SELECTED COMPOUNDS BENEFICIAL TO HEALTH IN APPLES AND OTHER LOCAL FRUITS

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Historical experience suggests that a diet high in fruits is beneficial and decreases the risk of many diseases, especially those connected with a Western-type diet. Apart from polyphenols with variable bioavailability and vitamins, soluble fibre and the triterpenoic acids (ursolic and oleanolic) were identified as the most promising for possible applications.

The soluble fibre of apples (0.5–1.6% of fresh fruit, 7–8% in dried pomace) is composed mainly of pectins, a highly fermentable viscous fibre. It is consumed by large bowel microbiota and other valuable compounds are produced – short chain fatty acids (acetate, propionate, butyrate), hydrogen and methane. In particular, hydrogen has attracted attention during recent years as a highly bioavailable antioxidant, and up to 100 ml of hydrogen may originate from the fermentation of one gram of pectin. Part of that volume is absorbed and may protect bowel or liver tissue against oxidative damage. The non-oxidized hydrogen is expired and the determination of hydrogen in expired air serves as an estimate of large bowel fermentation level.

Ursolic and oleanolic acids are found mostly in apple peel (6–7%), but dried pomace is also a valuable source (2–3%), as well as other fruits. Apart from antiproliferative, antiinflammatory effects, these compounds are inhibitors of pancreatic lipase. A half maximal inhibitory concentration (IC_{50}) 6.3 mmol/l was found for the triterpenoic acid mixture in apple extracts. These extracts can be a suitable supplement for obese or diabetic patients requiring lower lipid absorption.

Locally grown fruits and their products (juices, pomace, extracts) make a valuable and underrated source of compounds for healthy nutrition and nutraceutical production.

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Iwaniak A., Darewicz M.

THE STRUCTURAL SIMILARITY OF THE ACE INHIBITORY PEPTIDES DERIVED FROM FOOD PROTEINS

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Cardiovascular diseases including hypertension are directly related to diet. The nutritionists claim that peptides reducing blood pressure (ACE inhibitors) derived in food proteins are valuable food components supporting the therapy of hypertension (Jimsheena and Gowda 2011).

The work presents the procedure based on the application of the *in silico* tools in searching the structural similarities between tripeptides possessing the ACE inhibitory activity. The analysis of structural similarities between biopeptides may be helpful to discover the potential of the proteins, which so far have not been known as a "good" source of biologically active peptides. Moreover, it may be the one of the strategies suitable in production of food with designed and desired properties (Pihlanto and Korhonen 2003).

The final assumption resulting from the procedure applied was to indicate protein sequence containing the fragments defined as similar (potentially potent) to reference ACE inhibitor(s). Such hypothesis is consistent with idea of Zamyatnin (2009), according to which, relatively short, naturally and physiologically active molecules are the part of larger elements (fragments) and determine their function. Such approach is related to fragmentomic analysis, which found an application in medicine, dietetics, and cosmetology (Zamyatnin 2009).

The results showed that several protein sequences (animal and plant) contained fragments similar to reference peptides. It can be concluded that approach involving an *in silico* methods to find the structural similarities between the molecules can be the practical instrument for selection of proteins containing the "bioactive regions".

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THE USABILITY OF CHEMOMETRIC TECHNIQUES IN THE CHARACTERISTICS OF STRUCTURE AND FUNCTION OF PEPTIDES WITH SELECTED BIOLOGICAL ACTIVITY

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Peptides possessing biological activity (biopeptides, bioactive peptides) are encrypted in food proteins and after enzymatic release they show a variety of functions. Thus biopeptides became a subject of scientific interests worldwide. The origin of peptides (food proteins), as well as their multifunctionality, make them as promising alternative e. g. in the treatment of diet-related diseases (Korhonen 2009).

The properties of biomolecules, including bioactive peptides are described by their structure (sequence), which is related to its physicochemical attributes defined as descriptors (Karelson and Maran 2003). Identification of specific molecular properties affecting the peptide biological activity can be considered in designing of nutraceuticals and functional food. Such idea of research is consistent with the QbD approach meaning "*quality by design*" (Tsirk 2010).

The prediction of the activity of a molecule based on its structure is a modern trend of the characteristics of food components. It is related to the chemistry discipline named chemometry. According to definition, chemometry involves mathematics, statistics, informatics, and probablility theory to design or selection of the optimal experimental procedures to provide as many as possible information about analyzed objects (Massart et. al. 2003). The range of the application of chemometric techniques is wide and concerns the analysis of multiple variables.

The aim of the study was to propose and evaluate the usability of procedure to find the relationships between the structure and activity of peptide with selected biological activity. The procedure applied involves the chemometric technique to analyze the input data.

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

TOTAL ANTIOXIDANT CAPACITY OF LOW-FAT MEAT PRODUCTS CONSISTED OF EGG PROTEIN HYDROLYSATES

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Meat and meat products are essential components in people's diet. They are important source of protein, vitamins and minerals. On the other hand they consist of fat, saturated fatty acids and cholesterol that can have negative effect on human health. This is mainly due to oxidation processes during manufacturing (formation of free oxygen radicals and peroxids) and distribution of meat and especially emulsion type of meat product (e.g. frankfurters, patties). It can lead to reduction of their shelf life. Moreover, the diet rich in fat may cause obesity, increase the risk of colon cancer and cardiovascular diseases. Thus, recently many researches make an effort to create new type of meat products that would be called "healthier" or "functional". It can be related with avoiding undesired substances or reducing its content and increasing the amount of other substances with beneficial properties.

The aim of this study was to analyze the antioxidant capacity of low-fat emulsion type of meat products that consisted of three kinds of egg protein hydrolysates.

Stuffings of model meat products were manufactured from pork, backfat (10, 20%), water and curing salt. Different egg protein hydrolysates were added in two levels in production process as functional additives. Control samples were manufactured without functional additives. TAC (total antioxidant capacity) of protein hydrolysates and model meat products was evaluated by DPPH and ABTS assays. Moreover, antioxidant power of samples was determined using FRAP assay. All evaluations were conducted using QUENCHER procedure.

Egg white protein hydrolysate had the highest $ABTS^{\cdot+}$ and DPPH· scavenging capacity (112,63 nad 13,59 mmol Trolox Eq./kg respectively). Moreover, the highest FRAP value was in egg yolk protein hydrolysate (5,55 mmol Trolox Eq./kg). TAC of the experimental low-fat meat products determined by $ABTS^{\cdot+}$ and DPPH· radical assays in all variants was higher than in case of control samples that had no protein hydrolysates addition. Furthermore, the higher FRAP values were evaluated for experimental low-fat meat products than for a control samples.

The addition of egg protein hydrolysates to the model low-fat meat products lead to increasing the total antioxiant capacity of final products. It may be a start point to create new type of meat products with higher nutritional value and benefitial properties on human health.

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QUALITY CHANGES IN GREAT PUMPKINS AND COLOURED POTATOES DURING STORAGE

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Harvested potatoes and pumpkins can be stored before they will be processed or consumed. This makes it critical to understand the effect of storage on the chemical composition changes in potatoes and pumpkins. Prolonged storage can cause a decrease/increase or maintain the level of some nutrient.

The main aim of this study was to investigate the changes in the chemical composition during storage of the great pumpkin's 'Justynka F_1', 'Karowita', 'Amazonka' fruit flesh and the blue fleshed potatoe's 'Blue Congo', 'Vitelotte' and yellow fleshed potatoe's 'Blue Danube' tubers. Standard methods were applied to identify the following: dry matter, crude fibre, crude ash and weight loss.

Results indicated that after four months of storage, the dry matter content significantly increased in all potato varieties tubers. The largest increase in dry matter was measured in tubers of variety 'Blue Congo' (2.34%). During storage, crude ash content changed non-significantly in all variety. Crude fibre content decreased non-significantly in variety 'Blue Congo', in variety 'Blue Danube' and 'Vitelotte' decreased significantly. After four months of storage the largest weight losses was calculated in tubers of variety 'Vitelote' (6.73%).

After storage period dry matter value significantly decreased in all tested pumpkin cultivars. The maximum dry matter and weight loss decrease was indicated in flesh of cv. 'Justynka F_1' (5.36 %). Crude ash content increased significantly in two cultivars – 'Justynka F_1' (2.00 %) and 'Karowita' (1.46 %), but decreased in flesh of. cv. 'Amazonka' (1.03 %). After storage crude fibre values significantly increased in all pumpkin cultivars. The highest crude fibre increase was measured in flesh of cv. 'Justynka F_1' (2.54 %).

Jukna V., Jukna Č., Meškinytė-Kaušilienė E.

AMOUNTS OF ESSENTIAL AND NON- ESSENTIAL AMINO ACIDS AND THE RATIO IN LITHUANIA BRED CATTLE MEAT

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The aim of the research was to determine the amounts of essential and non-essential amino acids and the ratio in various breed cattle meat. The content of amino acids and the ratio at the longest dorsal muscle (*musculus longissimus dorsi*) was determined analyzing Angus, Hereford, Charolais, Limousine purebreds, Lithuanian Black and White x Charolais (LTBWx-CHA) crossbreed, Lithuanian Black and White x Limousine (LTBWxLI) crossbreed, Lithuanian Black and White x Simmental (LTBWxSI) crossbreed and Lithuanian Red x Limousine (LTRxLI) crossbreed. Analyzing the research results it was noticed that Lithuanian Black and White cattle breed meat contained the highest total amount of amino acids and Angus breed cattle meat contained the smallest amounts. The difference amounted to 33.87 g/kg or 4.1 percent ($p<0.01$). While comparing total amounts of amino acids at the purebred cattle breeds and the crossbreeds, it was noticed that purebred cattle breed meat contained higher amounts, the difference ranging between 18.54 and 19.00 g/kg or 2.23–2.28 percent ($p<0.01$). Purebred cattle meat contains higher amounts of essential amino acids comparing to crossbreed cattle meat. The Aubrac and Angus breed meat was determined to have the highest meat protein sufficiency rate. The lowest biological values were determined at Lithuanian Black and White x Charolais crossbreed meat.

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MINERAL ANALYSIS IN RABBIT MEAT AFTER APPLICATION OF EPICATECHIN AND PATULIN

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The aim of present study was to determinate the effect of epicatechin and patulin on content of selected macro elements and trace elements of meat quality of rabbits. Adult female rabbits (n = 25), maternal albinotic line (crossbreed Newzealand white, Buskat rabbit, French silver) and paternal acromalictic line (crossbreed Nitra's rabbit, Californian rabbit, Big light silver) were used in experiment. Animals were divided into five groups: control group (C) and experimental groups E1, E2, E3, and E4. Animals from experimental groups E1, E2, E3, E4 received patulin (10 μg.kg^{-1}) twice a week and animals from groups E2, E3, E4 received epicatechin three times a week. Both substance were applied intramuscularly. After 30 days animals were slaughter. For analysis of meat quality the samples of *musculus longissimus dorsi* (50 g) were used. In the samples concentration of macro elements (phosphorus, potassium, sodium, magnesium and calcium) and micro elements (zinc, copper and manganese) were measured using the atomic absorption spectrophotometry (AAS) method (wavelength for P 193.7 nm, Na 589 nm, Ca 422.7, Mg 285.2, Zn 213.9 nm, Cu 324.7, Mn 279.5 nm). No significant differences ($P>0.05$) in content of phosphorus, potassium, sodium, magnesium and calcium were found between the control group and experimental groups. Significant decrease in concentration of mangane in E3 and E4 groups vs. The control group was recorded ($p<0.05$). The values in other experimental groups (E1 and E2) were lower in comparison with the control group, however, without significant difference ($p>0.05$). We believe that the application of higher doses of pure epicatechin could lead to pro-oxidant imbalance, causing oxidative stress, which could contribute to the effects of the mycotoxin-patulin. However, further investigations are needed to prove the final statement concerning the effects of epicatechin and patulin

Kilar J., Ruda M.

THE NUTRITIONAL VALUE OF ORGANIC MEAT FROM THE LOIN OF DEER AND FALLOW DEER

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Breeding (growing in Poland) and organic farming of deer and fallow deer can extend the offer of raw meat. The wealth of animals' natural food in organic farming gives rise to obtain healthy-safe and high quality meat.

The aim of the study was to determine the nutritional value of organic meat from the loin of deer and fallow deer. The material consisted of 10 samples of meat from deer and fallow deer, whose – by means of modern laboratory methods – following parameters were specified : basic chemical composition, Ca, Zn, Fe, Cr and Pb, the profile of amino acids and fatty acids and cholesterol content. Loin of deer and fallow meat contained 24.03 and 29.65% dry weight, respectively. The loin of deer was richer in protein (22.10%), while the deer meat contained 19.66% protein. The meat of deer had more magnesium and deer meat had more calcium and iron. The cholesterol content was 62.10 mg/100 g (deer meat) and 65.00 mg/100 g (fallow deer meat). The loin of deer meat had from 7.83 mg / g of phenylalanine to 17.30 mg/g of lysine. The content of exogenous amino acids in the meat of deer ranged from 7.41 mg/g (histidine) to 16.80 mg / g (lysine) EFAs (Essential Fatty Acids) as linoleic acid and α -linolenic acid (particularly important for human health) were 9.63 and 0.83% respectively (loin of deer), and 2.84 and 1.12% (loin of fallow deer).

Work carried out in the framework of basic research on organic farming in 2013. The decision of the Minister of Agriculture and Rural Development No. PKre-029-22-22/13 (703).

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Klimczak I., Wróbel M.

THE EFFECT OF MANDARIN JUICE ON ENZYMATIC BROWNING OF CLOUDY APPLE JUICE

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Enzymatic browning is a major problem for the food industry because it causes changes in organoleptic properties, decrese of nutrition value, shortenin ofg shelf life, and in consequence may lead to deterioration of fruits, vegetables and beverages.

The aim of the study was to evaluate the effect of mandarin juice on the enzymatic browning of fresh, cloudy apple juice.

Juices were obtained by mixing the appropriate amount of fresh mandarin juice and apple juice. The addition of mandarin juice was 20 and 40% (v/v). The samples of juices were stored in glass-covered bottles for 48 h in the cold (4°C). The rate of browning was measured by the changes in colour parameters of juice (CIE $L^*a^*b^*$). Polyphenoloxidase (PPO) activity in juices was determined by a spectrophotometric method (400 nm). Moreover, in all analyzed juices (apple, mandarin and apple-mandarin juices), total phenolic content using Folin-Ciocalteu method and FRAP antioxidant activity were determined.

PPO was non active in fresh mandarin juice. The addition of mandarin juice had a good inhibitory effect on apple juice browning. The decrease in the content of polyphenols and FRAP value was observed in all juices during storage. However, these changes were significantly lower in mandarin-apple juice than in apple juice.

Klymenko S.

CORNELIAN CHERRY (*CORNUS MAS* L.) AND JAPANESE CORNEL (*CORNUS OFFICINALIS* SIEB. ET ZUCC.) PLANTS WITH ATTRACTIVE MEDICINAL PROPERTIES

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Genus *Cornus* L., which has fragmented on the globe, represented by four species: *C. mas* L. in the west mainland, *C. officinalis* Sieb. et Zucc in Japan, China and Korea, *C. chinensis* Wanger in the central China and *C. sessilis* Toor in North America. Cornelian cherry (*Cornus mas* L.) is well-known in Europe in countries such as Austria, Bulgaria, England, Hungary, Moldova, Poland, Slovakia, and Ukraine. This species known for hundreds of years is widely used as a valuable food, medicinal and ornamental plant. Still used the local varieties and the fruits are collected in natural populations, squares which is very reduced. In recent decades is reviving its culture and created interesting cultivars, biochemical properties, technology of breeding and cultivation are investigated. Fruits and other parts of plant are used as active antimicrobial remedy for various ailments due to the high content in fruits of biologically active substances. They contain 8.0 to 11.0% of sugars; 1.3–1.9% of organic acids; 101.0–193.0 mg% of the vitamin C; 670.0–850.0 mg% of anthocyan in the skin, and 36.0–121.3 mg% – in the pulp. Fruits and drugs of them (decoctions, tinctures, teas, concentrates of fresh and dried raw materials) exhibit antiscorbutic, general health-improving, tonic, astringent, temporary hypotensive, diuretic effect. Fresh fruits recommend 10–12 g/day for neurasthenia, common weakening, joint pains, infectious hepatitis and other. From the pulp of the fruits is prepared for centuries known antiscorbutic cornelian paste that contains 50–55% of ascorbic acid and does not lose the healing properties within 2 years. One hundred grams of this paste contains a daily dose of ascorbic acid. In Ukraine well-known cultivars of cornelian cherry with various biochemical properties and practical valuable characteristics (mass, shape, color fruit, ripening and other) are grown.

Cornus officinalis – the cornel medicinal (japanece) – is an aboriginal in Japan, China and Korea, in Europe it virtually unknown and is only in collections of botanical gardens. It is – one of the important types of plant material in Chinese traditional medicine. In large areas it is cultivated in Japan – the local name – sandzaki. En East Asia highlighted 24 key species of medicinal plants and are often used the cornel medicinal. The number of research and its pharmacological, biochemical properties in recent decades in Japan and China are impressive. Medicinal properties of fruits cornel medicinal dogwood caused by the presence

in the fruit pectin, easily digestible glucose and fructose, vitamins, minerals, iron, potassium, calcium, phosphorus and magnesium, which are beneficial to people with diseases of the cardiovascular system. Cornel drug traditionally used extensively in Korea, Japan and China as an analgetic and diuretic, has high antioxidant activity.

Cornus officinalis – one of the most popular and the most valuable herbal medicines in clinical practice worldwide. Infusion shoots with leaves used as stomachic measure for liver and gallbladder. Japanese cornel drug enters the nucleus of Japanese recipes for treating kidneys and bladder, as well as the Korean Assembly for the treatment of impotence. He is one of 31 species of medicinal plants; tone the body, in particular, part of the group of medicines known in China as "Saint- di Huang". It is often used as an antidiabetic medicinal plant, especially in Asia. Phytochemical and pharmacological studies have identified 10 irydoyidis that have anti-inflammatory, antiviral and antioxidant properties and can be used to treat diabetic nephropathy and renal failure.

In the National Botanic Garden cornel medicinal the same as cornelian cherry is winter-hardy, drought-resistant, can be grown on soils with wide pH amplitude (acidic to alkaline). The technology of vegetative reproduction of the cornelian cherry and cornel medicinal has been worked out; main method is budding, resulting in 90–98% output. The cornelian cherry and cornel medicinal are promising for ciltivation as a medicinal and food plants.

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THE QUALITY OF PEAR JUICE

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In epidemiological research, the occurrence of some diseases, like coronary heart disease, asthma, diabetes and some cancers, have been widely considered to be inversely related to the consumption of fruits and fruit juices. The pro-health properties of pear juices depend strongly on the variety and the processing technology. The aim of this study was to evaluate the effect of the L-ascorbic acid addition on the pear juice quality.

The effects of different production conditions on total soluble solids, viscosity, turbidity, cloud stability, L-ascorbic acid content and lightness of pear juices, were studied. Pear juice was obtained in 2013, from the fruits from Bolestraszyce Arboretum. The study was carried out on pears variety named '1960'.

Pear juice obtained with L-ascorbic acid addition was characterized by lower total soluble solids content (13.0%) than juice produced without L-ascorbic acid (13.8%). At the same time, viscosity of this juice was higher (11.7 mPa·s) than that of juice obtained without antioxidant (6.6 mPa·s). Turbidity of juice produced with acid (189.6 NTU) was higher than in the second juice (106.2 NTU), but simultaneously, cloud stability was lower (12.58% and 39.6% respectively). The content of Vitamin C in juice obtained without L-ascorbic acid addition (0.51 mg/100ml) was about one hundred-times lower than in juice after addition of the antioxidant (54.49 mg/100ml). Pear juice obtained with L-ascorbic acid addition was characterized by a higher lightness (L^* = 32.25) than juice produced without L-ascorbic acid (L^* = 31.13).

The analysis revealed a statistically significant effect of the production technology on the physico-chemical quality of pear juices. Addition of antioxidant causes an increase in the quality of juices.

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SCIENTIFIC BASIS OF UTILIZATION SPECIES ENUS *MONARDA, VITEX* AND *SALVIA* IN MEDICINE AND FOOD INDUSTRY OF UKRAINE

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There is totaled more than 3000 of the aromatic plants in the world. But only about 20 kinds are using in Ukraine for industrial processing. The objective of experiment was to examine several plants of genus *Monarda, Vitex* and *Salvia* as perspective crops for using in Ukraine. Researches have been carried out in NBG NASU throughout 2009–2013 years.

Search of new perspective plants of a wide spectrum utilization for introduction into the culture and into different branches of industry is relevant and have great economic significance.

Species of *Monarda, Vitex* and *Salvia* can be cultivated in Ukraine for culinary and medicinal purposes. It is such plants as *Vitex agnus castus, V. cannabifolia, Salvia sclarea, S. patens, S.verticillata, Monarda fistulosa, M. didyma, M. citriodora.* Aromatic plants of genus Monarda, Vitex and Salvia have high content of biologically active substances and have soft therapeutic influence, that is why they are used both as food and medicinal plants in folk and official medicine, usage of them practically does not provoke side effects.

It is determined that *Monarda, Vitex* and *Salvia* contain quite vitamin C, general sugar and other taste-forming substances. These plants contained essential oils with a pepper like fragrant in their flowers and leaves. Analysis of essential oils compound, micro- and macro elements, organic and fatty acids in plants were conducted to help evaluate the commercial potential of this crops in Ukraine.

Herbs of *Monarda, Vitex* and *Salvia* are used as spice in canning industry, for making pickling cucumbers and tomatoes, sausage and pork. The species of this genus can be used like as popular garden plants, too.

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INVESTIGATION OF COMPOSITION ESSENTIAL OILS SPECIES GENUS *MONARDA, VITEX* AND *SALVIA* – MEDICINAL AND FOOD PLANTS OF UKRAINE

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The objective of experiment was to examine several plants of genus *Monarda (M. didyma, M. fistulosa* and *M. citriodora), Vitex (V. agnus-castus, V. negundo* and *V. cannabifolia)* and *Salvia (Salvia sclarea, S. officinalis, S. patens* and *S.verticillata)* as perspective crops for using under condition of Ukrainian Forest-Steppe Zone. In this connection we have investigated essential oils compositions, which are determined taste and beneficial medicinal and food properties of herbs, organic and fat acids. Essential oil was obtained by hydrodistillation procedure for 2 h using Clevenger apparatus. The run of components was done using Agilent 6890 chromatograph. Analysis of essential oils compounds, organic and fatty acids in plants were conducted to help evaluate the commercial potential of these crops in Ukraine. Main and specific components of essential oils from species genus *Monarda, Vitex* and *Salvia* were characterized.

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Korzeniowska M., Kopeć W., Pudło A.

TOTAL ANTIOXIDATIVE POTENTIAL OF SELECTED GIBLETS OF BROILER CHICKENS

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Chicken giblets i.e. heart, gizzard and liver, are valuable raw materials either for further processing or direct consumption after thermal treatment. As a very complex systems containing high amount of lipids, minerals i.e. iron (esp. liver), and also different metabolites, they easily go through oxidation processes that significantly reduce the shelf-life and usability of the material. Being a carrier of numerous pro-oxidative substances they may also accelerate adverse changes in meat products or meals.

The objective of this study was to recognize the antioxidative potential of heart, gizzard and liver of broiler chicken fed diets enriched with dried porcine blood cells as a histidine sources, carnosine and zinc.

Giblets were collected immediately after slaughter of 42 days old Flex broilers and frozen at -80°C. Antioxidative activity of hydrophilic extract after centrifugation was analyzed using DPPH, ABTS and FRAP methods.

Among all analyzed chicken's offals the lowest ABTS radical scavenging activity was observed for gizzard extract collected from control animals (1.6 μM Trolox/ml). Significantly ($p>0.05$) higher antioxidative activity was analyzed for both liver and heart. Diet supplementation with histidine did not influence the ABTS scavenging ability of liver and gizzard. However, blood cells and zinc additions significantly reduced the ABTS antioxidative power of liver tissue, such relation was not observed towards DPPH radical. Heart and gizzard cells expressed relatively lower DPPH scavenging ability compared to liver. Moreover, carnosine supplementation of chicken diet tend to rise the antioxidative potential of heart (DPPH) and gizzard (FRAP). The highest iron reduction activity was analyzed in liver tissue and it was also related to a higher iron concentration in the tissue. Similarly to radical scavenging ability, the iron reduction capacity of liver was diminished by the addition of blood and zinc to the broilers diet. Chicken liver is characterized by the highest antioxidative potential within all analyzed giblets.

The addition of blood cells, also together with zinc, decreased the radical scavenging as well as iron reduction abilities of liver tissue. Carnosine added to the chicken diet tend to improve the total antioxidative potential of the heart cells.

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Kowalik J., Łobacz A., Żulewska J.

EFFECT OF COLD MICROFILTRATION ON THE PHISICOCHEMICAL PROPERTIES OF MILK

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Microfiltration (MF) is one of the main membrane processes that already belongs to the standard unit operations in the dairy industry. Using membranes with a pore diameter of 0.1 to 0.2μm, a physical separation of milk proteins is possible.

In present study a membrane microfiltration technique at a temperature below 10°C was used. The products of the membrane separation conducted at low temperature have changed proportions of αs-casein to β-casein. For membrane separation of milk a laboratory module installation equipped with a ceramic membrane with nominal pore size of 0.1μm and the surface of 0.005 m^2 was used.

The aim of the study was comparison of physico-chemical composition and gelling properties of different variants of milk: skimmed raw milk, thermized milk, pasteurized milk, milk after bacterial MF, retentate from pasteurized milk, retentate from thermized milk and retentate from milk after bacterial MF. The study was performed on three different batches of milk obtained from Educational and Research Station in Bałdy (UW-M Olsztyn).

All types of milk and retentate after MF separation were tested for chemical composition (protein, fat, lactose and casein) using MilkoScan (FOSS) technology with infrared spectrometry. The next stage of experiment was to test gelling properties, namely: coagulation time under the influence of rennet (according to McMahon), the phenomenon of syneresis (according to Harwalkari Kalab), water binding capacity (according to Parnell-Clunies) and the degree of protein hydration of obtained gels (according to Parnell-Clunies). Gels were obtained using rennet (CHY-MAX, Chr Hansen).

It has been shown that the gels obtained from retentate of pasteurized milk were characterized by the best binding of water and degree of hydration indicators.

The shortest coagulation time under the influence of rennet were obtained for retentate from milk which previously had been subjected to bacterial microfiltration.

Chemical composition of tested milk variants showed slightly differences in the protein content. Retentates after MF were characterized by lower lactose content than milk.

Properly selected parameters of MF process and determined proportion of protein fraction of milk enables to obtain the most optimized composition in the production of cheese. Application of obtained results can improve modification of the texture of the gels, and thus in the development of new solutions of rheological and sensory characteristics of rennet cheese.

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Kozłowska M.[1], Żbikowska A.[2], Wróbel A.[2]

THE EFFECT OF PLANT EXTRACTS ON THE SELECTED PROPERTIES OF COOKIES

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The study was carried out on biscuits prepared in 11variations. Control samples were prepared without addition of extracts. The other variations were obtained by adding synthetic antioxidant (BHA, 0.02%) and lemon balm, hyssop or nettle aqueous ethanolic extracts at 3 different levels: 0.02%, 0.1% and 0.2%. Freshly prepared plant extracts were added to the commercial fat which was enriched with walnuts oil. This oil has a specific nutty taste, sweet aroma with a hint of caramel and is a source of linoleic acid (omega-6) and alpha linolenic acid, which supplies the body with needed omega-3 fatty acids.

The aim of the study was to examine the effect of plant extracts on the sensory properties of cookies and their color changes 24 hours after backing. The measurements of cookies' colour were determined instrumentally using a tristimulus reflectance colorimeter. Analysis of sensory properties of cookies was conducted by the profile method.

The lightness of cookies with hyssop and lemon balm extracts (0.02%) was slightly higher than the control samples. Cookies fortified with nettle extract and BHA (0.02%) were characterized by lower lightness values if compared to control samples. Cookies with lower addition of plant extracts were characterized by greater lightness than cookies with higher addition of plant extracts. The a^* values, with all measurements above zero, confirmed that red tone dominates over green in all cookies. Slightly higher b^* values, which indicate that cookies tend to have more expressed yellow tone than the control sample, for cookies with lemon balm extract (0.2%) were observed.

Cookies with addition of lemon balm (0.1%) were assessed as the best regarding average sensory properties. The lowest overall acceptability was found for cookies containing 0.2% nettle extract. The industrial application of lemon balm, hyssop or nettle aqueous ethanolic extracts for preparation of cookies requires further study.

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Król Ż., Ulbin-Figlewicz N., Brychcy E., Kulig D., Jarmoluk A.

EFFECTS OF DIRECT CURRENT ON PH OF GELATIN GELS

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The acidity is one of the factors that influence the growth of microorganisms. Most of them grow best at pH values around 7.0 (6.6–7.5). Reduction of pH below the minimum range of growth results in inhibition of microorganisms.

The study was carried out on gelatin gels with 0 and 0,5 % (w/v) sodium chloride. The samples for pH measuring were treated by direct current (DC) of 200, 400 and 800mA; ≥10V, for 1, 5 and 15 minutes. After applying DC gels were open-stored in a fridge (4°C) for 7 days. In visualization of changes in acidity experiment gelatin gels contained litmus. In this case DC of 10, 20 and 30 mA for 2, 20, 30 minutes was applied.

The purpose of the study was to find the effects of direct current on pH of gelatin gels. The measurements included visualization of changes in acidity to determine presumed zone of inhibition microorganisms.

The measurements of the effects direct current via gelatin gels were made at opposite surface of the gels (anode and cathode side) and included: pH after 0, 3 and 7 days of storage and the range of pH changes. The results have shown that the higher miliamperage and the longer the duration of application DC,the lower pH on the anodic side and the higher on the cathodic side. Parameters in visualization study increased, respectively, as a function of time and application of the current.

Effects of DC on pH of gelatin gels have been measured. The results have shown that using direct current is a promising method for food decontamination. After applying DC, pH changed close to levels which can inhibit or slow the growth of foodborne pathogens. The acidity may depend on the type of used electrodes, therefore this method requires further investigation.

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Kubiak M.S.

INFLUENCE OF POWER NOZZLES MODIFICATION ON LOWERING THE CONTAINS OF PAH IN SMOKED MEAT PRODUCTS IN A SIGLE TRUCK SMOKING CHAMBER

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In this study, the level of PAH despoilment of meat products undergoing the industrial smoking in a chamber with classic arrangement of the power nozzles and arrangement modified according to change proposed has been determined. The materials for testing were the test samples of smoked meat products of oval geometrical body derived from the two examined variants of power nozzles arrangement and nozzles distributing the smoke mixture.

Quality and quantity analysis of the PAH was carried out using liquid chromatography with a selective detector – HPLC-FLD-DAD.

The research of the contents and accumulation of PAH in the meat products that underwent the process of dry-smoking using modified arrangement of power nozzles in comparison to their classic arrangement unequivocally points out the more favorable conditions for the smoke distribution in a smoking cabin with modified arrangement of power nozzles considering lower level of PAH. The sum of 8 and 4 PAHs in the samples tested significantly decreased in products where it was used to change the structure of feed nozzle in a mixture of smoke and air.

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Kubiak M.S.

NUMERICAL MODELING OF CFD AS A TOOL FOR FORESEING THE CONDITIONS OF MEAT SMOKING PROCESS

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In past few years the most dynamic development of the research has been noted and it concerns numerical modeling (CFD-Computational Fluid Dynamics). Due to using integrated experimental methods and numerical simulation it is possible to discover new aspects of the of processes happening in engineer environment, technological operations of food processing, constructions of the machines and many physical occurrences that affect a particular raw material. The usage of CFD environment makes it possible to conduct a detailed analysis of issues connected to flow of gases, fluids, heat and weight exchange, all of which are manners of creating a practical calculating tool that would be useful during the designing stage of industrial appliances.

The goal of this paper is to present the possibilities of using the numerical modeling that uses the CFD technique in order to introduce changes of construction of the powering elements (nozzles) into mixture of smoke and air in a smoking chamber to improve power distribution and spread of smoke molecules.

The usage of modern research tools such as the CFD code along with the Fluent software has enabled design of new solutions of construction elements improving spreading od te smoke and air mixture through appropriety designed powering nozzles as well as distribution of smoke molecules. Due to that a more even power mixture distribution of smoke in the chamber has been reached.

Proposed solutions of changes in the construction of powering elements (nozzles) have been tested in actual conditions, which have affirmed analysis coming from numerical calculations of the CFD environment. The solutions have been worked out as a patent file after two years of verification in industrial conditions.

Research financed in 2010–2013 by the National Centre of Research and Development as research project No. NR12 0125 10.

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Kubiak M.S.[1], Pietrzak-Fiećko R.[2]

TRADITIONAL DRY SMOKED MEAT PROCUCTS IN CONSUMER PREFERANCE EVALUATION

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In times of industrial production and food processing, consumer evaluation is the main criteria in shaping product quality. A product that does not fulfill consumer expectations is being eliminated.

The goal of this research was to describe consumer preference of choosing, buying and consuming dry smoked in a traditional way meat products with a background of meat products undergoing industrial process of dry-smoking.

100 adult people who declared consuming of dry-smoked meat products took part in the survey (53 women and 47 men). The representative group of consumers was inhabitants of a town Koszalin. Four meat products were evaluated – ham, thin sausage *kabanos*, sausage *myśliwska* and sausage *żywiecka*. All of these products were undergoing the process of dry-smoking in a traditional way as well as undergoing the process of dry-smoking in a smoking cabin. During both dry-smoking processes the alder chips of 6mm granules and 12% of moisture were used.

The questions posed treated about: frequency of consuming meat products, which of the dry-smoked product is most often purchased, the favorite assortment, opinion on the prices of those products and the comparison with other meat products undergoing the process of industrial dry-smoking. 94 correctly filled in questioners underwent the final statistical evaluation.

The received data show, that the most often consumed dry-smoked in a traditional way product was: ham – 36% and sausage *żywiecka* 31%. Other products received 22% – sausage *myśliwska* and 11% thin sausage *kabanos*. What concerns products smoked using the dry-smoking cabin the results showed a different outcome. Both sausage *żywiecka* and sausage *myśliwska* received 36% of favorable evaluation in the choosing section; thin sausage *kabanos* received 19% and ham only 9%.

Cross-check of the outcomes from both questioners points towards certain adjustment of the consumer and consuming preference to meat products dry-smoked in a traditional way in comparison to products smoked using the dry-smoking cabin.

The results from the questioner show that awareness of consumer preference and determination of the factors, which influence the purchasing and consuming of dry-smoked meat products is a crucial source of information for the producers.

Research financed in 2010-2013 by the National Centre of Research and Development as research project No. NR12 0125 10.

Kucharska A.Z.[1], Sokół-Łętowska A.[1], Klymenko S.V.[2], Zhaldak S.[3], Piórecki N.[4,5]

QUALITATIVE AND QUANTITATIVE EVALUATION OF THE CORNELIAN CHERRY COMPOTES

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Fruit compotes are traditional products with attractive physico-chemical and organoleptic properties. Their production on an industrial scale is rather small. Many products of this type are obtained according to household and traditional recipes. For the production of compotes, various species and varieties of fruit are used. Good raw material for the production of compotes seems to be cornelian cherry fruits, characterized by sour-sweet taste and unique composition of active compounds.

The aim of the study was a qualitative and quantitative assessment of cornelian cherry compotes obtained using traditional and industrial methods.

The research material were cornelian cherry compotes of Ukrainian varieties, prepared – according to traditional recipes – in Bolestraszyce and Kiev, and cornelian cherry compote purchased on the Georgian market (produced by Georgian company).

In compotes (separately in fruits and in syrup) after five months storage at room temperature in the dark, we determined: phenolic compounds and iridoids – by HPLC, vitamin C – by titrimetric method, the antioxidant activity – by FRAP method, and extract and acidity – by the method described in Polish Standards.

The predominant compound in cornelian cherry compotes obtained by both traditional and industrial methods, was loganic acid, the concentration of which was in a wide range from 102 to 394 mg/100 g. Among iridoids, we identified also sveroside and cornuside which constituted from 6 to 23% of total amount of iridoids. In smaller amounts we sequentially determined in the compotes: vitamin C, anthocyanins, phenolic acids, and flavonols. After 5 months of storage, the content of vitamin C and antioxidant activity of the extract was comparable in fruits and in the syrup. In contrast, the content of phenolic compounds was higher in fruits than in the syrup, and the content of iridoids and organic acids was higher in the syrup than in the fruit. Compotes obtained using the traditional method contained a greater quantity of extract, and comparable amounts of organic acids and vitamin C, in comparison to compotes obtained by the industrial method.

Our studies have shown that in terms of the content of bioactive compounds and the antioxidant properties, cornelian cherry fruits are attractive raw material for the production of compotes, also on the industrial scale.

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Kuchciak J.[1], Czubaszek A.[2]

THE ASSESSMENT OF MILLING PROPERTIES OF WHEAT BATCHES OBTAINED FROM SMALL AND LARGE CEREAL PRODUCERS MEASURED UNDER LABORATORY AND INDUSTRIAL CONDITIONS

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The purpose of the studies was to determine the effects of the quality of wheat grain obtained from different groups of Polish producers on the performance of technological processes under laboratory and industrial conditions. The experimental material consisted of common wheat grain (*Triticum aestivum* L.) harvested in 2013 by several small grain producers, 3 large grain producers (RSP Gądków, Polder Sp. z o.o. and Agrofam Sp. z o.o.), Premio wheat variety (producer – G.R. Wojciech Krasecki) and Asano wheat obtained from G.R. Solidex Sp. z o.o. Physical and technological properties of the grain were studied twice: 3–4 weeks after harvesting (minimum post-harvest ripening period) and 8–10 weeks after harvesting, i.e. when the grain reached full post-harvest maturation. The grain was milled under laboratory conditions using Bühler MLU-202 Automatic Laboratory Grain Mills. The industrial milling was performed by the Dolnośląskie Młyny Co. (Lower Silesian Mills Co.) in Ujazd Górny. Mill equipped with a complete set of Bühler grain mills.

The results of the studies showed considerable differences between the batches regarding contamination levels and sedimentation values. The coefficients of variation determined for the moisture content, bulk grain density, uniformity and total protein content were low. The values of standard deviation and coefficients of variation proved scarce differences between the batches in gluten content and the falling number. However, it seems quite likely that the extreme ranges affect the technological value of the grain. It was found that the grain batches delivered by several small producers showed greater differences in the uniformity and technological value of the grain than the remaining three batches. Total flour capacity under laboratory milling conditions was markedly lower than under industrial conditions. The highest total flour capacity in either conditions was observed with the Asano wheat, whereas this value was found at the lowest level in the mixtures of wheat collected from small producers.

As has been found, the capacity of flour types 450 and 500 was slightly better in the batches containing one wheat variety as well as those delivered by the 3 large producers, which can be very important from the economic point of view.

Kulaitienė J., Černiauskienė J., DanilčenkoH., Jarienė E.

FATTY ACIDS AND SOME ANTIOXIDANT PARAMETERS OF OIL PUMPKIN SEEDS

Aleksandras Stulginskis University, Faculty of Agronomy, Institute of Agriculture and Food Sciences, Lithuania

Pumpkin seeds are rich in biologically active substances such as a source of protein with good quantity of amino acids, especially essential acids, also tocopherols, carotenoids, especially β-carotene and lutein, mineral elements, fiber and other compounds, important as valuable properties of dietetic and medicinal.

The objective of this research was to evaluate the content of fatty acids and parameters of antioxidant activity of oil pumpkin seeds from Cucurbita pepo L. 'Miranda', 'Golosemiannaja', 'Herakles' cultivars grown in Lithuania. Oil pumpkin seeds were analyzed for crude fat, fatty acids, total phenolic contens and antioxidant activity measured by the DPPH method.

The four dominant fatty acids found are: palmitic, stearic, oleic and linoleic. The oil contains an appreciable amount of unsaturated fatty acids (about 83%) and found to be a rich source of linoleic acid (66 %). Pumpkin seeds recognized as a good source of phenolic compounds. The highest amount of total phenolic was found in seeds of cv. 'Golosemianaja' and 'Miranda'. The methanolic extracts of the seeds were characterized by statistically significant differences in their antioxidant activity. The highest antioxidant activity was displayed from pumpkin seeds of cv. 'Miranda' and little less – in 'Golosemianaja'. Antioxidant activity increased proportionally to the total phenolic content and a linear relationship between DPPH – radical scavenging activity and total phenolics was established.

Kulaitienė J., Černiauskienė J., Danilčenko H., Jarienė E.

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Kulig D., Brychcy E., Ulbin-Figlewicz N., Król Ż., Zimoch-Korzycka A., Jarmoluk A.

THERMOGRAVIMETRICAL PROPERTIES OF CROSSLINKED POLYELECTROLITE COATINGS

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

Chemical and physical stability is important factor for coatings used in food industry. By investigating the thermal behavior of polymers as a function of weight loss with heat, it is possible to obtain information about their stability. In case of application of coating on the most of food products thermal stability should be examined to 300°C which is maximum temperature used in manufacturing processes. In present study thermogravimetrical properties of crosslinked sodium alginate- chitosan coatings were tested.

Sodium alginate powder (1.5%, w/v) was dissolved in deionized water by stirring (IKA, RW 20 digital) at 350 rpm for 24 hours. Similarly, 1.5% of chitosan solution (w/v) was prepared in 1% solution of lactic acid (v/v). Polyelectrolyte complex solution was obtained by drop wise polycatione solution at three different concentrations (0.25, 0.50, 0.75%) to polyanione solution (0.15, 0.20, 0.25%) and plasticizer (glycerol, 30% solid mass of polysaccharides). Components were mixed by homogenization (IKA T18 basic, ULTRA TURRAX) for 1 min to achieve homogenous hydrogels. Solutions were degassed and structured on teflon plates in climate chamber (60% RH, 20°C, 48 h). The thermal gravimetric analysis (TGA) was used to measure the thermal stability of crosslinked chitosan-sodium alginate films. Hi-Res TGA 2950 Thermogravimetric Analyzer from TA Instruments company was used. The analyses were made varying the temperature from room temperature until 300°C in an inert nitrogen atmosphere with flow of 60 ml/min and rate warming of 10°C/min.

Studies showed that the first of decomposition inflection points were between 50–60°C which is due to the loss of water presented in the coating. It was observed that samples with the highest amount of chitosan (ACH-3, ACH-6, ACH-9) needed higher temperature to release bounded water than samples with lower concentration of this polysaccharide. All sodium alginate-chitosan films showed lower water mass lost at first step of decomposition than uncrosslinked chitosan. The second peak shows the breaking up of C-H bonds and decomposition of polyanione and was between 178–190°C in all samples. Some of samples (ACH-1, ACH-4, ACH-5, ACH-7, ACH-8) showed additional inflection point at temperature range 208–225°C which seems to be the result of interaction between sodium alginate and chitosan and may be considered as a proof of their polyelectrolyte complexation. In samples with the highest concentration of chitosan (0.75%) inflection point related to depolymerisation of chitosan chains was observed near 270°C. The final residue at maximum analysis temperature (300°C) for all complexed samples was about 30% of their total weight which confirm their thermal stability. The obtained results confirmed potential of sodium alginate-chitosan polyelectrolyte complexes as natural protective coatings in packaging applications.

Kulig D., Król Ż., Ulbin-Figlewicz N., Brychcy E., Zimoch-Korzycka A., Jarmoluk A.

WATER PROPERTIES OF CROSSLINKED SODIUM ALGINATE-CHITOSAN COATINGS

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Naturally occurring polymers have paid much attention in food, pharmaceutical and medical industry as coatings, additives, drug delivery carriers and wound dressing because of their biocompatibility, non-toxicity and biodegradability. Films derived from polysaccharides possess excellent mechanical, optical and organoleptic properties but are sensitive to moisture.

In present study ionic properties of sodium alginate (polyanione) and chitosan (polycatione) were used to produce polyelectrolyte complex material. A combination of the biopolymers has advantage of aggregating the positive aspects of each of the constituents; their interactional acting could be used to protect, enrich and improve quality of coated food. In this study we achieved insoluble material with good wetting properties which could be effectively used in food industry as coatings for products which require storage in high humidity conditions.

Sodium alginate powder (1.5%, w/v) was dissolved in deionized water by stirring (IKA, RW 20 digital) at 350 rpm for 24 hours. Similarly, 1.5% of chitosan solution (w/v) was prepared in 1% solution of lactic acid (v/v). Polyelectrolyte complex solution was obtained by drop wise polycatione solution at three different concentrations (0,25, 0,50, 0,75%) to polyanione solution (0,15, 0,20, 0,25%) and plasticizer (glycerol, 30% solid mass of polysaccharides). Components were mixed by homogenization (IKA T18 basic, ULTRA TURRAX) for 1 min to achieve homogenous hydrogels. Solutions were degassed and structured on teflon plates in climate chamber (60% RH, 20°C, 48 h). Obtained coatings were tested on wettability (contact angle), solubility and water content.

Results showed that the resistant to water was enhanced due to interactional acting of sodium alginate and chitosan in cross-linked material. Solubility of polyelectrolyte complex increased inversely to polymer ratio (R). Coatings with the highest polymer ratio have the greatest wetting properties. Also changes in water affinity in time were observed for samples with R>0.7. In the first phase of experiment, tested material showed hydrophobic properties and was resistant to water due to exposure of methyl groups on coating surface. Contact angle was changing in time of analysis, water starts to wet the surface of tested material, what suggest its dynamic reorganization. Hydrophilic hydroxyl groups progressively appeared on surface resulting in greater wettability of material - however, maintaining its resistance against water permeation.It was observed that formation of complexes close to stoichiometric balance (R~1, equivalent amount of polymers) followed with release of water, reduction of water content was observed in samples with ratio 0.5–0.8 (~27%) compared to samples with R<0.5 (~33%).

Research showed that polymer ratio influenced on water properties of coating. Multifunctional films with controlled properties are usable for a wide range of applications and could be obtained by manipulating the sodium alginate/chitosan ratio.

Kurek M., Piwińska M., Wyrwisz J., Półtorak A., Wierzbicka A.

THE RHEOLOGICAL AND TEXTURAL PROPERTIES OF WHEAT ROLLS DEPENDING ON THE ADDITIVE AND PARTICLE SIZE OF HIGH-FIBER POWDER

Warsaw University of Life Sciences, Division of Engineering in Nutrition, Faculty of Human Nutrition and Consumer Sciences, Warsaw, Poland

The study of rheological and textural properties of dough and wheat roll crumb with different level of high-fiber powder additive was conducted. The oat fiber powder used in the study had two particle sizes – 75 and 150 μm (WR75 and WR150). The dough was made from flour (type 500), high-fibre powder with 80% of dietary fiber content at the 0% (control group), 4, 8, 12, 16 and 20% of the flour replacement, yeast, enzyme improver, salt, sugar, fat and 50% w/w of water. The purpose of the study was to find the effect of fiber addition on the rheological and textural properties of wheat dough and rolls.

The forced oscillation test was conducted on dough without the yeast using the rheometer HAAKE RT20. The Texture Profile Analysis of the baked roll in terms of firmness, gumminess, springiness and chewiness after 1, 3, 24 and 48 h after baking was done using the Universal Testing Machine Instron 5965.

The significant differences ($p \leq 0.05$) between the control wheat dough and the dough with oat fiber addition in terms of the storage modulus (G'), loss modulus (G"), phase angle (δ) and deformation (γ) were observed. The significant differences of rheological properties were detected between the dough with 75 and 150 μm particle size. Dough with WR75 showed the larger values of G' and δ than the dough with WR150 what proved the higher elasticity of the dough with smaller fiber particles. The WR75 demonstrated rheological parameters closer to the control group.

The firmness, gumminess, springiness and chewiness were not significantly different within the measurement after 1 and 3h after baking. The firmness, gumminess and chewiness values increased with the storage time, but the springiness were on the same level. However, the texture parameters differed significantly between the WR75 and WR150. The replacement of the flour with the high-fiber powder caused the difference between the control group and rolls with oat fiber powder.

Correlation analysis showed that there was a significant positive interaction between firmness and G' (r=0.77) and G" (r=0.78), gumminess and G' (r=0.76) and G" (r=0.77) and chewiness and G' (r=0.74) and G" (r=0.75). The δ an γ values did not correlate with texture parameters.

The study proves that the decreasing of the particle size enables using higher additive of the fiber powder in rolls without the negative effect on the texture profile of the product. The usage of dietary high-fiber could improve the rheological properties of the dough as well.

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Lewko L., Gornowicz E.

COMPARATIVE ANALYSIS OF INTERIOR EGG FROM SELECTED FLOCKS OF DUCKS

Experimental Station of National Research Institute of Animal Production Kołuda Wielka, Waterfowl Genetic Resources Station in Dworzyska, Kórnik, Poland

Although there is no formal ban on eating duck eggs in Poland, they are questioned on the grounds of greater microbiological contamination compared to hen eggs and used only as hatching eggs. Duck eggs are most popular in the Far East, where they are eaten and processed in great quantities.

Tests were conducted with eggs from two selected flocks of Pekin ducks: Mini Ducks (K-2) and standard sized ducks (P-9) late in lay (weeks 21–22).

Birds intended for the study were kept in a windowless confinement house on straw (up to 3 weeks), indoors with outdoor access (weeks 3 to 5), and exclusively on sand yards (from 6 weeks of age). Ducks were fed ad libitum with the same diets, the nutritive value was appropriate for a given growth period.

The aim of the study was to estimate differences in physicochemical characteristics of interior eggs from ducks derived from the flocks enrolled in the genetic resources conservation programme.

Thirty eggs were randomly chosen from each flock to evaluate interior egg quality. Egg weight and percentage of egg fractions were determined. Quality traits of egg albumen were evaluated by determining albumen weight and height, Haugh units, pH value, water percentage, and the concentration and enzymatic activity of lysozyme in thin and thick albumen. Physical characteristics of egg yolks (weight, colour intensity, pH) were also estimated. The results were statistically analysed using Statistica 6.0.

As expected, eggs from P-9 birds were significantly ($p \leq 0.05$) heavier (85.91 g) and had a higher egg albumen percentage (52.64%) compared to K-2 ducks. In addition, these eggs had darker yolk colour (by 5.40 pts). In turn, egg albumens from K-2 ducks were characterized by greater height (by 0.41 mm on average) and higher Haugh units (by 8.91 on average) compared to albumens from P-9 birds. These albumens were also characterized by higher water content (84.19%). Analysis of the level and hydrolytic activity of lysozyme in egg albumen fractions showed that eggs from K-2 conservation flock were characterized by a higher content and activity of this enzyme in both thin (0.20%; 41782 U/ml) and thick albumen (0.14%; 31291 U/ml). The differences were statistically significant ($p \leq 0.05$).

End-of-lay K-2 Pekin ducks, which are characterized by low body weight and almost 30% lower laying performance compared to P-9 flock, produced eggs with a significantly ($p \leq 0.05$) higher content and enzymatic activity of lysozyme as well as more beneficial physical characteristics of egg albumen.

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Lewko L., Gornowicz E.

EFFECT OF WEIGHT OF CONSUMPTION EGGS ON THEIR QUALITY PARAMETERS

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The experiment used eggs from hybrids of laying hens aged 36 weeks.

Layers intended for the study were raised under identical hygienic conditions and fed the same rearing and laying diets. At 36 weeks of age, 160 eggs were randomly chosen on the same day to make the evaluation objective. The collected eggs were divided into four weight categories: below 57.0 g; from 57.0 to 60.0 g; from 60.0 to 63.0 g; more than 63.0 g.

The aim of the study was to determine the effect of egg weight on the quality of consumption eggs.

The weight of eggs and egg fractions, albumen height, Haugh units, yolk colour, and shell colour and density were evaluated using the EQM (Egg Quality Micro) system (Technical Services and Supplies Limited, UK). Egg shape index was determined. Air cell height was determined using a handheld egg candling lamp. Shell thickness was analysed using a micrometer and shell deformation using the TA.XT PLUS texture analyser (Stable Micro Systems). Next, the eggs were broken out and separated into albumen and yolk, and egg shells were weighed to determine shell percentage. The separated and individually weighed egg fractions were analysed for pH value. Thereafter, they were placed in identical disposable sterile containers, sealed, labelled and frozen. Weighed amounts were collected periodically from so prepared albumen samples to analyse lysosyme in egg albumen fractions.

Eggs from the highest weight range (>63.0 g) were characterized by the lowest shell percentage (10.56%) and highest albumen percentage (60.92%) and height (6.61 mm). Yolks were characterized by higher percentage in egg (27.48%) and darker colour (13.65 pts) compared to the other yolks of eggs from different weight ranges. Qualitative analysis of egg shells showed that eggs from the 57.0–60.0 g weight range were characterized by greatest thickness (352.46 μm) and highest breaking strength (3.82 kg). Detailed analysis of lysozyme in different albumen fractions showed that albumens of eggs from lightest birds (<57.0 g) were characterized not only by the highest percentage of lysozyme in thin albumen (0.61%) but also by the highest hydrolytic activity of 131105 U/ml. A similar situation was noted when analysing lysozyme in the thick albumen, where the highest lysozyme percentage (0.38%) and hydrolytic activity (80705 U/ml) was also observed in albumens from lightest eggs. The differences were statistically significant ($p \leq 0.05$).

Eggs from layers of lowest weight showed the least favourable qualitative traits of albumen but at the same time were characterized by the highest content and activity of lysozyme in both thin and thick albumen.

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Li-Chan E.C.Y.

BIOACTIVE PEPTIDES AND FOOD PROTEIN HYDROLYSATES – NEW TECHNOLOGIES AND RESEARCH TRENDS

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According to the World Health Organization, non-communicable diseases including cardiovascular diseases and diabetes accounted for two-thirds of all deaths globally in 2011.

The leading risks for mortality for non-tobacco users are high blood pressure, high blood glucose, overweight and obesity, and physical inactivity, all of which increase the risk of chronic non-communicable diseases. While pharmacotherapy is the commonly accepted approach to combat these diseases, it is estimated that a majority of premature deaths could be prevented by changes in lifestyle including a healthy diet. In recognition of the importance of dietary factors in promoting health, there has been an increasing demand to develop functional foods and natural health products containing bioactive phytochemical compounds. More recently, however, attention has been drawn to the tremendous potential opportunities for food proteins and peptides with anti-oxidative, anti-hypertensive, anti-diabetic and other bioactive properties, to complement synthetic pharmaceutical products for management of these non-communicable diseases.

This presentation will provide an overview of the core technologies as well as highlight recent research trends in the production and assessment of bioactive peptides and hydrolysates from food proteins. To minimize the cost and time associated with a trial-and-error approach for producing hydrolysates with bioactivity, *in silico* analysis may be applied at an early stage to select candidate proteins as precursors for bioactive peptide production. Moreover, systematic experimental designs can expedite the establishment of enzymatic hydrolysis conditions for optimal yield and bioactivity of protein hydrolysates. Further fractionation by membrane or chromatographic processes are often conducted to yield products with greater potency, and are necessary to yield fractions from which individual peptide sequences may be identified and their characteristics and mode of action elucidated. Finally, their use as functional food ingredients requires *in vivo* assessment of efficacy as well as analysis of sensory attributes. Since bitter taste is frequently reported in protein hydrolysates that possess bioactive properties such as ACE-inhibitory activity and hypertension, there is a need to evaluate masking, encapsulation or debittering treatments to ensure consumer acceptance. Recent advances in scanning peptide array technology suggest its prospective application as a high throughput tool to complement traditional laborious chemical synthesis of peptides for discovery of bioactive sequences, while the electronic tongue and other instrumental taste

sensing systems may offer expedient screening of hydrolysates prior to sensory evaluation by humans. The knowledge and insights gained from these studies are of critical importance to provide the scientific basis for producing and applying bioactive peptides derived from food proteins as dietary ingredients that can contribute to reducing the risk and managing the complications of non-communicable diseases, with the long-term goal of promoting human health.

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Łobacz A., Kowalik J., Pajer A., Wilga J.

APPLICATION OF IMPEDIMETRIC BACTRAC SYSTEM TO EVALUATE THE NUMBER OF *ESCHERICHIA COLI* AND *BACILLUS CEREUS* IN DIFFERENT TYPES OF MILK

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Impedance is the resistance to the flow of alternating current passing by the analyzed material. Using this phenomenon it is possible to perform quantitative and qualitative microbiological analysis of food products.

The purpose of present study was to calibrate and verify the BacTrac system (Sy-Lab) in order to evaluate the number of *Escherichia coli* and *Bacillus cereus* in different types of milk in terms of applied heat treatment.

The study was carried out on pasteurized, UHT, microfiltrated and raw milk. Microorganisms used in the present study were *E. coli* and *B. cereus* isolated from food at the Chair of Industrial and Food Microbiology, University of Warmia and Mazury in Olsztyn.

The first stage of work was to calibrate the BacTrac 4300 Microbiological Analyser (Sy-Lab) using UHT milk samples contaminated with *E. coli* or *B. cereus*. Traditional plate counts method was used to connect the number of microorganisms with obtained detection time from BacTrac system. As a result a calibration curves and a linear regression equations were obtained to assess the number of *E. coli* and *B. cereus* in UHT milk with high correlation coefficient (0.95 and 1.0, respectively).

The next step was to verify obtained calibration curves for UHT, pasteurized, microfiltrated and raw milk samples contaminated with *E. coli* or *B. cereus*. Traditional plate counting was used as a reference method.

It was found that impedimetric method can be successfully apply to assess the microbiological quality of milk subjected to different heat treatment processes. The evaluation of number of microorganisms present in final product is possible using the detection times. It was concluded that impedimetric method allows for faster analysis of food products in comparison to traditional plate counts method.

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A COMPARATIVE ASSESSMENT OF BAKING VALUE OF RYE FLOUR (BREAD AND WHOLEMEAL TYPE) FROM DIFFERENT VARIETIES RYE SEEDS (*SECALE* L.) FROM ECOLOGICAL FARM

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Rye is commonly consumed in Europe. Its energy and nutritional value are similar to wheat cereals. However, rye is mostly consumed as whole-grain bread and therefore provides a considerable amount of dietary fibre. Diets low in fat and high in dietary fibre are shown to be associated with a lower risk of chronic Western diseases, including cancer and athero-sclerosis. Nowadays a lot of people in Poland are resigning eating bread. In 1900 Polish people consumed more than 100 kg bread per person per year, now they consume only about 50 kg bread per person per year.

The aim of paper was a comparative assessment of baking value of rye flour (bread and wholemeal type) from rye seeds (*Secale* L.) from ecological farms.

The paper presents comparative assessment of rye flour type bread and rye flour wholemeal from rye seeds (of variety: Warko, Dańkowskie Złote, Amilo, Motto) from ecological farms. Baking value was evaluated by indirect and direct methods. The indirect method was used to determine the following: falling number, protein and ash content, acidity and water content of flour. Trial baking and spot assessment of bread constituted a direct method. Tests were performer in triplicate.

The results of the physicochemical analysis are consistent with the standards for rye flour and rye bread (PN-A74032 and PN-92A-7401). Results of the analysis point of bread have classified it for the second, third and fourth class, depending on the variety of rye and the degree of milling.

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Macura R., Michalczyk M., Macura M.

STABILITY OF SELECTED CONSTITUENTS IN THE STORED CONCENTRATED JUICES OBTAINED BY MEANS OF CRYOCONCENTRATION TECHNOLOGY

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A freeze concentration method is regarded as a method assuring better retention of thermolabile constituents than classical methods; however, its drawback is a limited degree of the concentration possible to obtain.

The aim of the work was to assess the effect of concentration through water freezing and then storage of the product obtained on the content of selected constituents. Raspberry, chokeberry and lemon juices were subjected to the process of cryoconcentration. One part of concentrates after sweetening with saccharose to 70% d.m. was stored at room (20±1°C) and chilling temperatures (3±1°C), and the other, without adding sugar, at -22°C. The products stored for 9 months were analysed for ascorbic acid content as well as anthocyanins content and their degradation index.

Concentration of juices increased from 100 to 180% after the freeze concentration applied. In raspberry and lemon juices, ascorbic acid content was steadily significantly falling; although, after 9 months of storage at -22°C, 50% of it's the initial content was retained. On the other hand, losses found in the sweetened products ranged from 30% (in raspberries) to 90% (in lemon concentrate) after only 3 months of storage at room temperature. Better stability characterized anthocyanins; the greatest losses in their level (of 80%) were found in the sweetened raspberry concentrate stored at room temperature for 9 months, while the lowest (of 8%) in the frozen chokeberry concentrate.

Changes in the levels of the constituents examined led to the conclusion that concentrates should be stored frozen to maintain benefits due to a gently method of their concentration.

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Michalczyk M.

EFFECT OF PRELIMINARY TREATMENT ON THE LEVEL OF MICROBIAL CONTAMINATION OF SPROUTED SEEDS

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Sprouted seeds are frequently contaminated with a large number of microorganisms, the level of which often exceeds 10^8 cfu/g. Some incidences of poisoning with *Sallmonella sp*. and pathogenic *Escherichia coli* strains were connected with such a product. In view of the above, especially when incidences of poisoning are recorded, heat treatment of such a product, particularly its boiling in steam, is recommended to consumers.

The aim of this work was to compare the effect of boiling in steam as well as short-term immersing in boiling water on the level of microbial contamination of sprouted seeds.

Wheat, alfalfa, radish, Mung bean, broccoli and lentil sprouts were subjected to 2-minute boiling in steam and 10-second immersing in boiling water.

Immediately after heat treatment, sprouts were cooled in cold running water. Before and after heat treatment, the following analyses were performed in the product: total viable count (TVC), *Enterobacteriaceae* bacteria count as well as yeasts and moulds count.

Both operations applied allowed the reduction of *Enterobacteriaceae* bacteria and moulds below level of detection. The TVC, compared to the initial values, was reduced by up to five log cycles and the results obtained for both kinds of the heat treatment applied were similar in the majority of the sprouts examined. Total viable count determined in the samples cooked as well as those immersed in boiling water was at the level of 10^3–10^5 cfu/g, while the level of yeasts ranged from below detection level to 10^2 cfu/g and was reduced by up to seven log cycles after processing.

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Michalski M., Osek J.

MECHANICALLY SEPARATED MEAT (MSM): TECHNOLOGICAL TYPES, CLASSIFICATION AND PUBLIC HEALTH RISK

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Mechanical recovering of poultry meat from necks, backs and other bones with attached flesh started in the late 1950s. Now mechanically separated meats (MSM) are produced from pork and poultry elements. Mechanically separated meat is defined in Regulation (EC) No 853/2004 (Annex I, point 1.14) as "the product obtained by removing meat from flesh-bearing bones after boning or from poultry carcasses, using mechanical means resulting in the loss or modification of the muscle fibre structure" and specific requirements for its production are described in Annex III, Section V of the same Regulation. Raw material used in separation process must comply with the requirements for fresh meat. Production must be done in hygienic conditions with keeping low temperatures. Using MSM for production of meat products performed follow the rules described in Regulation (EC) No 853/2004. Low and high pressure MSM products are defined according to the alteration of bone structure and calcium content. Low pressure: "MSM produced using techniques that do not alter the structure of the bones used in the production of MSM and the calcium content of which is not significantly higher than that of minced meat". The calcium content shall not exceed 1000 ppm of fresh product. High pressure MSM is produced using techniques other than those used for production of low pressure MSM. The microbial hazards, that may be present in MSM, depend on the hygiene of processing, the levels and types of contamination present in the raw materials and their storage history. Nevertheless, the risk of microbial growth increases with the degree of muscle fibre degradation. MSM is usually heavily contaminated with microorganisms, which originate from the carcass raw material, its storage history and the processing environment. Microbial hazards in pork and poultry MSM are expected to be the same as those in fresh meat, minced meat and meat preparations, and include *Salmonella, Campylobacter, Yersinia, Clostridium perfringens* and *Staphylococcus aureus*. According to Regulation (EC) 2073/2005 (microbiological criteria for foodstuffs), under the process hygiene criteria, 5 samples must be taken from one batch per sampling session and tested for total viable counts (TVC) and *Escherichia coli*. All 5 samples must have TVC of less than $5 \cdot 10^6$ cfu/g and 3 samples must be less than $5 \cdot 10^5$ cfu/g. Similarly, all 5 samples must have an *E. coli* count of less than $5 \cdot 10^3$ cfu/g and 3 samples must be less than $5 \cdot 10^2$ cfu/g. Under the food safety criteria, MSM must also be tested for *Salmonella*. Improper holding temperatures during the production and storage phases allow growth and multiplication of contamination. In MSM, bone content and

consequently calcium content are generally higher as compared to fresh meat. The calcium content is frequently used as the criteria to identify MSM. Calcium level and bone residues significantly increase when the extraction pressure increases. In addition to percentage of calcium, bone particles and their size are also of great importance, because large particles might cause a gritty texture and potential dental problems. The phosphorus content of MSM is dependent of raw material use to production: on animal species, age of the slaughtered animals, cuts of meat, bone type (cartilage, necks, wings, bones, back), previous treatment of the bones (trimming, freezing, etc.), and the machine type and operating conditions used in the recovery process. Phosphorus content is not considered to be a food safety or health issue.

Mizgier P.[1], Bober A.[1],Wyspiańska D.[1], Kucharska A.Z.[1], Sokół-Łętowska A.[1], Piórecki N.[2,3]

QUALITATIVE ANALYSIS OF THE PREPARATION FROM CORNELIAN CHERRY SUBJECTED TO SIMULATED DIGESTION IN VITRO

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Cornelian cherry fruit (*Cornus mas* L.) is attractive raw material, not only because of its quality and taste value, but also because of health benefits. These fruits are a rich source of biologically active compounds: in particular of compounds of the iridoid group and polyphenols. In the human body, biological functions of active compounds depend on their changes in the alimentary tract.

Their stability in the gastrointestinal tract and absorption are dependent on the chemical structure. It has been proven that the anthocyanins are characterized by low stability in the human alimentary tract. They are absorbed in a limited manner, and their plasma concentration is at a level of nM. Also the absorption of flavonols and phenolic acids is highly dependent on their structure.

The aim of the study was to determine the changes in the content of biologically active compounds in the preparation of cornelian cherry fruit during simulated in vitro gastric and intestinal digestion.

The preparation obtained from cornelian cherry fruit was digested. The study included two steps of digestion: in stomach and in small intestine. Simulated gastric digestion consisted of an incubation of samples for 2 h in the presence of pepsin, while simulated intestinal digestion of further incubation for 2.5 h in the presence of pancreatin (4 mg / ml), and bile salt (25 mg / ml). In order to maintain the conditions that prevail in the organism, in addition to the enzymes, we used the appropriate pH and temperature. Additionally, the dialysis membrane was used to determine the bioavailability of the compounds. At all stages of digestion, we determined the qualitative and quantitative changes of anthocyanins by LC-MS and HPLC methods.

Obtained results show high stability of polyphenols and iridoids during simulated gastric digestion. However, after intestinal digestion only 0.5–0.7% of anthocyanins was recovered, in comparison to their content before digestion. During intestinal digestion, iridoids showed high stability as compared to the polyphenols. After intestinal digestion, 36% of loganic acid remained in the dialysis fraction, which may indicate its good bioavailability. We have observed 9-fold higher concentration of ellagic acid inside the dialysis membrane, which is attributed to the release of this compound from macromollecular compounds.

The studies indicate that active compounds, in particular the loganic acid, may penetrate into bloodstream and participate in physiological processes of the body.

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Mizgier P., Wyspiańska D., Kucharska A.Z., Sokół-Łętowska A.

EFFECT OF MICROENCAPSULATED STRAWBERRIES ANTHOCYANINS ON THE QUALITY OF NATURAL YOGHURT

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Yoghurt is valuable product because of its health benefits and sensory properties. More and more often, one may buy such milk products enriched with biologically active compounds.

Among biologically active compounds, the anthocyanins exhibit a high potential for enrichment of yoghurts. In addition, those compounds, as natural colorants, give attractive color to many products. However, anthocyanins are unstable and easily degradable compounds. Microencapsulation is a one of the methods of improving the stability of colorants. Microencapsulation is a technique by which the active ingredients are packed within wall material, which protects the bioactive compounds from unwanted factors. The use of maltodextrin or inulin as wall material may improve physical and chemical properties of yoghurt, and they can replace commercial stabilizers.

The aim of this study was to determine the effect of the microencapsulated anthocyanins extracted from strawberries, on the quality of natural yoghurts and their organoleptic assessment.

Yoghurts were enriched with 1% strawberries anthocyanins microencapsulated with maltodextrin or inulin. Control sample was yoghurt with non-encapsulated colorant. After preparation and 4 days of storage, pH and colour parameters CIE $L^*a^*b^*$ were measured. Sensory analysis (flavor, aroma, texture, color) were evaluated using 5-point hedonic scale, and the overall acceptance was measured by linear scale method. The content of anthocyanins in yoghurts was determined using HPLC method.

After 4 days storage, in yoghurts with inulin capsules, the pH increased by 0,03, while in yoghurts with non-encapsulated anthocyanins – decreased by 0,04. Yogurts with microencapsulated anthocyanins were brighter than those where non-encapsulated colorant was used. Yoghurts with microencapsules with inulin were rated better during sensory analysis than yoghurts with non-encapsulated colorant. Based on the results obtained with the HPLC method, four anthocyanins were identified, among which dominated pelargonidin 3-*O*-glucoside. After storage, yoghurts with microencapsules with maltodextrin were characterized by higher content of anthocyanins. In these yoghurts it was kept 96% of the initial of content of anthocyanins.

Microencapsulation of anthocyanins creates chances for enrichment of food with health-promoting ingredients and their use as natural colorants in food production. Fruit pulps are most commonly used in the production of fruit yoghurts. Unfortunately, fruit pulps lose colour and nutrients during processing. Therefore, they may be completely or partially replaced with microencapsulated anthocyanins. The use of inulin or maltodextrin in microencapsulation may improve the physical and chemical properties of yoghurts without the use of commercial stabilizers.

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Munera-Picazo S., Nuncio-Jauregui N., Cano-Lamadrid M., Carbonell-Barrachina A.A.

ARSENIC IN RICE-BASED FOODS FOR CHILDREN WITH CELIAC DISEASE

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Celiac disease is an autoimmune disease that affects the villi of the small intestine causing abdominal pain, gas, diarrhea, or bad absorption due to gluten intolerance. The only treatment for this disease consists of a lifelong gluten free diet; this is, celiac people cannot consume products containing gluten, such as wheat, barley, and rye, but they can use rice and corn. Thus, rice flour is mainly used for the manufacturing of the basic products of this population. Unfortunately, rice can contain high contents of total (t-As) and inorganic (i-As) arsenic.

The current study demonstrated that products for celiac children with a high percentage of rice contained high concentrations of arsenic (256 and 128 μg kg^{-1}). The daily intake of i-As ranged from 0.61 to 0.78 μg kg^{-1} body weight (bw) in children up to 5 y of age; these values were below the maximum value established by the EFSA Panel (8.0 μg kg^{-1} bw per day), but it should be considered typical of populations with a high exposure to this pollutant.

Finally, legislation is needed to improve the labeling of these special rice-based foods for celiac children; label should include information about percentage, geographical origin, and cultivar of the used rice.

Practical Application: Companies manufacturing foods for celiac children should be aware that high iAs have been found and ask their rice suppliers to provide them with the safest rice (lowest i-As possible) for manufacturing of these special foods. Besides, manufacturers should include all available information on rice on the labels of their products.

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Nawirska-Olszańska A.[1], Biesiada A.[2], Sokół-Łętowska A.[1]

EFFECT OF SULFUR FERTILIZATION ON THE QUALITY OF RAW KALE

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Among vegetables with a particularly high demand for sulfur are brassicas currently rated as a very positive acting on the human body the particularly valuable components found in cruciferous vegetables are vitamins A, C and polyphenols and glucosinolates.

Sulfur is one of the primary nutrients, affecting the normal growth and development of both plant organisms, animal and man. It plays an important role in the plants in the process of protein synthesis, reduction of the fraction of non-protein nitrogen form in the plant (including nitrates), improves the resistance of plants to environmental stress (pathogens, drought) likewise increases aromatic qualities of vegetables.

The aim of the study was to determine the effect of the applied forms of sulfur fertilization on the chemical composition of raw kale.

Kale was grown in 2012–2013 in Research Station belonging to the Department of Horticulture of Wrocław University of Environmental and Life Sciences, chemical analyzes were performed in the laboratory of the Department of Fruit, Vegetable and Grain of Wrocław University of Environmental and Life Sciences.

Kale was fertilized with 30 kg S ha^{-1} in the form of elemental sulfur, ammonium sulphate and potassium sulphate.

After harvesting, the samples are drawn from five randomly selected plants from each plot and homogenized. The so-prepared material was performed to determine the content of the extract according to PN-90/A-75101/02, dry weight according to PN-90/A-75101/03, acidity (PN-90/A-75101/04), ash according to PN-90/A-75101/08, vitamin C as L-ascorbic acid according to PN-90/A-75101/11, chlorophyll content and total carotenoids by Rumińska et al. (1990), the contents of anthocyanin (Fuleki, Francis 1968), total polyphenol content by Folin-Ciocalteu'a (calculated as gallic acid) (Slinghart and Singleton 1977). Antioxidant activity was determined as the force radical scavenging 2,2-diphenyl-1-pikrylhdrazylowych (DPPH) and by Yen and Chen (1995), and the method of ABTS given by Re et al.(1999. Anthocyanins, polyphenols and the antioxidant properties was analyzed in the methanolic extracts (80% v / v, the ratio of extraction reagent material to 1:5).

The extract content, dry matter, ash, chlorophyll and anthocyanin was the lowest in the control sample of kale. The highest contents of vitamin C and anthocyanins (respectively:

89.16 mg/100 g f.m. and 49.65 mg/100 g f.m.) were determined in the kale fertilized with sulfur in the form of potassium sulphate. The highest anti-oxidizing properties had kale fertilized with sulfur in the form of ammonium sulfate (ABTS – and DPPH 17.26 – 215.92 mM Trolox for 1 g fresh weight). There was no correlation between the content of vitamin C, carotenoids, total polyphenols and total antioxidant properties. Various forms of sulfur had an positive effect on the content of the individual bioactive components contained in kale, however, not possible to determine which of the most preferred forms of sulfur had an impact on the test material.

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MUSCLE FIBRE DIAMETER AND MEAT QUALITY TRAITS OF FAST- AND SLOW-GROWING BROILER CHICKENS

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Subjects were Hubbard Flex broiler chickens and slow-growing Hubbard JA 957 chickens. Birds were raised until they reached a similar body weight of around 2.5 kg at 42 and 56 days of age (fast- and slow-growing birds, respectively). Throughout rearing, all birds were kept on deep litter under optimal environmental conditions of a broiler house and fed *ad libitum* the same starter, grower and finisher diets containing 22, 20.5 and 20.5% CP and 2990, 3130 and 3130 ME/kg, respectively. On the last day of growth, 160 fast-growing chickens (Gr. I) and 160 slow-growing chickens (Gr. II) in an equal sex ratio were selected.

pH of breast muscles was determined 15 min postmortem with a CyberScan10 pH meter equipped with a glass electrode for analysis of meat pH. Samples of breast muscles were then collected to determine the diameter of muscle fibres. The measurement of meat acidity was repeated after 24-h chilling of carcasses at +4°C. Dissected breast muscles were analysed for the technological parameters of colour (CIE, L*a*b*), drip loss, thawing loss, thermal loss, and technological yield of meat. In addition, the breast muscles were evaluated for texture parameters (TPA) and shear force (Warner-Bratzler) using an Instron 5542 device.

The aim of the study was to compare breast muscle quality traits in fast- and slow-growing chickens and to determine the relationship between fibre diameter and breast muscle quality parameters.

Carcass percentage of breast muscles differed significantly at 27.4% (Flex) and 22.8% (JA957), with body weight of 2479 and 2577 g, respectively ($P \leq 0.01$). Breast muscle fibre diameter was significantly higher in fast- compared to slow-growing chickens. Breast muscles of JA 957 chickens were characterized by significantly lower pH, lighter colour (L*) and lower redness (a*) compared to the muscles of Flex chickens. Both yellowness (b*) and thawing loss for meat of chickens from groups I and II were similar. In addition, breast muscle of slow-growing chickens was characterized by significantly higher drip loss ($P \leq 0.01$) and lower thermal loss ($P \leq 0.01$), which contributed to smaller technological losses of meat in this group ($P \leq 0.01$). Fast- and slow-growing birds differed in texture and shear force parameters of meat ($P \leq 0.01$). More tender meat was found for Flex chickens, which were also characterized by poorer parameters of meat texture (toughness, springiness, gumminess, chewiness) compa-

red to JA 957 birds. Analysis of Pearson's correlations showed several significant relationships between muscle fibre diameter and meat quality traits. A positive correlation was found between fibre diameter and pH of muscles, both at 15 min and 24 h postmortem ($P \leq 0.01$). Furthermore, a positive relationship was noted between muscle fibre diameter and meat texture parameters ($P \leq 0.01$): hardness, springiness, gumminess and chewiness. In addition, shear force and meat colour L^*, similar to drip and thawing loss were negatively correlated to fibre diameter ($P \leq 0.01$ or $P \leq 0.05$).

The present study showed that fast- and slow-growing broiler chickens differ significantly in the microstructure and quality of breast muscles. Breast muscle fibre diameter was found to have a significant effect on most of the meat quality parameters analysed.

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COMPOSITION AND QUANTIFICATION OF MAJOR BIOACTIVE COMPOUNDS AND COLOR PROPERTIES OF SOUR CHERRY SMOOTHIES

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Nowadays diets rich in fruits and vegetables have been associated with reducing the risk of chronic diseases, such as cancer, cardiovascular disease and stroke. The lower mortality rates have been attributed to the higher concentration of phytochemicals, especially polyphenolics which demonstrated antioxidant potential. Sour cherry (*Prunus avium*) is a valuable source of polyphenolics compounds such as anthocyanins and phenolic acid, with proven health-promoting compounds. These fruits are usually earmarked for direct fresh consumption and are also processed by the food industry for the elaboration of nectars, jams and frozzen fruits. Generally these fruits sour and acid and thus it is not very offen suitable for consumption when raw. Additionally due to seasonal availability of fruits, it is interesting to determine whether fruit-derived products such as smoothies could also represent good sources of bioactive compounds.

Therefore the aim of the study was to establish whether the addition of fruits by proportion 50:50 during smoothies processing as improves content of bioactive compounds, antioxidant activity, color and sensory properties.

Fruits were harvested at the Research Station for Cultivar Testing in Zybiszów near Wrocław at processing maturity in 2013. The production process included 3 main technological stages: juices (I) or puree (II) and mixing both semi-products in proportions juice : puree (sour cherry: peach or apricot or plum) or puree:juice (sour cherry: apple or quince or pear or flowering quince) as the proportion: 50:50. Polyphenolic compounds were identified by LC-MS QTof and quantified by UPLC, antioxidant activity was measured by ABTS method, color of products was expressed as CIE Lab system.

The total content of polyphenolic compounds in sour cherry smoothies varied from 472 to 956 mg/100g but concentration range depending on the addition type of fruits. The dominant phenolic compounds in this sample were flavan-3-ols, namely polymeric proanthocyanidins, than hydroxycinnamic acid and anthocyanins. The highest level of polyphenolic compounds and antioxidant activity ($p<0.05$) was observed in samples with the addition of flowering quince and quince juice and the lowest with the addition of peach puree to sour cherry puree and juice, respectively. The color of examined smoothies could be due to type of fruit addition, the nature of the pigments in these fruits. The lightness (L*) of analysed smoothies was from 29.12 to 33.66, redness (a*) was from 11.68 to 23.39 and yellowness (b*) was from 3.17 to 7.51.

Overall, the results indicated that some mixed smoothies can represent a good source of antioxidant compounds and can have an attractive color for the consumer.

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Nuncio-Jáuregui N.[1], Hernández F.[2], Munera-Picazo S.[1], Noguera L.[1], WojdyłoA. [3],Carbonell-Barrachina A.A.[1]

POMEGRANATE JUICE ADULTERATION BY ADDITION OF GRAPE OR PEACH JUICES

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Nowadays, the pomegranate (*Punica granatum* L.) is gaining acceptance because it ismore recognized for its beneficial health properties. On the other hand, consumption is beingtranslated into an increase in products derived from this fruit, like pomegranate juice. Adulteration of this type of product is increasingly present in national and international marketsdue to various factors such as the high demand for the product, the shortage of the fruit incertain seasons of the year and geographic areas, which search company in developing cuttingcosts and materials and finally to mask the astringent taste typical of pomegranate juice andpale color of some varieties. The purpose of the study was to evaluate three types of commercial juices: pomegranate, grape and peach. Described the main features of quality organic acids, total sugars, minerals, proline and volatiles compounds. To simulate tamperingand possible changes in the chemical composition of pomegranate juice, grape juice was addedat concentrations of 10, 25 and 50% and peach juice at concentrations of 5 and 10%. Theresults showed that pomegranate juice adulterated with grape juice significantly increased ($p<0.05$) tartaric acid content, Ca, Mg, Fe, Cu, Mn and mainly proline content. Likewise,decreased significantly ($p<0.05$) the content of K. Adulteration with peach juice showed nosignificant changes in the organic acid profile of pomegranate juice, however, the sucrosecontent increased significantly ($p<0.05$). As the volatile composition, adulteration ofpomegranate juice with up to 50% of grape juice behaved significant increase: acetic acid,isoamyl alcohol, isoamyl butyrate, and especially, 1-hexanol and linalool, by contrast, somecompounds such as ethyl acetate, hexanal, cis-3-hexenol, 2-ethyl-1-hexanol and terpinen-4-ol,decreased. The pomegranate juice adulteration with up to 10% peach juice resulted insignificant increases butyl acetate, isobutyl butyrate, benzyl acetate and isoamyl butyrate, onthe contrary, some compounds, such as ethyl acetate, hexanal, cis-3-hexenol, 1-hexanol, 2-ethyl-1-hexanol, terpinene-4-ol and α-terpineol decreased.

Onacik-Gür S.[1], Żbikowska A.[1], Kowalska M.[2], Marczak J.[1]

EFFECT OF ADDITION OF INULIN AS A FAT REPLACER ON THE QUALITY OF SPONGE CAKES

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Nowadays consumers are more interested in healthy food and products with reduced fat content. It is caused by a greater knowledge of consumers and easier access to information concerning food and nutrition.

The fat content in food products might be limited by adding different ingredients to replace fat, so-called fat replacers. These compounds are a group of food additives, which in respect of functionality and sensory properties are similar to fat, but have lower energy value.

The aim of this work was to reduce fat content without quality deterioration in sponge cakes by adding inulin.

Cakes were baked in two versions with Akobake S100 (low-trans) and hydrogenated rapeseed fat. The inulin addition to cakes was: 0, 2, 3.5, 5 and 6.25% in whole weight of dough.

Examinations used to evaluate and to compare quality of cakes were: volumetric mass of dough and baked product, volumetric mass density of crumb, moisture, porosity, maximum cutting force, cohesiveness, elasticity, hardness, mastication (on a Zwick testing machine type 1120) and sensory evaluation. The statistical analysis of the obtained results was performed using ANOVA and PCA. The significance level was set at $\alpha = 0.05$.

The use of inulin as a fat replacer in sponge cakes has a positive impact on their quality. The addition of inulin caused an increase in moisture content of baked products from 16 to 22%. Products with 2% addition of inulin and with Akobake S100 were characterized by the biggest volume and porosity (855 cm^3 and 57,5%). Similar results were obtained from sensory analysis, products with 2% of fat replacer addition got high scores in terms of fluffiness and porosity.

Undesirable increase of hardness and mastication was observed in products with increasing content of inulin. In the case of hardness from 27 to 40.9 N (hydrogenated rapeseed fat) and from 7.8 to 43.5 N (Akobake S100), results were confirmed by sensory analysis. Mastication increased from 12 to 20.6 N for rapeseed fat and from 5.3 to 17.5 N for Akobake S100. These observations were confirmed by sensory analysis.

The addition of inulin less than 3.5% caused an increase of moisture, volume and porosity of products. Presence of inulin did not limit the water loss during 14 days of storage.

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EVALUATION OF FATTY ACIDS COMPOSITION OF GEESE BREAST MUSCLES DURING STORAGE IN A HIGH OXYGEN MODIFIED ATMOSPHERE AND VACUUM

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The objective of the work was to compare the evolution of intermuscular fatty acids (FA) composition during geese breast muscles storage in a high oxygen modified atmosphere (MA) and vacuum.

The experimental material was White Kołuda geese boneless breast muscles with the skin from the industrial slaughter. Two packaging methods and four periods of storage (4, 7, 11, 14 days) were studied. The following two modified atmospheres were used in the carried out study: vacuum and modified atmosphere consisting of 80% O_2, 20% CO_2. Control samples were geese breast muscles stored in air and tested after 24 hours after slaughter.

The fatty acids composition of meat was determined by Capillary Gas Chromatography technique. For the determination of fatty acids composition the lipid samples were converted to their corresponding methyl esters by AOCS official method Ce 2-66 (AOCS 1997).

The experiments were repeated five times for each atmosphere type (vacuum and modified atmosphere). Every time 25 muscles were investigated. Twenty breast muscles were used in each packaging method. The remaining five muscles were used for fresh sample analysis carried out 24 h after slaughter and were used as initial values for each atmosphere type. All the samples were stored in a refrigerator at +1°C and were examined in 24 h after slaughter (unpacked muscles) and after the 4th, 7th, 11th, 14th day of storage (muscles packed in vacuum and in MA). The determinations were performed for each of the muscle.

The storage time and kind of atmosphere had a significant effect on the fatty acids profile in the breast muscles lipids.

Samples packed in MA had the highest change in FA profile during storage, increasing saturated fatty acids (SFA) (12,3%) and monounsaturated fatty acids (MUFA) (6,2%) after 14 days of storage in relation to values denoted in unpacked samples, whereas polyunsaturated fatty acids (PUFA) decreased (20,9%) in the same period. In samples packed in vacuum there was not a change in FA profile of lipids.

Based on the obtained results it was shown, that packaging in modified atmosphere containing high oxygen levels promoted fatty acids oxidation in geese breast muscles during storage, which implied changes in fatty acids profile, decreasing PUFA percentage and increasing SFA and MUFA percentages. Vacuum packaging was shown to be the best method for geese muscles fatty acids profile preservation during 14 days of storage.

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Oziembłowski M.

NUTRIGENOMICS IN PREVENTION OF HUMAN HEALTH

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The concept that diet influences health is an ancient one, but modern nutrigenomics includes known interactions between food and inherited genes, such examples can be Phenylketonuria or lactose intolerance. Nutrigenomics aims to identify and characterize the effects of food components on genome expression at several molecular levels.

Single nucleotide polymorphism (SNP) is a local variation of a DNA sequence in the chromosome, which is subject to inheritance. SNPs make up about 90% of all human genetic variations; humans have about 5 to 8 million SNPs. Some of them may be partially responsible for variations in individual's response to bioactive food components. Present studies are focused also on SNPs and its associations with such diseases like cancer, obesity, diabetes, cardio vascular diseases (CVD), neural tube defect (NTD), leukemia, Down syndrome, spina bifida, etc. Nutrigenomics investigations in disease prevention are often connected with another 'omics' studies like genomics, proteomics or metabolomics.

One of the example of SNP and phenotype effect correlation for European population (CEU) is as below:

SNP rs762551 can be characterized by 3 genotypes: AA (frequency in CEU population – 53%), AC (38%) or CC (9%). People with AA genotypes have fast metabolism of caffeine and lower risk of heart attacks caused by the use of coffee. People with AC or CC genotypes have slow caffeine metabolism and higher risk of heart attack, especially if they consume 2–3 cups of coffee and more. For another population that percentage ratio is different. For instance Luhya in Webuye, Kenya (LWK population) have only 20% people with AA genotypes, 55% with AC genotypes and 25% with CC genotypes, so it is very important to know such relationships (i.e. SNPs – potential diseases) for specific populations.

Modern societies live in a 'nutritional environment' that is very different from the environments to which we had genetically adapted. Major changes in human's food supply accompanied the domestication of animals and the agricultural revolution about 10 000 years ago. Later, the Industrial Revolution and especially developments in chemicals usage in agriculture and developments in food technology during the last 20–40 years (depending on country) brought about further major changes in the composition of food, also in the context of huge numbers of chemical additives. Rapidly diet changes can be potentially connected not only with nucleotides sequence, but also with different gene expression what is investigated

by epigenetics, i.e. study of heritable changes in gene activity that are not caused by changes in the DNA sequence.

Epigenetics mechanisms include DNA methylation, histone modifications, gene silencing by microRNA and chromosome stability. Epidemiologic evidence suggests that early-life environmental exposures are related to disease risk, what was investigated in well known long-term studies on people born during the Dutch Hunger Winter 1944/1945. Recent studies suggest that diet and environmental factors directly influence epigenetic mechanisms. Some nutrients seems be especially very important in nutrigenomics and epigenetics context, like: Folic Acid, Vitamins B12, B6, E, D, A, Niacin, Zinc, Fatty Acids, Flavonoids or even Proteins.

It seems that nutrigenomics and epigenetics studies are revolutionary way of viewing the food, but finding new genomics and epigenome based biomarkers of the early phase of diet related diseases is very important. This goal is rather ambitious, but is based on the idea that nutrition should focus primarily on health and disease prevention and be complementary to pharmacological therapy. So the main aim of nutrigenomics and epigenetics studies is prevention focused not only on adults, but also on children.

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Oziembłowski M.

SNPS GENETICS STUDIES OF LACTASE PERSISTENCE IN THE HUMAN POPULATION

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Adult-type hypolactasia or lactose intolerance is worldwide common phenotype determined by lactase deficiency. The activities of lactase and most of the other digestive hydrolases are maximal at birth of human. The majority of the world's human population experiences a decline of the digistive enzyme lactase-phlorizin hydrolase during maturation, with the age of onset ranging from the toddler years to young adulthood. Adult-onset lactase decline appears to be a risk factor for osteoporosis due to avoidance of dairy products or undigisted lactose interference with calcium absorption. However, in a minority of adults, high levels of lactase activity persist in adulthood.

One of the first population studies about lactase persistence (LP) were investigations of Cuatrecasas and team in 1965. It was found that 3 of 19 white people and 11 of 42 black people had deficient absorption of lactose. The next studies had confirmed that adult lactase deficiency is a racial characteristic and family studies demonstrated autosomal recessive inheritance. Montgomery stated in 1991 that in those humans who have low lactase activity as adults, the decline occurs at approximately 3 to 5 years of age. It was suggested that the developmental pattern of lactase expression is probably regulated at the level of gene transcription. Enattah in 2002 found a complete association between biochemically verified lactase nonpersistence in Finnish families and a -13910C-T single nucleotide polymorphism (SNP) of the MCM6 (Minichromosome Maintenance Complex Component) gene roughly 14 kb (14000 base pairs) upstream from the lactase gene locus (LCT), located on 2q21 (region of the 2 chromosome). It was the C allele that associated with hypolactasia, so in the conclusion was stated that individuals with lactase deficiency of the adult type were homozygous with respect to the C allele. It means that people having CC gentotype for -13910C-T (SNP rs4988235) can be classified as persons with lactose intolernace, while people with CT or TT genotype – as persons with lactase persistence. Kuokkanen investigated in 2005 lactase persistence for women in Finland, Poland and Sweden. The highest level of CC genotype for -13910C-T SNP (connected with lactose intolerance) was found in Poland (33,1%), while in Sweden and Finland it was 10,3% and 18,1%, respectively.

Barsaglieri in 2004 found that in northern European-derived populations, not only -13910C-T SNP can be associated with lactase persistence, but also -22018G-A SNP (rs182549) identifed previously by Enattah in 2002. So, both -22018A and -13910T alleles of mentioned

early SNPs uniquely mark a lactase persistence-associated haplotype found in approximately 77% of European Americans (CEU population). Barsaglieri estimated also that strong selection occurred within the past 5,000 to 10,000 years, consistent with an advantage to lactase persistence in the setting of dairy farming. The signals of selection observed in this study were among the strongest seen to that time for any gene in the genome.

Ingram in 2007 concluded that the mutational basis of lactose intolerance in Africa appears to be different from that in Europeans and -13910C-T SNP is inappropriate diagnostic test for lactase persistence in people of East African or Arabian ancestry, indicating new SNPs for these populations, like -13915G and others associated with lactose tolerance. That observation was later confirmed and nowadays it seems that European -13910C-T and the earlier identified East African -13907C-G (rs41525747) SNPs share the same ancestral background and most likely the same history, probably related to the same cattle domestication event. These 2 major global LP alleles have probably arisen independently, as a result of cow and camel milk consumption, reflecting different histories of adaptation to milk culture.

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Pawlak-Lemańska K., Silska K.

MULTIVARIABLE QUALITY ANALYSIS OF COFFEE BRANDS ON THE POLISH MARKET

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Coffee is one of the popular beverages of the world. It is cultivated in about 80 tropical and subtropical countries and being for some of them the main agricultural export product.

Most coffee beverage consumed around the world is produced by the species *Coffea arabica*.

(Arabica) and *Coffea canephora* (Robusta). The former one is considered to be superior due to its sensory properties and, therefore, it is the most expensive. Different spectroscopic methods were used for controlling the roasted coffee quality and differencing the genuine coffee samples and their adulteration.

The present study was focused on commercially available on the Polish market coffee brands with different compositions of coffee fruits. The aim of the study was to assess the quality differences of *Coffea arabica* i *Coffea canephora* by determination the physicochemical parameters and near infrared spectroscopy (NIRS) data.

For eight coffee brands with different composition of Arabica and Robusta fruits the colour, pH of infusions, caffeine, chlorogenic acid and total phenolic content and also antioxidant activity quantified by the TEAC value, were determined. Also for each sample spectral profiles in the reflection mode in range 4,000–10,000 cm^{-1} by FT-near infrared spectroscopic analysis (NIRS) were recorded. Spectroscopic data with combined chemometric methods to

Higher content of Arabica fruits resulted in lower pH values of infusions and also influenced caffeine content and the TEAC antioxidant activity of coffee mixtures. Total phenolic compound content depends on their concentration in green coffee fruits and there is no correlation with composition of coffee fruits in selected coffee brands.

PLS1 regression analysis was performed in order to obtain quantitative models for the prediction of Arabica content and caffeine amount based on spectral information. The excellent prediction ability obtained by multivariate calibration and indicated by the low values of RMSE confirmed that non-destructive NIR measurements can be successfully employed for the Arabica content and caffeine detection in roasted coffee brands.

Piepiórka-Stepuk J., Kubiak S.M.

THE PHYSICAL ANALYSIS OF CLEANING SOLUTIONS USED FOR HYGENISATION OF VESSELS AND WORT LINE IN BREWERIES

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Cleaning and disinfection processes in brewing, due to the way of production, are carried out in closed piping systems connected with high capacity tanks, heat exchangers and pumps. Cleaning chemical solutions are prepared in the CIP storage tanks and repeatedly used for cleaning. During their use, they are regenerated after the cleaning process, then again returned to the tanks and condensed. It is crucial for the economic aspect of the process (saving chemical preparations) and for environmental protection (minimizing the amount of discharged waste and their negative impact). Cleaning media go through standard control of their conductance, pH and chemical activity. The conducted studies indicate a different kind of threat, namely colloidal suspensions present in solutions recycled to the storage tanks, which once again pollute cleaned installations.

The paper presents the results of study on particles' size and their quantity in cleaning solutions taken from the vessels and wort cooling line in brewery. The study was performed in DynamicStudio measuring station with the use of the software based on Shadow Sizing method. FlowSence 2M camera equipped with a 1600x1200 pixels matrix and manual macro lens Nikkor50 f.1.8 was used for the measurements. On the basis of the survey, pieces of information about the equivalent diameter of the sediment particles were obtained.

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Piepiórka-Stepuk J.[1], Tandecka K.[2]

THE INFLUENCE OF SS SURFACE ROUGHNESS ON THE AMOUNT AND MICROSCOPIC STRUCTURE OF THE MILK SEDIMENTS CREATED DURING HEAT TREATMENT

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Fouling in dairy industries formed on surfaces in milk heat treatment is still quite a severe problem both technically and economically. Altering the surface properties of the heating surfaces could be a way of solving this issue. The paper presents the results of research on the effect of stainless steel surface roughness on the amount and microscopic structure of milk impurities, created under the influence of high-temperature milk processing. Milk impurities were obtained in the laboratory environment. Three types of plates of varying roughness were used in the study: S_a = 0,028 μm; S_a = 0,174 μm; S_a = 0,445 μm. The plates were immersed in raw milk and heated in 85–90°C for 20 minutes, imitating pasteurization conditions. As a result of this action, a difficult to remove milk sediment was created. The amount of impurities was evaluated by weight while their structure was determined by CLSM method, using the confocal scanning laser microscope Olympus LEXT OLS4000.

On the basis of the results it has been observed that much more sediments of fine structure are created on plates of little roughness. The analysis of the microscopic structure of milk impurities being created enabled classification into three types depending on their structure and method of bonding with the surface. The research results suggested that the roughness plays a prominent role in the level of fouling and probably in cleaning efficiency.

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Piwińska M., Kurek M., Wyrwisz J., Półtorak A., Wierzbicka A.

EFFECT OF THE ADDITION OF MICRONIZED HIGH-FIBER OAT POWDERS AND STORAGE TIME ON WHEAT ROLLS CRUMB COLOUR CHANGES

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The subject of the research was wheat rolls with the addition of fiber powder of varying degrees of micronization. The mean particle size of two high-fiber oat powders, analyzed by the usage of static automated imaging method, was $D_{[4,3]} < 150$ μm and $D_{[4,3]} < 75$ μm.

The purpose of the study was analysis of the effects of the addition of high-fiber oat powder, their micronization degree and storage time on wheat rolls crumb colour changes. Colour is the first parameter perceived by the consumer that decides about the general perception of the product. The addition of fiber powder to wheat rolls has shown to have significant impact on the crumb colour. It has been reported that the increase of fiber powder addition reduces lightness of the crumb. However, the effect of dietary fiber micronization has not been fully investigated.

Particle size was measured with the use of static image analysis technique (Morphologi G3S, Malvern). A dry dispersion with accurate dispersion energy control has been performed before the measurement. Mean particle size of 100 000 particles has been calculated.

Crumb colour was determined instrumentally, using Minolta CR-200 Chroma Meter with the L*a*b* measuring system. Values of L* (lighteness), a* ("-a" greenness; "+a" redness) and b* ("-b" blueness; "+b" yellowness) were determined. Crumb colour evaluation was performed on crumb of wheat rolls, in ten measuring places each. Samples were measured after 1, 3, 24 and 48 hours of storage time. All measurements were carried out in triplicate. Statistical differences in measured parameters were determined by one-way analysis of variance (ANOVA).

The study showed that high-fiber oat powder addition level had significant impact on wheat rolls crumb colour ($p<0.05$). A decrease of wheat rolls crumb lightness has been observed with an increase of flour substitution level. Results of colour measurement indicated that oat fiber particle size had significant effect on L* value ($p<0.05$). Wheat rolls containing coarse particle size powder (<150 μm) had darker crumb than wheat rolls containing fine particle size (<75 μm). The study has also shown an increase of red (a*) and yellow (b*) colour saturation with an increase of high-fiber oat powder addition level. Particle size had significant impact on redness and yellowness saturation ($p<0.05$). Value a* was slightly lower in sample

containing fine particle size (<75 μm), while value b* was lower in sample containing coarse particle size powder (<150 μm). Storage time did not have a significant impact on the wheat rolls crumb colour changes, except for the sample containing fine particle size (75 μm) after 48h of storage ($p<0.05$).

The study was carried out within the framework of "Bioproducts" Project No. POIG.01.03.01-14-041/12, which focuses on innovative technologies of pro-health bakery products and pasta with reduced caloric value. The project is co-financed by the European Regional Development Fund under the Innovative Economy Operational Programme 2007–2013.

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Pokora M., Zambrowicz A., Dąbrowska A., Szołtysik M., Babij K., Buda B., Trziszka T., Chrzanowska J.

EVALUATION OF BIOLOGICAL ACTIVITY OF EGG WHITE PROTEIN BY-PRODUCT BY HYDROLYSIS WITH THE USE OF PROTEASE FROM *YARROWIA LIPOLITYCA*

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Egg proteins are known to have a wide range of nutritive and biological properties. These proteins, e.g. ovotransferrin, lysozyme, cystatin and phosvitin are of a special interest of pharmaceutical as well as food industry. Therefore they are isolated from eggs on the industrial scale. On the other hand, the procedures of isolation biological active proteins generate significant amounts of different protein by-productsamong them are ovalbumin and ovotransferrin.

The objectives of this study was valorization of egg protein preparation generated as by-product in industrial process of lysozyme and cystatin isolation from egg white by itsenzymatic hydrolysis with uncommercial serine protease from *Yarrowia lipolytica* yeast. The obtained hydrolysate possesses antioxidant and angiotensin I-converting enzyme (ACE) inhibitory activity. Purification procedure including membrane filtration and reversed-phase high-performance liquid chromatography (RP-HPLC) led to obtain several peptide fractions. The molecular masses and amino acid sequences of the purified peptide fractions with a strongest activity were determined using electrospray ionization (ESI) mass spectrometry. A novel ovalbumin- derived peptide: YQIGLFRVASMASEKM (f 212–228) with DPPH scavenging, ferric reducing, chelating of iron activity and ACE inhibitory activity was obtained. It was proved that application of serine protease from *Yarrowia lipolytica* for the hydrolysis of egg white protein by-product can generate a natural antioxidants and ACE inhibitors. These biological active peptides can be used as potential nutraceuticals in functional food systems.

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Polak-Śliwińska M.[1], Szczech M.[1], Kubiak M.S.[2]

CHEMICAL CONTAMINANTS IN COFFEE

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Coffee is one of the most valuable primary products in world trade. Its cultivation, processing, trading, transportation and marketing provide employment for millions of people worldwide. Any disruption to trade in coffee would have major and direct negative implications for the livelihoods of rural populations in many developing countries.

Chemical contaminants and residues can enter the food supply through environmental factors such as air, soil and water or through food processing factors. In coffee a number of chemicals have been identified such as metals and contaminants such as pesticide residues and mycotoxins. Chemical contaminants such as acrylamide, furan and PAHs have also been identified in coffee and are a result of food processing. Ochratoxin A (OTA) is a form of mycotoxin produced as a metabolic product of certain fungi, mainly of the genera *Aspergillus* and *Penicillium*. Ochratoxin A is a nephrotoxic and nephrocarcinogenic mycotoxin. Acrylamide is typically formed via a process termed the Maillard reaction, which is common to foods high in carbohydrates. Acrylamide has been found to cause cancer in experimental rodents, however, there is currently a lack of evidence to suggest that dietary exposure to acrylamide will result in an increase in the incidence of cancer in humans.

The purpose of the study was to assess the occurrence of OTA and acrylamide in coffee from different types available in Poland. The material to study consisted of natural coffee (n=7) and instant coffee (n=4). OTA was extracted, cleaned-up by immunoaffinity columns, and detected by HPLC-fluorescence detection. Analytical separation of acrylamide from coffee was performed by liquid chromatography – diode array detector. OTA was found in 100% of pure Arabica coffee, pure Robusta coffee, and Arabica / Robusta mixture coffee, with OTA levels ranging from 7 to 22 $\mu g \cdot kg^{-1}$, 7 to 10 $\mu g \cdot kg^{-1}$ and 8,7 to 18 $\mu g \cdot kg^{-1}$, respectively. Arabica Coffee brands are the most contaminated, follow by Arabica coffee brands and coffee mixture brands. The ground coffee was characterized by significantly higher concentrations of ochratoxin A than instant coffee. The highest mean acrylamide concentrations were found in instant coffee followed by roasted coffee. Roasting process had the most significant effect on acrylamide levels in natural coffee, however there were no relationships found with coffee species.

Our results suggest, therefore, that regular coffee consumption may contribute to exposure of humans to OTA and acrylamide. The existing data on the presence of these chemicals in coffee available in Poland is currently limited. Therefore, developing and enhancing the evidence base on the levels of chemical contaminants and residues in instant and ground coffee types in Poland will provide valuable input into future assessments of dietary exposure and the evaluation of any potential risks to human health for the Polish population.

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Połtowicz K.[1], Nowak J.[1], Wojtysiak D.[2]

DIFFERENCES IN TECHNOLOGICAL SUITABILITY OF POULTRY MEAT DEPENDING ON THE BODY WEIGHT OF BROILER CHICKENS

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The study used fast-growing Ross 308 broiler chickens (cockerels). Chickens were raised under optimal environmental conditions and fed *ad libitum* complete starter, grower and finisher diets containing 22, 20.5 and 20.5% CP and 2990, 3130 and 3130 ME/kg, respectively. At the end of the rearing period, 42-day-old birds were assigned to 3 experimental groups depending on the final body weight. Group I (n=30) contained chickens weighing 2.0 kg, and groups II (n=30) and III (n=30) were formed by chickens weighing 2.5 and 3.0 kg, respectively. pH_{15min}, pH_{24h} and pH_{72h} were determined 15 min postmortem and after 24 and 72 h of breast muscle storage at 4°C, respectively. Simplified slaughter analysis was performed to calculate the proportion of breast and leg muscles, giblets, bones and abdominal fat. Dissected muscles were subjected to evaluation of colour (CIEL*a*b*), drip loss, cooking loss, thawing loss, shear force and texture parameters. The results were analysed statistically using analysis of variance and Duncan's test.

The aim of the study was to determine the effect of growth potential of broiler chickens on the incidence of watery breast muscle and on differences in other quality traits of this muscle.

The chickens differing in body weight also differed in breast muscle percentage, with no differences in the percentage of leg muscles, dressing percentage and body fatness. The highest proportion of breast muscles in the carcass (29.17%) was characteristic of heaviest chickens. The lowest proportion of these muscles (25.20%) was found in slowest growing chickens from group I.

The body weight of chickens had a significant effect on the pH and water holding capacity of breast muscles. The highest pH_{15min} and its highest decline during the first 24 h after slaughter were noted in fastest growing chickens. These chickens, similar to birds from group II, were characterized by a tendency for higher ultimate pH measured 72 h postmortem compared to slowest growing chickens from group I.

The least favourable water holding capacity of breast muscles was characteristic of birds with medium and highest body weight (groups II and III). In both these groups, drip loss following cold storage of breast muscles was similar and averaged 1.07%. The slowest growing chickens were characterized by a more favourable, significantly lower values of this parameter

(0.88%). Most cases of meat with considerable drip loss exceeding 1.5% were found in the group of heaviest chickens. In the groups of heavier birds (2.5 and 3.0 kg body weight) in some cases drip loss exceeded 2% of the weight of the analysed muscle. The most favourable results were obtained in the group of slowest growing birds, in which 76.7% of chickens had muscles with low drip loss (<1%) and in the other 23.3% this parameter ranged from 1.05% to 1.39%. The breast muscle of slowest growing birds was also characterized by the lowest cooking loss ($P \leq 0.01$), darker colour, lower shear force, toughness, chewiness and springiness, and greater cohesiveness.

The results obtained indicate that the growth rate of fast growing broiler chickens has an effect on the physicochemical properties of breast muscles and, as a result, the considerable differences in the body weight of chickens on slaughter day contribute to the raw material being inconsistent in terms of important quality traits.

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Przybysz M.A., Gąszczyk M.

THE EFFECT OF SPRAY-DRIED MICROENCAPSULATION OF NATURAL CAROTENES ON THE STORAGE STABILITY OF THE PIGMENTS

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This study is a comparison of carotenes (α- and β-carotene) stability in oil solutions with its stability when spray-dried encapsulation is applied. Carotenes were isolated from carrot. *A* storage test *was subsequently performed: without access to daylight* at 20 ± 2°C, *with access to daylight* at 20 ± 2°C and *without access to daylight* at 4 ± 2°C. The stability of carotenes in oil solutions was determined with the HPLC method. The color of the samples was also analyzed. The oil solutions of carotenes microencapsulation by spray-drying method. Gum Arabic and maltodextrin mixture were used as a matrix. The stability of microencapsulated carotenes was determined with the use of s*pectrophotometric method*.

HPLC analysis showed that carotenes oil solution consists of α-carotene and β-carotene in 1:2 ratio.

Degradation of carotenes during storage of the oil solutions followed first-order kinetics. The energies of activation were 58.7 and 33.6 kJ mol^{-1} for α- and β-carotene, respectively.

Among the studied factors (time, daylight, temperature), it was the time and the temperature that influenced carotenes degradation the most. Storage of carotenes oil solution at 4 ± 2°C has significantly slowed the process of pigments degradation, in comparison to its storage at 20 ± 2°C.

Spray-drying encapsulation caused a significant decrease in the content of carotenes. However, retention times of pigments stored in microcapsules were longer than retention times of pigments stored as oil solutions. The matrix composed of a mixture of gum Arabic and maltodextrin is a good protection of carotenes against environmental factors.

Pudło A., Kozaczkiewicz A., Kopeć W., Chorążyk D., Korzeniowska M., Zapolski R., Skiba T.

ISOLATION OF GLYCOSAMINOGLYCANS AND GELATIN FROM MECHANICALLY DEBONED MEAT AND CONNECTIVE TISSUE FRACTION

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The aim of this study was to find the optimal conditions of the enzymatic hydrolysis of connective tissue to isolate glycosaminoglycans and gelatin from MDM and its fractions.

The raw material for the study was mechanical deboned meat (MDM) from poultry and pigs and connective tissue fraction isolated from MDM. Raw material was hydrolyzed for 12 h, 24 h, 48 h by papain (Sigma Aldrich) (2–8 mg/g material) and proteinase Protamex® (Novozymes) (3–6 mg/g material). The hydrolysis temperature was 60°C for papain and Protamex (close to the optimal temperatures for enzymes). Inactivation of the enzymes was accomplished by heating for 5 min in boiling water and centrifuged at 5200 × g for 15 min.

Total nitrogen, moisture, lipid, ash and hydroxyproline contents in the raw material and in hydrolysates were determined according to the methods of AOAC (1995). The GAG content was determined with glucosamine analysis (Elson and Morgan 1933, Cessi and Piliego 1960) and a dimethylmethylene blue (DMB) binding assay (Farndale et al. 1986).

The highest yield of gelatin and glycosaminoglycans was obtained with the extraction time for 48 h, using 8 mg/g papain and 6 mg/g Protamex. Mechanically separated pork meat and its connective tissue faction are more susceptible to enzymatic hydrolysis than meat mechanically deboned from poultry and fractions from MDPM. As a result of a long-term enzymatic extraction about 50% of collagen in the form of gelatin and 40% glycosaminoglycans from mechanically separated meat can be obtained in hydrolysates.

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Rak L.

INSTRUMENTAL METHODS IN THE SERVICE OF FOOD QUALITY

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The development of analytical techniques enabled the detection chemical substances present in food in very low concentrations. This raises hopes for the development of knowledge about the role and functions of food components at the molecular level, ie their interaction with genes that impact on protein and metabolites. The goal is to develop strategies to manipulate cell functions through diet for its beneficial effects on human health. The discipline that studies the area of food and human nutrition through the use of advanced omics technologies to improve the consumer's well-being health and confidence was called foodomics. In this perspective, foodomics is a discipline combining advanced analytical techniques, mainly omics and bioinformatics tools. Among omics tools can list genomics, transcriptomics, proteomics, metabolomics and nutrigenomics. These tools can be utilized, inter alia, to evaluate the food quality, detection adulteration, safety and traceability, identify cellular mechanisms of action of bioactive food ingredients, to understand the stress adaptation responses of foodborne pathogens to ensure food hygiene, processing and preservation, to clarify the impact of the genome on the body's response to certain diet, knowledge of the role and function of the intestinal microflora, to carry out the investigation on unintended effects in genetically modified crops, to understand postharvest phenomena through a global approach that links genetic and environmental responses and identifies the underlying biological networks.

Without questioning techniques used in genetic studies, mass spectrometry is seen as the most effective tool in the analysis of food. The expected results can be obtained only by mass spectrometry combined with other techniques of extraction and separation of chemical substances.

Raspor P.

FOOD SAFETY IN THE CLEFT – BETWEEN EFSA AND CONSUMER

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

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THE IMPACT OF THE GROWING SEASON ON FRUIT QUALITY OF STRAWBERRY

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Fruit strawberry *Fragaria x anannasa* are a valuable source of polyphenolic compounds such as anthocyanins, flavonoids, phenolic acids, catechins and tannins derivatives, especially ellagotananoids. Significant content of vitamin C and organic acids are also present. Due to its biological properties foods rich in these substances may be helpful in preventing and mitigating the course of many diseases and even their treatment. Understanding the varieties with a high content of active compounds and the factors that influence it is also important from the point of view of the quality of the tested materials.

The aim of this study was to evaluate the content of selected compounds (anthocyanins and tannins, vitamin C, organic acids) in the fruits of strawberries in two growing seasons.

The material consisted of five varieties of ripe fruit strawberry *Fragaria x anannasa* collected in two growing seasons (June 2011 and 2012) in the same raipening stage. The raw material came from Station of Variety Assessment in Masłowice.

The content of polyphenolic compounds was determined by validated HPLC – DAD methods using the octadecyl Hypersil GOLD column (250 × 4.6 mm, 5 mm Ø; Thermo Scientific, UK) for anthocyanins and tannins; Cadenza column for ascorbic acid and Aminex column HPH-87 H (300x7, 8 mm) for carboxylic acids. All compounds were identified by their retention times and absorption spectra. The amounts of the individual compounds (mg/100 g) were calculated from the regression equation determined experimentally for the respective standard substances.

When comparing the content of the above compounds in raw material from two consecutive growing seasons the following trends were observed. The content of quinic and citric acid was at similar or higher level for 2012 material depending on the variety. The content of agrimoniin and elagic acid was comparable for material from both growing seasons with the exception of the Pandora variety, for which the argimoniin content increased from 12.81 mg/100 g in 2011 to 17.13 mg/100 g in 2012. The ammount of vitamin C increased for the Pandora variety from 156.22 mg/100 g in 2011 to 164.77 mg/100 g in 2012 and for the Rercoda variety from 157.22 mg/100 g to 207.86 mg/100 g. For all other tested varieties the vitamin C content was lower for the 2012 material. The anthocyanins content decreased in 2012 for the Vit and Pandora varieties and increased for Vicoda, Rercoda and Selvik varieties.

The above differences could be influenced by the overall lower quality (smaller, less juicy fruits for some varieties) of fruit material from 2012 caused by poorer weather conditions (lower temperatures, less sun and increased rainfall).

Rola J.G., Korpysa-Dzirba W., Czubkowska A., Osek J.

REGIONAL CHEESES – PREVALENCE OF STAPHYLOCOCCUS AUREUS AND STAPHYLOCOCCAL ENTEROTOXINS

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Cheeses made from raw milk may pose a risk to public health since milk that has not undergone heat treatment may be contaminated by coagulase positive staphylococci (CPS).

The aim of this study was to identify the potential sources of contamination by *Staphylococcus aureus* and staphylococcal enterotoxins of traditionally made cheeses.

Samples at various stages of cheese manufacturing were collected at 9 dairy farms located in the north – east region of Poland from 2009 to 2013. A total of 271 samples, including 36 raw milk, 90 half and 40 final products as well as 105 swabs from the production environment, were taken and transported to the laboratory within 24 h after collection.

Enumeration of CPS was performed using Baird-Parker agar with rabbit plasma fibrinogen (BP-RPF) (bioMerieux, France). CPS strains were biochemically analyzed using ID 32 Staph, and tested for antibiotic resistance by the MIC method. Classification of isolated Staphylococci to MRSA was performed by the PCR method. *S. aureus* and the final products were analyzed for the presence of staphylococcal enterotoxins A - E using a two-step method consisted of extraction/concentration and detection by enzyme-linked fluorescent assay (ELFA). Two multiplex PCR assays were used to detect genes encoding SE.

Spa - typing was performed according to Harmsen et al. (2003), using primers 1095F and 1517R. The sequence of the repeat-containing region of the spa gene was obtained from both strands of the PCR product. Sequencing was performed using the BigDyeTM Terminator Ready Reaction Cycle Sequencing kit (Genomed, Warsaw, Poland). The analysis of repeats and assignment of *spa* type was performed using the resources of Ridom Spa Server (spa.ridom.de).

CPS were isolated from 149 samples with the highest level of contamination in mature cheese up to 10^7 cfu.g^{-1}. One strain was classified as MRSA. More than half of tested strains were resistant to antimicrobial agents. Resistance to penicillin was the most common. No staphylococcal enterotoxins were detected in any of tested samples; however, CPS strains with enterotoxic genes were found, mainly *sed*.

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Rola J.G., Ostrowska M., Sosnowski M., Osek J.

PREVALENCE AND ANTIBIOTIC RESISTANCE OF COAGULASE – POSITIVE STAPHYLOCOCCI ISOLATED FROM RAW GOAT MILK

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Consumption of goat milk products is still increasing due to beneficial health effects and their nutritional value. Microbial quality of raw goat milk should be strictly controlled. *Staphylococcus* bacteria, especially *S. aureus*, are the main etiological agents involved in milk contamination, resulted in infections of human.

The study was carried out on 223 raw goat milk samples, collected from 39 goat's farms located in the western and central parts of Poland from October 2011 to September 2013.

The prevalence of coagulase – positive staphylococci (CPS) in raw goat milk and their antimicrobial resistance, especially to methicillin, were the objectives of this study.

To detect CPS, milk sample was inoculated on Baird – Parker agar with rabbit plasma and fibrinogen. The antibiotic resistance was determined using the Sensititre microplate DKVP TREK and PCR method.

CPS were present in 86.1% samples obtained from 36 farms. The level of contamination was from 1.0×10^0 to 4.0×10^4 cfu mL^{-1}. One or two isolates from CPS – positive samples were selected for antimicrobial resistance examination. In total two hundred and seven strains were isolated. Resistance of the *S. aureus* strains to penicillin was the most common finding (15.5%), followed by sulphamethoxazole (12.1%), tetracycline (6.3%) and cefoxitin (6.3%). Of the penicillin resistant strains, 5.3% were also resistant to other drugs: tetracycline, streptomycin, cefoxitin, sulphamethoxazole, gentamicin. The analyzed strains were the most sensitive to ciprofloxacin (100%), chloramphenicol (99.5%), trimethoprim (99.5%), florfenicol (99.5%), and gentamycin (99.0%). One hundred thirty six (65.7%) isolates were susceptible to all 11 antimicrobial agents used in this study. The presence of the *mec*A gene was not detected, thus, all strains were identified as methicillin – sensitive (MSSA).

This study showed that bacteria of *Staphylococcus* genus, especially *S. aureus* is commonly found in goat milk. High prevalence of antibiotic resistant *S. aureus* in goat milk may cause some risk for public health.

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Ruda M., Kilar J., Kilar M., Fedio M.

CONSUMER DETERMINANTS OF THE CHOICE OF CARP

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Fish as rich source of highly digestible protein, mineral elements and omega 3 acids are an important component of the diet at every stage of life and human development. They are considered particularly effective, natural part of preventive care. However, freshwater fish, mainly carp still seem to be occasional food on the tables of the Poles.

The aim of the study was to investigate determinants of consumer choice carp as food. Research using survey methods (direct interview questionnaire) was conducted from October 2013 to January 2014 in the town of Krosno and the surrounding countryside. The sample of respondents was random and amounted to 418 people, of which 62.20% were women, and 53.11% were residents of the city. Of all the respondents 88.51% eats fish but only 55.02% eat carp. The most important factor in the selection of carp was the tradition of Christmas Eve (71.12%) and taste (50.00%). Next, came factors such as dietary diversity (28.01%), nutritional value (21.12%), ease of preparation (8.18%) and medical recommendations which were indicated only by 3.87% of the respondents. As many as 93.10% of the respondents answered that they eat carp the occasion of Christmas Eve, and only 9.00% eat the fish very often without any occasion. Carp is a dinner domestic dish for 26.29%, and fish grilled for 22.84% of people. Research shows that 46.12% of respondents buy live carp, 40.94% choose fresh fillets, and 32.75% fresh carp gutted. Approximately 19.00% of the respondents buy ready meals with carp. It was found that the most serious concern before buying carp is suspicion of use of hazardous substances (antibiotics, hormones) by breeders – 26.29% of responses. Consumers are also concerned with feeding by GMO (24.13%) and intensive production (17.24%).

The results show that 88.51 % of respondents consume fish, and 55.02% carp. The most important factor in the selection of carp is a tradition of Christmas Eve. 26.29% of carp consumer is concerned with the use by farmers of hazardous substances (antibiotics, hormones).

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Rys M., Korablova O., Rakhmetov D.

ELEMENTAL COMPOSITION OF PLANTS SPECIES GENUS *MONARDA*

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Species of the genus *Monarda* L. are medicinal, aromatic and ornamental plants. *Monarda*'s essential oil has pronounced antibacterial properties and bitter taste. It is used in medicine and food industry as a substitute for imported black pepper and at canning of vegetables. Species of the genus Monarda have a rich chemical content that are make them valuable therapeutic and prophylactic plants. The aim of our study was to examine of the composition macro- and microelements and their absorption in the system soil - roots - above-ground part of species genus *Monarda* and to determine their safety under condition introduction and cultivated in Forest-Steppe of Ukraine.

Monarda species are perspective crops for food and pharmaceutical industries. It's requiring determine an elemental composition of plant material. Element content of species *M. didyma* and *M. fistulosa* was carried out using by Roentgen-Fluorescent method research. Samples were collected in the phase of full flowering in the National Botanic Garden in Kiev. It was identified 20 micro- and macro- elements in the aboveground plant parts, roots and the soil under plants. Accumulation in the plant some elements were studied.

Our studies were shown that aerial part of species *Monarda* contains the most important elements in the life of plants – K, Fe, Cu, Zn, Mn (cobalt and molybdenum are not defined).

The most abundant component of species Monarda was an important biogenic element K (*M. fistulosa* – 12162.01 and *M.didyma* – 9888.86 mg/ kg). It is noted that the in over ground mass of plants *Monarda* was accumulated Zn in a large quantities, at the same time Fe does not accumulate in plants even at very high concentrations in the soil.

Content mezo-elements Ca and S are high enough. It's needed for plants much more than other minerals. Content of potentially toxic elements Sr, Zr in aboveground mass species *Monarda* are minor and lies within the RC. A small number Pb was found in roots of plants, but in the aboveground parts of plants it wasn't found. As a result of research of plants elemental composition was determined.

Results of investigation were shown ability of plants to accumulate or not to accumulate certain elements. Raw materials of species *Monarda* are very perspective to be used in the manufacture of plant medicines and food.

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EFFECT OF PROCESSING CONDITIONS ON THE COLOUR OF EXTRUDED SNACKS

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The aim of the experiment was to study the effect of traditional corn snacks supplementation with flour from uncommon, organic plant sources and the temperatures used for extruded snacks processing on the colour of obtained final products.

Raw material used for the studies were corn grits from trade in Poland and flour of amaranth seeds, jerusalem artichoke tubers and pumpkin tissue prepared in laboratory conditions in Aleksandras Stulginskis University, Kaunas in Lithuania. Corn grits was supplemented with 10, 15 and 20% level of experimental flour. To the recipe of all samples of snacks 1% of salt and 2% of light malt extract (Bekery Malt Extract E1) were additionally put in. Cooking extrusion process was utilized for snacks manufacturing at two different temperatures: 160^0C i 170^0C, by one-screw extruder of Brabender 20 DN type.

Colour of milled samples of snacks by Konica Minolta CM-5 spectrophotometer was measured and expressed as Hunter L, a, b colour space coordinates.

On the base of the results obtained there was stated that lightness of snacks depended on the type of additive and extrusion temperature used. Supplementation on the level of 10% with amaranth and jerusalem artichoke and extrusion in lower temperature were the most profitable conditions to obtain light snacks and for snacks supplemented with pumpkin higher temperature of the process. In higher level of supplementation (15%) the use of amaranth in the extruding mixture improved the lightness of snacks. Extrusion temperature had only slight impact on the share of red and yellow chroma in the colour of snacks. There was noted the effect of the type of additive on the share of "a" and "b" coordinates in overall colour of snacks. More intensive colour characterized products with pumpkin flour and with jerusalem artichoke but with higher level of supplementation independently on the temperature of extrusion.

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Rytel E.[1], Tajner-Czopek A.[1], Kita A.[1], Aniołowska M.[1], Miedzianka J.[1], Kucharska A.[2], Sokół-Łętowska A.[2], Hamouz K.[3]

CONTENT OF POLYPHENOLS IN COLOURED AND YELLOW FLASHED POTATOES DURING DICES PROCESSING

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The purpose of the research was to examine the effect of the laboratory production of dried potato dice on the content of phenolic compounds in one yellow-fleshed potato variety and four blue-fleshed potatoes varieties.

The material used for the study included four varieties of potatoes: Valfi, Blaue Elise, Bore Voley and Blue Congo with blue flesh from the experimental plots belonging to testing station of The Central Institute for Supervising and Testing in Agriculture at Přerov nad Labem (The Czech Republic). In the investigation were used potato tubers with traditional, yellow-fleshed (variety Innovator), which were collected from the storage room at a factory for potato products. From all potato tubers varieties were prepared dehydrated dice of laboratory methods. The samples of: unpeeled and peel potatoes, potatoes after cutting and washing, potatoes after blanching and after pre-drying, were frozen and freeze-dried with the use of a lyophilizer. Then prepared samples and dehydrated potato dice were ground and used to determine the concentrations of phenolic compounds. The quantities of phenolic compounds were determined using HPLC method.

Coloured-flesh potato varieties were characterized by about three times higher amount of total phenolic content than traditional yellow-fleshed ones. The predominating phenolic acids in potato were chlorogenic acid and its isomers, which account about 90% of total phenolic content in tubers. The phenolic acid content decreased by 80% after peeling the blue-fleshed potatoes and by 60% after peeling the yellow variety. The dried potato dice obtained from yellow-fleshed potatoes had no content of phenolic acids but produced from colour-fleshed potatoes contained about 4% of the original phenolic content of the raw material. Total phenolic acid remained in ready product about 97% residue was chlorogenic acid and neochlorogenic acid accounted for the 3%.

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CHEMICAL COMPOSITION AND IN VIVO ACTIVITIES OF SOME SPICIES OF GENUS SALVIA WIDESPREAD IN UKRAINE

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The widespread genus Salvia has about 900 species. On the territory of Ukraine is represented by 21 species of genus Salvia. Sage (*S. officinalis* L.) is a well-known medicinal and culinary herb that has been used as spice and flavoring agent in food industry, perfumery and cosmetics. *S. verticillata L.* is one of the salvia species which possesses remarkable antioxidant, anti-inflammatory, antidiabetic and antiulcer activities. However, in the literature there is no information on the pharmacological activity of *Salvia patens L.*

We investigated of chemical composition of herbs of *S. verticillata L.* and *S. patens L.* and the possible effects of their dry herbal extracts in various models of diseases in rats.

Study of chemical composition of two species of genus Salvia revealed 89 compounds in *S. verticillata* L. herb and 82 compounds in *S. patens* L. herb. Tannins, flavonoids, hydroxycinnamic acids, such as rosmarinic acid, triterpenoids, such as viridiflorol, 1,8-cineole, α-thujone and α-humulene, were identified as the major components of *S. verticillata* L. and *S. patens L. herbs.*

S. verticillata L. and *S. patens L.* were investigated for their possible anti-diabetic effect in normal and streptozotocin-induced diabetic rats. The dry herbal extract of *S. patens* L. showed higher anti-diabetic activity compared with the studied herbal extracts *S. officinalis* L. and *S. vetricillata* L. and could be helpful to develop medicinal preparations for diabetes and related symptoms.

The anti-ulcer activity of herbal extract of *Salvia patens* L. was evaluated for its antiulcer activity against the alcohol-prednisolone induced gastric ulcer model. The herbal extract of *S. patens* L. was significantly less efficiency than herbal extract of *S. officinalis* L. The herbal extract of *S. verticillata* L. does not show anti-ulcer activity.

In additional the anti-inflammatory activity of herbal extracts of *S. verticillata* L. and *S. patens* L. has been studied. It is shown that the herbal extract of *S. patens* L. is not inferior to the anti-inflammatory activity of *S. officinalis* L. in dose 1000 mg/kg. The herbal extracts of *S. verticillata L.*and *S. patens* L. are practically nontoxic by terms of acute toxicity.

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FOOD SAFETY BY CONSUMERS – SELECTED ASPECTS

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In this paper food safety according to consumers opinion is presented. Three aspects of food safety by consumers are described: assessment of the influence of selected issues on health on a 5-point scale, the assessment of the importance of food characteristics, and the perception of the information about HACCP/ISO 22000 in the following situations such as: buying food products, the indicators of food quality, and in the situation of food scare.

Survey questionnaire was used as a research method. The survey was built of 22 questions – closed or opened type. The survey was carried out among 712 consumers (convenience sample) in three regions of south-east Poland.

It was found that the perceived influence of i.e. food additives, GMO, pesticide residue, physical hazards, food terrorism, and contamination with pathogenic bacteria on health is various. Consumers taking part in the survey most feared: contamination with pathogenic bacteria and food terrorism (4.6 on a 5-point scale) and physical hazards (4.4).

Respondents answered that the most important characteristic of food was its taste (4.5 on a 5-point scale) and safety (4.4) as well as a lack of food preservatives and other food additives (3.9). They declared that nice appearance of food was not important for them.

Respondents were asked about the perception of the information about HACCP/ISO 22000 in various situations. It was found that the information about HACCP/ISO 22000 didn't play an important role in decision making about the purchase of food products. That answer accounted only for 11.9% of respondent's indications. The importance of the information about HACCP/ISO 22000 seemed to be quite different as far as the indicators of high quality of food were considered. The answer that the mentioned information is the indicator of high quality of food accounted for 31% of all indications. The third aspect of the importance of the information about HACCP/ISO 22000 was the situation of food scare. It was declared by respondents that if food hazard appeared, they would perceive that information as a source of trust in food safety (30.3% of indications).

The answers varied depend on socio-demographic characteristics of respondents.

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FATTY ACIDS AND CHOLESTEROL CONTENT IN BROILER BREEDERS' EGGS

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Producers of broiler parent stock (broiler breeders) have the sole aim of obtaining the maximum number good-quality, fertile eggs and hatched broiler chicks. Therefore, a high quality of both external and internal characteristics needs to be maintained in broiler breeder eggs because these influence embryo development. In turn, fatty acids (PUFAs) are the best source of energy for the full completion of the development of the embryo in its final form. Identification of genetically superior hybrids is of great importance for production.

The aim of the study was to evaluate the influence of different broiler breeds on fatty acids and cholesterol content in their eggs.

Experimental monitoring was performed on three hybrids of broiler chicks (Cobb 500, Hybro G, Ross 308). Birds in the end of laying rate were kept in a battery system (15 in each group). Feeding and drinking have been *ad libitum*. Standard diet contained 14% of protein and metabolic energy of 13.40 MJ/kg in feed mixture.

Eggs were collected once at the end of the evaluation and morphological parts were weighted on laboratory scale. The weights of albumen, yolk and shell were calculated in relation to egg weight and expressed as percentages. Fatty acids and cholesterol concentration in eggs' yolks was determined with generally accepted methods and analyzed by gas chromatography.

Cobb 500 was characterized with the highest egg and albumen weight (12.3 g and 6.5 g, respectively; $P \leq 0.05$) in relation to equal results for Hybro G and Ross 208 (11.7 g and 5.9 g).

The analysis of the results demonstrated that fat quality of egg yolks vary significantly ($P \leq 0.05$) among broiler breeders with tendency of cholesterol lowering Cobb>Ross>Hybro G (66.5>63.8>52.4 mg of yolk).

Evaluation of fatty acid profile showed the greatest PUFA content in Cobb 500 eggs (22.2%) as a result of higher level of linoleic, arachidonic and eicosapentaenoic acids ($P \leq 0.05$). High content of DHA acid was determined in Hybro G egg yolks (1.7%; $P \leq 0.05$). Eggs from Ross 208 breed contained the highest value of saturated FA (37.1%; $P \leq 0.05$).

In conclusion, despite significant differences between examined broilers breeders' eggs, the obtained results of analyzed parameters do not allow clearly identify the breed with fat quality which can best contribute to the development of the embryo. Further examinations need to be provided.

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Skiepko N., Chwastowska-Siwiecka I., Kondratowicz J.

PHYSICOCHEMICAL PROPERTIES OF BOILED EGGS DEPENDING ON THE PACKAGING METHOD AND COLD STORAGE TIME

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The research materials comprised of 70 consumer eggs obtained from hens Lohmann Brown at the age of 32 weeks. The eggs have been boiled for 12 minutes, then they have been chilled under running cold water (30 min.) and they have been peeled of the shells. Eggs prepared in this way and weighted were packaged in vacuum (28 samples) and protective atmosphere of gas of composition: 30%Ar+60%CO_2+10%O_2 (28 samples). All packaged eggs have been stored in refrigeration conditions (±4°C) for 7 and 14 days. However, unpackaged eggs (14 samples) were directly transferred to the laboratory analysis. The object of the analysis was to determine the weight losses of eggs after storage, measurement the pH of the white and to designate the colour of white and yolk according to CIE (1978), which was based on values of the L*, a*, b*, C*, h° and ΔE parameters described in the system CIE LAB with the camera MiniScan XE Plus. Physicochemical properties were measured after taking out eggs from packages after the end of fixed storage periods.

Due to the very high importance of applying various packages and systems of packing in the forming quality of a new range convenience food, studies were conducted, whose the aim was to determine the effect of the packaging method and cold storage time on selected physicochemical properties of boiled eggs.

The greatest weight losses of eggs and the highest pH value of white were detected during the entire period of cold storage in the group of samples packed in vacuum. The results of the research proved that the brightness of white for egg packed in vacuum and modified atmosphere was close to absolute white, because the L* values persisted at a level of 94.60 to 95.60. Statistical analysis demonstrated significantly ($p \leq 0.05$) lower brightness of white of eggs packed in vacuum and stored 7 days at refrigerated conditions, compared to 14-day eggs and samples packaged in MAP. The resulting negative values of the parameter a* testify to shift of colour white in the direction of green spectrum. Eggs packed in vacuum were characterized by highest value component of a * (respectively: -1.86 and -1.95), which was confirmed statistically. Taking into account the share of yellow colour, saturation and stability were not significant differences. However, it has been shown that after 7 and 14 days of refrigerated storage in samples packed in vacuum were characterized by higher ($p \leq 0,01$) value of the parameter h, which was respectively: 81.03 and 81.32.

The results obtained for the eggs yolk showed that attempts packaged in 30%Ar+ +60%CO_2+10%O_2 and stored in the refrigerator 14 days were the lightest (73.87), which was confirmed statistically. The highest ($p \leq 0.01$) share of red colour were found in eggs packed in vacuum in two periods of refrigerated storage (respectively: 23.93 and 23,68). Whereas the lowest value of the parameter b* occurred in the 7-day eggs packed in vacuum. The value of coordinate C* in each group was maintained on similar level and averaged 66.39. It was noted that the protected egg yolk mixture of gases was characterized by the highest ($p \leq 0.01$) tint colour (76.77) and the worst ($p \leq 0.01$) colour stability (12.51).

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Skiepko N.[1], Chwastowska-Siwiecka I.[1], Kondratowicz J.[1], Michalik D.[2]

EFFECT OF LYCOPENE ADDITION ON THE SENSORY QUALITY OF PRODUCTS OF TURKEY BREAST MUSCLES

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The experimental material were turkeys (♀) Hybrid XL, which were feed standard mixture, reared to 15 weeks of age, weighing about 10 kg live weight. Slaughter of turkeys and slaughtered processing of carcasses were done by industrial accordance with the requirements of technical and sanitary force in the poultry industry. The carcasses were cooled at ±4°C for 24 h.

The material studied consisted of 28 breast muscles (left and right), which 8 samples were directly transferred to the laboratory analysis. In contrast, the samples in an amount of 20 pcs was subjected to thermal treatment (baking + grilling), with half of them (product II) was pre-cured by flood blend comprising: tomato extract standardized to 5% – the lycopene content, salt, glucose, black pepper powder and granular, bay leaf, allspice, marjoram and garlic. All muscles were evaluated in terms of sensory quality traits according to 5-point scale (ISO 4121:1998), extended by half notes. The obtained results were statistically analyzed. The significance of differences between the results of individual characteristics in the tested experimental groups was determined by analysis of variance and Duncan's test using the Statistica computer program licensed version 10.0.

The aim of the study was to determine the effect of lycopene in the production technology baked and grilled pectoral muscles on the sensory properties of the finished products. This follows from the continuous growth of consumer interest in food with higher quality care, mainly related to presence in its composition of bioactive substances such as lycopene.

Based on the data, it was found that a higher mean ($p \leq 0{,}01$) notes point for intensity and desirability of aroma acquired muscles will not immersion cured (by 0,78 and 0,92 points). For juiciness and the tenderness of the tested products there was no statistically significant difference, however, more favorable average ratings were also observed in the same group (4.43 and 4.34 points). Statistical analysis revealed that the product I was characterized by a greater palatability (intensity- $p \leq 0{,}05$and desirability- $p \leq 0{,}01$) than muscles cured with the addition of lycopene. Taking into account the mean of the note for the colour point has been demonstrated that the samples undergo a heat treatment without prior curing had statistically highly significantly higher intensity and the desirability (4,93 points) compared to the dye product II.

Conducted tests indicated a significant effect of lycopene in the production process of baked and grilled turkey breast muscle of the aroma, palatability and colour. Despite the reduction in the average not point sensory attributes, the quality of the product II was as still at a good level.

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Smith M.

THE ROLE OF FOOD SAFETY MANAGEMENT SYSTEMS IN ENSURING FOOD SECURITY

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There is concern in some quarters that the food chain may be vulnerable to a terrorist attack. Although there have been some deliberate attempts to contaminate the food chain very few have been carried out for political reasons or have successfully used a biological agent or toxin. The presentation considers aspects of the UK food chain, specifically food safety management systems, and highlights characteristics which, if properly implemented, may provide some protection against attempted food terrorism, thereby enhancing the food security of UK consumers.

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INFLUENCE OF STORAGE CONDITIONS ON THE QUALITY OF CORNELIAN CHERRY LIQUEURS

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Alcoholic beverages made from plant raw material have been produced in Poland for a long time. Cornelian cherry (*Cornus mas* L.) fruits were traditionally used for liqueurs because of their taste and health-promoting properties.

The aim of our study was to investigate phenolic compounds content, color and aroma of cornelian cherry liqueurs.

The liqueurs were prepared from fruits (cultivar "Podolski", from Arboretum and Institute of Physiography in Bolestraszyce) and 65% ethanol at a weight ratio of 1:1.The steeping process was carried out in the dark, at the room temperature for three weeks. Then liqueurs were separated from fruits, and sugar was added to some samples. Liqueurs were stored for 26 weeks at 15°C and 30°C. Identification of cornelian cherry compounds was made using ESI-MS/MS GC/MS and HPLC analysis. Color was measured by instrumental method (ColorQuest, HunterLab).

In cornelian cherry fruits and liqueurs, we identified following anthocyanins: 3-galactosides and 3-robinobiosides of cyanidin and pelargonidin; gallic and ellagic acid and their derivatives, hydroxycinnamic acids: quinic, chlorogenic and coumaric acid derivatives, quercetin and kaempferol derivatives; iridoids: loganic acid and cornuside.

During storage, the liqueurs color became lighter. The value of parameter a^* (red color) significantly decreased. After 26 weeks of storage, the difference in a^* value was lower by about 9 units at 15°C and about 20 units at 30°C in comparison with not stored samples. Directly after the preparation of liqueurs the content of anthocyanin polymers was about 7% and after storage their content increased to 23–29% (at 15°C) and 67–70% (at 30°C).

Liqueurs showed the best organoleptic properties after 24 weeks of storage at 30°C. The best aroma had liqueur without sugar, and the best taste showed sample with sugar.

Cornelian cherry liqueurs were characterized by a typical, but weak aroma. 16 volatile compounds were identified. Diethyl malate, which represented almost 95% of identified compounds, and acetate succinate were dominant. The content of diethyl malate increased

during storage, but perceptibility threshold is high and it is not decisive for the aroma compound. The greatest influence on the flavor of cornelian cherry has vanillin and cinnamic acid. Vanillin content increased slightly during liqueurs storage. The simultaneous sensory analysis demonstrated the presence of vanillinm, the intensity of which increased during storage. Other compounds which complemeted liqueurs flavor included monoterpenoids menthol, citronellal and pentalakton.

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Strugała P.[1], Wyspiańska D.[2], Kucharska A.Z.[2], Dudra A.[1], Gabrielska J.[1]

POLYPHENOLS FROM CHOSEN FRUITS AS NUTRACEUTICALS WITH HIGHT ANTI-INFLAMMATORY PROPERTIES AND THEIR MICRO- AND NANO-ENCAPSULATION

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The existence of risk relation between the so-called civilizational diseases and the diet has contributed to the development of the concept of functional food, which in turn is associated with the production of nutraceuticals. Therefore, it is desirable to search for new biologically active plant compounds having a healthy effect on the human body which, as the raw materials for the production of nutraceuticals, will be available for use in the diet of aged people and those who are exposed to stress and physical strain, or have limited ability to absorb some of the diet ingredients.

The aim of the work was to examine the antioxidant and anti-inflammatory activity of extracts of quince and Japanese quince and to determine the mechanism of their interaction with the phosphatidylcholine (PC) liposome membrane as a model of biological membrane, and to investigate the possibility of trapping them in an inulin medium (micro-encapsulation) and a liposomal one (nano-encapsulation).

The anti-inflammatory properties of the extracts were determined spectrophotometrically on the basis of cyclooxigenaze (COX-1 and COX-2) inhibition test, and their antioxidant activity was tested using spectrophotometric and fluorimetric methods.

In the spectrophotometric method, the level of liposome membrane oxidation inhibition was measured with the TBARS test. With fluorimetric method, free radicals were induced with AAPH compound which decreased fluorescence of DPH-PA probe by oxidizing it.

Encapsulation of extracts was performed in liposomes made of egg yolk PC. Trapping of extracts in inulin was done using the spray-drain method. Using the Laurdan,TMA-DPH and DPH fluorescent probes that become localized at different depths within the lipid bilayer, we have specified the effect of extracts on properties of the hydrophilic and hydrophobic region of membrane.The packing arrangement of the hydrophilic phase of liposomes was examined using the Laurdan probe, and the effect of extracts on fluidity of the hydrophobic interior of the liposome membrane was determined on the basis of changes in fluorescence anisotropy of DPH and TMA-DPH probes.

The results on anti-inflammatory activity have shown that both the quince and Japanese quince extract have a considerable ability to inhibit COX-1 and COX-2 enzymes. This

research showed that both the extracts are capable of protecting liposome membranes against peroxidation. The investigation on the effect of extracts on the packing arrangement of the lipid membrane hydrophilic area showed that the extracts increase the value of generalized polarization (GP) of the Laurdan probe. Fluidity of phosphotidylcholine membrane in its hydrophobic region did not significantly change as a result of extract incorporation, and that is indicated by the small changes in anisotropy of DPH and TMA-DPH probes. Preliminary investigation on drying the extracts with the spray-drain method in presence of inulin (micro-encapsulation) and their closure in liposomal carries (nano-encapsulation) indicate that efficiency of the trapping depends on the method used. Encapsulation of active substances in carries offers the possibility of creating promising food additives, in particular functional food which is supplemented with stable, active components that can have e.g. antioxidant and anti-inflammatory properties.

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Szwejda-Grzybowska J., Kosson R., Tuszyńska M., Szczech M.

MYCOTOXIN CONTENT IN ORGANIC AND CONVENTIONAL VEGETABLES

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Mycotoxins are toxic metabolites produced by filamentous fungi belonging mostly to genera *Aspergillus, Penicillum* and *Fusarium*. They may be present in various plant products causing immunological effects, specific organ damage or cancer in human or animals. Organic products, not treated with pesticides, are supposed to be especially exposed to mycotoxic contamination.

The aim of the work was to evaluate the quality of organic and conventional vegetables on the base of mycotoxins content. This work presents result of two years research of vegetables from organic and conventional farms located in central and northwestern Poland. The content of total aflatoxin, zearalenone and ochratoxin A in carrot, beetroot and corn was studied, immediately after harvest and after six months of storage at 2°C. The analysis of mycotoxins in vegetables was performed using the ELISA immunoenzymatic method.

All analyzed mycotoxins were found in carrot, beetroot and corn. The highest concentrations of total aflatoxins were observed in corn from organic farms. On the other hand the highest level of zearalenon was noted in the beetroots from conventional cultivation The content of ochratoxin A was the highest in beetroots from organic farms and carrot roots from conventional cultivation. Immediately after harvest in vegetables there were no differences in mycotoxin content between the samples from organic and conventional farms. After six months of storage at 2°C the content of mycotoxins have increased especially in vegetables from conventional farms.

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Skomorucha I.[1], Sosnówka-Czajka E.[1], Muchacka R.[2]

EFFECT OF HOUSING SYSTEM ON FATTY ACID PROFILE OF MEAT FROM RHODE ISLAND RED CHICKENS

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Fatty acid profile is an important determinant of animal product quality. Polyenoic fatty acids play a significant role in the prevention of metabolic lifestyle diseases, and n-3 fatty acids are essential to the normal growth and development of the human body. Essential fatty acids (EFA) include linoleic acid (C18:2) and α-linolenic acid (C18:3), which cannot be synthesized by animals and have to be supplied through the diet. Literature reports that pastures are a rich source of α-linolenic acid (ALA) and access to free range can significantly increase the content of n-3 fatty acids in meat.

The aim of the study was to determine the effect of barn system with and without free-range access on the fatty acid profile of breast and leg muscles from Rhode Island Red broilers.

The experiment used one-day-old Rhode Island Red chickens assigned to 2 groups differing in the housing system. In group I, broilers were kept in the barn system without outdoor access, and in group II, birds were raised in the barn system with outdoor area (1 m^2/bird). The outdoor runs, available from the first day of growth, were equipped with roofs and drinkers. Birds from both groups were fed standard diets and had free access to feed and water throughout the study. After reaching the body weight of around 1.7–2.1 kg, birds were slaughtered and samples of meat were collected from breast and leg muscles to determine fatty acid profile. The fatty acid profile of meat was determined by gas chromatography.

The results were analysed statistically by analysis of variance and significant differences were estimated using Duncan's multiple range test.

The present study only showed a statistically significant increase in dihomo-γ-linolenic acid (C-20:3 n-6) in breast muscle from chickens raised in the barn system with outdoor access compared to those without outdoor access. The other fatty acids determined in both breast and leg muscles had similar levels in both experimental groups.

In conclusion, the rearing systems used in the present study had no significant effect on the fatty acid profile of meat from Rhode Island Red broiler chickens.

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Sosnówka-Czajka E., Skomorucha I., Herbut E.

EFFECT OF ENRICHED CAGE, LITTER-BASED AND FREE-RANGE SYSTEMS ON FATTY ACID PROFILE OF EGGS FROM HY-LINE LAYERS

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The aim of the study was to determine the effect of enriched cage, litter-based and free-range housing of Hy-Line layers on the fatty acid profile of egg yolks.

The experiment used 18-week-old Hy-Line pullets, which were assigned to three groups. In group I, pullets were reared in compartments on litter at a stocking density of 9 birds/m^2, in group II in compartments on litter (9 birds/m^2) with free-range access (2.5m^2/bird), and in group III in enriched cages (750 cm^2/bird). Birds were fed standard layer diets and had free access to feed and water drinkers throughout the study. At 22, 32 and 56 weeks of rearing, 10 eggs were collected from each group to determine the fatty acid profile of egg yolk.

The results were analysed statistically using analysis of variance and significant differences were estimated with Duncan's test.

At 22 weeks of the study, the yolks of eggs from hens reared with free-range access had a higher content of linoleic and α-linolenic acids compared to those from hens kept in enriched cages ($p \leq 0.05$). Egg yolks from hens in groups I and II had a significantly higher content of PUFA and n-3 PUFA compared to egg yolks from hens in group III. There was also a higher content of conjugated linoleic acid (by 0.081%) in egg yolks from litter-raised hens compared to eggs from hens in enriched cages ($p \leq 0.05$). At 32 weeks of the experiment, t10-c12-CLa isomer was higher in eggs from groups II and III compared to group I, and at 56 weeks statistically significant differences were observed for eicosapentaenoic acid between group III and groups I and II.

In summary, at 22 weeks of growth a better fatty acid profile was characteristic of eggs from litter-raised hens and eggs from those raised on litter with free-range access compared to eggs from hens in enriched cages. At 32 and 56 weeks of the experiment, housing system had no appreciable effect on the fatty acid profile of egg yolk.

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Sosnówka-Czajka E.[1], Skomorucha I.[1], Muchacka R.[2]

SOME QUALITY PARAMETERS OF MEAT FROM YELLOWLEG PARTRIDGE AND RHODE ISLAND RED BROILER CHICKENS KEPT IN A BARN SYSTEM WITH OUTDOOR ACCESS

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The aim of the study was to determine the effect of breed of broiler chickens raised in the barn system with outdoor access on selected parameters of meat quality.

The experiment used one-day-old Yellowleg Partridge and Rhode Island Red (RIR) chickens raised on litter with outdoor area (1 m^2/bird). The outdoor runs, available from the first day of growth, were equipped with roofs and drinkers. Birds were fed standard diets and had free access to feed and water throughout the study. After reaching the appropriate body weight (around 1.7–1.8 kg in Yellowleg Partridge, around 1.7–2.1 kg in RIR), birds were slaughtered and pH of meat was measured 15 min postmortem and after 24-h chilling. Water holding capacity of breast and leg muscles was determined according to Grau and Hamm (1953), drip loss after 24-h chilling of meat, and meat colour using a Minolta reflectance chroma meter.

The results were analysed statistically by analysis of variance and significant differences were estimated using Duncan's multiple range test.

Rhode Island Red broilers had a highly significantly lower pH_{24} of breast and leg muscles compared to Yellowleg Partridge chickens. Highly significant differences were also observed between the breeds in drip loss from breast and leg muscles. RIR broilers were characterized by higher L^* and b^* values of breast muscle compared to the Yellowleg Partridge breed ($p \leq 0.01$ and $p \leq 0.05$, respectively). Higher b^* values were also observed for leg muscles of RIR compared to Yellowleg Partridge broilers. There were no statistically significant differences between the experimental groups in water holding capacity of breast and leg muscles.

In conclusion, the origin of birds had an effect on most of the analysed quality parameters of meat from broiler chickens kept in a barn system with outdoor access.

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Sosnówka-Czajka E.[1], Skomorucha I.[1], Puchała M.[2]

QUALITY OF EGGS FROM ORGANICALLY RAISED HENS OF CONSERVATION BREEDS

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The aim of the study was to determine the quality of eggs from organically raised Greenleg Partridge and Rhode Island Red hens.

Birds were assigned to 2 experimental groups (Greenleg Partridge hens in group I, Rhode Island Red hens in group II) and raised according to organic farming recommendations on litter at a stocking density of 6 birds/m^2 of floor space with free-range access (4 m^2/bird). The outdoor runs were equipped with roofs and drinkers. Hens were fed diets containing organic components, and were allowed free access to feed and water throughout the study. At 25 and 40 weeks of rearing, 20 eggs were collected from each group to analyse their quality using EQM (Egg Quality Measurements) system. The following parameters were included in the analysis: egg weight, height of thick albumen, Haugh units, yolk colour, yolk weight, shell thickness, shell weight, shell density, shell colour, and shell strength, which was measured with the use of an Egg Crusher. Egg shape index was also calculated.

The results were analysed statistically using analysis of variance, and significant differences were estimated with Duncan's test.

At both 25 and 40 weeks of rearing, eggs from Greenleg Partridge hens were characterized by significantly lighter shell colour, lower egg weight and lower thick albumen height compared to the eggs from Rhode Island Red hens. Lower Haugh units were also observed for eggs from group I compared to those from group II ($p \leq 0.05$). At 25 weeks of the study, shell weight of eggs laid by Greenleg Partridge hens was lower by 0.34 g compared to the other experimental breed ($p \leq 0.05$). At 40 weeks of rearing, a highly significant difference was found between the groups in yolk colour. Eggs produced during this period by Greenleg Partridge hens were also characterized by significantly higher yolk weight and lower shell thickness, weight and density compared to the eggs from Rhode Island Red hens.

In conclusion, the quality of eggs from the two compared breeds reared under organic conditions showed differences. Eggs from Rhode Island Red hens had better quality at both 25 and 40 weeks of the experiment compared to eggs laid by Greenleg Partridge hens.

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Spychaj R.[1], Gil Z.[1], Wojciechowicz-Budzisz A.[1], Bojarczuk J.[2]

RHEOLOGICAL PROPERTIES OF DOUGH AND PASTA QUALITY FROM *TRITICUM DURUM* BRED IN POLAND

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The goal of this study was to determine correlations between quality features of pasta and rheological properties of dough from flour and semolina produced from winter durum wheat bred in Poland.

The experimental material included grains from a field experiment where three lines of durum wheat (SMH 62, SMH 75 and SMH 131), durum wheat cultivar Komnata and common wheat cultivar Tonacja were grown in three levels of cultivation intensity. Flour was obtained from grain milling at the Quadrumat Senior mill, whereas semolina from grain milling at Quadrumat Junior mill.

Grain milling products were evaluated based on amylographic (PN- ISO 7973:2000) and farinographic (PN- ISO 5530-1:1999) measurements, and analyses conducted in a Mixolab Standard protocol (AACC Method 54-60.01). The qualitative assessment of pasta involved analyses of the minimal cooking time, weight ratio and dry matter loss at cooking.

The statistical analysis of results included determination of coefficients of a simple linear correlation ($p<0.05$) between quality attributes of pasta and amylographic and farinographic parameters and values read out from the Mixolab Standard curve.

The determined correlation coefficients prove a higher correlation between the analyzed quality attributes of pasta from flour than from semolina and parameters obtained from farinograms, amylograms and mixolab standard curves.

The time of cooking pasta from semolina was not correlated with any of the determined rheological parameters of dough. In the case of pasta made of the material with smaller granulation, this traits was correlated only with dough stability ($r=0.61$) read out from the mixolab standard curve.

Cooking index of pastas made of both materials was correlated with all farinographic parameters to a similar extent. Only the correlation between water absorption of semolina and this parameter was below the level of significance. Cooking index of both type pasta was positively correlated with dough softeninng ($r= 0.88$; $r= 0.64$). For all other farinographic parameters, the values of correlation coefficient were negative and ranged from -0.60 to -0.79 for pasta from flour and from -0.63 to -0.73 for pasta from semolina.

The values of cooking index and cooking losses noted for pasta made of flour were, to a significantly greater extent than for semolina pastas, correlated with amylographic parameters and characteristics read out from the mixographic curve. The weight ratio of pasta

from flour was negatively correlated with the final temperature (r= -0.95) and time of pasting (r= -0.94) and with the maximum viscosity of pastes (r= -0.86). For pasta made of semolina, a negative correlation of this parameter was determined with the maximum viscosity of pastes (r= -0.66). Cooking losses of both pasta type were negatively correlated with the initial temperature of pasting (r= -0.62 and r= -0.52). In the case of pasta made of flour, this parameter was positively correlated with the final temperature (r= 0.69) and time of pasting (r= 0.68). Cooking losses of pasta made of semolina were correlated only with the maximum viscosity of pastes (r= 0.65). Among the correlations between characteristics read out from the mixographic curve and quality attributes of pasta, a negative correlation was demonstrated between time to characteristic point C1 and the weight ratio of pastas from flour (r=-0.55) and semolina (r=0.66).

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Spychaj R.[1], Gryszkin A.[2], Kapelko M.[2], Gil Z.[1], Zięba T.[2]

INSTRUMENTAL METHODS IN ASSESMENT OF *TRITICUM DURUM* FLOUR

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This study was aimed at comparing instrumental methods applied in the evaluation of cereal raw material and these used in the assessment of rheological and thermal properties of starch and its modified preparations. The comparison was based on determination of correlations between quality attributes of flour from durum wheat and parameters assayed with instrumental methods.

The experimental material included flour from grain milling at the Quadrumat Senior mill. Grains were obtained from a field experiment where three lines winter durum wheat bred in Poland (SMH 62, SMH 75 and SMH 131), durum wheat cultivar Komnata and common wheat cultivar Tonacja were grown in three levels of cultivation intensity.

Flour was determined for: falling number, wet gluten yield and contents of total protein, dietary fiber and starch, and for the level of starch damaged. Instrumental analysis included farinographic (PN- ISO 5530-1:1999) and amylographic measurements (PN- ISO 7973:2000) and plotting a Mixolab Standard curve (AACC Method 54-60.01). An oscillating-rotary viscosimeter by HAAKE (RS-6000) was used to determine the mechanical spectrum and the flow curve of pastes that were described with Herschley-Bulkley's and Casson's models. In turn, differential scanning calorimetry was applied to assay thermal properties of the analyzed objects.

Coefficients of simple linear correlation ($p< 0.05$) were determined between quality features of flour and parameters achieved in each instrumental method.

Water absorption of the examined flours, determined using a farinograph and a mixolab apparatus, was correlated with the analyzed chemical properties of flour in a similar way.

Water absorption of flour and dough softening were positively correlated with contents of total protein and dietary fiber, degree of starch granules damage and wet gluten yield. Dough stability and quality number was negatively correlated with contents of total protein, dietary fiber and mechanically-damaged starch. The falling number and starch content were negatively correlated with water absorption of flour rand dough softening, and positively correlated with dough stability.

At characteristics points of the Mixolab Standard curve (C2, C3, C4 and C5), dough consistency was negatively correlated with total protein content, dietary fiber content and degree

of starch granules damage. Parameters describing the mechanical spectrum were negatively correlated with contents of dietary fiber and wet gluten and with the level of starch granules damage.

The amylographic analyses demonstrated the initial temperature and time of pasting and the maximum viscosity of pastes to be positively correlated with the falling number and starch content. The other analyzed quality features of flour were negatively correlated with the values of the above-discussed amylographic parameters.

The falling number and starch content were positively correlated with the final temperature and time of pasting and with the maximum viscosity of pastes. The analyzed chemical properties were similarly correlated with parameters describing the flow curves and mechanical spectra. In the case of the correlation between development time and temperature of dough at point C2 (protein weakening), a positive correlation was noted with the content of damaged starch and dietary fiber, whereas at point C3 (starch pasting) the correlation was negative.

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Stuper-Szablewska K.[1], Kurasiak-Popowska D.[2], Nawracała J.[2], Perkowski J.[1]

PHENOLIC ACIDS CONTENT IN WINTER WHEAT GENOTYPES DIFFERING IN RESISTANCE TO FUNGI DISEASE

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One of the most significant factors affecting resistance to fungal diseases in winter wheat genotypes is the content of phenolic compounds. It was found that there is dependence between phenolic acid contents and susceptibility of plants to diseases. A total of 100 winter wheat cultivars of various origin were investigated. The contents of five phenolic acids: ferulic, vanillic, syringic, vanillin and p-coumaric as well as free phenolic acids (FPA) were determined.

Considerable variation was found both within tested cultivars and between location. Among the investigated acids the greatest amounts were recorded for ferulic acid and its mean concentration was 975 μg g -1, p-coumaric acid was characterised by a lower mean concentration (52 μg g-1), while the lowest concentration was recorded for vanillin, amounting to 5 μg g -1. Variation was found It was also stated that genotypes considered to be less susceptible to infestation contain greater amounts of phenolic acids.

Ferulic acid, was the dominant phenolic acid in all winter genotypes and accounted for 92, 4% of total phenolic acids, while most of these genotypes was characterized by lack or low concentration of vanilic, syringic and vanillin acid. Mean concentration of ferulic acid, detected in all samples was 975 μg g -1. Conducted analysis of winter wheat grain showed very high differences between analysed genotypes in ferulic acid content.

Analysis of the heatmap made it possible to identify genotypes distinguished in terms of both high and low contents of individual phenolic acids, total phenolic acids and FPA. Thus selected genotypes will facilitate further verification of the dependence between this content and their resistance to diseases caused by *Fusarium*. In order to conduct a detailed analysis of these dependencies experiments should also be conducted considering the environmental effect as well as a potential genotype-environment interaction.

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Szmańko T., Górecka J., Berlińska A.

THE EFFECTS OF TRIMMING STYLE OF CULINARY PORTIONS WITH MUSCLE ON THE YIELD OF MEAT PRODUCTS AFTER THERMAL TREATMENT

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The purpose of these study was determine of the influence of trimming style of culinary portions with pork loin (*musculus lonogissimus dorsi, LD*) on the physical parameters of meat products after heat treatment.

The muscles excised from six half carcasses of Polish Large White (PLW). Experimental muscles dissected in the middle of the width along the long axis, perpendicular to the base. In these way the raw material was divided into two parts, an outer (P) and an inner (T). The P slices having a thickness of 30 mm excised parallel to the direction of the muscle fibers of the outer part of the muscle *LD*. The T slices trimmed perpendicular to the long axis of the muscle *LD* with *LD* muscle adjacent parts of the carcass, before wrenching the spine bone of backbone. The trials in the shape of cuboid with dimensions: length · width · thickness of 50 mm, 40 mm, 30 mm from P and T slices were trimmed. Thus prepared samples were heat treated: in water at 85 and 95°C, in hot air at 125 and 150°C as well as in water vapor at 100°C. Attempts were heated until the temperature reached 72°C in the geometric center.

The value of drip loss, changes in the volume and length of the samples after heat-treatment, the cutting force as well as the water holding capacity were estimated.

The culinary portions cutting from the *LD* muscle parallel to the to the direction of the muscle fibers, which was heat treated in water characterized by lower weight losses, less cutting force and higher value of water holding capacity. On the basis of the results of cutting individual portions of the *LD* muscle parallel to the course of muscle fibers was confirmed.

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THE MEAT QUALITY OF RABBITS FED THE FODDER WITH ADDITIVE OF THE HUMIC PREPARATIONS

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The aim of this work was to investigate the influence feeding with the humic preparations additive on the physicochemical and sensory properties of meat and fat of rabbits.

The research material consisted of 45 rabbits of the New Zealand White, fed *ad libitum* with a standard commercial feed, i.e. "Rabbit Mix Optima". The rabbits of groups C (control) were fed standard pelleted diet, group H5 received a control diet supplemented with 5% and H10 a control diet with 10% humic preparation. The humic preparations: Humokarbowit, Humobentofet as well as the fish-mineral concentrate in the feeding of rabbits were used. The experiment was terminated after 6 weeks feeding, when rabbits were slaughtered.

Physicochemical parameters and sensory assessment were performed on the fresh, frozen and after heat treatment meat of rabbits.

Statistical analysis of the results was carried out using STATISTICA 10.0 software. Averages, standard deviations, least significant differences and estimation of differences between mean values at $p < 0.05$ were calculated.

As a result of the study of adding humic preparations the effect on the sensory properties of meat were observed, for example the improvement of tenderness and juiciness of meat were noticed. Also, increase the dry matter content and value of fat-free dry matter in meat as well as lower melting temperature of fat were determined. As a results, diet supplementation with 5% and 10% the fish-mineral concentrate were the meat flavor deterioration as well as the increase of the red color in the spectrum of reflectance of rendered fat. Also, adversely affected of experimental preparations to a greater susceptibility to oxidation changes in fat were recorded.

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EFFECT OF RAW MATERIAL AND PROCESSING PARAMETERS ON SOME SENSORY FEATURES OF EXTRUDED SNACKS

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The aim of the experiment was to study the effect of traditional corn snacks supplementation with flour from uncommon, organic plant sources and the temperatures utilized for extruded snacks processing on the texture of obtained final products and their some sensory features.

Raw material used for the studies were corn grits from trade in Poland and flour of amaranth seeds, jerusalem artichoke tubers and pumpkin tissue prepared in laboratory conditions in Aleksandras Stulginskis University, Kaunas in Lithuania. Corn grits was supplemented with 10%, 15% and 20% level of experimental flour. To the recipe of all samples of snacks 1% of salt and 2% of light malt extract (Bekery Malt Extract E1) were additionally put in. Cooking extrusion process was utilized for snacks manufacturing at two different temperatures: 160^{0}C i 170^{0}C, by one-screw extruder of Brabender 20 DN type.

In ready products texture by Instron 5544 texture meter with attached cut element of QTS-25-SB type and sensory features according to 1–7 points hedonic scale, like consistence, appearance, colour, taste and flavour as well as overall acceptability were determined.

On the base of the results it can be stated that the supplementation of traditional corn snacks with amaranth and jerusalem artichoke flour affected the improvement of the texture of final products, particularly manufactured at lower temperature of extrusion (160°C) and that the use of pumpkin tissue flour in this process need to mix it with some small quantity of amaranth flour to obtain crispy, of profitable consistence snacks. Also, such sensory properties of supplemented snacks, like colour, appearance, taste and flavour as well as overall quality were better estimated in samples extruded at lower temperature, obtained with not higher than 15% level of addition, particularly with amaranth and jerusalem artichoke but also with pumpkin but in the mixture with 5% of amaranth seed flour. In the conditions of the experiment samples of snacks supplemented with 20% of pumpkin tissue and amaranth had not expanded and were not analysed. Particular profitable effect on the quality of extruded corn snacks was the supplementation on the level of 10% with amaranth and jerusalem artichoke flour.

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Tajner-Czopek A., Rytel E., Pęksa A., Miedzianka J., Kita A., Aniołowski K.

EFFECT OF CUTTING AND FRYING PROCESS ON THE PROPERTIES OF POTATO PRODUCTS AND ACRYLAMIDE CONTENT

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Consumers prefer the attractive appearance and original form of fried potato products. Smaller and thinner products are supposed to be more convenient, however consumers do not realize that so good looking snacks can contain more fat and accumulate more toxic compound, such as acrylamide (AA).

The aim of carried over study was to determine the impact of the size of frozen French fries and Dollar chips half-products available at retail on fat, colour, texture and acrylamide contents in ready-to-eat products prepared by frying in oil at different temperatures.

Samples of semi-frozen of straight shaped French fries (0.7 · 0.7 cm and 1 · 1 cm) and Dollar chips (of two different thickness) have been taken for the experiment. They were fried in rapeseed oil at the temperature of 130, 150, 170 and 190°C. There were determined the contents of fat (Soxhlet method) and acrylamide by HPLC/MS/MS in frozen semi-products and in ready-to-eat products and also their colour after frying (by a spectrophotometer Minolta CR-200) and texture with the use of Instron 5544 apparatus.

It was found that the fat content of products clearly decreased with the rising of frying temperature. Regardless of the temperature smaller products contained more fat than larger (French fries-by about 7%, slices-by about 5%). Increasing the temperature of frying from 130 to 190°C affected on the increase of acrylamide content by about 93% in fried, ready-to-eat products (regardless of their size). Independently on the temperature used for frying of studied samples, French fries of the size 0.7 · 0.7 cm contained about 14% AA more when compared to French fries of bigger size i.e. 1 · 1 cm, while thinner slices by about 10% more each of this compound in comparison with thicker one. Regardless of the size, French fries characterized higher AA content than Dollar chips. French fries of the section of 0.7 × 0.7 cm were of too soft texture comparing with other studied samples. Both, French fries and Dollar chips characterized of the suitable colour, however Dollar chips appeared brighter.

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FOOD QUALITY AND SAFETY MANAGEMENT SYSTEMS – PERSPECTIVES OF DEVELOPMENT AND IMPROVEMENT

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System changes concerning food safety and quality management demonstrate two main trends: the development of standards containing requirements to be met by food manufacturers and the exploration and application tools which allow to reduce and/or eliminate hazards, and predict safety of end-products. Continuous improvement is one of the conditions for the effective functioning of the quality and food safety management systems.

The studies carried out on a group of 108 dairy plants have shown that the most common elements requiring improvement are: the area of legal requirements related to food safety (traceability system, HACCP plan, control of CCPs, preventive and corrective actions, control of prerequisite programmes and legal requirements), facilitated actions which aim to increase the repeatability of operations (evaluation system of end-products, process monitoring system, evaluation system of suppliers and purchasing procedures), requirements that are parts of a standardized, voluntary management systems (management reviews, internal audits, customer communication, internal communication, the establishment and implementation of system policies, supervision over outsourced processes) as well as improvement of personnel competences and control of documentation. Scope of improvement actions, type of applied quality management instrumentation, account of quality costs and implementation of risk analysis approach are determined by the size of organization and the origin of the share capital.

Implementation and functioning of different standardized management systems which allow flexibility in selection of control measures as well as implementation of risk analysis causes that validation becomes increasingly significant. Refer to food safety, validation should lead to obtaining an evidence that not only control measures are effective but also the hazards are properly identified.

Food safety and quality management systems fulfil their function properly when they are put to validation, verification, updating and reviewing on the regular basis.

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THE INFLUENCE OF FATTENERS' MEAT-CONTENT ON THE COURSE AND DEGREE OF EXSANGUINATION

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Fatteners during slaughter are killed by means of exsanguination. Appropriately conducted exsanguination should be abundant and full, and completed in the shortest time possible. Reaching the maximum degree of the exsanguination of meat, which constitutes the most valuable slaughter material, is the sanitary and technological aim of slaughter exsanguination of fatteners. Maximum slaughter exsanguination is crucial for a proper course of glucolisis and for the activation of the enzymatic processes of meat maturation which shape its functional properties, as well as for the generation of positive sensory properties, and for the reduction of susceptibility to the processes of microbiological decay.

The aim of the study was to assess the influence of meat-content on the course of fatteners' exsanguination and exsanguination degree of the carcass.

The study was carried out on 120 fatteners and their carcass, divided into three groups according to meat-content (group I – carcass with meat-content below 56%, group II – carcass with 56–59% meat-content, group III – carcass with meat-content above 59%). During the experiment the following aspects were measured: exsanguination time, blood content in the first and second minute of exsanguination, total blood content, blood pH, weight of internal organs (heart, lungs, liver, spleen, kidneys), muscle exsanguination degree (neck muscle, oblique internal abdomen muscle, diaphragm muscle). The exsanguination degree was estimated with a heamoglobin diffusion test and a compressor test.

Statistical analysis showed a significant influence of meat-content on the time of slaughter exsanguination of the examined fatteners. Exsanguination time was longest in fatteners with meat-content between 56–59%. In other groups, the time of blood flow was statistically significantly longer. It was observed that fatteners with meat-content below 56% were characterized by lower blood content obtained during slaughter and lower blood content obtained in the first minute of exsanguination. Influence of meat-content on the weight of internal organs (heart, lungs, spleen, kidneys) was also observed in the study. Fatteners with meat-content above 59% were characterized by a higher weight of these organs. The analysis of muscle exsanguination degree proved that the highest percentage of muscles characterized by complete exsanguination was observed in carcass with meat-content below 56%.

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CONTENT OF SUGARS IN LOCAL CULTIVARS OF APPLE

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Research has been carried out on the sugar composition of apples. Differences in the chemical composition of apple cultivars have been presented. The aim of our study was to determine the sugar profile of apple cultivars from the East Bohemia region. The source of the cultivars is from the Research and Breeding Institute of Pomology. Research at the Institute is involved in the breeding research of apples, collection of regional and primitive varieties of local origin and introduction of foreign varieties. Cooperation with University Hospital is important for human nutrition. The purpose of the study was to find suitable cultivars for healthy nutrition from a sacchcaride point of view. For example, fructose is a highly lipogenic sugar that has profound metabolic effects in the liver and has been associated with many of the components of the metabolic syndrome (insulin resistance, elevated waist circumference, dyslipidemia, and hypertension).

Measurement of the apple sugar content included: dry matter content (by moisture analyzer); fructose, glucose and sucrose in different apple cultivars were extracted with ethanol, derivatized and determined by gas chromatography. Total sugar, the ratio of fructose and glucose (including fructose and glucose from sucrose after hydrolysis in the gut), and sweetness (relative to sucrose) were calculated. The obtained data are presented as mean ± standard deviation (the highest found amount; the lowest amount in the tested cultivars).

17 cultivars of apple were analysed. Dry matter was 15.56±1.85% (20% – Boskoopske; 12.4% – Ontario). Fructose content was 6.52±1 g/100 g of apple (8.1 – Golden Delicious; 4.8 – Selena), glucose content 1.46 ±0.55 g/100 g of apple (3 – Red Delicious; 0.9 – Ontario), sucrose was 4.75±1.35 g/100 g of apple (7.2 – Opal; 2.1 – Melrose). Total sugar content was 12.73±1.72 g/100 g of apple (16.1 – Boskoopske, Opal; 10.1. – Selena, Ontario). Sweetness was calculated 15.64±2 g/100 g of apple (19.5 – Boskoopske, Opal; 12.2 – Selena, Ontario).

In conclusion, cultivars suitable for nutriton of patients with metabolic syndrome are Selena and Ontario.

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Trafiałek J., Czarniecka-Skubina E., Pałubicki B., Makuszewska K.

THE ASSESSMENT OF COMPLIANCE THE RULES OF HYGIENE IN CATERING ESTABLISHMENTS PRODUCING FOODS IN THE PRESENCE OF THE CONSUMER ON SELECTED EXAMPLES

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Many catering establishments produce and distribute foodstuffs directly with the presence of the consumer. These are usually catering establishments located in tourist resorts, along the walking streets or in shopping malls where operating in small spaces of shopping arcades.

The aim of the study was to assess and compare the observance of hygiene rules in this type of establishments in different countries.

To evaluate and compare the observance of hygiene rules in catering establishments the unified sheet of audit questions was constructed. Audit form was divided into group of questions: questions concerning on hygiene of employees, production hygiene and hygiene of production areas.

The research method was inspection of processes executed by trained auditors. Thirty inspections at various catering establishments situated in the following locations were conducted: in Warsaw (Poland) shopping center, in Fulda (Hessen, Germany), in Berchtesgaden (Bavaria, Germany), in Saltzburg (Austria), New York (USA) and in Taiwan.

In all examined catering establishments were found many variances in the area of worker hygiene (hands and head), production premisses and production hygiene. Despite the cultural differences and legal conditions, presence of common and recurring variances were identified in all establishments. These were: incorrect functional system of rooms and the lack of separation between dirty and clean production activities. It has been shown many errors in the range of proceedings hygiene of staff, as touching hands, nose, ears, hair, and then serving of food.

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Tsyurik A.

PHYSIOLOGICAL BIOCHEMICAL ANALYSIS OF THE VITAMIN MINERAL ADDITIVE APPLICATION FOR RAISING OF LAYING HENS PRODUCTIVE INDICATORS

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Physiological biochemical analysis of the vitamin mineral additive application for raising of laying hens productive indicators is studied in the paper. An important part of the paper is the study of physiological and biochemical processes in laying hens' organisms.

The usage of vitamin mineral additive provides raising of egg production, egg quality, promotion of immune system, stimulation of metabolic processes in laying hens organisms.

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Ulbin-Figlewicz N., Brychcy E., Król Ż., Kulig D., Jarmoluk A.

EFFECT OF COLD PLASMA TREATMENT ON COLOR PARAMETERS OF MEAT

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Meat color is a main factor evaluated by consumers during purchase. Any deviations may result in consumer complaints and consequently in reduce sales. Cold plasma could be an effective method of decontamination in meat industry but its influence on quality attributes need to be investigated.

The objective of the present study was to evaluate the effect of helium plasma treatment on meat color over a storage period of 14 days.

Samples of meat were exposed to low-pressure helium plasma (20 kPa) for 0 (control), 2, 5 and 10 minutes and then were storaged at 4°C. The color of meat samples before and after cold plasma treatment was measured using colorimeter Minolta Cr4. The results were expressed in CIE LAB color scale, where L* determines lightness, a* redness, b*yellowness. L* value is in the range of 0–100, where 0 represents black and 100 represents perfect reflecting diffuser. The a* and b* indicate colour directions, where +a* is red; –a* is green; +b* is yellow; –b* is blue. The total color difference (ΔE*), hue angle (H), and chroma (C) were calculated.

Plasma treatment for 10 minutes resulted in significantly lower ΔE* and H values compared with others samples. In addition ΔE* and H values of meat showed significant changes throughout the storage period. Those color parameters decreased from 53.0 to 49.2 (ΔE*) and from 0.56 to 0.37 (H) after 14 days of storage. There were not observed significant differences in C values.

Cold plasma treatment for 10 minutes led to color changes, but the differences are slightly and may be unnoticeable by consumers. However sensory analysis needs to be carried out.

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Ulbin-Figlewicz N., Brychcy E., Kulig D., Król Ż., Jarmoluk A.

FATTY ACID COMPOSITION OF ADIPOSE TISSUE EXPOSED TO HELIUM PLASMA TREATMENT

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Foods derived from animals provide about 30% of the total energy intake. Meats are the main source of energy and a high proportion of this energy is derived from fat. The lipids in pork contain much higher polyunsaturated fatty acid (PUFA) than cattle and sheep. The fatty acid composition of adipose tissue and muscle is broadly similar.

The aim of present study was to evaluate the influence of helium plasma treatment on fatty acid composition of adipose tissue. The susceptibility of lipids to oxidation depends on their degree unsaturation thus n – 3 PUFA are more prone compared to saturated fatty acid and as a consequence their anti-atherogenic, anti-thrombotic and anti-inflammatory effects may be reduced.

Adipose tissue were exposed to low-pressure plasma treatment for 2, 5, 10 minutes. Reference sample was an untreated tissue. Lipids were extracted from adipose tissue using Folch method. Gas chromatography technique with mass spectroscopy analyzer (GC-MS 6890N) was used to determine the fatty acid profile. The column used HP-88 and the flow of carrier gas (He) was set at the initial level of 1 mL/min. Temperature program was established in the following time frame: 70°C for 1 min, 70–180°C (20°C/min), 180–220°C (3°C/min), 220°C for 15 min, 220–240°C (5°C/min), 240°C for 11 min.

There were no observed significant differences beetwen saturated (SFA) and monounsaturated (MUFA) fatty acid composition in all samples. Their contents were at the similar level and equal 41 and 45 %, respectively. The same proportions of PUFA in all adipose tissues were also noted. The ratio of n-6:n-3 was about 10. The percentage of the main fatty acids: 16:0, 18:0, 18:1 and 18:2 were about 20, 18, 38 and 11 %, respectively.

There was found, that low-pressure plasma treatment does not affect on fatty acid composition. Thus, it can be assumed that the cold plasma does not induce oxidative processes in lipids.

Ulbin-Figlewicz N., Zimoch-Korzycka A., Kulig D., Brychcy E., Król Ż., Jarmoluk A.

THE WETTING PROPERTIES OF CHITOSAN FILMS EXPOSED TO LOW-PRESSURE PLASMA

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Edible films and coatings can reduce physical changes in fresh products as well extend the shelf-life of food due to incorporation of antimicrobial components. These films are an excellent oxygen barrier and their mechanical properties are comparable to many commercial polymer films. However, the effectiveness of edible coatings depends primarily on the control of the wettability of the coating solutions. For this reason the surface energy or surface tension of the food product should be controlled. The determination of surface tension usually involves measuring the contact angles that several standard liquids make with that surface. The surface energy of the solid surface is then related to the surface tensions of the liquids and the contact angles. The objectives of this study were to characterize the wetting properties of edible films and to determine the effects of cold plasma treatment on the wettability of chitosan films.

Film solution was prepared by dissolving 1% low molecular weight chitosan (DD: 75–85%) in diluted lactic acid (0.5%). Glycerol was added as a plasticizer (25% of dry weight of used polymers). The mixture was dried at 4°C and 60 % RH for 96 h. Then samples were exposed to helium plasma treatment for 0, 5 and 10 minutes at low-pressure (20 kPa). Contact angles of wettability were measured in an air using a Contact Angle Analyzer (Surface Electro Optics). A film sample (2cm2) was put on a movable sample stage and leveled horizontally; then a drop of about 6 ml of distilled water was placed on the surface of the film using a microsyringe.

The results have shown decrease in contact angle of film from initial value 62 to 57% after cold plasma treatment, but the differences were not statistically significant. Contact angle below 90° correspond to hydrophilicity of surface and more than 90° correspond to hydrophobicity of surface. It is well known that water contact angle decreases when surface hydrophilicity is higher. Therefore, it can be assumed that tested film indicate high wettability. It is worth noting that coating solutions must wet and spread on the surface of the food product, and upon drying they must form a film that has the adequate properties and durability. Thus higher wettability of chitosan coatings is beneficial in application of food.

Wawer I., Łastawska K.

MIXTURES OF ANTIOXIDANTS IN FUNCTIONAL FOOD

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Increasing scientific interest in polyphenolic antioxidants, especially flavonoids, has been observed. Numerous studies have indicated that flavonoids have anti-oxidant, anti-carcinogenic, anti-viral and anti-inflammatory activities. Due to their wide range of activities, numerous herbal preparations containing either flavonoid glycosides or aglycones are now marketed in various formulations as drugs, functional foods and dietary supplements. The intake of flavonoids with typical foods was estimated as ca. 25 mg/day, whereas after taking these products it is likely very high. For example, the commonly used dose of rutin is 1–2 grams per day. The recommended dose of quercetin supplements is one capsule (620 mg) daily. Therefore, the flavonoid concentration, at least in the intestine, could be very high after ingestion of flavonoid-containing supplements, suggesting a potential for flavonoid-drug and flavonoid-food interactions. In animals, baicalin and its aglycone baicalein both increase the oral bioavailability of cyclosporin, flavone and quercetin can increase the bioavailability of paclitaxel. The frequent presence of high flavonoid content in food supplements, require careful evaluation of molecular mechanisms, determining their absorption and elimination as well as mutual interactions.

The use of herbal preparations for health maintenance has become popular. Herbal products are ingested by about 10% or more of the general population. The benefit of a diet rich in fruit and vegetables is attributed to the complex mixture of phytochemicals. The additive and synergistic effects of phenolics in fruit and vegetables are responsible for their potent antioxidant activities. Therefore, it is reasonable first to identify the components of such antioxidant mixture, and then to develop the "antioxidant cocktail" as functional food or food supplement.

Single or mixed?

The key question is whether a purified flavonoid has the same health benefit as the flavonoid present in whole food matrix. The individual antioxidants studied in clinical trials do not have consistent preventive effects. The isolated pure compound either loses its bioactivity or may not behave the same way as the compound in whole foods. However, many of the dietary supplements have been developed based on the results from in vitro and animal studies, without human intervention studies. What dose of a single antioxidant should be used as a dietary supplement or functional food? We do not have an RDA for flavonoids! Natural antioxidants at the low levels present in fruit and vegetables offer health benefits, but these compounds may not be effective or safe when consumed at higher doses. Therefore, it is not wise to take

megadoses of purified flavonoids as supplements or functional food before strong scientific evidence supports doing so.

Numerous studies have focused on determining flavonoid antioxidant activity, many of which have used pure compounds, calculating their individual antioxidant power and performing structure–activity relationship studies. Some in vitro studies showed that biological interactions took place between flavonoids and vitamins. The synergic antioxidant effect between tocopherol and epicatechin and epigallocatechin gallate has been described. An antioxidant effect was observed with the flavonoids quercetin and catechin, indicating that these components of red wine act synergistically to inhibit platelet adhesion to collagen by virtue of their antioxidant effect.

Many studies on the antioxidant potential of flavonoids in fruits, vegetables, wine or tea have concluded that it is impossible to predict the antioxidant power of a given product by studying just one type of flavonoid contained in the product. The possible existence of synergic or antagonistic effects between the various antioxidants present in plant foods has been postulated. However until now very few studies have focused on the assessment of flavonoid–flavonoid interactions in terms of antioxidant activity.

Binary mixtures

The studies of antioxidants focus either on single compounds or complex mixtures such as plant extracts. The results obtained for estimation of antioxidant activity of foods are difficult to interpret or explain. Logic step towards understanding complex mixtures should be more detailed study of binary systems. Therefore, the aim of our study was to find synergy relationships between different combinations of selected flavonoids. In particular, we have compared the antioxidant capacity of a system containing a mixture of two flavonoids with that of each single flavonoid measured individually. Antioxidant activity was determined for seven flavonoids (taxifolin, dihydromyricetin, fisetin, gossipin, epicatechin, baicalin and baicalein) and vitamin C. The same measurements were performed for 21 pairs flavonoid +flavonoid (1:1) and 7 pairs flavonoid+vitamin C. Synergistic or antagonistic effects were determined by spectrophotometric and EPR methods using DPPH• and $ABTS^{\bullet+}$ radicals and also ORAC assay. The reaction between free radical and the antioxidant significantly depends on the solvent (methanol, acetone, DMSO and water-lipid emulsion). NMR spectra did not indicate flavonoid-flavonoid intermolecular interactions. However, the appearance of a free radical in the system caused differences in the reactivity of particular flavonoids. Statistically significant increase in antioxidant activity can be described as a synergistic effect. Antagonistic effect was obtained when the activity was lower than the sum of the individual values. In methanol, mainly antagonistic effects were observed, in DMSO (aprotic solvent) more frequently synergistic ones.

In addition, antioxidant power depends on the nature of the radical and its specific reactions. These mechanisms are influenced by the presence of glycosidic moieties (baicalin and baicalein), the number and position of hydroxyl groups. The change of synergistic (+36) for antagonistic (-26) effect was observed for baicalein and baicalin, respectively, when paired with ascorbic acid. There are no evidences confirming beneficial cooperation of flavonoids with ascorbic acid.

To achieve better understanding of the antioxidant mechanism of flavonoids in food, their interactions must be further explored. The evidence of a higher antioxidant effect when combinations of flavonoids are used is promising. However, the mechanism of such interactions is not well understood.

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EFFECT OF TEMPERATURE AND MOISTURE CONTENT ON THE QUALITY OF RAPESEED STORED IN ANAEROBIC CONDITIONS

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Freshly harvested rapeseeds contain valuable oil. However, its quality may deteriorate during storage of seeds. Intensity of chemical changes in lipids reducing its technological and nutritional value depends on moisture content, storage temperature and access to oxygen. Apart from that when rapeseed is stored in a silo an additional threat is the possibility of mechanical damage of seeds caused by the pressure of the mass of stored seed. The aim of the work was to study the microbiological and technological quality of rapeseed stored in different anaerobic conditions. The storage conditions of rapeseed were simulated in compression chambers. Rapeseed with seed moisture content of 7, 10, 13 and 16% (w.b.) was stored at temperatures 25, 30 and 35°C. The stress of the mass of stored seeds in the chamber with rapeseed was simulated by applying pressure values (20, 40 and 60 kPa) corresponding to the actual levels that can be found in the silo. After 28 days of storage the acid value and the level of mould contamination of rapeseed were determined. Acid value (*AV*) was analysed according to ISO 660 (1996). Fungal contamination of rapeseed was expressed as the number of colony forming units (CFU) of moulds per 1g of seed. CFU of moulds per 1 g of grain were counted according to PN-ISO 7698:2004.

The tendency of changes in acid value was similar under each applied pressure conditions. The content of free acid increased with increasing moisture content of seed and applied temperature. In samples with a moisture content of 16% at each applied pressure conditions, acid values exceeded admissible level of 3 mg $KOH \cdot g^{-1}$ of oil. Mould growth in mass of stored rapeseed was more dependent on the pressure conditions. An increase in value of applied pressure in the silo caused that the maximum level of fungal contamination of rapeseed was observed in samples with higher moisture content. In samples of seed with moisture content of 7% fungal development was limited and at each temperature and applied values of pressure, CFU did not exceed initial level of 2.0×10^3 $cfu \cdot g^{-1}$. The analysis of variance showed a statistically significant effect of storage conditions (moisture content, temperature and pressure) on the level of CFU of moulds. A much greater share of the total variation in the CFU level of moulds was found for moisture content and pressure conditions. All two and tree factor interactions were also significant.

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RIPENING EFFECT ON PH, SHEAR FORCE AND COLOUR PARAMETERS: A CASE STUDY OF PORK AND BEEF HOMOGENATES WITH THE ADDITION OF COAGULASE-NEGATIVE COCCI

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The aim of this study was to determine the changes in the pH, shear force and colour parameters of pork and beef homogenates with the addition of coagulase-negative cocci. The strains were isolated from the raw fermented meat products, originating from the Podlasie region and belonged to *Staphylococcus equorum*, *St. xylosus, St. simulans*, *St. warneri* and *Aerococcus viridans* species. The ΔE* measurement was approximately 7.47 in pork and 9.35 in beef homogenates. As homogenates dried consequently, the L* parameter slightly decreased, although the surface was moist and strongly reflected the light during the entire ripening period. The rise of a* and C* parameters showed a red colour intensity increase during first 3 days of processing and this coincided with the decrease of pH values in pork homogenates. The even decrease of pH values was observed during the entire ripening period in beef samples. Finally, the mean ΔpH for pork and beef homogenates was 0.32 and 0.22, respectively. The increase of the WB shear force was approximately 1.03 kG in pork samples. Otherwise, not significant decrease of the WB shear force, about 0.36 kG, was observed in beef samples, in spite of the 7–day drying process. The reduction of bacteria populations by 1.39 log cfu/g was noted during ripening of all homogenates, with the exception of *St. warneri* strains. The results of the two-way analysis of variance showed that both factors – the type of strain and the ripening period significantly influenced the level of the analysed variables, with the exception of pH (0-3-day ripening period) and WB shear force (whole processing) in beef homogenates.

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Wieczorek K., Osek J.

CAMPYLOBACTER CONTAMINATION OF CHICKEN CARCASSES SLAUGHTERED IN POLAND DURING 2009–2013

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The purpose of the study was to assess the incidence and to identify the species of *Campylobacter* on chicken carcasses slaughtered in 16 voivodeships in Poland during 2009–2013. The surface swabs were collected from poultry broiler carcasses at the abbatoir level directly after immersion chilling but before further processing such as freezing, cutting or packaging. The neck skin and the skin surface under the wings were wiped 10 times with sterile swabs and the samples were immediately transported to a laboratory in Amies transport medium with charcoal. Then, the swabs were placed in Bolton enrichment broth supplemented with 5% of horse blood and modified Bolton broth supplemented with anibiotics. The cultures were incubated at 41.5°C for 48 h under microaerobic conditions. *Campylobacter* were isolated according to the ISO 10272-1:2006 standard and identified using PCR as described before (Wieczorek and Osek, 2005).

A total of 1,210 (55.9%) of the 2,166 swabs samples collected during the study period were positive for *Campylobacter*, either *C. jejuni* (612 isolates, 50.6%) or *C. coli* (598 strains, 49.4%) as determined by the PCR analysis. The chicken carcasses were identified to be most contaminated in 2009 (70.9% of positive results) whereas in 2013 only 39.2% of them *Campylobacter*-positive. It was also found that in years 2009 and 2010 most samples were contaminated with *C. jejuni* (54.4 and 55.8%, respectively), whereas in years 2012 and 2013 the predominant species was *C. coli* (55.5 and 52.7% isolates, respectively). Taking into account the geographical distribution, most *Campylobacter*-positive chicken carcasses were detected in lubelskie and zachodniopomorskie voivodships (82.1 and 71.7%, respectively). On the other hand, less than 50% of contaminated samples were identified in pomorskie, and lubuskie voivodeships. In half of voivodeships *C. jejuni* was most often found with the higher prevalence in zachodniopomorskie (80.8%). In the remaining 8 voivodeships *C. coli* was the predomonat, especially in lubuskie voivodeship (84.2%).

The results obtained in the present study show a high level of chicken carcasses contaminated with *Campylobacter* in Poland. It suggests the needs to improvement of hygiene during broiler slaughter and processing.

Wieczorek K., Osek J.

OCCURRENCE OF *CAMPYLOBACTER* IN CATTLE AND SWINE CARCASSES IN POLAND DURING 2009–2013

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The investigation was conducted in slaughterhouses located in 16 voivodeships in Poland during 5 years (from 2009 to 2013). The pig and cattle carcasses were surface swabbed at the brisket area (cattle) or ham (swine) using sterile sponges. To each swab, 90 ml of Bolton Broth (Oxoid, United Kingdom) was added. Then the samples were tested for the presence of *Campylobacter* spp. using ISO 11272-1:2007+Ap1:2008 standard and identified by multiplex PCR.

During the study period 502 carcass swabs of swine (n = 311) and cattle (n = 191) were investigated. In total, 81 (26.6%) and 28 (14.7%) samples were positive for this pathogen, respectively. PCR analysis revealed that *Campylobacter* isolated from cattle were identified either as *C. jejuni* (16 strains, 57.1%) or as *C. coli* (12, 42.9% isolates). The opposite results were obtained regarding strains isolated from pigs, where the majority of them (61 strains, 75.3%) were *C. coli* and the remaining 20 isolates (24.7%) was identified as *C. jejuni*. The higher prevalence of *Campylobacter* in cattle carcasses was identified in 2012 (25.6%) whereas in 2013 only 2.6% of such samples were positive. In 2013, also the lowest level of *Campylobacter* contamination of pig carcasses was observed. In this year *Campylobacter* was detected in 17.6% of samples as compared to 31.6% positive results in 2009. *C. coli* was the predominant species during the whole study period when pig samples were taken into consideration. On the other hand, different prevalence of *C. jejuni* and *C. coli* was found among strains isolated from cattle depending on the year. If the place of sampling was taken into consideration, *Campylobacte*r was most often isolated from cattle in zachodniopomorskie voivodeship (33.0% positive samples) and from swine carcasses in lubuskie (62.5%). *C. coli* was predominant in swabs of swine origin in most of voivodeships except podkarpackie, podlaskie, and lubleskie were *C. jejuni* was most often identified. Among *Campylobacter* isolated from cattle in some voivodeships *C. coli* was predominant species and in the others *C. jejuni* was most often found.

The obtained results suggested that not only poultry may be a source of *Campylobacter* for humans but also pig and cattle revealed a significant level of contamination with this foodborne pathogen.

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Włoch A.[1], Strugała P.[1], Żyłka R.[1], Oszmiański J.[2], Kleszczyńska H.[1]

BIOLOGICAL ACTIVITY OF BAICALIN AND *SCUTELLARIA BAICALENSIS* EXTRACT IN *IN VITRO* STUDIES

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One of the most important factors deciding of the state of health of the organism is nutrition. An adequate composition of human daily diet exerts positive affect not only on the human condition but it can also protect the organism against some serious diseases, i.g. circulatory ailments, tumours or diabetes. The aim of the study was to determine if extracts of scutellaria baicalensis and their main component baicalin qualify as a potential constituent of functional food.

The biological activity of an extract of scutellaria baicalensis and its main component baicalin was tested. In particular, the study was concerned with anti-inflammatory activity of the compounds, their efficacy in protecting membrane lipids against oxidation, protection of red blood cells against osmotic pressure changes, and determination of their effect on the hydrophilic and hydrophobic part of the erythrocyte membrane and its hydration.

The anti-inflammatory activity of the compounds was determined on the basis of the measurement of inhibition of cyclooxygenase (COX-2) activity. In the antioxidant activity tests, the compound AAPH was used as inducer of oxidation. The fluorimetric method was used to specify the concentration of free radicals in solution in the presence of test substances on the basis of intensity of DPH-PA probe fluorescence. The investigation of osmotic resistance was done on red blood cells modified with the compounds and then suspended in aqueous hypotonic solutions of sodium chloride. With fluorimetric method the arrangement of the hydrophilic part of membrane was determined, using Laurdan probe, and fluidity of the membrane using DPH probe; and by means of the spectrophotometric method in infra-red (FTIR) the effect of studied compounds on membrane hydration was examined.

The study has shown that the test substances are effective in preventing lipid peroxidation in membranes, by removing the excess of free radicals from the medium and reducing their diffusion into the membrane interior. The fluorimetric tests showed that the substances practically do not penetrate the hydrophobic part of membrane but bind to its surface, thus forming a barrier that protects the membrane against invasion by free radicals. The tested substances have a high anti-inflammatory activity and cause an increase in osmotic resistance of erythrocytes,

making them less sensitive to changes in osmotic pressure. The FTIR investigation of hydration products indicates slight changes in the choline and phosphate bands in absorption spectra.

The overall conclusion is that the test substances qualify as components of functional food, as they have an anti-inflammatory activity, protect erythrocyte membranes against oxidation and make them more resilient.

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Włoch A.[1], Strugała P.[1], Żyłka R.[1], Oszmiański J.[2], Kleszczyńska H.[1]

BIOLOGICAL ACTIVITY OF BUCKWHEAT HUSK AND STALK EXTRACTS IN *VITRO* AS POTENTIAL COMPONENTS OF FUNCTIONAL FOOD

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Buckwheat is a valuable source of many biologically active compounds, and nutrients. It has properties that reduce blood cholesterol levels, and so reduces the risk of atherosclerosis, seals the capillaries and lowers blood pressure. The seeds are rich in protein, minerals, microelements and flavonoids, the last having antioxidant properties that protect biological structures against oxidation.

The aim of the study was to determine the biological activity of buckwheat husk and stalk extracts. As a measure of biological activity was assumed their antioxidant and anti-inflammatory activity, and the extent of changes in the physical parameters of erythrocyte membranes modified by the extracts. Membrane oxidation was induced by two agents: physical - UV radiation and chemical - AAPH compound. The antioxidant activity of the extracts was determined based on their ability to inhibit the process of oxidation of membrane lipids. The osmotic resistance of erythrocytes treated with the extracts was determined on the basis of the level of hemolysis of cells modified in hypotonic solution of sodium chloride. The anti-inflammatory activity was specified on the basis of cyclo-oxigenase (COX-2) inhibition. The study also includes fluorimetric and spectrophotometric (FTIR) methods that enabled us to determine the location of polyphenols in the erythrocyte membrane and changes in membrane properties caused by the extracts compounds.

The results showed a high antioxidant activity of buckwheat extracts with respect to membrane lipids. In addition, the activity of the stalk extract is close to activity of buckwheat husk extract - a result confirmed in both the methods. Our investigation also showed that polyphenol compounds contained in wheat extracts become localized mainly in the hydrophilic part of the erythrocyte membrane. Their presence in that part of membrane induces a lesser packing order of the polar heads of membrane lipids. The results showed an increase in osmotic resistance of erythrocytes, as they hemolyze less in hypotonic solutions. The extracts also caused inhibition of the COX-2 enzyme and increased membrane hydration, evidenced by the FTIR method.

The study showed that the biological activity of buckwheat husk and stalk extracts, in particular the antioxidant and anti-inflammatory, qualifies them as components of functional food.

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

QUALITY OF CLEAR AND CLOUDY APPLE JUICES ASSESSED BY PHYSICOCHEMICAL PROPERTIES

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The present study is focused on commercially available on the market apple juices produced from concentrate (FC), clear and cloudy, and juices not form concentrate (NFC), naturally cloudy pressed and freshly squeezed.

The aim of the study was to assess the quality of juices by determination of the physicochemical parameters including colour, turbidity, total soluble solids, sucrose, D-glucose, D-fructose, titratable acidity, pH, total content of phenolic compounds, and antioxidant activity quantified by the TEAC value.

The differences in colour of commercial apple juices were observed, the value of the lightness coordinate L* ranged from 63.25 (the darkest) in juice NFC to 93.54 (the lightest) in clear juice FC. Hue ranged from 78.14° (the most reddish) to 92.44° (the most yellowish), and the chroma coordinate C* from 28.02 to 59.27 demonstrating the differences in colour saturation. The solids content in the juices was in the range of 10.7 in the apple juices FC to 13.7° Brix in the naturally cloudy juice. The content of sucrose was at the level of 3.01–37.27 g/L. Pasteurized juices NFC were characterized by the lowest sucrose content and clear juice FC by the highest value. The glucose content ranged from 13.64 to 35.82 g/L and was lower in fresh juices. Fructose content in juices was at the level of 52.12–104.14 g/L. The value of acidity was in the range of 3.19 to 8.13 g of apple acid per liter of juice, and pH 3.16–3.64.

The total content of polyphenolic compounds varied in juices from 170.71 in one naturally cloudy juice to 686.11 mg GA/L in other juice NFC. TEAC value also varied markedly among the different brands and categories of apple juices studied, and ranged from 1.43 in the clear juice FC to 6.43 mM in the cloudy juice FC.

Correlation coefficients were calculated to evaluate relationship between the parameters studied ($p<0.05$). Turbidity of juices was correlated with colour coordinates L* (-0.933), C* (0.690), h° (-0.842), and with°Brix (0.650), phenolic content (0.600) and TEAC value (0.695). The correlation coefficients between acidity on one side, and°Brix and pH on the other side, were 0.577, and 0.910 respectively. The high correlation (0.864) between polyphenols and TEAC indicates that the antioxidant activity of apple juices significantly depends on their polyphenolic content.

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DRYING KINETICS AND QUALITY OF JUJUBE FRUIT DEHYDRATED BY DIFFERENT METHODS

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Jujube (*Zizyphus jujuba* Miller) is popular fruit in many countries due to high nutritional value, antioxidant potential and functional activities in terms of liver protection and antitumor properties. However, this fruit is exposed to spoilage in the fresh state. One of the preservation method ensuring long shelf life of fruits is drying.

The purpose of the study was to determine the drying kinetics and find the optimal drying conditions ensuring the best quality of the dried jujube fruit in terms of chemical composition, antioxidant capacity and colour.

The jujube fruits were dehydrated by convective drying CD at three temperatures (50, 60 and 70°C), vacuum-microwave drying VMD at different microwave powers (120, 480 and 480/120 W) and the combination of CD and VMD (480/120 W). The control samples were prepared by freeze drying FD. The drying kinetics was determined by a gravimetric method and the temperature of VMD samples was measured with the infrared camera Flir i50. The colour of fresh and dried samples was measured with the chroma meter Konica Minolta CR-400. The content of total polyphenols and the antioxidant capacity were determined by Folin-Ciocalteau method and $ABTS^{+}$.

The decrease of moisture ratio in time was described by modified Page model, which was fit to experimental points at satisfactory statistical coefficients. The time of drying was from 270 to 570 min for CD and from 28 to 96 min for VMD depending on the drying parameters. The application of VM finish drying radically decreased the time CD. The highest temperature of the samples measured during VMD amounted to 68°C for 120 W and 74°C for 480 W and 120/480 W. Samples dehydrated by CD and VMD were significantly darker comparing to fresh fruit and FD samples. The highest colour alteration was found for VMD samples, while the lowest were stated for FD samples and CD fruits dehydrated at 50 and 60°C.

The content of phenolic compounds in the samples dried by FD was higher than in the CD-dried samples and combination of CD and VMD dried samples treated at the final

microwave power of 120 W but lower than in the VM method. Compared to the other analyzed methods of drying, the greatest change in polyphenols was found in the fruits dehydrated by CD, especially at 50°C. There was a clear dependency between hot air temperature and polyphenols loss. Additionally, in this study, it was observed that the polyphenols content and antioxidant capacity of the jujube were changing under different drying conditions in the same way. It may therefore be concluded that the polyphenols content of dry materials is largely responsible for their antioxidant capacity.

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Wojdyło A., Teleszko M., Nowicka P., Oszmiański J.

NATURAL SWEETNERS AS A GOOD OPTION FOR SWEET AND NUTRITION VALUE OF CHOKEBERRY BEVERAGE

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Chokeberries (*Aronia melanocarpa*) have recently received much attention as a functional food due to their abundant levels of polyphenols. The dark purple berries contain exceptionally high levels of anthocyanins and procyanidins compared to other berries. Due to an abundance of polyphenols, chokeberries have demonstrated potent antioxidant activity in both in vitro and in vivo. Additionally these berries possess antidiabetic, antiproliferative, and antimutagenic properties as well as cardio-, hepato-, and chemoprotective effects. However chokeberries are also rich in proanthocyanidins which impart a very astringent taste. Due to their astringent taste, these berries are commonly processed only to nectars after dilution in water. However this products loss many important levels of phenolic compounds.

Therefore, the aim of the study was to added the natural substances as sweetness (stevia, inulin, erythritol, xylitol, sugar) to correction of astringency taste and to evaluated the influence of polyphenolic compounds and antioxidant activity prepared beverages.

Fruits were harvested at ecological farm in September 2013. Sucrose and natural sweeteners commercially available. From raw fruits was prepared chokeberry juice and was added to its sweetness as: 7 and 15 % (inulin, erythritol, xylitol, sugar) and 0.1; 0.25 and 0.5% of glycosides of stevia. In beverages physico-chemical analysis were determined by PN method, total polyphenols by Folin-Ciocalteu method and antioxidant activity by ABTS method. The organoleptic assessment of smoothies was carried using a 5-degree hedonic scale with boundary indications: '*I do not like very much*' (1) – '*I like very much*' (5). The assessment included the following quality attributes: taste, total acceptance and sweet- astringent, and was conducted by a group of 10 trained panelist.

The obtained results of the studies showed, that the most attractive natural sweeteners added to chokeberry juice were: inulin and erythritol >> sugars, but the lowest after mixed with glycosides of stevia. The worst additive according to consumer's opinion was stevia, which impairs the taste, especially after dose of 0.5%. Chokeberry juices with addition of inulin was more attractive for consumer than with addition of xylitol > erythritol > 0.1 and 0.25% of glycosides of stevia. Beverages with higher dose of natural sweetness characterized high extract ($p<0.05$) but they not significantly after preparing change of polyphenolic compounds.

All sweeteners influence the taste of product and keep the bioactive compounds at a high level.

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Wójcik-Stopczyńska B., Kądziołka D.

LABORATORY ESTIMATION OF ANTIFUNGAL ACTIVITY OF THYME (*THYMUS VULGARIS* L.)

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Synthetic chemical substances usually are applied for a protection of agricultural food commodities from fungal disease and spoilage. However, indiscriminate use has resulted in such problems as toxic residues in food, causing health hazards, and disruption of eco-system. Plant-origin products are an alternative to the use of chemical substances because they are safer and eco-friendly. Herbs are a potential source of compounds, which have antimicrobial properties and can be used as natural antifungal agents for the raw material and ready foodstuff preservation. The aim of this work was "*in vitro*" estimation of antifungal activity of essential oil, hydrosol and dried powdered material obtained from thyme herb.

Plants of thyme (*Thymus vulgaris* L.) 'Sloneczko' variety, were cultivated on an experimental field (near Szczecin) of Department of Horticulture. The herb was collected in the beginning of flowering and then was dried at room temperature. The powdered material was obtained from aerial-dried herb, grounded to pass through 0.5 mm sieve. The essential oil was extracted by hydrodistillation and the hydrosol was a by-product of this process. Chemical composition of the oil was determined chromatographically (GC/MS). Total phenols content was estimated in the powdered material and hydrosol. Antifungal activity of thyme derivatives was tested against *Alternaria alternata, Apergillus niger, Botrytis cinerea, Cladosporium herbarum, Fusarium oxysporum, Penicillium chrysogenum, Trichothecium roseum.* A disc diffusion method was used to evaluate the influence of oil (dose 10µl/disc) on fungi growth. A "poisoned medium" technique was used to estimate the hydrosol (dose 30%) and powdered material (dose 1.5%) effectiveness. The activity of oil was expressed as a size of inhibition growth zones of fungi (mm) and as a percentage of inhibition growth in the case of hydrosol and powdered material. Measures were made on the 3rd, 6th, 9th and 12th day of incubations. Distillated water and Topsin (thiophanate-methyl) were used as controls.

It was stated that antifungal activity of thyme depended on a kind of derivative, strain of fungi and time of incubation. The oil and powdered material inhibited the growth of all tested strains. Their effectiveness decreased when the incubation time was longer. On the last day of observations, mean diameters of fungi growth inhibition zones caused by the oil ranged from 32 to 70 mm and inhibition of fungi growth caused by the powdered material ranged from 18.5 to 94%. The oil was most effective against *T. roseum, A. alternata* and *B. cinerea*. The activity of the powdered material was highest against *B. cinerea, F. oxysporum* and *A. niger*.

Topsin was generally less effective than the oil and powdered material. Hydrosol stimulated the development of *P. cyclopium, A. niger* and *C. herbarum* and only weakly inhibited the growth of the other fungi. The effectiveness of thyme derivatives was probably connected with their chemical composition and concentration of biological active compounds. The oil content in dried herb was found to be 1.8%. Thymol was the main oil constituent (61.47%). The level of polyphenols in hydrosol and powdered material amounted 0.38 and 5.1%, respectively.

The results show a potential possibility of using the essential oil and powdered material, obtained from thyme herb, as natural antifungal agents, but further "*in vivo*" research is needed.

Weng C.J.

BENEFITS OF NUTRACEUTICALS IN FUNCTIONAL FOODS TO HUMAN HEALTH (HEPATOPROTECTION, ASTHMA AND CANCER)

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Flavonoids are natural phenolic substances widely found in fruit, vegetables, grains, and wine. Most of these compounds exert health-promoting effects seem to attribute to their antioxidant activity. Metallothioneins (MT) has been suggested to protect against acute heavy metal toxicity in the liver, and the proteins of MT can be induced by various stimuli including antioxidant. Quercetin can induce MT expression and exhibit a potential protective effect on t-BHP-caused injury in hepatocytes through the induction of MT. Diallyl sulfide (DAS) is a natural organosulfuric compound which found in garlic. Oxidative stress-aggravated chronic inflammatory diseases of the airway are well documented; hence, treatment with antioxidants to ameliorate oxidative stress might be an effective strategy to reduce airway complications. DAS inhibited histamine-induced inflammation by decreasing reactive oxygen species (ROS) levels by enhancing the nuclear factor-erythroid 2-related factor 2-related antioxidative enzyme. DAS also inhibited inflammation by suppressing interleukin-1β and TNF-α. Patients with lung adenocarcinoma are often diagnosed with metastasizing symptoms and die of early and distal metastasis. Substances carrying the ability to stop one of the metastasis-associated steps could be a potential candidate for preventing tumor cells from metastasizing and prolonging the life of cancer patients. Cinnamic acid (CA) was demonstrated to be such a candidate for human lung adenocarcinoma cells. Nevertheless, the effectiveness of CA derivatives on invasion of lung cancer cells is still unclear. Caffeic acid (CAA), chlorogenic acid (CHA), and ferulic acid (FA) can inhibit phorbol-12-myristate-13-acetate (PMA)-stimulated invasion of A549 cells. The MMP-9 activity was also suppressed by these compounds. These lines of evidence suggest that quercetin could be beneficial for the prevention of environmental oxidant-induced liver damage; DAS might be an effective dietary agent for the prevention of oxidative stress-induced inflammation of the airway; CAA, CHA, and FA are considered as potential inhibitors for invasive behaviors of human lung adenocarcinoma cells. Therefore, the consumption of functional foods with nutraceuticals is supposed to be a beneficial way to promote human health.

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Wyspiańska D., Bober A., Mizgier P., Sokół-Łętowska A., Kucharska A.Z.

QUALITATIVE ANALYSIS OF THE PREPARATION OF FLAVONOLS FROM ONION SUBJECTED TO SIMULATED DIGESTION *IN VITRO*

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Bioavailability is defined as the degree to which a nutrient is absorbed by the body. This process is higher when process of absorption occurs faster and easier. Bioavailability covers the process of digestion, absorption from the gastrointestinal tract, and metabolism. *In vitro* simulated digestion was developed to evaluate the stability of the various ingredients during the etching process, as an alternative to *in vivo* testing.

The aim of the study was qualitative analysis of the preparation from onion skins, subjected to *in vitro* simulated digestion.

In the study, we used a preparation derived from onion skins by extraction with 96% ethanol with SO_2. The preparation was digested with pepsin / HCl to simulate conditions in the stomach (2 h, 37° C) and then with a mixture of bile salts (2.5 mg / ml) and pancreatin (4 mg/ml), in order to simulate conditions in the intestine (2.5 h, 37°C). Hemodialysis membranes were used to determine the bioavailability of the compounds. Quantitative composition of flavonols was determined by LC-MS/HPLC method.

Six flavonols were identified in the dialysates after stomach and intestinal digestion (Q-7, 4'-diglucoside, Q-3 ,4-diglucoside, Q-3-glucoside, Q-4'-glucoside, Iso-4'-glucoside, and quercetin). Large losses of flavonols occurred after 2 hours of simulated gastric fluid digestion. The magnitude of these losses depends on the structure of compounds. Diglucosides had the highest stability (47-58% losses), then monoglycosides with sugar attached to C4 '(78-83% losses) and sugar attached to C3 (93% losses). Almost completely degraded (losses of 99%) was quercetin aglycone. Changes in the concentrations of flavonols during simulated intestinal fluid digestion were no longer significant. A small decrease in the concentrations of monoglycosides and a small increase in the concentrations of diglucosides was observed after 2 h in those conditions. Inside the dialysis membrane there was identified only one flavonol-Q-4'-glucoside, which was 0.6% of the initial quantity of the compound.

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Wyspiańska D., Mizgier P., Kucharska A.Z., Sokół-Łętowska A.

PHYSICAL AND CHEMICAL PROPERTIES OF YOGURT ENRICHED WITH MICROENCAPSULATED EXTRACT OF ISOFLAVONES FROM SOY

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Yogurts are an important component of the human diet, possessing nutritional properties. However, they are not important source of phenolic compounds. The addition of isoflavones to yogurt may increase their health benefits. Isoflavones have anti-oxidative, anti-angiogenic and anti-carcinogenic effects. They reduce the risk of hormone-dependent diseases and relieve symptoms associated with menopause. The addition of isoflavones to yogurt is difficult because of their beany off-flavor, bitter taste and brown color. The process of microencapsulation can be used to mask those sensory defects.

The aim of the study was to determine physical and chemical properties of yogurt enriched with microencapsulated extract of isoflavones from soybean.

In the study, we used natural yogurt commercially available, and the preparation of isoflavones derived from soybeans by extraction and purification on a column of Amberlite XAD 16 resin. Microencapsulation process was carried out by spray drying. Inulin was used as the coating material. Yogurt was prepared with different addition of microcapsules. The control sample was yogurt enriched with pure preparation of isoflavones. Color (CIEL*a*b* system) and pH were measured in the yogurts. General appearance was assessed by linear scale method. The sensory evaluation (colour, aroma, consistency) was performed using a 5-point hedonic scale. The quantitative and qualitative composition of yogurt was determined by the LC-MS/HPLC method.

Daidzein aglycone, malonylglucosides (malonyldaidzin, malonylglycitin, malonylgenistin) and glycosides (daidzin, glycitin, genistin) were identified in the yogurts. Addition of microcapsules had no effect on the acidity of the yogurts. The higher value of L^* parameter (brightness), exhibited yoghurts with the addition of microcapsules. The b^* index value was highest for the yogurts with the addition of pure preparation of isoflavones and those products were characterized by a bitter taste and beany off-flavor. Yogurt with 0.25% addition of microcapsules received highest organoleptic acceptance**.**

The process of microencapsulation can be used to improve the sensory properties of food products.

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TRENDS IN MEAT PROCESSING – ADDITIVES

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The additives have been in use since people started processing meat. Food storage was always a problem, therefore the various ways of its preservation were developed. After years of meat products manufacturing the list of additives is still extending. On the one hand, they are important for producers, because they make the technological processes easier and cheaper. On the other hand, they are enabling the consistent quality, improving safety or prolonging product's shelf-life, which is also meaningful for consumers. The current trends in consumers demands are contradictory sometimes. There is need for natural, more healthy products that do not contain preservatives, but at the same time those products are supposed to have stable quality and long shelf-life. The manufacturers of meat and related sectors (ingredients or equipment branch) work hard to stand up to those demands.

The list of ingredients that are in use at the moment is quite long. They all have various functions. There are preservatives (which in regulations are quite limited as far as meat products are concerned), antioxidants, emulsifiers, colourants, flavour enhancers etc. Some of them have been used in meat industry for many years: nitrites, phosphates or soy proteins.

What we can observe in research and industry is the appearing of products that may be divided into two groups. There are novel additives which are creating new foods, very often called "functional". They are supposed to add usually health related value to existing products. Scientists analyse the effects of bioactive substances, fibre, essential oils etc. Most of those compounds are known for their positive effect, but there is little information about how incorporating them into meat products actually works for human organism. In the other group there are substances that are supposed to replace those, which are in common use, but for various reasons are not fully accepted by consumers. The most controversial ones are probably nitrites, phosphates and sodium glutamate. The quality of products processed with those substances is recognisable and consumers are used to that known quality. To get exactly the same effect using different substances may be very hard. There is one thing those two groups have in common – natural ingredients. Using herbs, berries, plants that are popular or those which are exotic is highly acceptable. It has been proved, that the decision of purchase is dependent on the appearance, texture and taste of those products. The other aspect of adding natural substances is the fact, that consumers may accept the new products but they will be searching for traditional foods as well. This trend is very noticeable in Poland at the moment. Consumers tend to pay more for products manufactured in the traditional way.

What is the future for meat and meat products? It is definitely dependant on consumers. Their decisions of purchase will be the indicator for producers of how and what with they should produce food.

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ANTILISTERIAL ACTIVITY OF ENZYMATICALLY PREPARED CHITOSAN HYDROLYSATES

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Commercial, a low molecular weight chitosan from crab shells was dissolved in aqua lactic acid solution. The pH chitosan solution was adjusted to 5.5 by adding NaOH solution (2 M). The lysozyme was used to carry out an enzymatic process in optimum conditions of enzyme activity. Obtained hydrolysates were fractionated by methanol/water solutions (v/v) at three different concentrations 70, 80 and 90%, into two fractions, soluble and insoluble in water.

The effect of antimicrobial activities of chitosan hydrolysates and lactic acid against *Listeria monocytogenes* were investigated. *Listeria monocytogenes* is a Gram-positive bacteria, which is capable to grow at refrigerator temperatures. Microbial inoculum was deposited on the tryptose/agar medium in amount of 10^7 CFU/mL and left to dry in the flow hood at 25°C for 30 minutes. Then hydrolysates fractions (soluble and insoluble) (1 mL) were deposited on the surface of inoculated Petri dishes and distributed evenly. Plates were incubated for 24 hours at 37°C. Growth controls were incubated with both chitosan hydrolysates solutions and with 1% (v/v) lactic acids (pH=5.5).

The aim of this study was to obtain chitosan hydrolysates with higher antilisterial activity than original chitosan.

Insoluble fractions of chitosan hydrolysates completely inhibit the *L. monocytogenes* growth. A small reduction of Gram–positive bacteria by soluble fractions was noted, in comparison to growth control with lactic acid and growth control of chitosan. The main conclusion is that chitosan hydrolysates with high antimicrobial activity are possible to be produced with lysozyme aid.

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RENNET AND ACID COAGULATION OF MILK ENRICHED WITH MICELLAR CASEIN CONCENTRATE

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The aim of this work was to evaluate the use of micellar casein concentrate in cheese-making process.

Micellar casein concentrate was produced from pasterurized (71± 1°C, 16s) skim milk (200L each time). The process was carried out in microfiltration pilot plant unit equipped with ceramic membranes with nominal pore size 0.1μm. The process was continued until 3X concentration factor was achieved. Final retentate was spray dried with inlet temperature 180±10°C and outlet 85±10°C. The composition (moisture, ash, fat, protein, lactose and casein content), pH, powder bulk density were analyzed in milk and MCC samples.

The samples of micellar casein concentrate MCC (n=3), the mixture of MCC with skim milk (ratio 50:50) and skim milk were analyzed. The acid gels were produced by adding a lyophilized starter cultures (DVS) to milk at 23°C and the milk was held at this temperature for 12h. The rennet gels were obtained by adding the same amount of rennet to each sample. The gelling properties (renneting time, gel strength, water holding capacity, syneresis) of the produced gels were determined.

The fractionation of proteins in the process of microfiltration allowed the effective separation of casein micelles from serum proteins. The degree of casein concentration was 2.72. Higher concentration of micellar casein contributed to reduction of renneting time. Water holding capacity was higher for MCC as a result of lower syneresis. The average force used to destroy the gel was the highest for gels made from MCC. The gels produced with micellar casein concentrate had better hardness and firmness.

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