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**Latvia University of Agriculture
Faculty of Food Technology**

**11th Baltic Conference on
Food Science and Technology**

**“Food science and technology
in a changing world”**

FOODBALT 2017

Abstract Book

**Jelgava
April 27–28, 2017**

FOODBALT 2017

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Dear participants,

I am proud and honoured that 11th Baltic Conference on Food Science and Technology „Food Science and Technology in a changing world” (FOODBALT 2017) takes place from 27th to 28th April, 2017 in the Latvia University of Agriculture. The conference aim is to bring together leading food scientists and new researchers, as well as doctoral students from European countries to advance food science globally.

The conference plans to attract more than 110 delegates from 10 countries. The conference programme covers 4 key lectures and 36 oral presentations over 7 sessions. Additionally a total of 71 posters will be presented. The conference Organising Committee had received 42 full paper submissions from 6 countries. A peer review process was enforced with the contribution of experts and researchers from Conference Scientific Committee and Latvia University of Agriculture, all of them internationally recognized in one of the conference topic areas.

On behalf of the Organising Committee I welcome you at FOODBALT 2017 conference and hope that conference will provide a venue for scientific discussion and exchange of the information, for the development of common ideas and the initiation of international cooperation among young researchers, doctoral students and established experts in the area of Food Science.

Inga Ciprovica

The chair of the 11th Baltic conference of Food Science and Technology

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11th Baltic Conference on Food Science and Technology

“Food science and technology in a changing world”

FOODBALT 2017

Programme

April 27, 2017

9⁰⁰-10⁰⁰ **Registration and Poster installation**

10⁰⁰-10¹⁵ **OPENING** Vice-rector of studies LLU Aigars Laizans, Dean of the Faculty of Food Technology Inga Ciprovica, Professor of Kaunas University of Technology Petras Rimantas Venskutonis

Session I **Room Aula, LLU main building**

Moderators: Viktor Nedovic, University of Belgrade, Serbia

Inga Ciprovica, Latvia University of Agriculture, Latvia

10¹⁵-10⁵⁵ **KEY LECTURE** Petras Rimantas Venskutonis, *Professor of Department of Food Science and Technology, Kaunas University of Technology, Lithuania* **Berry pomace: an underutilized source of valuable bioactive compounds**

10⁵⁵-11¹⁰ **O1** – I. Urbanaviciute, R. Bobinaite, D. Urbonaviciene, P. Viskelis *Antioxidant activity, proanthocyanidins and total phenolics content of Japanese quince (Chaenomeles Japonica) by-products*

11¹⁰-11²⁵ **O2** – R. P. F. Guine, S. Seabra *Development of nutritive snacks: kiwi bars*

11²⁵-11⁴⁰ **O3** – S. Stead, I. Marcinkevics *Current developments in metabolomic profiling and REIMS for food applications*

11⁴⁰-11⁵⁵ **O4** – D. Urbonaviciene, R. Bobinaite, C. Bobinas, M. Rubinskiene, J. Viskelis, P. Viskelis *Stability and isomerisation of lycopene in oil-based model system during accelerated shelf-life storage*

11⁵⁵-12¹⁰ **O5** – L. Pricina, D. Karklina *Quality assessment of convective and microwave-vacuum drier processed garlics*

12¹⁰-13⁰⁰ **LUNCH**

Session II **Room Aula, LLU main building**

Moderators: Petras Rimantas Venskutonis, Kaunas University of Technology, Lithuania
Ruta Galoburda, Latvia University of Agriculture, Latvia

13⁰⁰-13⁴⁰ **KEY LECTURE** Jeans Dahlman, *SCIEX, Germany* **What's in your food? Accurately find and identify residues and contaminants with advances in LC-MS/MS**

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- 13⁴⁰-13⁵⁵ **O6** – **V. van Anдел** *Growth rate analysis of micro-organisms on high pressurized ham*
- 13⁵⁵-14¹⁰ **O7** – **A. J. A. Santos**, **A. P. Pereira**, **L. M. Estevinho**, **O. Anjos** *Honey characterization by FTIR-ATR spectroscopy*
- 14¹⁰-14²⁵ **O8** – **R. Bobinaite**, **G. Pataro**, **M. Visockis**, **C. Bobinas**, **G. Ferrari**, **P. Viskelis** *Potential application of pulsed electric fields to improve the recovery of bioactive compounds from sour cherries and their by-products*
- 14²⁵-14⁴⁰ **O9** – **M. Klavins**, **L. Klavina**, **A. Kukela**, **L. Klavins** *Berry press residues as a valuable source of polyphenolics: extraction optimisation and analysis*

14⁴⁰-15¹⁰ COFFEE BREAK / POSTER SESSION

Parallel Session III **Room 278, LLU main building**

Moderators: **Joerg Hampshire**, Fulda University of Applied Sciences, Germany
Sandra Muizniece-Brasava, Latvia University of Agriculture, Latvia

- 15¹⁰-15²⁵ **O10** – **L. Strauta**, **S. Muizniece-Brasava** *Influence of active packaging on the shelf life of extruded pea (*Pisum sativum* L.) based snacks*
- 15²⁵-15⁴⁰ **O11** – **M. Liepa**, **J. Zagorska**, **R. Galoburda**, **E. Straumite**, **Z. Kruma**, **M. Sabovics** *Characterisation of sensory properties in high-pressure-treated milk*
- 15⁴⁰-15⁵⁵ **O12** – **V. Sulniute**, **P. R. Venskutonis**, **A. Pukalskas**, **R. Baranauskiene** *Antioxidant activities and phytochemical composition of products isolated by high pressure extraction methods from *Salvia* spp.*
- 15⁵⁵-16¹⁰ **O13** – **P. Correia**, **S. Esteves**, **R. P. F. Guine** *Development of a fresh mushroom pasta*
- 16¹⁰-16²⁵ **O14** – **O. Anjos**, **D. Lopes**, **T. Delgado**, **S. Canas**, **I. Caldeira** *Influence of raw-material in the fruit liquor preparation*
- 16²⁵-16⁴⁰ **O15** – **R. Zarins**, **Z. Kruma** *Accumulation of glycoalkaloids in potatoes: A review*
- 16⁴⁰-16⁵⁵ **O16** – **I. Lidums**, **D. Karklina**, **A. Kirse**, **M. Sabovics** *Nutritional value, vitamins, sugars and aroma volatiles in naturally fermented and dry kvass*

Parallel Session IV **Room 293, LLU main building**

Moderators: **Ievina Sturite**, Norwegian Institute of Bioeconomy Research, Norway
Evita Straumite, Latvia University of Agriculture, Latvia

- 15¹⁰-15²⁵ **O17** – **N. Petrovska-Avramenko**, **D. Karklina**, **I. Gedrovica** *Water soluble B group vitamins in triticale and hullless barley grains*
- 15²⁵-15⁴⁰ – **E. Straumite**, **J. Zagorska**, **R. Galoburda**, **Z. Kruma**, **D. Klava**, **I. Sluka** *Innovative approach to hull-less spring cereals and triticale use from human health perspective*
- 15⁴⁰-16⁰⁰ **O18** – **I. Sturite**, **A. Kronberga**, **M. Aassveen**, **V. Strazdina**, **A. Kokare**, **V. Sterna**, **A. K. Bergjord Olsen** *Field trials with spring and winter cereals in different climate regions*

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16⁰⁰-16¹⁵ **O19** – **T. Kince**, E. Straumite, Z. Kruma, M. Sabovics, R. Galoburda, S. Senhofa, I. Cinkmanis, L. Tomson, I. Gramatina *Germinated grains performance in cereal flakes production*

16¹⁵-16³⁰ **O20** – **D. Klava**, Z. Kruma, I. Gramatina, E. Straumite, T. Kince, R. Galoburda, I. Cinkmanis, S. Senhofa, M. Sabovics, I. Murniece, J. Zagorska, L. Tomson *Quality and safety evaluation of breakfast cereals made from triticale and / or hull-less spring cereals*

16³⁰-16⁴⁵ **O21** – **L. Meija**, G. Havensone, L. Balode, A. Lejnicks *Glycemic and insulin response after consumption of different grain flakes*

16⁴⁵-17⁰⁰ **DISCUSSION**

19⁰⁰ **CONFERENCE DINNER – AULA, LLU main building**

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Session V **Room 278, LLU main building**

Moderators: **Thierry Talou**, National Polytechnic Institute of Toulouse, France
Zanda Kruma, Latvia University of Agriculture, Latvia

9⁰⁰-9⁴⁰ **KEY LECTURE M. Jansons** *Patron of Contemporary Latvian Cuisine and Board Member of Latvia's Chefs Club, Latvia, Contemporary Latvian cuisine (CLC)*

9⁴⁰-9⁵⁵ **O22** – **I. Kalnina**, E. Straumite, D. Klava, Z. Kruma, R. P. F. Guine *Latvian citizens' eating motivations*

9⁵⁵-10¹⁰ **O23** – **L. Litavniece**, I. Silicka, R. Tretjakova, I. Dembovska *The significance of local food in the consumption of modern consumer*

10¹⁰-10²⁵ **O24** – **R. P. F. Guine**, P. Correia, D. Klava, E. Straumite, V. Szucs, J. Harangozo, M. Tarcea, Z. Fazakas, I. Rumbak, I. C. Baric, D. Komes, Z. Satalic, M. M. Saric, E. Yalcin, C. Kosemeci, M. Leal, D. Jovanoska, D. Vanevski, E. Vittadini, N. Pellegrini, A. EL-Kenawy, O. EL-Shenawy *Factor and cluster analysis to knowledge about dietary fibre*

10²⁵-11⁰⁰ **COFFEE BREAK / POSTER SESSION**

Session VI **Room 278, LLU main building**

Moderators: **Raquel P. F. Guine**, CI&DET Research Centre, Polytechnic Institute of Viseu, Portugal
Martins Sabovics, Latvia University of Agriculture, Latvia

11⁰⁰-11¹⁵ **O25** – **P. M. R. Correia**, R. P. F. Guine, F. J. A. Goncalves, S. F. Oliveira *Analysis of some chemical components, phenolic compounds and antioxidant activity in physalis*

11¹⁵-11³⁰ **O26** – **D. Grauzdyte**, P. R. Venskutonis, C. El Kalamouni *Phenolic compounds and antioxidant activity of Phyllanthus phillyreifolius*

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11³⁰-11⁴⁵ **O27** – **I. Joudu**, L. Teder, K. Laikoja *Quality assessment of salted and unsalted sweet cream butter during storage at different temperatures*

11⁴⁵-12⁰⁰ **O28** – **L. Dienaite**, M. Pukalskiene, A. Pukalskas, A. A. Matias, P. R. Venskutonis *Phytochemical composition, bio and antiradical activity of various Nepeta species*

12⁰⁰-12¹⁵ **O29** – **L. Ozola**, S. Kampuse, R. Galoburda *The effect of high-pressure processing on enteral food made from fresh and semi-finished ingredients*

12¹⁵-13⁰⁰ LUNCH

Session VII **Room 278, LLU main building**

Moderators: **Erkan Yalçın**, Abant Izzet Baysal University, Turkey

Asnate Kirse, Latvia University of Agriculture, Latvia

13⁰⁰-13⁴⁰ **KEY LECTURE Nedovic Viktor**, *Department of Food Technology and Biochemistry, Faculty of Agriculture, University of Belgrade, Republic of Serbia, Encapsulation of bioactives – application in food processing*

13⁴⁰-13⁵⁵ **O30** – **A. Steponaviciene**, N. Vasiliauskiene, D. Steponavicius, E. Kurtkuvieni *Quality and food safety management systems applied to the Lithuanian food sector*

13⁵⁵-14¹⁰ **O31** – **L. Tamkute**, R. Vinauskiene, P. R. Venskutonis *Fermentation of rehydrated freeze-dried celery and parsnip juice with different starter cultures for nitrate reduction*

14¹⁰-14²⁵ **O32** – **V. Ceksteryte**, B. Kurtinaitiene, P. R. Venskutonis *Protective effects of herbal supplements on antioxidant activity of bee products*

14²⁵-14⁴⁰ **O33** – **K. Zolnere**, J. Liepins, I. Ciprovica *The impact of calcium ions on commercially available beta galactosidase*

14⁴⁰-14⁵⁵ **O34** – **L. Aumeistere**, I. Ciprovica, D. Zavadzka, K. Celmalniece *Lactose content of breast milk among lactating women in Latvia*

14⁵⁵-15¹⁰ **O35** – **T. Talou**, B. Sayed Ahmad, O. Merah, P. Evon, M. Cerny, E. Straumite, M. Sabovics, Z. Kruma, Z. Saad, A. Hijazi *Aroma-tincto-oleo-crops agrorefinery: cases of fennel, cumin and caraway seeds global valorization*

15¹⁰-15²⁵ CLOSING OF CONFERENCE

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Poster Programme April 27–28, 2017

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P2.	A. Blija, A. Kotlarovs, G. Orymbetova, I. A. Skrupskis Microbiological risk assessment in catering establishments
P3.	J. Hampshire Nutrient profiling of German breakfast cereals
P4.	I. Beitane, G. Krumina-Zemture Dietary micronutrient content of pea (<i>Pisum sativum</i> L.) and buckwheat (<i>Fagopyrum esculentum</i> M.) flours
P5.	I. Vidziunaite, G. Juodeikiene, S. Vaitunaityte, E. Bartkiene, D. Zadeike The possibilities to use air separated protein rich corn processing by-products for wheat bread production
P6.	D. Konrade, D. Klava, M. Sabovics, T. Kince, Z. Kruma Plant by-products as source of functional ingredients for production of crispbreads
P7.	A. Salevic, A. Kalusevic, S. Levic, B. Bugarski, V. Nedovic Effect of extraction conditions on antioxidant compounds from blackberry leaves
P8.	E. Puidaite, R. Gendvilas, A. Sarkinas The efficiency of ultrasound impact on decontamination of <i>Escherichia coli</i> on lettuce leaves
P9.	A. Patetko Possibilities to prevent meat product spoilage by reducing chemical compounds
P10.	A. Kirse, I. Beitane, R. Riekstina-Dolge, S. Vilums Survival of lactic acid bacteria from fermented dairy products in a gastrointestinal tract simulator
<i>Quality and safety of processed foods</i>	
P11.	F.-K. Lucke Microbiological safety of organic and conventional foods
P12.	A. Kluga, M. Kacaniova, A. Kantor, K. Kovalenko, M. Terentjeva Identification of microflora of freshwater fish caught in the Driksna river and pond in Latvia
P13.	L. Volkute, R. Zvirauskiene, R. Kazernaviciute, M. Tichonovas, A. Sipailiene Effect of ozone on <i>Listeria monocytogenes</i> in Atlantic salmon during storage
P14.	R. Jukonyte, D. Zadeike, E. Bartkiene, V. Krungleviciute, G. Juodeikiene Acidification rate, carbohydrate metabolism and enzyme active peptide production in rice bran medium by newly lactic acid bacteria

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P16.	V. Liorancas Chilled perch fillet quality improving using different essential oils
P17.	P. Zavistanaviciute, V. Krungleviciute, V. Starkute, E. Bartkiene Fermented and immobilized hemp seed products for the higher value biscuits production
P18.	E. Straumite, V. Sackis, T. Kince, D. Klava Investigation of accelerated shelf-life testing method suitability for biscuits expiry day detection
P19.	D. Klupsaite, G. Juodeikiene, D. Zadeike, E. Bartkiene, Z. Maknickiene Impact of ultrasound treatment on <i>Lupinus angustifolius</i> protein, enzyme activities and microbiological contamination
P20.	V. Starkute, E. Bartkiene, V. Bartkevics, V. Krungleviciute, P. Zavistanaviciute, G. Juodeikiene The influence of fermentation technology on the amino acids profile and antioxidant properties of lupin seeds
P21.	K. Sprogis, T. Kince, S. Muizniece-Brasava Investigation of fertilisation impact on fresh strawberries yield and quality parameters
P22.	I. Beitane, A. Blija, S. Boca, A. Aboltins, I. A. Skrupskis Research of half-finished frozen berry products
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<i>Trends in new food product and technology development</i>	
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P27.	L. Rimkiene, L. Ivanauskas, M. Marksa, V. Jakstas Development of a simple RP-HPLC-ELSD method and extraction procedure for quantification of terpene lactone in ginkgo preparations
P28.	D. Povilaitis, P. Raskauskas, P. R. Venskutonis Optimisation of supercritical carbon dioxide extraction of <i>Echinops sphaerocephalus</i> using response surface methodology

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P30.	S. Sazonova, R. Galoburda, I. Gramatina Application of high-pressure processing for safety and shelf-life quality of meat
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P32.	A. Kalusevic, S. Despotovic, S. Levic, N. Ilic, S. Zilic, V. Nedovic Black soybean coat as a source of natural pigments: extraction and encapsulation
P33.	V. Starkute, V. Krungleviciute, E. Bartkiene, V. Bartkevics, D. Zadeike, G. Juodeikiene Cereal by-products conversion to stock with high content of <i>P. acidilactici</i> by using enzymatic treatment combined with solid state and submerged fermentation
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P41.	I. Sivicka, E. Osinska, Z. Kruma, A. Adamovics Content and composition of essential oil of oregano genetic resources in Latvia
P42.	G. Dauksaite, V. Kitryte, P. R. Venskutonis Isolation of aroma compounds and antioxidants from oregano (<i>Origanum vulgare</i>) by conventional and high-pressure extractions
P43.	L. Tomsona, Z. Kruma Influence of harvest time on the phenolic content of horseradish leaves

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P46.	I. Cinkmanis, F. Dimins, V. Mikelsone Influence of lyophilization and convective type drying on antioxidant properties, total phenols and flavonoids in pollens
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P48.	B. Sayed Ahmad, E. Straumite, M. Sabovics, Z. Kruma, O. Merah, Z. Saad, A. Hijazi, T. Talou Evaluation of nutritional quality of protein bread enriched with chia (<i>Salvia hispanica</i>)
P49.	K. Juhnevica-Radenkova, V. Radenkovs, D. Seglina Effect of storage technology on structure and some physical attributes of apples (<i>Malus domestica</i> Borkh.)
P50.	V. Radenkovs, K. Juhnevica-Radenkova, D. Seglina Effect of storage technology on some chemical attributes of apples (<i>Malus domestica</i> Borkh.)
P51.	R. Riekstina-Dolge, Z. Kruma Comparison of volatile and phenolic composition of commercial and experimental ciders
P52.	K. Gaigalaite, P. Kraujalis, P. R. Venskutonis Chemical composition and stability of camelina (<i>Camelina sativa</i>) seed oil obtained by conventional and high-pressure extractions
P53.	I. Cinkmanis, A. Grava Anti-aging compounds in Latvian wild growing plant of <i>Fallopia japonica</i>
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P55.	K. Antonenko, V. Kreicbergs, I. Cinkmanis Influence of selenium, copper and zinc on phenolic compounds in rye malt
P56.	Z. Kruma, E. Straumite, D. Klava, T. Kince, R. Galoburda Effect of germination to the content of B vitamins in cereal flakes
P57.	M. Sabovics, L. Gudreniece, T. Kince, P. Semjonovs Investigation of fructans increasing possibilities in rye bread
P58.	D. Pyanov, K. Molchanova, E. Khrustalev The chemical composition of two commercial fish species - pikeperch (<i>Sander lucioperca</i>) and rainbow trout (<i>Oncorhynchus mykiss</i>) cultivated in artificial conditions

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<i>Sustainable processing and packaging</i>	
P61.	R. Riekstina-Dolge, K. Treibaha Analysis of waste management in Latvian restaurants
P62.	R. Rimkevicius, D. Cizeikiene, G. Juodeikiene, J. Damasius, E. Bartkiene Bioconversion of agro-industrial by-products to lactic acid applying by enzymatic hydrolysis and lactic acid bacteria fermentation
<i>Consumer behaviour and sensory issues</i>	
P63.	A. Eglite, D. Kunkulberga Bread choice and consumption trends
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<i>Food chain management (raw materials, logistics, economics, information systems, etc.)</i>	
P65.	A. Budriene, I. Koscelkovskiene, J. Margeliene, I. Pupeliene The survey of the economic value and meat quality indicators of beef cattle breeds Lithuania
P66.	D. Kunkulberga, A. Linina, A. Kronberga, I. Lenenkova Grain quality of rye varieties grown in Latvia
P67.	A. Linina, A. Ruza, D. Kunkulberga Cultivar, weather condition and nitrogen fertiliser impact on wholemeal rheological properties
P68.	V. Sterna, L. Vilmane, S. Zute, Z. Vicupe, I. Karkla Evaluation of oat grain pertinence to production of flakes and porridge preparing
P69.	L. Basinskiene, G. Juodeikiene, D. Vidmantiene, Z. Maknickiene Functional properties of lupine (<i>Lupinus angustifolius</i> L.) protein hydrolysates and possible use in gluten-free products
P70.	L. Tamkute, R. Vinauskiene, P. R. Venskutonis The influence of freeze-dried celery juice on the colour formation of dry-fermented sausages
P71.	T. Talou, S. Grivot VFWV wheel: an interactive model illustrating potential valorisations of vegetables & fruits wastes

ORAL PRESENTATIONS

BERRY POMACE: AN UNDERUTILISED SOURCE OF VALUABLE BIOACTIVE COMPOUNDS

Petras Rimantas Venskutonis

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Many berry species are known for their excellent flavour and abundance of bioactive compounds. The majority of berry crops are processed into juices and other products. Pressing of juice produces large quantities of pomace, which contain valuable phytochemicals – polyphenolics, carotenoids, vitamins. However, currently they are used inefficiently and in many cases wasted, mainly due to a lack of valorisation of their processing methods and products. This paper highlights the problems and the prospects in converting berry pomace into high value ingredients using conventional, high pressure, ultrasound, microwave and enzyme-assisted extraction / fractionation methods. The composition, antioxidant properties and bioactivities of the fractions obtained are also discussed. Different analysis methods were for these purposes, including various chromatographic and spectroscopic techniques, as well as the *in vitro* assays of antioxidant properties and other bioactivities.

The fractions isolated from berry pomace may find applications in functional foods and nutraceuticals. Firstly, lipophilic fractions consisting mainly of triacylglycerols may be extracted with supercritical carbon dioxide. At optimal conditions the yields of oily extracts are from 3 to 20%. These extracts usually are rich in polyunsaturated fatty acids, tocopherols, and carotenoids. Higher polarity fractions may yield in total up to 50–70% of the initial materials. These fractions contain various phytochemicals; most of them are strong antioxidants. Consequently, the concept of biorefining may be successfully applied to berry pomaces for the development of high added value functional ingredients; technological and economical aspects of upscaling the processes should be in the focus of future research.

Keywords: berry pomace, biorefining, polyphenolics, antioxidants, pressurised extraction

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WHAT'S IN YOUR FOOD? ACCURATELY FIND AND IDENTIFY RESIDUES AND CONTAMINANTS WITH ADVANCES IN LC-MS/MS

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Food testing can be a challenging and complex job. From sample preparation (so many different matrices!) to residue detection (so many different compounds from pesticides and mycotoxins, and not to mention the mysterious unknowns!), going from the raw sample to the final result of “What is in this food sample?” is no trivial task.

Luckily, a number of analytical tools and workflows are available to ease the pain and help you to answer the question above, quickly and efficiently, but also with the confidence that you arrived at the right result, every time.

In this presentation, we will describe new LC-MS / MS technology and software tools that will make your food testing workflows more routine than ever. We will highlight new High Resolution LC-MS / MS instrumentation that can allow you to screen large samples sets for hundreds of contaminants and residues, whilst reducing the risk of reporting a positive results and lowering the likelihood of missing a result (fewer false positives). We will also show new routines for bringing together both quantitation and identification data into a single, intuitive to use platform, for streamlined data interrogation, and touch upon novel ways to reduce troublesome matrix interferences.

Tables, figures, photographs and references should not be included in the abstract.

Keywords: LC-MS / MS, food testing, contaminants

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ENCAPSULATION OF BIOACTIVES AND CELLS- APPLICATION IN FOOD PRODUCT DESIGN AND FOOD PROCESSING

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This paper presents a review of different encapsulation technologies and trends in their application in food production. Encapsulation technologies have been used to protect the bioactives during processing, storage, and transport and to improve their thermal / chemical stability and delivery at targeted place into the human body.

Bioactives, usually sensitive, volatile, and very reactive components like vitamins, flavours, pigments, phenolic compounds, oils, minerals, enzymes, cells, etc., can be stabilized by encapsulation. In the food industry most of encapsulates are produced by spray drying, but also by freeze-drying, spray-chilling, emulsification, melt extrusion and injection. Some of less exploited techniques are molecular inclusion and electrospinning, since these are more expensive technologies. Carrier materials used for protection of bioactives have to be biodegradable, food-grade, and able to form a barrier between the bioactives and its environment. Alginate, pectin, gum Arabic, guar gum, starches, maltodextrins, milk proteins are some of commonly used materials with desirable properties for carriers.

In addition to that, these technologies may be used to immobilize cells or enzymes into the proper carrier material for the purpose of food processing (alcoholic fermentation, malo-lactic fermentation, metabolite production and so on). In this regard, the demand is to provide high productivity and at the same time adequate quality of the final food products.

This paper provides a short overview of commonly used processes to encapsulate bioactives and to immobilize yeast or probiotic cells for the food industry applications.

Keywords: encapsulation, immobilization, carrier material, bioactives, cells

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CONTEMPORARY LATVIAN CUISINE

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We Latvian chefs are proud to be among those few who continuously develop Contemporary Latvian Cuisine. Latvian cooking art has gone a long and bumpy way. At the modern restaurants and other public catering places we can still see the influence of either wealthy German food traditions, or unified thermal food processing, which was typical for Soviet period. As we know, in the entire world there always are some fashion products that influence content and quality of menu; and Latvia of course is not the exception. All these factors have influenced the development of cooking art in our country. Nowadays gastronomic tourism has become popular worldwide, and for such a small country as Latvia, it is important to be individual and to keep and develop its identity. Nobody will be interested to eat tuna in Latvia. But we have many things to offer, as we have unique ingredients on hand. Rye bread is the basis of many foods; our bees are collecting the best honey in world, Heston Blumenthal once said that the cleanest taste of lamprey is here in Carnikava, Latvia. And if Olympic summer games would ever be held here in Latvia, there would be a new discipline – wild mushroom and berry picking contest.

Keywords: You are what you eat

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**ANTIOXIDANT ACTIVITY, PROANTHOCYANIDINS AND
TOTAL PHENOLICS CONTENT OF JAPANESE QUINCE
(*CHAENOMELES JAPONICA*) BY-PRODUCTS**

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Quince by-products left after fruit processing are highly suitable for further product development while minimizing waste treatment and disposal costs and possibly generating additional income streams by finding secondary markets for food processing waste. Furthermore, processes to treat waste and put it back into productive use have a role to play in delivering a more circular economy. Peeled or unpeeled fresh quince fruits were processed into juice. Pomace left after the juice pressing was dried, ground and extracted with methanol. The antioxidant activity of the samples was tested using the DPPH free radical scavenging assay. The concentrations of total phenolic compounds were measured spectrophotometrically using the Folin-Ciocalteu phenol reagent and expressed as gallic acid equivalents and proanthocyanidin contents were expressed as (+)-catechin equivalents. The quince pomace constituted from 32 to 51% of fresh fruit weight. The total phenolics content in pomace was 22.9 and 25.9 mg g⁻¹ dry weight (DW) for peeled and unpeeled fruits, respectively. Proanthocyanidin content in pomace obtained from peeled and unpeeled quince was 5.23 and 9.62 mg g⁻¹ DW, respectively. Antioxidant activity of dried pomace was found to be more than four times higher than in quince juice. The results of this study show that quince pomace is a rich source of phenolic antioxidants which could be used for new value-added products development.

Keywords: quince, pomace, antioxidant activity, phenolics, condensed tannins

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DEVELOPMENT OF NUTRITIVE SNAKS: KIWI BARS

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Presently there is an increasing concern about not wasting any type of product with potential commercial utility, like food waste. Thus, this work was undertaken in collaboration with a company in order to find a nutritionally interesting form of valorisation of kiwi waste, namely the pulp from fruits not compliant with commercial standards (like size or shape).

Based on the proposed aims, kiwi based snacks (bars) were developed from kiwi pulp with the addition of gelling agents and some other ingredients. The product development was an intensive task, with multiple experiments until the desired characteristics could be achieved. Because the company intends to commercialize the bars it was also necessary to make a sensory evaluation, to assess the opinion about the developed product(s). Two final products were obtained: a simple kiwi bar and a bar with nuts and oat.

Based on the results obtained it was possible to conclude that, at the nutritional level, the bars revealed low values of energy, moisture or carbohydrates, which is positive because nowadays foods with low caloric density and little sugar are valued. Moreover the values of fibre and minerals were high, thus bringing added nutritional advantages.

Through sensory evaluation it was possible to understand that the simple kiwi bar was that preferred by the panellists. Colour evaluation showed that the simple kiwi bar had more intense yellow and green colourations as compared to the other bar. Also textural results showed that the simple kiwi bar was softer inside but with a hard surface.

Keywords: chemical properties, nutritional properties, physical properties, sensory analysis

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REVIEW: CURRENT DEVELOPMENTS IN METABOLOMIC PROFILING AND REIMS FOR FOOD APPLICATIONS

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Metabolomics allows us to obtain a unique chemical fingerprint while measuring the metabolite content of a sample. Due to the extensive data obtained during the analysis, metabolomics have established a firm place in human health, food component, food quality and other challenging fields of research.

The aim of this review is to use literature data to discuss application of chemical profiling in food authenticity, identification of plant species, populations and phenotypic traits. As the global concerns for grass weed species developing herbicide resistance are growing, the group of the University of Newcastle has developed a rapid phenotyping methodology for selective herbicide treatment of weeds. On the other hand, similar experiments have effectively been used for culinary herb identification, allowing to clearly distinguish 4 herbs of *Lamiaceae* family.

Further experiments in field of food fraud, have proved methodology effective on example of honey authenticity and fish fraud studies.

In mentioned above research the method of choice was Rapid Evaporative Ionisation Mass Spectrometry (REIMS), which allows fast characterisation of the material without extensive sample preparation.

Keywords: REIMS, culinary herbs, phytochemistry, metabolomics, profiling

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STABILITY AND ISOMERISATION OF LYCOPENE IN OIL-BASED MODEL SYSTEM DURING ACCELERATED SHELF-LIFE STORAGE

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Consumers increasingly demand products with high quality (taste, appearance, texture, flavor) whilst keeping their nutritional value. For this purpose, determining properties of food products during their shelf-life is very important for the research and the food industry. Shelf-life prediction of a product could be assessed by measuring quality attributes through accelerated shelf-life testing (ASLT) under extreme conditions. The ASLT could be beneficial to specify the effects of different storage temperatures on quality properties of food products in some cases where the environmental conditions exceed the limits. The objective of this study was to evaluate the effect of temperature and light on lycopene stability in oil-based food model system after 100 days of storage.

Samples were tested at 1 ± 1 °C in absence of light, ambient temperature at 20 ± 1 °C in natural light, ambient temperature at 20 ± 1 °C in absence of light, temperature at 37 ± 1 °C in absence of light and temperature at 37 ± 1 °C in UV irradiation. Lycopene and its *cis*-isomers in oil-based model system and control were determined by high performance liquid chromatography (HPLC / DAD). The colour measurements of the samples were made using MiniScan XE Plus spectrophotometer.

The addition of tomato extracts to vegetable oil might increase the level of lycopene in a human diet and enhance its bioavailability. The optimum storage conditions for lycopene-enriched oil were at 20 °C in the dark. The temperature has a greater influence on lycopene isomerisation (17% change from *trans*- to *cis*-isoforms) than light irradiation.

Keywords: lycopene, stability, isomerisation, accelerated shelf-life testing

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QUALITY ASSESSMENT OF CONVECTIVE AND MICROWAVE-VACUUM DRIER PROCESSED GARLICS

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Garlic (*Allium sativum* L.) contains various phytochemicals, for example, phenolics, and organic acids, sulphuric compounds with antioxidant and antimicrobial properties. Using thermal processes these compounds differently changes and precisely how much of total amount are degraded or increased are not well researched. Therefore, the aim of the research was to analyse steam-blanching at 95 ± 3 °C for 1.5 and 3.0 min, convective drying and microwave-vacuum (MV) drying processing effect on garlics phytochemicals (carotenoids, sugars, total phenolics – phenols, flavonoids, flavonols, flavan-3-ols, phenolic acids, antiradical activity, individual phenolics and organic acids) and colour changes. Using previous parameters integrated evaluation for garlics was performed to maintain their nutritional and biological value (evaluated the best drying technique). Fructose, glucose and maltose of dried garlics increased but were detected in lower concentrations than sucrose compared with fresh sample. Total carotenoids were detected in lowest concentrations and with thermal process minimally changed, but drying gave significant decrease. Main organic acids detected at highest concentrations were oxalic, tartaric, quinic and malonic acids. Significant decrease of ascorbic acid was observed in convective dried garlics, but lowest – using MV drying. Garlics contain average amount of phenolics and from subgroups, the highest concentrations was in flavonoids, which changes depending on processing type. Similar tendency was with antiradical activity, which increases in drying processes. Garlics are great source of various phytochemicals and processing affects total amount differently. Decreases of initial amount should be explained by oxidation processes and thermal degradation of corresponding compounds. From results it can be concluded that the best drying method for maintaining biological compounds is MV drying, where oxidation processes are limited. Research has been supported by AgroBioRes (2014–2017).

Keywords: garlic, phytochemicals, drying, integrated evaluation

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GROWTH RATE ANALYSIS OF MICRO-ORGANISMS ON HIGH PRESSURIZED HAM

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The aim of this research was to evaluate the effectiveness of high pressure processing (HPP) of ham on the reduction of microorganisms. For this, (unidentified) bacteria were isolated from naturally spoiled ham. A sample of naturally spoiled ham has been scraped off the spoiled ham and has been streaked on six different blood agar types. This technique is known as the streak plating method. The bacteria obtained from streak plating were quantified by total plate counting. Also, the bacteria obtained from streak plating have been applied to the ham samples that were then ready for high pressure processing.

Two different hams, one with 2.29% potassium lactate and without potassium lactate, were processed under two different high pressure conditions of 400 MPa for 10 and 20 minutes, respectively. The results were compared with unpressurized ham products. The microbiological assessment was evaluated by total plate counting on nutrient agar after 48 hours at 30 °C. The counting was executed six times over 39 days, (day 4, day 7, day 11, day 18, day 25 and day 39, respectively). The microorganisms were considerably reduced using HPP with respect to the unpressurized ham products. The pressurized ham products showed a decrease of up to $^{10}\log 3$ microorganisms compared to the unpressurized samples. However, during storage, the microbial count of samples came closer to each other. After 39 days, this difference in microbiological counting was reduced to a $^{10}\log 2$ difference. It was concluded that the application of HPP at 400 MPa for 20 minutes showed higher reduction of microorganisms.

Keywords: HPP, ham processing

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HONEY CHARACTERIZATION BY FTIR-ATR SPECTROSCOPY

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Infrared spectroscopy (IR) measures the wavelength and intensity of the absorption of infrared light (vibrations) of the different compounds available in a sample. A sample may have different functional groups that produce a unique spectrum that may be considered a “finger print” and can be used to confirm the identity, origin or adulteration of that specific sample.

The Fourier transform technique in IR (FTIR) is a technique that does not require sample preparation, is quick and allows running multiple tests with a single portion of a sample. Due to those advantages, its use for food analysis is increasing.

The aim of this work was to discuss the performance of FTIR with an ATR (Attenuated Total Reflectance) crystal for the multivariate characterization of honey's chemical composition. In the first approach, some chemical parameters of 150 honey samples were determined according to the regulatory standards of the International Honey Commission. The calibration model was obtained by Partial Least Squares regression (PLS) in comparison to the results obtained using the reference methods. The models presented a R^2 ranging between 96.7% and 81.8%, with a RPD between 5.5 and 2.4 and a low root means square error of cross-validation and prediction.

The precision achieved suggests the potential applicability of the infrared spectroscopy in food products, particularly for quality control of honey samples.

Keywords: FTIR-ATR, PLS-R, honey, physicochemical characterization

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POTENTIAL APPLICATION OF PULSED ELECTRIC FIELDS TO IMPROVE THE RECOVERY OF BIOACTIVE COMPOUNDS FROM SOUR CHERRIES AND THEIR BY-PRODUCTS

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Pulsed electric fields (PEF) treatment induces transmembrane potential by means of an externally applied electric field of sufficient intensity which causes an increase in the permeability of a cell membrane. PEF can be applied for plant cell disruption as upstream step to enhance mass transfer in further processing such as hydraulic pressing or extraction. The objective of the study was to evaluate the potential of using PEF technology for the increase of the juice yield and bioactive compounds extraction from sour cherries (*Prunus cerasus* L.) and their by-products.

PEF treatments (1–5 kV cm⁻¹ at 10 kJ kg⁻¹) were applied to cut, de-stoned cherries before the juice pressing. By-products generated after juice pressing were extracted with aqueous methanol. The samples from PEF pre-treated cherries and their by-products were compared to both untreated (control) samples and with samples obtained from freeze-thawed (PEF untreated) cherries. The highest increase in juice yield by 45% was obtained at PEF intensity of E=3 kV cm⁻¹, showing similar results to freeze-thawed sample (41%). The application of PEF significantly increased the release of total anthocyanins (from 48.3 to 53.3 mg 100 mL⁻¹) and total phenolics (from 126.6 to 133.9 mg 100 mL⁻¹) into juice as compared with the control (33.8 and 112.9 mg 100 mL⁻¹, respectively), whereas juice from freeze-thawed sample exhibited the highest value only for total phenolics content (164.4 mg 100 mL⁻¹). The extracts from by-products obtained after PEF assisted juice pressing showed significantly higher contents of bioactive compounds and higher antioxidant power as compared with the control extract and the extract of freeze-thawed sample. The results demonstrate promising use of PEF technology in sour cherry processing.

Keywords: PEF, extraction, juice pressing, by-products, phenolics

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BERRY PRESS RESIDUES AS A VALUABLE SOURCE OF POLYPHENOLICS: EXTRACTION OPTIMISATION AND ANALYSIS

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Wild and cultivated berries from forests and bogs of Northern Europe are an excellent source of natural antioxidants, vitamins and fatty acids, all of which are substances with high biological activity. One of ways of berry processing includes production of berry juices leaving as a waste berry press residues. The aim of this study was to consider possibilities to use berry press residues as a source of polyphenolics, to optimise their extraction conditions and characterise the obtained extracts. The following berries were analysed: blueberry (*Vaccinium myrtillus* L.), bilberry (*Vaccinium uliginosum* L.), two cultivars of highbush blueberry (*Vaccinium corymbosum* L.), lingonberry (*Vaccinium vitis-idaea* L.), black crowberry (*Empetrum nigrum* L.) and cranberry (*Vaccinium oxycoccos* L.). Yield of biologically active substances in extracts influence the polarity of extrahents and procedure of extraction: extraction method (treatment with ultrasound, conventional, Soxlet extraction, treatment with microwaves, and extraction with supercritical CO₂), solid-liquid ratio and others. Using surface response method optimisation of the extraction conditions was done, resulting in high yields of the polyphenolics. The composition of the obtained extracts was characterised using UPLC as well as HPLC-MS. In the obtained extracts main classes of polyphenolics were identified. The analysed berry polyphenolic profiles were compared using the principal component analysis and hierarchical cluster analysis. The two analyses showed that the polyphenolic profiles of the studied berries reflect their taxonomy.

Keywords: *Vaccinium* berries, press residues, polyphenols, flavonoids, extraction optimisation

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INFLUENCE OF ACTIVE PACKAGING ON THE SHELF LIFE OF EXTRUDED PEA (*PISUM SATIVUM* L.) BASED SNACKS

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New products should be manufactured to increase the presence of peas in human diet. In order to make the grey pea easier for people to consume, extrusion cooking was used. The aim of this research was to determinate best packaging material and technology for extruded grey pea products.

The research was carried out at the Faculty of Food Technology of the Latvia University of Agriculture (LLU). Peas of variety 'Bruno' were obtained from Institute of Agricultural Resources and Economics. In extrusion process different recipes were used (without and with additives). Extruded peas (*Pisum sativum* L.) snacks with salty (Grill Roll spice and fried, grinded onion spice) and sweet tastes (almond flour and chocolate powder), were used for experiments. Snacks without tastes were used as a control. For shelf life extension an active packaging was investigated. Following packaging two laminate materials were used: OPP / CPP and PET / ALU / PA / PE. Extruded snacks samples of 50 ± 5 g were packaged in pouches (220×100 mm) and an iron based oxygen scavenger sachets of 50 cc obtained from Packaging Solutions OÜ was added. Pouches were hermetically sealed by MULTIVAC C300 chamber machine, stored at the room temperature of $+20 \pm 0.5$ °C up to 24 months and analysed before packaging and in the 6th, 12th, 18th, and 24th month of storage. Physical properties as moisture content, hardness and colour were evaluated.

The obtained results show that by selecting active packaging can significantly extend extruded snacks storage time from 12 months without oxygen scavengers till 24 months with oxygen scavengers.

Keywords: peas (*Pisum sativum* L.), extrusion, active packaging

Acknowledgement. The research has been prepared within the 7th Research Framework Programme of the European Union Project "EUROLEGUME", Contract No. 6134781.

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CHARACTERISATION OF SENSORY PROPERTIES IN HIGH-PRESSURE-TREATED MILK

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The acceptance and preference of milk and dairy products by consumers is determined by the products sensory characteristics. High pressure processing can be applied as an alternative to thermal technologies to provide sensory quality remain unaffected.

The effect of high pressure processing on sensory properties of cow`s milk was studied during current research. Cow`s milk was treated at 400 MPa at 30 °C inlet temperature and compared with untreated sample and pasteurized milk (78 °C, 15–20 s). Sensory evaluation of milk samples was carried out in two different groups – respondents (during the Baltics food industry fair `Riga Food 2016`) and trained panellists (finished basic course of sensory evaluation). Both groups evaluated samples using a five point hedonic scale.

The hedonic evaluation of milk samples sensory properties liking showed that there were no significant differences ($p>0.05$) in aroma, but there were significant differences in the liking of milk samples colour, taste and aftertaste ($p<0.05$).

Keywords: milk, high pressure, sensory properties

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ANTIOXIDANT ACTIVITIES AND PHYTOCHEMICAL COMPOSITION OF PRODUCTS ISOLATED BY HIGH PRESSURE EXTRACTION METHODS FROM *SALVIA* SPP.

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The genus *Salvia* (sage) is one of the largest and the most important *Lamiaceae* family genera of medicinal and aromatic plants, which is widespread throughout the world. *S. officinalis* and *S. sclarea* are the most thoroughly studied *Salvia* species, whereas the information about phytochemicals in many other *Salvia* species are rather scarce. The aim of this study was comprehensive evaluation of antioxidant potential and phytochemical composition of products isolated by high pressure extraction methods. Supercritical carbon dioxide extraction (SFE-CO₂), pressurized liquid extraction (PLE) with various polarity solvents were used for separating sage herb into several soluble fractions. Total content of phenolic compounds (TPC) was analysed by UV-spectrophotometry method using Folin-Ciocalteu reagent. The antioxidant activity of extracts was evaluated using ABTS⁺ scavenging and ORAC assays. Individual polyphenolic constituents were analysed by UPLC-Q/TOF-MS. SFE-CO₂ of *Salvia* spp. yielded from 1.84±0.03% (*S. stepposa*) to 5.22±0.2% (*S. sclarea*) of lipophilic fraction. Further PLE of SFE-CO₂ residues was performed consecutively using ethanol (96%) and water. The highest yields were obtained with water (30.2±0.18–43.7±0.14%). TPC and antioxidant properties of the analysed *Salvia* spp. extracts were largely dependent on the extraction solvent. Ethanol extracts possessed significantly higher antioxidant capacity and TPC comparing to the extracts isolated with other solvents. Results also show that rosmarinic acid was a major quantitatively compound in the analysed *Salvia* spp. extracts. In conclusion, the results obtained may serve as valuable information for the valorisation of *Salvia* herbs as raw materials for the isolation of functional ingredients for human nutrition and other purposes.

Keywords: antioxidant capacity, high pressure extraction, polyphenols, *Salvia* spp.

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DEVELOPMENT OF A FRESH MUSHROOM PASTA

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Fresh pastas with Shiitake mushroom flour (MF) were produced. The MF was produced by drying the mushrooms at 40, 50, and 60 °C. Proportions of 5%, 10%, and 15% MF were used to prepare the fresh pastas (FP), with two types of wheat flour (regular (RWF) and 30% semolina wheat flour (SWF)). Mushroom pastas were analysed before (FP) and after cooking (CP).

FP presented moisture and water acidity lower than 35% and 0.95, respectively. The L* and b* colour parameters were similar for pasta produced with RWF and SWF, with the major differences for pastas with mushroom flours obtained at 40 °C and with the increasing of MF. Thus, with increasing of MF and high drying temperatures, pastas were redder, darker and less yellow. The CP showed high colour similarities between them.

Generally, the introduction of MF changes the texture of pastas. Internal and external firmness, and adhesiveness, decreased with increasing MF and for higher drying temperatures. CP presented similar tendencies, with low firmness, high adhesiveness and high stickiness.

The soluble solids were determined in CP cooking water, and range between 5.8 and 9.0%, without a consistent pattern, allowing classifying the pastas as high and medium quality.

Sensorial analysis revealed that consumers preferred pastas produced with high content of MF with similar profiles for all the parameters tested, and the influence of the type of wheat flour was not important.

It could be concluded that MP could be used to produce alternative foods, innovative and easy to cook.

Keywords: shiitake, flour, noodle, physicochemical properties, sensory analysis

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INFLUENCE OF RAW-MATERIAL IN THE FRUIT LIQUOR PREPARATION

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Fruit liqueur is an alcoholic beverage obtained by mixing alcohol, sugar and fruits. The final quality of this beverage depends on the appropriate combination of its components. According to the legislation (EC Regulation No. 110/2008), this type of product must contain a minimum alcoholic strength by volume of 15% and a minimum sugar content of 70 to 100 g dm⁻³, variable with the type of fruit.

In this work the influence of distillate types (grape marc spirit or wine spirit), sweetener (sugar or honey) and fruit quantity were studied for blueberry liquor preparation.

To evaluate the characteristics of different produced beverages, alcoholic strength, dry matter, total acidity, fixed acidity, volatile acidity, pH, chromatic characteristics, methanol, acetaldehyde, fusel alcohols and ethyl acetate concentration were determined.

According to the factorial ANOVA results, three studied factors significantly influenced the physicochemical composition of the liqueurs, and the quantity of fruit was the most discriminating factor, except the CIELAB colour and reducing sugar. The kind of distillate used in the different produced beverages influenced significantly the volatile composition of the final product.

Keywords: liquor, distillate, sweetener, fruit quantity, physicochemical characterization

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ACCUMULATION OF GLYCOALKALOIDS IN POTATOES: A REVIEW**Reinis Zarins, Zanda Kruma**

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Potatoes are one of the most consumed and nutritionally important vegetables in the world that is why its quality and safety is very important. Potential risk factor for potato consumers are toxins called glycoalkaloids which naturally accumulates in potatoes during grows and storage. World Health Organization has stated maximum allowable glycoalkaloid concentration into fresh potato tubers as 200 mg kg⁻¹. Exceeded concentration might affect health of consumers inciting them, for example, digestive troubles and nerve system damage.

Objective of the review is to outline glycoalkaloid classification, factors affecting accumulation process and glycoalkaloid analytical methods. Findings of the research will provide overview of glycoalkaloid dynamics determining how the glycoalkaloid levels are changing in different temperatures, light intensity, relative humidity and technological processes.

Different investigations show that most significant glycoalkaloid concentration rise happens during potato tuber exposure to sunlight. During few hours under sunlight glycoalkaloid concentration exceeds maximum allowable limit. Also, prolong potato storage under bright room light, for example, in shop counters, rises glycoalkaloid concentration. Peeling significantly reduces glycoalkaloid concentration due to their presence mainly in peels. Also, boiling of potatoes in water reduces glycoalkaloid levels, but nor frying nor pulsed electric field and high pressure treatment do not affect glycoalkaloid concentration in tubers.

Keywords: glycoalkaloid, potatoes, accumulation

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NUTRITIONAL VALUE, VITAMINS, SUGARS AND AROMA VOLATILES IN NATURALLY FERMENTED AND DRY KVASS

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Naturally fermented rye bread kvass is a seasonal product with a pronounced rye bread flavour having the highest demand during hot summer days. However, non-pasteurised and non-filtered kvass has a very short shelf-life. There are numerous benefits of drying to extend kvass shelf-life, however it can have a significant influence on the product composition and quality.

The aim of this research was to assess and compare nutritional value, vitamins, sugars and aroma volatiles in naturally fermented and spray dried kvass. Naturally fermented non-pasteurised, non-filtered bread kvass was used to produce dry kvass at Institute of Process Engineering and Equipment, The University of Warmia and Mazury in Olsztyn, Poland. Maltodextrin was used in 25% quantity to kvass dry matter in order to aid the spray drying process. Nutritional value of liquid (7% solids) and dry kvass (powder, 93% solids) samples was determined according to EU Regulation 1169/2011, B group vitamins – according to AOAC 986.27 (B₁), AOAC 970.65 (B₂) and AOAC 961.14 (B₃). Content of sugars was determined using high performance liquid chromatography, whereas aroma volatiles were assessed using solid phase microextraction in combination with gas chromatography/mass spectrometry. Dry kvass had a higher energy value than naturally fermented kvass. Drying process had a significant influence on the content of B group vitamins in kvass; the highest decrease was observed for niacin (B₃). Kvass contained fructose, glycose and maltose. 26 different volatile compounds were detected in liquid and dry kvass, total values of peak areas were significantly lower in dry kvass ($p < 0.05$).

Keywords: kvass, spray drying, energy value, volatile compounds

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WATER SOLUBLE B GROUP VITAMINS IN TRITICALE AND HULLESS BARLEY GRAINS

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Whole cereal grains contain nutritionally significant quantities of vitamins that are important for health. The aim of this study was to assess the amount of vitamins B group in mature and immature triticale and hull-less barley. All grains were obtained from the experimental farm of Latvia University of Agriculture in immature and mature conditions in 2016. The vitamins were determined by AOAC official methods. The highest content of vitamin B₁ (thiamine) was found in mature triticale (0.52 ± 0.01 mg 100 g⁻¹). The amount of vitamin B₂ (riboflavin) was higher in immature triticale (0.40 ± 0.01 mg 100 g⁻¹) compared with other grains mature or immature conditions. Vitamin B₃ (niacin) amount was higher in immature hull-less barley (7.11 ± 0.01 mg 100 g⁻¹). According to the results of the study can be seen that the immature grains can be used to enrich foods with water-soluble B group vitamins. Immature triticale grains are great source of vitamins B₂ and B₃. The mature triticale and hull-less barley and immature hull-less barley, accordingly was using for production of functional foods and increasing nutrition value.

Keywords: Immature grains, mature grains, thiamine, riboflavin, niacin

Acknowledgement. Research has been supported by the National research programme "Agricultural Resources for Sustainable Production of Qualitative and Healthy Foods in Latvia" (AgroBioRes) (2014–2017).

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FIELD TRIALS WITH HULL-LESS AND HULLED BARLEY VARIETIES IN DIFFERENT CLIMATE REGIONS

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In recent years, hull-less barley (*Hordeum vulgare* L.) varieties have been included in food production in Europe due to their diverse health benefits. In Latvia and Norway, new hull-less varieties have been developed as interest to grow hull-less genotypes has increased. The main objective of this study was to evaluate hull-less and hulled barley yield, yield stability and grain quality grown under different climatic and management conditions. Latvian and Norwegian hull-less and hulled barley varieties were tested in field experiments at Priekuli (57.32°N) and in Stende (57.10°N) in Latvia and at Apelsvoll (60,7°N) and at Kvithamar (63,5°N) in Norway. On average across environments grain yield of hull-less barley varieties was significantly lower than for hulled barley varieties. Use of regression analysis indicated that particular hull-less varieties might have good yield stability across environments and might adapt well in conventional and organic cropping systems. The grains of hull-less barley varieties contained more protein and beta-glucans than the grains of hulled barley varieties in the most of studied environments. Particularly, hull-less barley variety cv Kornelija (originated in Latvia) showed large capacity to store nitrogen in grains. This resulted in high grain protein content particularly under conventional growth conditions. However, genotype × environment interaction affected cv Kornelija significantly. This study confirmed that both Latvian and Norwegian varieties might be successfully grown across environments. Moreover, the field trials in different climate regions might help us to recognize cultivars for future climate. The research leading to these results has received funding from NFI/R/2014/011.

Keywords: hull-less barley, quality, stability, yield

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GERMINATED GRAINS PERFORMANCE IN CEREAL FLAKES PRODUCTION

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The research leading to these results has received funding from NFI/R/2014/011. The aim of the current research was to investigate the effect of germination on chemical composition of the selected grains and their suitability for production of breakfast cereals. Triticale (cv Inarta), hull-less barley (cv Irbe), hull-less oat (cv Lizete), rye (cv Kaupo), and wheat (cv Ellvis) grains were used in the experiments. Grains were cleaned, washed and steeped in water. After steeping, grains were allowed to germinate for 12, 24, 36, and 48 hours at 17, 25 and 35 ± 2 °C; relative humidity $95\pm 2\%$. During present research the quality parameters were analysed: content of starch, protein, resistant starch, β -glucan, individual sugars, total phenolic compounds and radical scavenging activity. Non-significant protein content increase was observed in the analysed cereals during their germination for 48 hours. Starch content in hull-less barley, wheat and rye grains decreased non-significantly during germination for 24 h. In the present research non-significant changes ($p>0.05$) were obtained in fructose content of analysed cereal grains during germination for 48 h. During germination process total phenolic content and antiradical activity increased in all studied cereal grains. The most significant changes were observed in grains during their germination at 25 and 35 °C. During the germination phenolic compounds posing antioxidant activity are synthesised resulting in cereals with improved nutraceutical properties. Thus grain germination improved nutritional value of products, suggesting potential use in new product development. In the current study germinated grains were flaked and dried for further use in breakfast cereals.

Keywords: cereals, germination, flakes, nutritive value

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QUALITY AND SAFETY EVALUATION OF BREAKFAST CEREALS MADE FROM TRITICALE AND/OR HULL-LESS SPRING CEREALS

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Breakfast cereals are frequently made from mixtures of one or several grain components with other ingredients. Germination is actually scientific theme for increasing nutritional value of cereals products – the content of vitamins B2, E and niacin, total sugar, dietary fibre and glucosamine increase; vitamin C is synthesized, and the content of irreplaceable amino acids is increased during the process of protein hydrolysis. The aim of research is to evaluate quality and safety of breakfast cereals made from triticale and / or hull-less spring cereals during the product storage time.

Three types of breakfast cereals (blend of various cereal flakes) were developed: S1 – source of B₁ and B₃ vitamins (germinated cereals – 40%); S2 – source of proteins (germinated cereals – 30%); S3 – high fibre (germinated cereals – 50%). Two types of Stand up pouches (Pap50g / Alu7 / Pe60 and Pap40g / PELD20 / PE40) were used in the study. For the accelerated shelf life test the samples were stored for 6 months (at 35±2 °C and relative humidity – 65±3%). All developed samples are high in fibre and thiamine (vitamin B₁). Additionally S2 is a source of protein, riboflavin (vitamin B₂) and niacin (vitamin B₃); S3 – is a source of riboflavin (vitamin B₂) and high in niacin (vitamin B₃). Storage and selected packaging material influenced stability of nutrients, except proteins. During storage fat content and TPC reduced, whereas antioxidant activity increased. The best quality of dried breakfast cereals flakes in terms of sensory properties, microbiological stability, moisture migration, and water absorption could be achieved by the Fibrecote® HB MG 40/60 pouches.

Keywords: breakfast cereals, quality, safety, nutrition value

Acknowledgment. The research leading to these results has received funding from the Norwegian Financial Mechanism 2009–2014 under Project Innovative approach to hull-less spring cereals and triticale use from human health perspective (NFI/R/2014/011).

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GLYCEMIC AND INSULIN RESPONSE AFTER CONSUMPTION OF DIFFERENT GRAIN FLAKES

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There is a lot of evidence that whole grain foods could be protective in prevention of metabolic diseases. The protective mechanisms may be related to bioactive substances including fibre and antioxidants. Germination of grains increase concentration of antioxidants but little data are available about their effect of germinated grain flakes and so called non-traditional flakes like hulless barley, hulless oat on glycaemia and insulinemia. The aim of study was to investigate glycaemic and insulin response after consuming flakes made from different germinated and ungerminated wholegrains.

Participants received equivalent carbohydrate amounts of test food: different kind of germinated and ungerminated whole grain flakes and reference food (glucose). Postprandial blood glucose and plasma insulin concentration were measured according to methodology by the ISO (International Organization for Standardization) method 26642:2010.

The most beneficial, meaning low and more stable in 2 h period, glycaemic and insulin response, showed flakes made from hulless barley, germinated hulless barley and rye. Germinated hulless barley flakes portion was the biggest because of lower content of carbohydrates, which is essential for appetite control.

Selected whole grain flakes, especially hulless barley, germinated hulless barley and rye could be potentially useful option in daily meals for prevention and treatment of metabolic syndrome.

Keywords: grains, glycaemic, insulin response

Acknowledgment. The research leading to these results has received funding from the Norwegian Financial Mechanism 2009–2014 under Project Innovative approach to hull-less spring cereals and triticale use from human health perspective (NFI/R/2014/011).

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LATVIAN CITIZENS' EATING MOTIVATIONS

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The society's dietary habits make an important impact on overall health status, the food that are consumed daily can be one of factors that prevent or, on the contrary, intensify health issues. The aim of this research was to find out the factors that influence food choice of Latvian citizens.

In the survey there was studied Latvian citizen's eating motivation. The questionnaire was used as a basic tool which was completed by 240 respondents (80% female and 20% male) from different Latvia regions. The survey included ten parts – demographical information, anthropometric data and behavioural and health related elements, healthy food and sources of information about healthy eating, factors related to food choices according to healthy motivations, emotional motivations, economic and availability motivations, social and cultural motivations, environmental and political motivations, marketing and commercials motivations. The results of questionnaire show, that the 40% of respondents have motivation to eat healthy; Latvian citizens haven't united viewpoint regarding emotional motivations for eating, but 47% of respondents have economic motivations for different food purchases; 44% of respondents are motivated by social and cultural issues, 32% of respondents have political motivations in food choice, but only 31% of respondents are affected by different marketing actions.

This research was prepared in the ambit of the multinational project from CI&DETS Research Centre (IPV e Viseu, Portugal) with reference PROJ/CI&DETS/2016/0008: EATMOT.

Keywords: eating motivation, survey, food choice

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THE SIGNIFICANCE OF LOCAL FOOD IN THE CONSUMPTION OF MODERN CONSUMER

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With changing time, also change consumer diet. Food industry trends show that people are increasingly choosing local food. This study aims to explore the local food choices and the use of modern consumers. Researchers organize survey to find out the citizens' understanding of the different types of food, such as functional foods, novel foods, ecological, etc. The aim of this questionnaire was to research how often modern consumer choose the local food and what is their attitude to this kind of food. Survey was organized in the beginning of year 2017 and totally in this survey participate more than five hundred respondents. The survey results show us that people don't know about novelty food, but a lot of people very often use functional food, ecological food and also local food. Survey shows that consumer when by food pay attention to food quality, expire date and price. Respondents regularly buy food from local producers. Consumer behaviour impact economic development and educational level in the country. If increase educational level also increase demand of quality food in this case – local food.

Keywords: local food, local food producer, consumer behaviour

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FACTOR AND CLUSTER ANALYSIS TO KNOWLEDGE ABOUT DIETARY FIBRE

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The present study was aimed at investigating what are the people's levels of information about dietary fibre (DF) and how they relate to some factors that result from the people's perceptions associated with the knowledge about DF. The study consisted of a descriptive cross-sectional survey undertaken on a sample of over 6 thousand participants, original from 10 countries. Statistical techniques like factor analysis and cluster analysis were applied to the data. Factor analysis showed that 10 out of the 12 variables used to measure the knowledge about DF could be grouped into 2 factors: one associated with health effects of DF and the other with its natural sources. The internal consistency of both factors was evaluated by the Cronbach's alfa (0.854 and 0.644, respectively). Cluster analysis revealed that the participants could be divided into 3 groups: Cluster 1 – good knowledge both about sources and health effects of DF; Cluster 2 – good knowledge about the sources of DF but poor knowledge about its health effects; Cluster 3 – poor knowledge both about sources and health effects of DF. The results were subject to analysis of stability by splitting the data set in 2 halves. The cluster membership was found associated with living environment and level of education, but not with age, gender or country.

Keywords: dietary fibre, knowledge, sources of fibre, survey

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ANALYSIS OF SOME CHEMICAL COMPONENTS, PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY IN PHYSALIS

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Physalis peruviana L. is appreciated for its organoleptic characteristics, besides being rich in many beneficial compounds. Because its characteristics are yet not fully understood, the present work aimed at studying some of its chemical properties and bioactive phenols and the corresponding antioxidant activity. For obtaining the phenolic extracts three methods with different combinations of extracting solvents were essayed and the evaluation of total phenols, ortho-diphenols, flavonoids and antioxidant activity by DPPH and ABTS were done following established methodologies.

The results showed that *P. peruviana* had important amounts of fibre, vitamin C and carotenoids. Regarding the methods for extraction of phenolic compounds, the most efficient were those in which a combination of the solutions methanol : water and acetone : methanol were used. The phenolic compounds contents were quantified as being p to 59.9 mg GAE 100 g⁻¹, flavonoids up to 0.340 mg QE 100 g⁻¹ and ortho-diphenols up to 94.6 mg GAE 100 g⁻¹. The antioxidant activity ranged between 7.7 and 9.6 µmol TE g⁻¹ for method DPPH and between 12.3 and 13.7 µmol TE g⁻¹ for method ABTS.

Keywords: *Physalis peruviana*, extraction, phenolic compounds, antioxidant activity

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PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY OF *PHYLLANTHUS PHILLYREIFOLIUS*

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The growing public interest in natural products has been fostering numerous studies of new sources of natural substances, which might find numerous applications in novel ingredients for functional foods, nutraceuticals and drugs. The genus *Phyllanthus* consists of more than 1000 species; many of them are used as traditional medicines in tropical and subtropical countries. However some species of this genus remain very poorly investigated. So far as the scientific reports on *Phyllanthus phillyreifolius*, an indigenous to Reunion Island species, which has been locally known for its benefits on the treatment of diarrhoea and as diuretic, it was chosen as an object of our study.

The main objective of this study was to evaluate extraction methods, phytochemical composition and antioxidant activity of *P. phillyreifolius* extracts, obtained using conventional and innovative extraction methods and applying both one step and sequential extraction procedures with various polarity solvents. Antioxidant properties of extracts were evaluated by total phenolic content (TPC) and other widely used assays, namely DPPH and ABTS radical scavenging, FRAP, ORAC. In addition, the *in vitro* intracellular antioxidant activity of extracts was also evaluated. The presence of geraniin, phyllanthusiin D, elaeocarpusin, rutin, quercitrin, quercitin-3-glucuronide, gallic and ellagic acids as phenolic constituents of *P. phillyreifolius* were confirmed by UPLC-Q/TOF-MS analysis. Three isomers of tocopherol (α , β and γ) were quantified by HPLC in lipophilic extracts. Generally, the results from this study demonstrated that *P. phillyreifolius* contains large amounts of antioxidants and could be considered as a promising source of ingredients for functional foods, nutraceuticals and pharmaceutical formulations.

Keywords: *P. phillyreifolius*, antioxidant properties, phenolic compounds

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QUALITY ASSESSMENT OF SALTED AND UNSALTED SWEET CREAM BUTTER DURING STORAGE AT DIFFERENT TEMPERATURES

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The quality of butter depends on many factors such as the quality of the raw material, production method, supplements used and packaging. Chemical changes that take place during the storage of the finished product are also very important. The objective of this investigation was to evaluate the quality of salted and unsalted butter during different storage temperature regimes: -20 °C for 24 weeks, +5 °C for 18 weeks and +20 °C for 8 weeks. Acid value, peroxide value and sensory quality of salted and unsalted butter were determined at different time points of storage.

No major differences were found when comparing acid values and peroxide values at different storage temperatures. In addition, there were no significant differences between salted and unsalted butters and no age trends for the values. At all storage temperatures, the level of acid value was lower (maximum value 0.81 mmol 100 g⁻¹ fat) than the upper limit established for high quality butter (1.2 mmol 100 g⁻¹ fat). The peroxide value was also lower (maximum value 0.050 meqv kg⁻¹ fat) than the upper limit established for high quality butter (0.3 meqv kg⁻¹ fat) all storage temperatures. After eight weeks of storage the sensory characteristics of butter – like appearance, taste and smell – corresponded to those indicating good quality, as all the characteristics scored at least 4 points or higher. Good sensory characteristics of the butter were also confirmed by chemical analyses – acid value and peroxide values remained lower than the established requirements for high quality butter.

Keywords: butter, salted butter, free fatty acids, peroxide value, sensory analysis

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PHYTOCHEMICAL COMPOSITION, BIO AND ANTIRADICAL ACTIVITY OF VARIOUS *NEPETA* SPECIES

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There are more than 300 species in genus *Nepeta*, however most of them are poorly studied. The aim of this study – to evaluate biochemical composition, bio and antiradical activity of extracts isolated from six *Nepeta* species (*N. cataria*, *N. racemosa*, *N. sibirica*, *N. nuda*, *N. melissifolia* and *N. grandiflora*) by different polarity solvents, namely acetone, methanol and water.

Antioxidant potential of extracts was evaluated by ABTS^{•+}, DPPH[•] scavenging, oxygen radical absorbance capacity (ORAC), hydroxyl radical antioxidant capacity (HORAC), cellular antioxidant activity (CAA), hydroxyl radical scavenging (HOSC) capacity and total phenolic content assays. Water extracts of *N. sibirica*, *N. melissifolia* and *N. nuda* possessed the highest activities in all assays. Individual phytochemicals were identified by high performance liquid chromatography with UV detection (HPLC-UV) and ultra performance liquid chromatography coupled with mass quadrupole time of flight detector (UPLC-Q-TOF). In total, 29 compounds were detected in the analysed extracts, 27 of them were identified. The most common compounds found in *Nepeta* species were phenolic acids, ferulic, chlorogenic, rosmarinic, and caffeic. Ferulic acid was quantitatively major constituent in water and acetone extracts, while rosmarinic acid was dominant in methanol extracts. Antiproliferative assay was used for assessing bioactivity of the selected extracts, which demonstrated the highest antioxidant potential. It was found that water extract of *N. nuda* demonstrated the best antiproliferative activity after 24 and 48 h of incubation at the concentration of 7.5 and 2.75 mg mL⁻¹, respectively. In general, the results obtained suggest that selected *Nepeta* extracts might be promising functional ingredients.

Keywords: *Nepeta*, antioxidant activity, antiproliferative effect, chromatography

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THE EFFECT OF HIGH-PRESSURE PROCESSING ON ENTERAL FOOD MADE FROM FRESH AND SEMI-FINISHED INGREDIENTS

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The enteral feeding can be defined as delivery of nutrients directly into the stomach, called also enteral nutrition. Dietetic products for enteral nutrition are a specific group of products designed to provide nutrients to the human body in case of various diseases and after surgery, when the daily intake of the product is affected. Today market offers special dietetic products, which are supplemented with synthetic vitamins and minerals, which bioavailability in the body is lower than that of natural organic complexes. Therefore it is important to develop special dietetic products from natural raw materials. The aim of this study was to analyse the effect of high-pressure processing on bioactive compounds in enteral products. For this research enteral food was made using fresh and heated fruit and vegetable juices. Products were treated using pressure of 400 MPa, 500 MPa and 600 MPa for 5 minutes at room temperature. All samples were tested on their content of vitamin C, total carotenes, anthocyanins, total phenols and antioxidant activity, as the control untreated enteral food samples were used. The obtained data showed that samples made from semi-finished juices have higher contents of vitamin C and total anthocyanins than samples prepared from fresh juices. Similarly this was observed with total phenol content where after high-pressure treatment in samples made from semi-finished juices it was more stable and had in higher amounts than in samples from fresh ingredients. There were no significant differences in content of bioactive compounds between products treated at different pressures.

Keywords vitamin C, total carotene, total phenols, antioxidant activity

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QUALITY AND FOOD SAFETY MANAGEMENT SYSTEMS APPLIED TO THE LITHUANIAN FOOD SECTOR

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Food safety assurance is one of the most important and significant things in the activity of the food sector. Product certification process according to various standards means like the highest quality not only for the company but for the consumer as well. Company's executives are free to choose what a management system should be an organization. It must be effective and viable. Effective food quality and safety assurance is one of the most important tasks of the food sector. Implementing an ISO 9001, ISO 22000, BRC, IFS or another international standards modern quality management systems have been developed and currently are widely used to accomplish this task. In order to ensure the highest quality requirements in all food supply chain (from raw material to finished product that reaches the consumer), companies are often implemented and integrated with each other quality, environmental and food safety management. However, for the company's executives faces many difficulties to assess which the management system is superior and which is more different. This paper analyse the food safety and quality of international standards requirements for the establishment of food quality and food safety management system standards; similarities and differences between them, to evaluate the application of these systems, the main advantages and disadvantages. Development of implementing management systems in Lithuanian food companies was analysed. At least one management system is certified at the 80 Lithuanian food companies. Of these, the management system according to the ISO 9001:2008 standard is certified at 44 companies, according to the ISO 22000:2005 – at 26 companies, according to the ISO 14001:2005 – at 22 companies and according to the requirements of the BRC standard – at 12 companies. Even 44% of the companies are implemented and certified by two or more integrated with each other management systems.

Keywords: food safety assurance, certification, quality management systems

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FERMENTATION OF REHYDRATED FREEZE-DRIED CELERY AND PARSNIP JUICE WITH DIFFERENT STARTER CULTURES FOR NITRATE REDUCTION

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Vegetables can accumulate considerable amount of nitrate, which can be reduced to the nitrite by the action of nitrate-reducing bacteria; the product obtained may be used for colour and flavour formation in meat products. The aim of the study was to evaluate the possibilities of reducing nitrates to nitrites by using starter cultures (*St. carnosus*, *St. xylosus* and the mixture of *St. xylosus* with *P. pentosaceus*) for freeze-dried celery and parsnip juice fermentation. Juice before fermentation was rehydrated with distilled water (1:4). The objectives were to determine juice chemical composition, including nitrates and sugars content and to evaluate the formation of nitrites, free glutamic, lactic acid, and pH changes during fermentation. Comparing the freeze-dried celery and parsnip juice it was determined that the former had higher amount of minerals (14.49 vs 3.54%), proteins (17.72 vs 7.28%) and nitrates (6876 vs 636 mg kg⁻¹), while the latter had more carbohydrates (83.11 vs 57.27%). The amount of sugars was similar in both vegetable products. Fermentation of juice with *St. carnosus* and *St. xylosus* cultures was the most effective in terms of the nitrate reduction to nitrite. The highest amount of lactic acid was produced when the mixture of starter culture was applied. At the end of fermentation the highest amount of free glutamic acid was in the freeze-dried celery juice samples, most likely due to a larger amount of proteins as compared to the freeze-dried parsnip juice. In conclusion, fermented celery juice might be a promising natural additive containing nitrite (colour stabiliser) and glutamic acid (flavour enhancer) for meat products.

Keywords: fermentation, freeze drying, celery, parsnip, starter culture

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PROTECTIVE EFFECTS OF HERBAL SUPPLEMENTS ON ANTIOXIDANT ACTIVITY OF BEE PRODUCTS

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We studied pure bee-collected beebread (BB) and pollen (BP) originating mostly from oilseed rape (*Brassica napus*). Another group of blends was produced from the beebread as well as pollen mixed with honey (H) at a ratio (1 : 2) (BBH or BPH) and additives of vegetable oils: sea buckthorn (SBO – 1%), flax seed (FSO – 2%), royal jelly (RJ – 2%), and algae Spirulina (SA – 0.5%) was blended into the BBH and BPH.

The aim of present study was to characterize the total phenolic content and antioxidant activity of BB, BP and their mixtures with honey, oils and (SA) during two years' storage in refrigerator.

The total phenolic content (TPC) extracted from pure BP amounted to 53.68 mg GAE g⁻¹ dry weight and oxygen radical absorbance capacity (ORAC) of this extract was the highest: 2063.0 mg TE g⁻¹ dry weight. The corresponding values for the pure BB were lower 48.86 mg GAE g⁻¹ and 1445.3 mg TE g⁻¹, respectively. The TPC and ORAC in the BB and BP decreased within the two years of preservation. The remaining value of TPC for BB amounted to 31.5% and for BP it was 29.7%; while ORAC for BB was 62.3% and for BP it was 64.3%. SBO was found to stabilise ORAC activity in the mixtures of BB and BP with honey.

After two years of preservation in a refrigerator, the ORAC activity in the BBH-SA and -RJ mixtures as well as in those of BPH-SA was more unstable compared to that in the other preserved products.

Keywords: pollen, beebread, honey, royal jelly

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THE IMPACT OF CALCIUM IONS ON COMMERCIALLY AVAILABLE BETA GALACTOSIDASE

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Commercial lactose hydrolyzing enzymes producers provide purchasers with information as optimal enzyme temperature and pH, as well recommended amount of enzyme. However, there are also other indices in food substrate which might have impact on enzyme activity. The cations concentration in the substrate is the one of those.

Whey is a dairy by-product with a relatively high Ca^{2+} , K^+ and Na^+ ions concentration. These cations (especially Ca^{2+}) are added in cheese making and remain in whey in comparatively large amounts. Moreover, Na^+ also remains in whey since salt is added for cheese grains salting.

The aim of the study is to determine the impact of Ca^{2+} ions on commercially available β -galactosidase preparates.

The effect of Ca^{2+} ions on commercial β -galactosidase preparates (NOLA Fit5500, Ha-Lactase 5200, Chr. HANSEN, Denmark; Lactozym[®] Pure 6500 L, Novozymes, Denmark) were tested. For investigation of the effect of Ca^{2+} ions on the β -galactosidase activity, chromogenic lactose analogue – oNPG (2-nitrophenyl β -D-galactopyranoside; Sigma, Germany) was used, reactions were carried out in pH 6.6, using 0.1 M Tris-HCl buffer, and Ca^{2+} ions concentration range from 5 to 50 mM. The enzymatic reactions were measured spectrophotometrically at 410 nm using Tecan 96-well plate reader (Tecan Group, Switzerland).

The results imply, that Ca^{2+} ions alone do not have effect on lactose hydrolysis, moreover, in some they even stimulate it (NOLA Fit5500). The study results will help to precisely adjust the amount of commercially available enzymes to dairy substrates with high cations content.

Keywords: β -galactosidase commercial preparations, lactose hydrolysis, calcium ions, enzyme kinetics

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LACTOSE CONTENT OF BREAST MILK AMONG LACTATING WOMEN IN LATVIA

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Human milk is the best nutrient source providing everything for the infant's development. Lactose, after the fat, is the second most energy-dense macronutrient found in the breast milk but its concentration can be affected by factors like mother's current body mass index (BMI), birth weight of an infant, duration of lactation, etc.

The aim of this study was to determine lactose content in mature breast milk among lactating women in Latvia and factors affecting it.

The preliminary study was carried out from November 2016 to February 2017. In total, 28 mature milk samples pooled within 24 h were collected from mothers whose infants had reached the age of at least two months. Participants (28 mothers with singleton deliveries of 13 male and 15 female infants) were 26 to 39 years old with an average BMI 21.85 ± 2.69 . Personal information including birth weight and age of an infant, breastfeeding method (exclusive, mixed) and milk expression manner (by hand or using breast pump) was recorded. Lactose content was determined by ISO 22662:2007.

Mean lactose concentration was $6.52 \pm 0.35\%$ which is comparable to data obtained from other studies. Although breast milk composition is variable and changes according to the needs of an offspring, no significant difference in lactose content was found for age (2 to 21 months), gender or birth weight (3.53 ± 0.63 kg) of an infant ($p > 0.05$). None of the recorded maternal characteristics influenced lactose's content in milk. Also milk expression or breastfeeding method did not affect it.

Preliminary results show that lactose concentration is kept relatively constant in human milk, however more samples need to be analysed for further conclusions.

Keywords: human milk, lactose, composition

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AROMA-TINCTO-OLEO CROPS AGROREFINERY: CASES OF FENNEL, CUMIN AND CARAWAY SEEDS GLOBAL VALORIZATION

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Aroma Tincto Oleo Crops (ATOC) are vegetal species containing both Vegetal Oil (VO) and Essential Oil (EO) or Natural Dye (ND) which could be cultivated all around the world. Presently, depending on the industrial sector concerned (oil or aromatic-dye industry), only one of these two fractions is valorized, the other being considered as waste as well as all other extraction residues which could go up to 80%. So the development of an integrated valorization of ATOC, allowing extraction of VO / EO and valorization of solid residues, constituted the basics of our lab-developed "ATOC-Refinery" concept.

It is based on a two stages valorization process allowing co-extractions of VO / EO while not penalizing the subsequent valorization of residual solid by-products, using a single-screw extruder for extracting virgin VO+EO from seeds while extraction cake being valorized as odorous powder after grounding of obtained pellets.

Experiments were conducted with three plants commonly used as condiment or spice in both northern and southern Europe: fennel (*Foeniculum vulgare*), cumin (*Cuminum cyminum*) and caraway (*Carum carvi*).

Results obtained at lab and pilot-scale levels with the three seeds reported extraction of a flavored virgin oil (VO+EO) with high amounts of valuable components, respectively petroselinic acid (VO) and anethole, cuminaldehyde and carvone (EO) for food or cosmetics uses (soaps) and obtention of flavored extraction cakes given flavored flours (EO) tested in bread making.

Keywords: aroma tincto oleo crops, agrorefinery, apiaceae, essential oil, vegetable oil, flavored flour

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**HEALTH-RELEVANT FOOD
PRODUCTS AND ISSUES**

FOODBALT 2017

THE EVALUATION OF PROVIDING SPECIAL DIETS IN RIGA'S PRE-SCHOOLS

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Rational, or a wholesome diet, is a prerequisite of healthy lifestyle for children normal development and health. Malnutrition or unhealthy eating habits are risk factors for various health problems. Based on national regulation pre-school should provide a wholesome diet for children, including children with special diets. For providing special diets school canteens are need to cook separate meals for small groups of children using a limited numbers of food-products. There are some problems which don't allow providing high-quality diets in preschools. The aim of current research was to evaluate main problems and to find proposals for improvement technological processes of food preparation.

Riga has 168 educational institutions that implement preschool education programs. The results showed that there was necessity for different special diets and menu types in pre-schools which should be introduced additionally to the main menu. The quality of special diets in preschools depended on correct diagnosis of child disease and on allowed / not allowed food products recommendations from the doctor. At the same time there were other significant conditions, like technological process organization of food preparation, which included providing of additional staff, capacity of workplace, implementation of internal system of food traceability and the staff knowledge about nutrition and special diets.

Keywords: special diets, pre-school

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MICROBIOLOGICAL RISK ASSESSMENT IN CATERING ESTABLISHMENTS

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Food quality and safety have an important role in consumer health and life defence. Microorganism quantity is exactly one of the main indicators influencing product safety. The aim of the research was to analyse the factors influencing microbiological contamination of ready-to-eat food in the catering establishments of closed-type institution. The effectiveness of risk assessment and quality control methods influencing the microbiological safety of the food raw materials was evaluated. The hygienic condition was assessed in accordance with the normative acts. The performed analysis of average values of ACC, coliforms and *S.aureus* in the ready-to-eat products, environmental objects samples, surface of human hands and surfaces that come into contact with food shows that microbiological contamination are controlled according to the self-control procedures and normative acts. Microbiological contamination risk of foods is dependent of technological processing method and equipment too. The results on microbiological contamination of ready-to-eat food correlate with the results on contamination of food items, equipment and personal hygiene indices. The obtaining results of microbiological risk assessment can be used for improvement of the self-control and personal hygiene procedures and educational programs of employees of catering establishments.

Keywords: microbiological contamination, risk assessment, catering, HACCP

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NUTRIENT PROFILING OF GERMAN BREAKFAST CEREALS

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The WHO Regional Office for Europe published a nutrient profiling model for several food categories (WHO 2015). The aim of this model is to identify which foods are high in total sugars, added sugars, non-sugar sweeteners, total fat, saturated fat, salt and energy content in order to reduce food marketing pressure to children. This model has been applied to German breakfast cereals. 322 products (174 conventional and 148 organic breakfast cereals) from several supermarkets in the area of Fulda were included in the study.

For the food category breakfast cereals the criteria total fat ($\leq 10 \text{ g } 100 \text{ g}^{-1}$), total sugar ($\leq 15 \text{ g } 100 \text{ g}^{-1}$), salt ($\leq 1.6 \text{ g } 100 \text{ g}^{-1}$) are defined. The countries may choose to include a threshold for dietary fibre content. In this study the threshold of more than $\text{g } 100 \text{ g}^{-1}$ is used. Only 15.8% of investigated breakfast cereals fulfilled the criteria for total fat, total sugar and salt. If additional dietary fibre is included in the profiling model only 9.6% of the breakfast cereals fulfilled all 4 criteria. Organic breakfast cereals more often have lower contents of total fat, sugar and salt (22.3%) compared to conventional produced breakfast cereals (10.3%). If dietary fibre was also taking into account only 6.9% of conventional and 12.8% of organic breakfast cereals fulfilled the profiling criteria.

These new nutrient profiling is suitable to differentiate breakfast cereals with good and insufficient nutrient profile. The nutritional quality of organic breakfast cereals are often better than the conventional counterparts.

Keywords: nutrient profiling, breakfast cereals, nutritional quality

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DIETARY MICRONUTRIENT CONTENT OF PEA (*PISUM SATIVUM* L.) AND BUCKWHEAT (*FAGOPYRUM ESCULENTUM* M.) FLOURS

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Micronutrient (Fe, Zn and etc.) malnutrition is a major public health problem in the most parts of the world. The attempt to solve micronutrient malnutrition could be to increase the consumption of nutri-dense products, like pseudocereals or legumes. This study was carried out to determine the minerals (P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, Mo and B) and vitamins (B₁ and B₂) content of pea (conventional and organic) and buckwheat (raw, roasted, white and dark) flours. Conventional and organic pea flours (PF) were naturally rich in Fe (36.0 mg kg⁻¹ and 64.0 mg kg⁻¹, respectively). Iron content of buckwheat flours (BF) ranged from 7.2 mg kg⁻¹ (white-BF) to 260 mg kg⁻¹ (dark-BF). Zinc content of BF was between 7.0 mg kg⁻¹ (white-BF) and 24 mg kg⁻¹ (raw- and roasted-BF) while that of pea flours ranged from 20.0 mg kg⁻¹ in organic-PF to 24.0 mg kg⁻¹ in conventional-PF. There were small differences in the contents of P, K, Ca, Mg, S, Fe, Mn, Cu, Mo and B between raw- and roasted-BF. Ca : P ratio in PF and BF revealed a high concentration of phosphorus compared to calcium. This ratio was less than 1.0. The pea and buckwheat flours showed a good content of vitamins B₁ and B₂. The highest content of vitamins B₁ and B₂ was observed in roasted-BF under buckwheat flour samples (1.39 mg 100 g⁻¹ and 1.35 mg 100 g⁻¹, respectively) and in conventional-PF under pea flour samples (1.11 mg 100 g⁻¹ and 0.71 mg 100 g⁻¹, respectively).

Keywords: minerals, vitamins, pea, buckwheat, flour

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THE POSSIBILITIES TO USE AIR SEPARATED PROTEIN RICH CORN PROCESSING BY-PRODUCTS FOR WHEAT BREAD PRODUCTION

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Natural by-products derived from food processes present the potential to be used as valuable materials for food production. The aim of this study was to apply corn processing by-products, stabilised by using different treatments such as extrusion and infrared radiation, for wheat bread production. The treatment of corn by-products was performed by using one screw extruder and an infrared generator followed by an air separation in facilities of JSC "Ustukiu malunas" in (Lithuania). The chemical composition (moisture, protein and fat content) and microbiological contamination of the corn by-products were analysed by using traditional methods. For the baking tests only the protein richest fractions obtained by air separation were selected. Baking trials were performed by using straight and sponge dough preparation methods with additions of corn by-products (20%) to wheat flour. The results of the chemical composition of corn by-products, showed that the extrusion has the highest impact on moisture and fat content by reducing values of these parameters with 3.56% and 15.1%, respectively, while the protein content increased with 12.54%. It was determined, that infrared radiation showed similar tendencies on moisture and fat content but in smaller ranges (reduced moisture 1.53%, fat 2.65%, and increased proteins – 2.96%). Both technologies had a positive impact on the microbiological safety. The total number of microorganisms has been reduced by 73.1% (extrusion case) and by 86.8% (infrared radiation). The best results of the tested bread according to the crumb porosity and specific volume criteria were obtained with the addition of corn by-products (20%) and by using the sponge dough preparation method. Bread made with a corn by-products, which was treated using infrared radiation, was the most acceptable for the consumer.

Keywords: corn by-products, extrusion, infrared radiation, wheat bread

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PLANT BY-PRODUCTS AS SOURCE OF FUNCTIONAL INGREDIENTS FOR PRODUCTION OF CRISPBREADS

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Production of different food from vegetables result by products – peel, mark, bark, seeds still rich in bioactive compounds. Carrot and pumpkin peel and mark powdered ingredients developed may be used in the formulation of crispbreads as functional ingredients. Research was carried out to evaluate the effect of extrusion cooking on the antioxidant capacity and texture attributes of extruded products prepared from pumpkin and carrot by products in cereal crispbreads. Total phenolics content was determined using the colorimetric method. Antioxidant activity by 2,2-diphenyl-1-picrylhydrazyl (DPPH) was evaluated by the free radical scavenging activity of DPPH using a modified colorimetric method. Extrusion process was performed using a laboratory single-screw extruder GÖTTFERT 1 screw Extrusionmeter L series (Germany). The basic ingredients for extruded crispbreads were wheat flour, rice flour, wheat bran (70%, 20%, 4%) with addition of by product powder in different proportions (5%, 10%, 15%, 20%). Extrusion led to a decrease in the concentration of antioxidants. Comparing different raw formulations it was observed that the TP content of the pumpkin by product formulation was significantly higher ($p < 0.05$) than carrot formulation. Addition of carrot and pumpkin by-product increased TP content in crispbreads from $13.3 \pm 2.9 \mu\text{g}$ of GAE g^{-1} DW to $103.5 \pm 11.7 \mu\text{g}$ of GAE g^{-1} DW. Antioxidant activity increased from $0.04 \mu\text{g}$ of TE g^{-1} DW in control sample to $0.57 \mu\text{g}$ of GAE g^{-1} DW in samples with addition of 20% pumpkin by products.

Keywords: antioxidants, by products, crispbreads, extrusion, phenols

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EFFECT OF EXTRACTION CONDITIONS ON ANTIOXIDANT COMPOUNDS FROM BLACKBERRY LEAVES

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Blackberry leaves have been used as a tea substituent in many herbal mixtures. Medicinal properties of this plant material are related to a high level of components with antioxidant activity, such as phenolic compounds. In this study, blackberry leaves extracts were produced by an aqueous extraction procedure in order to simulate tea preparation. The aim of the research was to determine the effect of different extraction conditions: water temperature (40 and 80 °C) and extraction time (15 and 30 minutes) on the content of phenolic compounds and antioxidant capacity of blackberry leaves. The obtained results indicated that the produced extracts are a rich source of phenolic antioxidants. The blackberry extract prepared by applying higher temperature (80 °C) and longer time (30 minutes) was characterized by the highest contents of total phenolic compounds (153.41 mg GAE g⁻¹), flavonoids (71.50 mg QE g⁻¹) and flavan-3-ols (2.82 mg CE g⁻¹). Also, this extract expressed the strongest antioxidant activity in terms of the ferric reducing ability of plasma (2.73 mM TE g⁻¹) and generation of 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) radical cation (0.15 mM TE g⁻¹). Further researches are needed to determine the exact phenolic profile and their bioavailability, as well as to develop new functional food ingredients or nutraceuticals containing blackberry leaves extracts.

Keywords: blackberry leaves, polyphenols, antioxidant activity, flavonoids, flavan-3-ols

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THE EFFICIENCY OF ULTRASOUND IMPACT ON DECONTAMINATION OF *ESCHERICHIA COLI* ON LETTUCE LEAVES

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The consumption of fresh vegetables has increased in the past few decades. The main transmission of pathogens to vegetables is through faecal contamination, cross contamination and food handling. One of the most important pathogen of fresh products is *Escherichia coli*. Ultrasound technology is a decontamination method for ready to eat products. It has been shown, that ultrasound can be used to influence pathogen activity.

The aim of this study was to evaluate the microbial reduction of *E. coli* by different ultrasound configurations tested on the surface of lettuce leaves. *E. coli* ATCC 25922 was obtained in a lyophilized form. The bacteria culture was inoculated onto lettuce and then treated with ultrasound.

Three treatment modes of 100 W, 200 W and 300 W were used to determine ultrasound effect on microorganism. It has shown, that the power of ultrasound has no effect on bacteria. There was no significant difference in control and *E. coli* samples. Second microorganism treatment had different time and power modes. The processing time and power modes used were 5, 10, 15 and 20 minutes and 300 W and 600 W. While testing in the 15 min / 600 W configuration the sample started to boil and all of the bacteria in it were destroyed. In conclusion, the most efficient method for *Escherichia coli* was the one that was used with the time mode, not the power modes.

Keywords: ultrasound, food safety, *Escherichia coli*, lettuce

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POSSIBILITIES TO PREVENT MEAT PRODUCT SPOILAGE BY REDUCING CHEMICAL COMPOUNDS

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Food preservation involves taking action to maintain foods with the desired properties for as long as possible. On the industrial scale of meat product making, companies are using different types of chemicals to extend shelf life and save the product from potential microbiological spoilage. Bacteria such as *Bacillus spp.*, *Clostridium*, *Escherichia*, *Pseudomonas*, *Lactobacillus*, *Micrococcus*, *Streptococcus*, *Sarcina*, *Salmonella* occur most commonly. Molds that can take part in meat spoilage are *Cladosporium*, *Geotrichum*, *Mucor*, *Penicillium Sporotrichum* etc., yeasts are less commonly occurring. The quality and quantity of microorganisms associated with food depends on the ingredients used and preparation methods. All methods of food preservation are based on prevention or removal of contamination, inhibition of microbial growth and killing of microorganisms by pasteurization, sterilization, low temperature, dehydration, osmotic pressure, radiation, enzymatic and chemical activities. Besides preservation there is also an interest to prolong shelf life of meat products for longer storage at the market. Researches to increase shelf life using modified atmosphere packaging, spraying for example probiotic lactic acid bacteria on the treated product, fermentation, acidification, drying and freezing are being conducted. Often the fastest, more effective and cheaper way to solve the shelf life problem is chemical usage in some products. It is hard to find a better and more economical solution for industrial scale. Some Latvian meat processing companies are interested in cooperation with scientists to make more natural products, but at the same time keeping or prolonging shelf life of the final product.

Keywords: meat products, spoiled food, chemical compounds

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SURVIVAL OF LACTIC ACID BACTERIA FROM FERMENTED DAIRY PRODUCTS IN A GASTROINTESTINAL TRACT SIMULATOR

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Fermented dairy products advertised as containing probiotic cultures must contain bacteria that survive the passage from stomach to intestines. In this study, a single bioreactor gastrointestinal tract simulator system was used to evaluate the probiotic potential of fermented dairy products containing probiotic and non-probiotic cultures. The survival of lactic acid bacteria from four commercial yoghurts was studied using dynamic gastrointestinal tract simulator (GITS).

The GITS system comprised of a single stirred tank reactor, simulating the conditions in the stomach, duodenum, jejunum and ileum, connected to the PC and controlled by bioprocess monitoring and control software 'Iris 6'. Controlled parameters were temperature, pH, secretion control of HCl in stomach, NaHCO₃ and bile in small intestine. The survival of lactic acid bacteria was calculated as the difference of colony forming units at four time-points: the beginning, at the end of stomach phase, 30 min after exposure of maximum bile concentration and at the end of the GITS experiment. Bacteria count was determined by plate counting on MRS agar, plates were incubated aerobically at 37 °C for 48 h.

Results showed that the critical point of survival of lactic acid bacteria was the addition of bile by simulation of duodenum; a significant reduction in bacteria count was observed. The next phase (dilution used to simulate the digestion and absorption process in the small intestine) did not show significant changes, however, a slight increase in bacteria count was established.

Keywords: GITS, probiotic potential, commercial yoghurts, bioprocess control

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**QUALITY AND SAFETY OF
PROCESSED FOODS**

MICROBIOLOGICAL SAFETY OF ORGANIC AND CONVENTIONAL FOODS

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Occasionally, concerns are expressed that use of organic manure in fertilisation, and free-ranging of livestock may result in higher loads of (mainly) enteric pathogens in organic food, and that avoiding the use of synthetic fungicides may increase the risk of mycotoxin contamination. Therefore, we compared published data on the levels of these hazards on some organically and conventionally produced foods. The results can be summarised as follows:

- There is no evidence that use of organic fertilizer in organic crops increases the prevalence of bacterial pathogens and / or antibiotic-resistant bacteria on fresh produce.
- The prevalence of *Campylobacter* in live free-ranging poultry and of *Toxoplasma* in live free-ranging pigs tends to be somewhat higher than in animals kept conventionally indoors. However, this difference is hardly seen any more if carcasses and meat are analysed.
- Methicillin-resistant *Staphylococcus aureus* (MRSA) strains were found much more frequently in conventionally-produced raw food while the levels of extended-spectrum- β -lactamase-positive *Escherichia coli* (ESBL) were reported as similar on somewhat lower on organic raw food.
- Most studies found lower levels of *Fusarium* toxins in organic grains and cereal products, if compared to conventional products.

In conclusion, common practice in the organic sector (in particular, allowing sufficient time for transformation of manure; crop rotation) leads to food with similar or even lower levels of microbiological hazards and mycotoxins.

Keywords: organic food, food safety, enteric pathogens, antibiotic resistance, mycotoxins

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IDENTIFICATION OF MICROFLORA OF FRESHWATER FISH CAUGHT IN THE DRIKSNA RIVER AND POND IN LATVIA

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Identification of freshwater fish microflora is an important tool for evaluation of quality and safety of fish intended for human consumption. The aim of the present study was to detect the microflora of freshwater fish caught by fishermen. Altogether, 23 samples of freshwater fish were collected from fishermen in two different water sources – river Driksna and pond in Dobeles. For detection of microbiological contamination, fish samples were tested for total bacterial count (TBC), coliforms, *Enterobacteriaceae* and zoonotic pathogenic microorganisms - *Salmonella* spp., *Listeria* spp. and *Yersinia* spp. according to the ISO requirements. Identification of bacterial species was carried out by MALDI-TOF MS Biotyper. TBC ranged from 2.7 to 4.78 log cfu g⁻¹ and 3.68 to 4.11 log cfu g⁻¹, coliforms from 2.55 to 4.1 log cfu g⁻¹ and 1.38 to 2.73 log cfu g⁻¹, *Enterobacteriaceae* from 1.95 to 4.05 log cfu g⁻¹ and 1.72 to 2.69 log cfu g⁻¹ in pond and river fish samples, respectively. Between two fishing locations, fish caught in pond carried significantly higher number of TBC, coliforms and *Enterobacteriaceae* than fish from river (P>0.05). Freshwater fish microflora consisted of *Pseudomonas* spp. (55%), *Serratia* spp. (7%), *Candida* spp. (6%), *Rahnella* spp. (7%), *Pantoea* spp. (9%), *Aeromonas* spp. (5%), *Buttiauxella* spp. (8%), *Stenotrophomonas* spp. (2%) and *Enterobacter* spp. (1%). *Salmonella* spp., *Listeria* spp. and *Yersinia* spp. were not identified. Despite the human pathogenic microorganisms were not identified in the present study, the composition of microflora and especially abundance of *Pseudomonas* spp. indicates that the fish are prone to spoilage process development that potentially may alter the quality of freshwater fish meat.

Keywords: freshwater fish, bacteria, MALDI-TOF MS Biotyper

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EFFECT OF OZONE ON *LISTERIA MONOCYTOGENES* IN ATLANTIC SALMON DURING STORAGE

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Ozone is a strong oxidant that also possesses antimicrobial properties and deodorizing effects, and thus offers many advantages in the food industry. The objective of this research was to investigate the influence of gaseous ozone treatments on the microbial and lipid oxidation of Atlantic salmon fillets inoculated with *Listeria monocytogenes* during refrigerated storage at 1 °C for 5 days. It was found that application of ozone reduced the total count of bacteria (TCB) and *L. monocytogenes* number in salmon fillet during the storage. However, the influence of higher dose (3.0 mg L⁻¹) of ozone on the total number of bacteria was the same as compared to lower dose (1.3 mg L⁻¹) of ozone. The thiobarbituric acid reactive substances (TBARS) and the induction period assays were used to monitor oxidation in salmon fillet samples. TBARS assay indicated that no significant changes occurred in the level of oxidation of salmon fillet during ozonation at both ozone concentrations. Results of the present study showed initial of TCB and *L. monocytogenes* can be considerably reduced by (1.3 mg L⁻¹) dose of gaseous ozone treatment without causing significant increases in lipid oxidation levels in salmon fillets. Although extension in refrigerated shelf-life was not observed because further research is still needed to evaluate the changes in nutritional and sensorial properties of salmon fillets.

Keywords: ozone, *Listeria monocytogenes*, lipid oxidation, salmon

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ACIDIFICATION RATE, CARBOHYDRATE METABOLISM AND ENZYME ACTIVE PEPTIDE PRODUCTION IN RICE BRAN MEDIUM BY NEWLY LACTIC ACID BACTERIA

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Rice bran contains various nutrients such as protein, fat, carbohydrate, minerals, and vitamins, making it a very useful food source. Whole rice grains can also be modified to improve their nutritional value or to promote their functional properties. For centuries fermentation with lactic acid microorganisms has been a simple and inexpensive method to improve the functional and nutritional value of foods. The aim of this study was to characterize the lactic acid bacteria previously isolated from a different spontaneously fermented cereal based media. Lactobacilli such as *L. plantarum*, *L. brevis*, *L. paracasei*, *L. uvarum* and *Pediococci* such as *P. acidilactici* and *P. pentosaceus*, were characterized by their growth and acidification rate, carbohydrate metabolism, and xylanase and protease activity production during fermentation of rice bran. The rice bran fermentations were carried out in a single step without growth supplementation at solid state (SSF) conditions. The *P. acidilactici* and *P. pentosaceus* showed very good properties of acidification, the pH in fermentation medium ranged from 3.92 to 3.16. Among the tested strains, the *L. plantarum* and *L. brevis* and *P. acidilactici* and *P. pentosaceus* strains were able to ferment L-arabinose and D-xylose, also hexoses D-galactose, D-glucose, and N-acetylglucosamine. All tested strains differed in the L- and D- lactic acid production rate.

Keywords: rice bran, lacto-fermentation, acidity, carbohydrate metabolism, L- / D- lactic acid

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ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF MIXTURES OF TAXIFOLIN AND ASCORBIC ACID AS ALTERNATIVE TO THE ADDED NITRITE IN DRY-CURED SAUSAGES

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Taxifolin (TXF) is a flavonoid rarely used as a single compound. It was recently rediscovered as a highly potential antioxidant with reported therapeutic properties. TXF shows a relatively low toxicity, and could be used as food supplement. However the data about possible protective properties of TXF and information about its stability is scarce. The aim of this work was to evaluate the antioxidant and antimicrobial activity of TXF when it is used together with ascorbic acid (AA) in sausages. Activity of tested materials against lipid (TBA) and protein oxidation, total flavonoid and phenol contents, thiobarbituric acid-reactive substances (TBARS) values, DPPH free scavenging activity, ferrous ion chelating ability and microbiological counts were evaluated in dry-cured sausages after 0, 30 days of ripening and 30, 90 and 150 days of storage. TXF+AA effectively inhibited the processes of lipid and protein oxidation and slowed down the rate of lipolysis. Addition of antioxidants decreased ($p < 0.05$) the oxidation, showing TBARS values below $0.4 \text{ mg MDA kg}^{-1}$ of sausages. Therefore, total phenol and flavonoid contents, were higher in samples with TXF + AA than in samples treated only with TXF. Moreover antioxidants reduced the counts of total aerobic bacteria, lactic acid bacteria, mold and yeast during ripening and storage of dry-cured sausages without nitrites. The outcome of this study can help develop new meat products with better nutritional quality and beneficial health aspects.

Keywords: antioxidant activity, antimicrobial activity, taxifolin, ascorbic acid, dry-cured sausage

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CHILLED PERCH FILLET QUALITY IMPROVING USING DIFFERENT ESSENTIAL OILS

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The aim of the study – to improve the quality and acceptability of the chilled perch fillet using functional ingredients. Perch fillets divided into 5 treatment groups: 1st group Perch fillet treated with 0.5% rosemary extract; 2nd group perch fillet treated with 2.5% rosemary extract, 3rd group treated with lemon essential oil; 4th group treated with lemon and rosemary essential oil mixture of 0.5%; 5th control group without functional additives. The study examined microbiological indicators after 24, 72, 120, 168 and 216 hours. The investigation showed that rosemary extract had the greatest impact on prolonging shelf life of the chilled perch fillet ($p < 0.05$). Natural rosemary extract has a significant impact on the acceptability, improved organoleptic characteristics: taste and smell of the overall intensity.

Keywords: perch fillet, essential oils, shelf life

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FERMENTED AND IMMOBILIZED HEMP SEED PRODUCTS FOR THE HIGHER VALUE BISCUITS PRODUCTION

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The main challenge of the food industry in the world today is to make food products more sustainable, competitive and healthier for consumers. In this case, different pseudo-cereal, having specific chemical composition, became very interesting subject of investigations. Our previous studies showed, that fermentation of proteinaceous plants could increase their protein digestibility, total phenolic compounds content, and radical scavenging activity. However, by using fermented raw material, to high moisture content in biscuits could be achieved, which could have negative impact on products texture and microbiological stability during the storage. To reduce water migration from fermented products to biscuits dough, immobilization technology could be adapted. The aim of this study was to increase *Cannabis sativa* protein and expeller protein digestibility, total phenolic compounds (TPC) content, and antioxidant activity by using fermentation with selected lactic acid bacteria (LAB) strains, and to adapt the *Cannabis sativa* protein and expeller for higher value biscuits production.

It was obtained, that *Lactobacillus plantarum* and *Lactobacillus paracasei* strains could be used for hemp seed protein and expeller fermentation in order to increase their antioxidant activity. For hemp seed expeller protein digestibility increasing *L. plantarum* could be recommended (digestibility increase 15.26%, in compare with non-fermented expeller samples). Fermented hemp seed products have significant influence on most of the biscuits parameters, and for biscuits value increasing with *L. plantarum* fermented and immobilized hemp seed protein and expeller could be recommended.

Keywords: biscuits, *Cannabis sativa* products, fermentation, lactic acid bacteria

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INVESTIGATION OF ACCELERATED SHELF-LIFE TESTING METHOD SUITABILITY FOR BISCUITS EXPIRY DAY DETECTION

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Shelf-life testing procedures become more as standard practice that is used to estimate the stability of quality of food products during storage and commercialization. Usually, real time shelf-life tests are time-consuming. In an effort to speed up this process and to fully account for all the degradation criteria, accelerated shelf-life testing (*ASLT*) methods have been adopted. The aim of current research was to investigate suitability of *ASLT* method for oat flakes biscuits with chocolate shelf-life determination.

For shelf-life determination packaged oat flakes biscuits were stored in dark for four months at 35 ± 2 °C (*ASLT*) and at 22 ± 2 °C for comparison. During the storage moisture content, water activity, hardness, acid value, pH, microbiological parameters and sensory properties of biscuits were evaluated using standard methods. Results of the present experiment demonstrate, that after four months of storage at 35 ± 2 °C temperature, oat flakes biscuits hardness, water activity and moisture content decreased in comparison with the control sample. The hardness of biscuits increased during storage at 22 ± 2 °C temperature. However, the storage temperature did not affect ($p>0.05$) changes of microbiological parameter in biscuits. Results of sensory evaluation demonstrated that in biscuits stored at elevated temperature after two months bitter taste and fats oxidation aroma was observed; what was similar in samples stored at 22 ± 2 °C after four months. Therefore, it is possible to determine shelf-life of oat flakes biscuits with chocolate 2.0 times rapidly during storage at 35 ± 2 °C.

Keywords: oat flakes biscuit, *ASLT* method, quality, shelf-life

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IMPACT OF ULTRASOUND TREATMENT ON *LUPINUS ANGUSTIFOLIUS* PROTEIN, ENZYME ACTIVITIES AND MICROBIOLOGICAL CONTAMINATION

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Ultrasound technology has been widely used in food processing and ensuring food quality and safety. The aim of this study was to evaluate the impact of ultrasound treatment (UT) alone and in combination with solid state fermentation (SSF) with *Lactobacillus sakei* KTU05-6 on narrow-leaved lupine (*Lupinus angustifolius* L.) flour. The changes of protein functionality, microbiological contamination and enzymes activities of wholemeal lupine flour were assessed. The decline in total protein (TP) and the increase in water soluble protein (SP) contents were noticed after application of ultrasound to lupine flour at different treatment times (15, 30, 60 and 80 min). The greatest reduction of TP (8%) and increase in SP (18%) was assessed in lupine samples after 72 h of fermentation, when UT was used after SSF. The results indicated that ultrasound treatment increased the emulsifying activity, emulsion stability and foam capacity of lupine protein isolates (LPI) by 8%, 11% and 7%, respectively. Moreover, UT treatment in combination with 24 hours SSF enhanced foam stability of LPI at 90 min by 24%. The highest decrease of the total microorganism counts (TMC) in lupine flour was reached after 60 min of UT. In this case, TMC were 5.5-fold lower compared with other UT durations. Furthermore, activities of α -amylase and endoxylanase in non-fermented and fermented lupine flour after UT were lower from 24% to 39% compared with unsonicated samples. The application of UT on lupine flour is beneficial in modification of protein and enzymes characteristics and ensuring microbiological safety.

Keywords: ultrasound, lupine, protein functionality, enzyme activities, microorganisms

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THE INFLUENCE OF FERMENTATION TECHNOLOGY ON THE AMINO ACIDS PROFILE AND ANTIOXIDANT PROPERTIES OF LUPIN SEEDS

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The influence of submerged (SMF) and solid state fermentation (SSF) with *Lactobacillus sakei* KTU05-6 on acidity parameters, changes of total amino acids (TAA) profile, total phenolic compounds content, and antioxidant activity of lupin seed *Lupinus luteus* L. variety 'Vilciai' and *Lupinus angustifolius* L. variety 'Vilniai', and six new hybrid lines (No. 1700, 1701, 1703, 1072, 1734 and 1800) were investigated.

Fermented lupin samples pH was ranging from 3.64±0.01 to 4.84±0.03 and D / L lactic acid ratio from 0.15 to 0.45 and from 0.12 to 0.46 (in SMF and in SSF samples, respectively). Fermentation increased TPC and antioxidant activity in lupin seeds. The interaction of analysed factors (different lupin seed and fermentation conditions) had significant influence on essential and nonessential TAA content in lupin (p=0.0001). By modelling fermentation conditions of lupin seed it is possible to produce new food / feed stock with higher functional and nutritional value.

Keywords: lupin, antioxidant activity, amino acids

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INVESTIGATION OF FERTILISATION IMPACT ON FRESH STRAWBERRIES YIELD AND QUALITY PARAMETERS

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Strawberries are a choice fruit crop for many home gardeners. The low-growing plants are reliable and quick to produce. June bearers provide a delicious supply of fruit from late spring through early summer, while day-neutral types produce berries throughout the summer. Main purpose of the current research was to evaluate fertilizers impact on strawberries yields and quality parameters. For experiments freshly picked garden strawberries variety 'Polka' harvested in Koknese region (Latvia) at July 2016 were used. For strawberries fertilization Ferticare™ Kombi 1 (NPK 14-11-25+micro) with and without $\text{Ca}(\text{NO}_3)_2$, YaraLiva™ Calcinit with and without $\text{Ca}(\text{NO}_3)_2$ with 100 kg N ha^{-1} and 50 kg N ha^{-1} doses were used. As a control – no-fertilized strawberries were analysed. Main quality parameters were tested using standard methods: yields (t ha^{-1}); berries hardness (N); pH; nitrates (mg kg^{-1}); soluble solids ($^\circ\text{Brix}$); extra, I and II class berries amount from total yields (%); sensory properties of strawberries (line scale). During current research significant impact of nitrogen fertiliser upon the pH and hardness of strawberries, the content of soluble solids, nitrates amount in berries, as well as the yields has been established. As a result, 50 kg of nitrogen fertiliser per hectare should be recommendable during spring strawberries fertilization with NPK 14-11-25+micro when the strawberry yields were 12.7 tons , the berry hardness – 0.94 N , pH – 3.67 , nitrates in berries was below 36 mg kg^{-1} , the content of the soluble solids – $11.8 \text{ }^\circ\text{Brix}$ and the amount of Extra, I and II categories berries was 83% from total yields.

Keywords: strawberries, fertilisation, quality parameters

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RESEARCH OF HALF-FINISHED FROZEN BERRY PRODUCTS**Ilze Beitane¹, Anita Blija¹, Sigita Boca¹, Aivars Aboltins², Imants Atis Skrupskis¹**

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The great significance of berries in human's diet is determined by the physiologically active matters in them. Good quality is one of the main issues in every stage of freezing. It is necessary to research suitability of different berries cultivars to freezing, as well as influence of freezing on quality of the final product. Food quality and safety issues depend on the quality of raw stuffs and half-finished products. Research was carried out at the Latvia University of Agriculture, strawberries and blackcurrants grown in Latvia were used in the study. The freezing dynamics of fruits is characterised by temperature measurements in a layer and on its surface. Experience shows that only few products need very quick freezing, such as berries, whose quality is largely influenced by freezing rate. The aim of the research is the quality evaluation of processed products made of fresh and frozen berries. Desserts prepared from berries are products, quality of which depends on storage conditions of half-finished products. The nutritive value of biologically active substance is retained, while the organoleptic indices worsen only a bit. The objective characterization of physical properties of products allowed to evaluate quality and to incorporate it into technological regimes of the treatment. Also new information was gained on the freezing processes that are mutually interconnected. It provides scientifically practical evidence for some technological developments of qualitative improvement in berry freezing methods and their usage range.

Keywords: human's diet, quality, quick freezing, dessert

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FRESH-CUT APPLE QUALITY PROVIDING USING DIFFERENT ANTI-BROWNING AGENTS

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Apple cultivar 'Auksis' was chosen for testing in the research of anti-browning efficiency by slicing and treating them with antibrowning agents: solutions of sea buckthorn, quince and currant juices and Natureseal® AS1. Apple slices were packed into polypropylene boxes and stored in refrigerator for 13 days at 4 °C temperature. During storage samples were analysed every third day by estimating content changes of vitamin C, phenolics, as well as estimating changes in antioxidant activity (FRAP, DPPH) and microbiological (bacteria, yeast, mould, lactic acid bacteria, total *Pseudomonas*) and sensory evaluation (Hedonic scale). Untreated apple slices packed in polypropylene boxes were used as control. During the evaluation of all used anti-browning agents efficiency on the quality of fresh-cut apple slices, the best results were observed for treatment with 5% Natureseal® AS1 solution. Using of this selected anti-browning agent ensured maintenance of higher content of vitamin C, phenolics, higher antioxidant activity (FRAP, DPPH) in the product, as well as maintained initial light colour of apple slices in comparison with applications of other anti-browning agents. Evaluation by hedonic scale for sensory assessment showed, that in the beginning of the research untreated apple slices were considered as the tastiest, but after 6 and 9 day storage – apple slices, which were treated with 5% Natureseal® AS1 solution. Quince juice was approved as the most efficient agent in preventing development of microorganisms during storage of fresh-cut apple slices.

Keywords: fresh-cut, anti-browning, vitamin C, phenolics, microorganisms

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THE EFFECT OF HYDROGEN PEROXIDE, OZONISED WATER AND NATURESEAL® AS5 SOLUTION ON THE MICROBIOLOGICAL PARAMETERS OF FRESH-CUT CARROTS

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Innovative (ozonised water, hydrogen peroxide) treatment solutions is one of the newest treatment agents used to decrease the count of microorganisms in vegetables. However, NatureSeal® AS5 is a commercial solution used for the treatment of vegetables worldwide. The aim of this work was to study the effect of the various treatment solutions – hydrogen peroxide, ozonised water and NatureSeal® AS5 (in different concentrations and different treatment times) with the main purpose to ensure the microbiological safety of fresh-cut carrots. Non-treated carrots were used as control sample. The following treatment regimes were investigated: ozonised water treatment time 60, 120, 180±1 s and concentrations 1.0, 2.0, 3.0 mg L⁻¹; hydrogen peroxide solutions, treatment time 30±1 s, 60±1 s, 90±1 s and concentrations 0.5, 1.0 and 1.5%, NatureSeal® AS5 water solution 2.5% 5 min±1 s were prepared for treatment of shredded carrots. *E.coli* in fresh carrots was not detected. Mathematical processing of the obtained results revealed that various concentrations of hydrogen peroxide ($p=0.019$; $\alpha=0.05$) and treatment times ($p=0.049$; $\alpha=0.05$) significantly influenced the TPC colony forming units in carrots. The obtained results prove the treatment agent properties of hydrogen peroxide. The comparison of chosen treatment regimes detected a significant ($p=0.003$; $\alpha=0.05$) influence of the ozonised water on the decrease in the count of TPC colony forming units in carrots after treatment. During experiments it was proved that ozonized water could be recommended as treatment agent for the treatment of fresh shredded carrots.

Keywords: hydrogen peroxide, ozone, NatureSeal® AS5, microbial contamination, carrots

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THE QUALITY EVALUATION OF MINIMALLY PROCESSED PEAR SLICES AFTER FREEZING

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The aim of the study was to investigate the most effective combinations of sweeteners and inhibitors to prevent fruit browning and to maintain the quality of frozen pear slices. Pear cultivar 'Belorusskaya Pozdnaya' was used for the investigation. Ascorbic acid, citric acid and natural cranberry juice were added for colour stabilization. Calcium chloride and calcium lactate were applied for structure stabilization of the product. 15% sugar and 15% fructose syrups were used as sweeteners to improve the taste of pear pieces. Samples were stored at -18 ± 2 °C for 3 months. The best combination of the inhibitors was: ascorbic acid 1.5%, citric acid 0.5% and calcium chloride 0.5%. The samples treated with these inhibitors after defrosting were found to be in best quality, both with sugar and fructose syrup: the content of vitamin C was 71.9–87.3 mg 100 g⁻¹; total phenolic compounds were 72.5–86.8 mg 100 g⁻¹; firmness of pear slices was 15.5–16.2 N. However, the natural inhibitor – cranberry juice delayed fruit slices browning less than calcium chloride inhibitor composition. The results demonstrated that all samples contain soluble solids 11.9 Brix% and small amount of chlorogenic acid 3.5 mg 100 g⁻¹. Nevertheless, sensory evaluation of pear slices the highest was for both control samples.

Keywords: pear, fresh-cut, browning, nutritional parameters

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**TRENDS IN NEW PRODUCT AND
TECHNOLOGY DEVELOPMENT**

**DETECTION AND QUANTIFICATION OF THE MILK PROTEINS
BY RP-HPLC METHOD**

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Protein analysis is very important both in terms of milk quality and technological properties. Despite milk proteins having been extensively studied, there still is a substantial lack of characterization, and particularly of quantitative information, about whey proteins from cow's milk in Lithuania. The aim of this study was to detect major whey proteins α -lactalbumin (α -LA), β -lactoglobulin (β -LG) and bovine serum albumin (BSA) by reversed-phase high-performance liquid chromatography (RP-HPLC). A reverse-phase analytical column C18 (Nucleosil C18, 300 Å, 5 μ m particle size, 250x4.6, Macherey-Nagel, Düren, Germany) and UV detector were used for the analysis. The separation was carried out at 25 °C using the gradient system. All chosen proteins were detected and separated in 90 min; purified bovine milk protein genetic variants were employed in calibration. A linear relationship ($R^2 > 0.99\%$) between concentration and peak areas of individual milk protein variants was observed. The sample injection volume was of 20 μ L. Data collection and evaluation was performed by using LG Solution (Shimadzu Corp., Kyoto, Japan) operating system. In total 120 milk samples were collected individually from normal lactating dairy cows. Milk samples from individual quarters were collected once during the spring, summer and autumn (10 cows / 40 quarter samples / each season). The average concentrations mg mL^{-1} (mean \pm SEM) of α -LA, β -LG and BSA in cow's milk were 0.898 \pm 0.036, 3.330 \pm 0.121 and 0.371 \pm 0.023 in spring, 0.979 \pm 0.029, 2.942 \pm 0.097 and 0.273 \pm 0.030 in summer, 0.835 \pm 0.020, 3.744 \pm 0.156 and 0.349 \pm 0.028 in autumn, respectively. The final results of one-way analysis of variance indicate a significant effect of season on the content of all the proteins analysed α -LA ($p < 0.01$), β -LG ($p < 0.001$) and BSA ($p < 0.05$). In this study was achieved simple and sensitive method for proteins detection and quantification in cow's milk.

Keywords: alpha-lactalbumin, beta-lactoglobulin, bovine serum albumin, milk, RP-HPLC

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DEVELOPMENT OF A SIMPLE RP-HPLC-ELSD METHOD AND EXTRACTION PROCEDURE FOR QUANTIFICATION OF TERPENE LACTONE IN GINKGO PREPARATIONS

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This paper presents the development of simple extraction and analytical method for the simultaneous identification and quantification of the terpene lactone chemical markers in *G. Biloba* preparations.

A rapid extraction procedure has been developed for quantification of terpene lactone in *G. biloba* extracts. Suitable extraction conditions were optimized as follows: methanol – dilute hydrochloric acid mixture (1 : 1) was added to a vial containing a sample. The vial was performed in ultrasonic bath for 5 min and centrifuged. For each sample, the extraction was repeated two more times. All fractions were collected and diluted to 25.0 mL with methanol-water mixture (1 : 1). The combined supernatant extracts were heated in the boiling water bath for 2.5 hours. The optimized RP-HPLC-ELSD methodology: selected column – ACE C8, 4.6 × 250 mm, particle size 5 μm, column temperature – 25 °C, injection volume – 20 μL, evaporative light scattering detector parameters: nitrogen flow rate – 1.5 L min⁻¹; evaporator temperature – 55 °C. The developed and validated analytical procedure presented in this report is profitable for evaluation of the quality of *G. biloba* phytopharmaceuticals.

Keywords: *G. biloba*, terpene lactones, extraction method, RP-HPLC-ELSD

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OPTIMISATION OF SUPERCRITICAL CARBON DIOXIDE EXTRACTION OF *ECHINOPS SPHAEROCEPHALUS* USING RESPONSE SURFACE METHODOLOGY

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Search and characterisation of new sources of valuable bioactive compounds has been in the focus of numerous researchers due increasing demand of functional foods and nutraceuticals. Globe thistle (*Echinops sphaerocephalus*) can be considered as one of promising plants for wider applications. Its seeds contain up to 25% of oil, which is rich in unsaturated fatty acids. The aim of the work was to optimize supercritical carbon dioxide extraction process for isolating lipophilic fraction from globe thistle fruits and to evaluate the properties of obtained extracts.

Response surface methodology and central composite design with three independent variables, pressure (8, 31.5, 55 MPa), temperature (36, 48, 60 °C) and dynamic extraction time (30, 75, 120 min) was used to determine preferable extraction conditions. From calculated response surface model it may be observed that the highest yield ($14.32 \pm 0.41\%$) was obtained at 40 MPa, 50 °C, and 120 min. These conditions were tested on a pilot scale extraction system with 10 L extraction cell and similar extraction yield (15.08%) was achieved. The dominant fatty acid in *Echinops sphaerocephalus* oil was linoleic (68.32%), followed by oleic (21.26%), palmitic (4.98%) and stearic (2.79%) acids. Extract isolated at optimal conditions was also rich in α -tocopherol – $558 \pm 40 \mu\text{g g}^{-1}$ oil.

It may be concluded that the extract isolated from globe thistle fruits by supercritical carbon dioxide may be considered as a good source of food grade oil, which is composed of unsaturated fatty acids and contains valuable tocopherols.

Keywords: optimization, supercritical fluid extraction, globe thistle

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EFFECT OF HIGH HYDROSTATIC PRESSURE TREATMENT ON SHELF LIFE OF STRAWBERRY, ORANGE, ROSE HIP AND HONEY SMOOTHIE

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Smoothies are good source of bioactive compounds, but have short shelf life. Therefore processing methods are searched to extend shelf life and maintain the initial qualities. The aim of this research was to investigate the effect of high hydrostatic pressure and subsequent storage on physical, chemical, and microbiological attributes in a smoothie.

The results on high pressure treatments, showed no significant differences among the different pressures (450 and 600 MPa) and holding times (3 and 10 min) applied. The significant differences were observed along to the storage time. Red tone was slightly lost but luminosity (L^*) remained constant. Conglomerations were observed on the day 42; these could be formed due to syneresis caused by pressure treatment or the activity of some enzymes. Content of bioactive compounds such as anthocyanins and carotenoids, showed a slight tendency to decrease over the 42 day storage time. Vitamin C decreased significantly through storage time and not due to HPP, having losses of almost 85% for the treated samples of the total amount of the starting Vitamin C value. Thus HPP treatments can extend shelf-life of products but some compounds are affected by enzymatic and non-enzymatic reactions which are able to proceed during storage. The HPP has a significant effect on microflora. No yeasts and moulds were present in the treated samples, but as assessment showed spore forming bacteria were able to survive this treatment.

In future, it would be interesting to combine various pressures with temperature in order to understand the possible enzyme inactivation as well as killing of spore forming bacteria.

Keywords: total phenolic content, anthocyanins, carotenoids, vitamin C

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APPLICATION OF HIGH-PRESSURE PROCESSING FOR SAFETY AND SHELF-LIFE QUALITY OF MEAT

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In recent years, there has been growing consumer demand for the minimally processed, chemical additives free and healthier meat, which has led to the development of alternative technologies to conventional heat treatments. High pressure processing (HPP) is known as a non-thermal intervention for extending the shelf-life and safety of meat. The aim of this review is to analyse the scientific literature about the changes that occur in meat after application of the HPP.

The HPP is effective in controlling microflora in meat and meat products at 400–600 MPa, thus extending its shelf-life. The inactivation efficiency of the HPP mainly depends on treatment conditions, type of microorganisms, and food matrix characteristics. However, the HPP may negatively affect meat quality attributes, such as colour, texture, and flavour. Meat processed at pressures above 300 MPa has cooked like appearance, which might be unacceptable to consumers. The HPP increases meat toughness, but when processed at relatively low pressures (100–250 MPa) in combination with increased temperature (above 60 °C) meat becomes more tender. Pre-rigor muscle treatment proved meat tenderization after cooking. It has been revealed that the HPP above 400 MPa makes the polyunsaturated fatty acids more susceptible to oxidation, which may have negative effect on stored meat flavour. Another factor affecting meat flavour may be activity of enzymes. Processing of meat at 150 MPa decreases cook loss and increases water holding capacity. Several researchers suggest using multi hurdle approach (use of antimicrobials and antioxidants) for processing at lower pressures reducing negative effect on quality characteristics.

Keywords: microbial inactivation, meat colour, meat texture, shelf-life

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VIABILITY OF THE PROBIOTIC BACTERIA IN THE SOLUTIONS OF SURFANCTANTS

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In order to increase probiotics stability and resistance to external conditions, probiotic cells are often encapsulated using emulsification method. In the most cases during the emulsification process, the cells are affected by surfactans which could be toxic and can reduce viability of the probiotics. Therefore, there is a growing need to find surfactants that not only ensure the high viability of probiotics, but also do not dis-improve the properties of the capsules.

This paper presents the research when the viability of the probiotic bacteria was evaluated in the surfactants solutions commonly used in the encapsulation process. Three probiotic bacteria strains *Lactobacillus plantarum*, *Lactobacillus acidophilus* and *Lactobacillus helveticus* were inoculated into media with additive of polyoxyethylene sorbitan monooleate (polysorbate 80), polyoxyethylene sorbitan monostearate (polysorbate 60) and polyethylene glycol stearate (PEG 20) solutions. Bacterial growth was assessed for 24 hours. Results showed that PEG 20 did not affect bacterial growth, though the emulsion with this emulsifier separated. Good stability of the emulsion and small capsules were obtained with polysorbate 60, but this surfactant had bactericidal activity against *L. helveticus* and *L. acidophilus*. Polysorbate 80 had no bactericidal or bacteriostatic effect and emulsion was stable, though capsules had largest diameter. This research revealed that none of the used surfactants ensured stable emulsion and small capsules with low polydispersity index, as well as high viability of the probiotics. Therefore, future works should focus on search of the surfactants which would not affect neither the viability of the probiotics, nor the properties of the capsules.

Keywords: probiotic, viability, encapsulation, emulsification, surfactants

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BLACK SOYBEAN COAT AS A SOURCE OF NATURAL PIGMENTS: EXTRACTION AND ENCAPSULATION

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The goal of this study was to extract and encapsulate black soybean coat as a source of anthocyanins. For that purpose extracts were obtained using different solvents (ethanol, ethanol with citric acid, and ethanol with acetic acid) and freeze dried using maltodextrin as carrier material. Effects of solvents on physicochemical properties of extracts and encapsulates were investigated. The content of total phenolic compounds, total and individual anthocyanins were analysed in both type of samples. Water activity, bulk and tapped density, solubility and FTIR analysis were done for all encapsulates. Regarding potential applications of the encapsulates as bioactive food supplements, as well as natural pigments, the measurements of their total antioxidant capacity and colour were carried out. Freeze drying of soybean coat extracts with maltodextrin resulted in formation of non-uniform and porous encapsulates with irregular shapes. All the encapsulates exhibited significant antioxidant potentials. Low water activity ($a_w=0.2$), fair flow characteristics, high solubility (approximately, 90%) and high yields were achieved. The content of total anthocyanin in the encapsulates ranged from 1.7 to 2.3 mg CGE g⁻¹, with cyanidin-3-glucoside as the predominant.

Presented results imply that freeze drying could be used as effective technique for encapsulation of soybean coat extracts obtained using ethanol with citric acid as a solvent. Thus, black soybean coat, as a main by-product of soybean processing, could be used as a raw material for producing of natural pigments and / or functional food ingredients.

Keywords: black soybean coat, anthocyanins, extract, freeze drying, encapsulation

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CEREAL BY-PRODUCTS CONVERSION TO STOCK WITH HIGH CONTENT OF *P. ACIDILACTICI* BY USING ENZYMATIC TREATMENT COMBINED WITH SOLID STATE AND SUBMERGED FERMENTATION

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The aim of this study was to apply the enzymatic treatment and fermentation with *Pediococcus acidilactici* BaltBio01 MSCL P1480 for industrial cereal by-products on purpose to produce food/feed stock with high amount of lactic acid bacteria (LAB). Also, the possibility to use the potato juice for *P. acidilactici* multiplication was analyzed. Potato juice was found suitable substrate for *P. acidilactici* cultivation (cells count $9.6 \log_{10}$ CFU mL⁻¹). Two techniques (freeze- and spray-drying) were used for *P. acidilactici* stabilization in potato juice. Stabilized by spray-drying LAB powder remained stable ($7.0 \log_{10}$ CFU g⁻¹ of viable cells) during 12 months of storage and was used as bacterial starter for cereal by-products fermentation. The changes of microbial profile, BAs, mycotoxins, lactic acid (L+/D-), lignans and alkylresorcinols (ARs) contents of fermented cereal by-product were analysed. Cereal by-products enzymatic hydrolysis before fermentation allows obtaining a higher count of LAB during fermentation. Fermentation with *P. acidilactici* reduces mycotoxins content in fermented cereal by-products, and there was a significant effect of cereals enzymatic hydrolysis before fermentation on AFL, ZEA and DON concentration in cereal by-products. The BAs concentrations in fermented cereal by-products were far below those levels associated with a health risk. The use of *P. acidilactici* for cereal by-product fermentation increased matairesinol and secoisolariciresinol content, however ARs contents were reduced. According to our results multiplied in potato juice *P. acidilactici* could be used for cereal by-products fermentation, as a potential resource to produce safer food/feed stock with high amount of LAB for industry.

Keywords: cereal by-products, *Pediococcus acidilactici*, fermentation, enzymatic hydrolysis, mycotoxins

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**ENRICHMENT OF FRUIT LEATHERS WITH BERRY PRESS CAKE POWDER
INCREASE PRODUCT FUNCTIONALITY**

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Fruit leathers are tasty, chewy, dehydrated fruit products which are eaten as snack or dessert. Dried berry press cake powders could be a promising ingredient for enhancing nutritional value of such products. In this study, fruit leather made of apple and black currant puree was enriched with two different berry press cake powders (1) freeze-dried raspberry press cake powder (dry-matter content 97.3%) (2) convectionally dried black currant press cake powder (dry-matter content content 95.4%). The contents of total phenolics, total anthocyanins, antioxidant activity, colour and textural properties of the test samples was evaluated.

The content of phenolic compounds in raspberry and black currant press cake powders was 28.5 and 25.4 mg 100 g⁻¹ respectively. The content of anthocyanins in black currant press cake powder was more than 14-fold higher than in raspberry press cake powder. The addition of berry press cake powder reduced hardness of the fruit leathers. Fruit leather with black currant press cake powder was two times softer than the control. Raspberry press cake additive increased the lightness (L*=24.0) and the redness (a*=3.4), whereas black currant press cake powder reduced the lightness (L*=22.5) and the redness (a*=1.5) of the product. The content of anthocyanins in the fruit leathers enriched with black currant press cake powder was significantly higher than in control sample (116.4 and 74.1 mg 100 g⁻¹, respectively). Berry press cake powder also increased antioxidant capacity of the fruit leathers. The results of the study can be useful for health-conscious food producers and consumers.

Keywords: fruit leathers, berry by-products, total phenolics, texture

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FACILITIES OF BREAD ENRICHMENT WITH CALCIUM BY USING EGGHELL POWDER

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Today's food ration does not often contain enough vitamins, fiber, macro- and micronutrients, especially calcium.

Research aim – to study possibilities for the use of the eggshell powder in the production of bread enriched with calcium.

For the study, the free-range hen eggshells, main components of which are inorganic salts (calcium carbonate (98.4%), magnesium carbonate (0.8%) and tricalcium phosphate (0.8%), protein (6.4%), water (1.7%) and lipids (0.03%), were used. The eggshells have been washed, dried and ground. To avoid changing the texture of bread, the solubility of the eggshell powder was tested by putting different quantity eggshell powder (2.5, 5 and 7.5 g) into a solution of citric acid of different concentrations (2%, 4% and 6%) and rye sourdough with lactobacilli for 12 hours. After discovering good solubility of the eggshell powder in the fermented leaven samples, sourdough of rye bread was prepared (control, 1%, 2%, 3%, 4%; 5% addition of eggshell powder from mass leaven) and using them six samples of wheat bread were baked.

To estimate influence of eggshell powder on quality of a product and the acceptability of bread for consumers, the organoleptic analysis of samples of bread was made, porosity, moisture content, acidity, the actual acidity, specific volume of bread were defined, and also nutritional value and amount of calcium were calculated.

The study showed that when making the bread enriched with calcium, it is recommended to add an eggshell powder to rye sourdough with lactic acid bacteria without prior dissolution in acid. Sensory evaluation shows no change of taste and odor. The sensory evaluation shows no taste and odor changes. By increasing the amount of eggshells, bread porosity and specific volume of bread increased, while acidity and active acidity decreased. Best quality indicators marked bread with 3% of eggshell powder.

Keywords: eggshell powder, calcium carbonate, bread, lactic acid bacteria, yeast

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INVESTIGATION OF IMMATURE GRAINS IMPACT ON QUALITY PROPERTIES OF PASTRY PRODUCTS

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Current research has been supported by the National research programme AgroBioRes. In Latvia as well as in the world most used cereal grains are wheat. According to the traditions Latvia's inhabitants in their diet also include such grains as rye and oats. Each grain species has its own characteristics and different nutrient composition. In order to vary and enrich with valuable nutrients people could include in their diet potentially diverse and untraditional cereals such as hull-less barley and triticale. One of the possibilities how to gain benefit from grains further are usage of immature grains, which have a high nutritional value. Biscuits are a lot consumed, but they have low nutritional value. Therefore goal of this study was explore quality of biscuits made from different cereals varieties and enriched with immature grains flour. Main quality parameters using standard methods were analysed as: moisture content, dietary fibre, sugars, and protein content as well as sensory properties. The study results showed significant ($p < 0.05$) increase in moisture, dietary fibre, sugars and proteins content in samples with immature grains, but sensory indicators for the same products showed insignificant changes in comparison with biscuits without immature grain flour additive. Partly substitute traditional flour with immature grain flour it is possible increase nutritional value of biscuits without significant impact on sensory characteristics.

Keywords: immature grains, pastry, quality parameters, biscuits

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**FOOD CHEMISTRY, ANALYSIS
AND QUALITY ASSESSMENT**

FOODBALT 2017

MORFOMETRIC AND BIOCHEMICAL ANALYSIS OF YEAST CELLS UNDER LOW TEMPERATURE STORAGE

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The aim of the research is to measure thiol compounds as well as glycogen content in yeast cells of different sizes during long-term storage at low temperature. The size, SH-groups and glycogen content changes in the *S. cerevisiae* cells were studied over the period of 35 days storage at 0 ± 5 °C. The new morfometric method used has showed that the total amount of cells and number of large cells ($7-8 \times 12-15$ μm) remained unchanged when compared with control under model conditions; the number of budding yeasts decreased 4 times, and the number of dead cells increased 2 times during the storage period. The number of middle size cells ($5-7 \times 10-12$ μm) decreased 1.2 times, while the number of small cells ($4-5 \times 7-9$ μm) increased 9.5 times. Under the same conditions the quantity of low molecular SH-groups increased 2 times, while protein-containing SH-groups dropped down by 31%. The content of glycogen decreased 1.2 times. The results elaborated revealed that generally yeasts under unfavourable conditions lose the deposition nutrients such as glycogen and store up the adaptive SH-containing substances. The cells of a large size probably have more high adaptation capacity to long-term storage at low temperature and in the absence of a nutrient medium. The rising amount of small cells and of low molecular SH-groups evidently indicates the development of adaptation state in the yeast population. Future investigations have to find out the range correlations between morphologic parameters of yeast cells and the content of biochemical substances.

Keywords: yeast, size of cells, thiols

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PREVALENCE AND ANTIMICROBIAL RESISTANCE OF ENTEROPATHOGENIC *YERSINIA* IN PIG TONGUES AT RETAIL MARKETS IN LITHUANIA

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The Lithuania remains as one of the leader in confirmed yersiniosis cases per 100 000 population among EU member states during the last decade. The contaminated pork and pork products, including pig tongues, are known as one of a main sources of human infection. The objective of this study was to determine the prevalence of enteropathogenic *Yersinia* in pig tongues at retail markets and compare the antimicrobial resistance of *Y. enterocolitica* strains isolated from pig tongues and humans in Lithuania.

Altogether, 58 pig tongue samples collected from 10 markets in Lithuania in a period of 2015–2016 were tested. In total, 10 *Y. enterocolitica* strains isolated from pig tongues and 19 *Y. enterocolitica* isolated from human clinical samples, were tested for resistance to five antimicrobial agents: tetracycline, ampicillin, erythromycin, streptomycin and ciprofloxacin.

Human pathogenic *Y. enterocolitica* serotype O:3 and serotype other than O:3 (O:8; O:9; O:5,27) was found in 10% and 7% of sampled pig tongues, respectively. All *Y. enterocolitica* strains isolated from humans and pig tongues were resistant to erythromycin and ampicillin and sensitive to ciprofloxacin and tetracycline. In total, 10% of *Y. enterocolitica* isolated from pig tongues and 5% isolated from humans were resistant to streptomycin.

The study revealed a high prevalence (17%) of enteropathogenic *Y. enterocolitica* in pig tongues at retail market in Lithuania. These findings indicate a risk of human yersiniosis due to consumption of improperly heat treated pig tongues. No significant difference in antimicrobial resistance among bacteria strains isolated from pig tongues and humans was observed.

Keywords: *Y. enterocolitica*, prevalence, pig tongue, multiplex PCR, antimicrobial resistance

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USAGE OF ESSENTIAL OILS COMPONENTS AND LACTIC ACID IN MINCED PORK

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The aim of the research is to evaluate an impact of the essential oils components (cinnamaldehyde, thymol, linalool) and lactic acid mixtures on the quality indexes of minced pork. The object of the research is minced pork, without added water, mixed with aquatic solutions of thymol, linalool and cinnamaldehyde, containing lactic acid. After the analysis of the results, statistically reliable pH change was in all groups of pork samples, in comparison with control ($p < 0.05$). The counts of yeast and mould in the pork samples were decreased, however results were not statistically reliable ($p > 0.05$). During the all research the counts of yeast and mould were most decreased in samples processed with thymol (0.3%) and lactic acid (0.5%), there were no yeast and mould observed after 24 hours as well as after 3 days of storage. Total number of biogenic amines in pork samples processed with thymol and lactic acid was significantly decreased ($p < 0.05$). After evaluation of pork sensory properties common flavour intensity was in minced pork samples, processed with linalool and lactic acid mixture. Pork minced meat processed with cinnamaldehyde and lactic acid had more intense residual taste, and more intense outside taste.

Keywords: cinnamaldehyde, thymol, linalool, lactic acid, biogenic amines

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USED FOOD OILS: PHYSICAL-CHEMICAL INDICATORS OF QUALITY DEGRADATION

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Used food oil (UFO), designated as frying oil, is a residue. Degradation by reuse or during storage, may occur by contacting, chemical, enzymatic and microbiological pathways, but oxidation is a major concern of the industry, as it affects sensory and nutritional quality of edible oils, with potentially toxic compounds formation. In Portugal, UFO's main destination still is the sewerage system, a prohibited but common practice, an environmental problem and waste of raw material, which can be valued. However, quality control of edible oils applied to UFO's, often results into impractical expensive analysis in small laboratories and catering industry. This project, developed with the Musketeers Group Portugal co-promotion (2012–2016), aimed to identify low-cost physicochemical parameters in order to select UFO's *Quality Degradation Indicators* (QDI) that indicate defect attributes, quickly and accurately. It was proposed on-the-use UFO's analysis, from industrial frying, and by degradation induced in the laboratory (frying and heat stability tests), through the parameters: humidity, a_w , total acidity, peroxide index, iodine index, color (CIE, CIE Lab), UV absorbency and monitoring by Total Polar Compounds and microbiological control. Applying *Best Laboratory Practices Available*, internal procedures (ESAS) were validated, redefining working ranges and test conditions, as standards procedures did not provide reliable results for the entire life cycle of oil, whose profile changes with time and reuse. Results demonstrate significant differences with quick response parameters, total acidity, peroxide index and CIE Labcolor, outlined as QDI's. Humidity, a_w and CIE color proved to be inadequate. Iodine Index and UV absorbency profiled as reference methods.

Keywords: used edible oil, physicochemical parameters

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CONTENT AND COMPOSITION OF ESSENTIAL OIL OF OREGANO GENETIC RESOURCES IN LATVIA

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Oregano (*Origanum vulgare* L.) is one of the paramount species of genetic resources of medicinal and aromatic plants (MAPs) in Europe. The fundamental *ex situ* collection of MAPs in Latvia is attached to the Latvia University of Agriculture, Faculty of Agriculture, Institute of Agrobiotechnology, Laboratory of Horticulture and Apilology. It is located in Jelgava, Strazdu iela 1 (N 56° 39' 47"; E 23° 45' 13``). It includes 44 accessions of oregano collected all over the Latvia. The aim of this research was to evaluate the content and composition of essential oil of oregano genetic resources. The samples for experiment were selected from an *ex situ* collection, the accessions were cut in the stage of full flowering. The samples were dried at +26 °C temperature in a special drying cabinet with ventilation. The content and composition of essential oil were analysed at the Department of Vegetable and Medicinal Plants of Warsaw University of Life Sciences. Essential oil was isolated using solvent-free microwave extraction method. The analysis of distilled essential oil was performed using a gas chromatograph Hewlett Packard 6890 equipped with flame ionization detector FID and polar capillary column HP 20M. The results showed that the variability between samples and between years was significant ($p < 0.05$). In average, the content of essential oil (mL 100 g⁻¹ DW) was 0.1 in 2012, 0.1 in 2013, 0.19 in 2014. The most important compounds were caryophyllene oxide, β -caryophyllene, spathulenol, germacrene D and linalool. Oregano samples were not rich with thymol and carvacrol.

Keywords: oregano, essential oil, content, composition

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ISOLATION OF AROMA COMPOUNDS AND ANTIOXIDANTS FROM OREGANO (*ORIGANUM VULGARE*) BY CONVENTIONAL AND HIGH-PRESSURE EXTRACTIONS

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Oregano (*Origanum vulgare*) is flowering herb, widely cultivated in Europe, Asia, North and South America. Oregano is an important culinary herb, used in folk medicine for its antiseptic, toning, immune system strengthening, and diuretic properties. Due to the presence of important aroma compounds, oregano essential oil has wide applications in cosmetics and personal care product manufacturing. The aim of this study was to apply hydrodistillation, Soxhlet and supercritical carbon dioxide (SFE-CO₂) extractions for valuable aroma compounds and antioxidants recovery from oregano, grown in Lithuania.

Essential oils after hydrodistillation from ground plant material amounted 0.13–0.21 ml 100 g⁻¹ DW. Sabinene, α -pinene, α -caryophyllene and germacrene D were the main identified compounds in essential oils. After SFE-CO₂ (25–70 °C, 27.5–45 MPa, 210 min) 1.3–2.3 g 100 g⁻¹ DW of non-polar constituents was obtained from oregano. 5% EtOH modifier resulted in ~1.2–1.9-fold higher SFE-CO₂ yields, similar to those for n-hexane Soxhlet extraction (2.4–3.3 g 100 g⁻¹ DW). The antioxidant potential of water-soluble fraction after hydrodistillation and non-polar extracts after Soxhlet and SFE-CO₂ was evaluated measuring total phenolic content (26–377 mg GAE g⁻¹) and radical scavenging properties (TEAC_{DPPH} = 6–481 mg TE g⁻¹; TEAC_{ABTS} = 16–940; TEAC_{CORAC} = 125–2082 mg TE g⁻¹). Several compounds with well-reported antioxidant properties (e.g. squalene) were identified in SFE-CO₂ extracts. Nevertheless, considerable portion of antioxidants remained in *O. vulgare* solid residues (TPC=75–158 mg GAE g⁻¹; TEAC_{DPPH} = 80–251 mg TE g⁻¹; TEAC_{ABTS} = 185–479 mg TE g⁻¹; TEAC_{CORAC} = 299–750 mg TE g⁻¹) and could be further recovered applying pressurized liquid extraction (PLE) with different polarity food-grade solvents.

Keywords: *Origanum vulgare*, high-pressure fractionation, essential oils, antioxidant activity

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INFLUENCE OF HARVEST TIME ON THE PHENOLIC CONTENT OF HORSERADISH LEAVES

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A perennial herb horseradish (*Armoracia rusticana* L.) contains biologically active substances and cultivated in temperate regions of the world. The aim of the current research was to determine the content of phenolic compounds and antioxidant properties of horseradish leaves depending on harvest time. For experiments horseradish leaves three years at six different times (during the period from May to October) were collected. Fresh plant material was extracted with ethanol using conventional extraction. For all extracts total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activity (DPPH[•], ABTS radical scavenging activity (SA), reducing power) were determined using a spectrophotometric method. Results showed that content of phenolic compounds and antioxidant activity of horseradish leaves were significantly affected by harvest time and year. The highest TPC and ABTS radical scavenging activity was observed in the horseradish leaves collected in May, but highest TFC and antioxidant activity (DPPH[•] radical scavenging activity (SA) and reducing power) was observed in June. The content of phenolics compounds and antioxidant activity significantly decreases during post flowering stage and continues till October. Horseradish leaves contain considerable content of phenolics compounds and natural antioxidants. In further experiments, use of horseradish leaves as natural antioxidants in different food matrixes should be studied.

Keywords: horseradish, harvest time, antioxidant, phenolic

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PHENOLIC PROFILE OF FRESH AND FROZEN NETTLE, GOUTWEED, DANDELION, AND CHICKWEED LEAVES

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Worldwide it is of great interest to find new and safe antioxidants from natural sources. Green leafy vegetables and wild plant leaves are healthy nutrients, containing vitamins, minerals and biological active compounds, therefore these plants provide beneficial health effects due to the presence of antioxidant compounds. It is useful and popular to supplement human diets with fresh or frozen edible plants. It is known that freezing may help to preserve the quality of plants, and is superior to other preservation methods. The aim of research was to compare the phenolic compounds content of fresh and frozen edible wild plants leaves grown in Latvia. The samples were processed using freezing -20 °C and for a comparison fresh samples were analysed. The leaves of stinging nettle (*Urtica dioica*), common goutweed (*Aegopodium podagraria*), dandelion (*Taraxacum officinale*) and chickweed (*Stellaria media*) were collected in May 2016 in Latvia. In the current research the content of total phenolics was determined in four types of fresh and frozen plant leaves and they can be arranged as follows (starting from plant with less phenolics content as gallic acid equivalent): dandelion < chickweed < goutweed < nettle. The freezing process affected the values of extracted phenolics and results in an increase in the extractability of the polyphenols for about 9.3%. Using HPLC analysis, we quantified the eight most abundant phenolics: catechin hydrate, protocatechic acid, α -resorcylic acid, vanillic acid, sinapic acid, rutin, quercetin, luteolin, kaempferol. Experimentally it was ascertained, that in the frozen plant samples contents of some polyphenols increased ($p=0.007$), compared to the fresh samples.

Keywords: edible wild plants, phenolic compounds, HPLC

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ANTIOXIDANT ACTIVITY AND PHYTOCHEMICAL COMPOSITION OF EXTRACTS FROM *PAEONIA OFFICINALIS* LEAVES

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Paeonia officinalis has been used in folk medicine, while the reports on its antioxidant properties and phytochemical composition are rather scarce. This study was aimed at determining antioxidant activity and phytochemical composition of extracts isolated from *Paeonia officinalis* leaves with methanol and water by pressurized liquid (PLE) and traditional extraction methods, respectively. The composition of extracts was analysed by high performance liquid chromatography with UV detection (HPLC-UV) and ultra performance liquid chromatography coupled with mass quadrupole time of flight detector (UPLC-Q-TOF). In total 25 components were detected in the investigated extracts and 19 of them were identified. The major constituents were gallic acid and its derivatives (digallic acid, methyl gallate, methyl digallate, tri-galloyl-hexose and others). The extracts were also tested for their antioxidant activity by using *in vitro* and *ex-vivo* methods. Water extract was stronger antioxidant in ABTS^{••} and DPPH[•] scavenging and hydroxyl radical antioxidant capacity (HORAC) assays, while methanol extract possessed higher oxygen radical absorbance (ORAC) and hydroxyl radical scavenging (HOSC) capacity assays. Water extract containing higher total phenols content value than methanol extract demonstrated stronger antioxidant activity in cellular antioxidant activity assay (CAA).

The results obtained in this study show that *Paeonia officinalis* extracts are a good source of bioactive compounds possessing strong antioxidant capacity; therefore this plant may be further considered as a promising material for the development of functional ingredients for foods, nutraceuticals and natural medicine.

Keywords: *Paeonia officinalis*, antioxidant activity, phytochemicals

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INFLUENCE OF LYOPHILIZATION AND CONVECTIVE TYPE DRYING ON ANTIOXIDANT PROPERTIES, TOTAL PHENOLS AND FLAVONOIDS IN POLLENS

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Pollen is one of the most popular beekeeping products surpassed by honey and wax. In nature there is no food analogue, which can compare to pollen in terms of those biologically active substances, which are necessary for normal development and functioning of human body. The aim of this research was to determine total content of antioxidants, total flavonoids, total phenols, and antiradical activity in lyophilized and convection type dried pollen samples.

Content of total antioxidants (with DPPH), total flavonoids, total phenols and antiradical activity was determined by spectrophotometric method. 3 different pollen samples were analysed – fresh pollen, dried pollen at 42 °C and lyophilized pollen. Results of the analysis showed that the highest total antioxidant content is in fresh pollen – 0.0511 mg ACE 100 g⁻¹, but lowest in lyophilized pollen – 0.0415 mg ACE 100 g⁻¹. Dried pollen contains 17% less and lyophilized pollen – 19% less antioxidant content than in fresh pollen. Total antioxidant content in dried and lyophilized pollen is similar – it differs only by 2%. Total phenol content in dried pollen is 56.89 mg GAE 100 g⁻¹, in lyophilized pollen – 54.11 mg GAE 100 g⁻¹. Total phenol content in fresh pollen is 61.64 mg GAE 100 g⁻¹. Both thermal treatment and lyophilisation decreases flavonoid content in pollen. Thermal treatment affected by lower losses of total antioxidants, total flavonoids, total phenols and antiradical activity than in lyophilisation process.

Keywords: drying, lyophilisation, pollens, total phenols

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EVALUATION OF BIOLOGICALLY ACTIVE SUBSTANCES IN SPECIALTY COFFEES

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Coffee consumption in the world increased over the last 50 years. Recently the popularity of specialty coffee is increasing due to consumers' preference of high quality products. Coffee contains wide range of bioactive compounds as caffeine, antioxidant compounds, furans, pyrazines, esters etc. and extraction of these compounds depends on brewing method. The aim of current research was to evaluate biologically active substances in specialty coffees depending on brewing method. For experiment ten coffee samples were selected – 7 specialty coffees and for comparison 3 commercial samples. Coffee drinks were prepared using three methods: filtration, French press and pressure method (espresso). For all coffee samples aroma compounds were analysed and extraction of aroma compounds was performed using solid phase microextraction (Car / PDMS fibre). Analysis of volatile aroma compounds were made using a Perkin Elmer Clarus 500 GC / MS. For coffee samples the total phenol content (TPC) and DPPH, ABTS⁺ radical scavenging activity were determined spectrophotometrically. Mainly in specialty coffee samples content of biologically active substances were significantly higher. Although one of commercial samples had high TPC. Comparing brewing methods, higher content of biologically active compounds were determined in coffee drinks prepared by pressure method. The main volatiles in coffee samples were furans and pyridines and their profile were significantly influenced by both – type of coffee (specialty or commercial) and brewing method. These results gives first insight about benefits of specialty coffee but as popularity of such a products increases it is necessary to continue these investigations.

Keywords: specialty, coffee, brewing method, volatiles, TPC

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EVALUATION OF NUTRITIONAL QUALITY OF PROTEIN BREAD ENRICHED WITH CHIA (*SALVIA HISPANICA*)

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In times of economic turbulences linked to the fast-growing human population and the consequent increasing demand for food and energy, the utilization of crops residues as raw materials in a biorefinery approach is essential. Development of new renewable bio-based products could be a promising alternative that can unhook widespread dependence on fossil resources.

Single-screw extruder is a solvent-free technique used for Chia seed oil extraction and residual cakes were typically considered as by-products. In the framework of valorization of these cakes, the aim of our current study was to investigate the effect of chia seed cakes addition to protein breads. Thus, 1 to 6% of chia seeds and cakes were added to breads and different parameters were examined: moisture content, color $L^*a^*b^*$, hardness, total phenolic content, DPPH, ABTS radical scavenging activity, and nutritional value.

As the percentage of chia seeds and cakes increased an increasing tendency of moisture content, bread softness, color darkness as well as total phenolic content and radical scavenging activity compared to control was observed. Hence, the overall results showed that addition of chia seeds and cakes can improve the antioxidant potential and quality of protein bread which confirm that bread production could be an alternative way for valorization of chia seed oil by-products.

Keywords: chia, by-products, protein bread, antioxidant activity, bread quality

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EFFECT OF STORAGE TECHNOLOGY ON STRUCTURE AND SOME PHYSICAL ATTRIBUTES OF APPLES (*MALUS DOMESTICA* BORKH.)

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In this study, six frequently grown and commercially available cultivars of apples (*Malus domestica* Borkh.) grown in Latvia: 'Auksis', 'Orlik', 'Antej', 'Belorusskoje Malinovoje', 'Sinap Orlovskij', and 'Zarja Alatau' were chosen to evaluate the influence of 1-Methylcyclopropene treatment and Ultra-low oxygen conditions on the changes of structural and physical parameters of apple fruits while long-term storage. Experiments have been carried out during the period from 2013 to 2014 at Experimental Processing Department of the Institute of Horticulture, Latvia University of Agriculture in Dobele. During the research physical characteristics of apples: fresh weight loss, flesh firmness, and specific surface area of the cells had been evaluated. From the results is evident that better preservation of fresh weight loss has been obtained for samples kept in the ULO2 with controlled atmosphere. Our findings disclose that ULO1 and ULO2 maintained the fruit firmness better than cold storage. Results obtained after SEM analysis showed that Ultra-low oxygen storage has resulted in less pronounced de-compartmentalisation of apple matrix, nevertheless cellular membrane cracking and collapse as part of the normal metabolism of the product was evident. Furthermore, ULO storage has affected on better cohesion and higher compressibility of the cells found in apple. A significant positive effect of 1-MCP on cell integrity was also evident, where cell wall disassembly in many cases was more pronounced when apples were kept for a long-term storage under cold storage.

Besides, there was significant difference in cell size loss among all storage technologies while fruit storage, the changes were considerably slower in ULO1 storage than in other technics applied.

Keywords: surface area, 1-methylcyclopropene, structure, apple matrix

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EFFECT OF STORAGE TECHNOLOGY ON SOME CHEMICAL ATTRIBUTES OF APPLES (*MALUS DOMESTICA BORKH.*)

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Apples are by far the most common fruit crop consumed in Latvia. In general, fruits are an important part in the human diet in that they provide many essential nutrients, such as vitamins, minerals, complex carbohydrates, dietary fibre and antioxidants. Apple storage in conditions of low oxygen concentration slows down the intensity of fruit respiration providing constant quality parameters during long-term storage. 1-Methylcyclopropene, an inhibitor of ethylene perception, has been commercialized as SmartFresh technology for postharvest use on fruits and vegetables around the world.

Experiments have been carried out during the period from 2013 to 2014. Research has been performed at Experimental Processing Department of the Institute of Horticulture, Latvia University of Agriculture in Dobele. During the research chemical parameters (soluble solid, total acids, vitamin C, total phenols, pectin content) apples had been evaluated.

Results indicate that soluble solids content increases during the storage for the most apple samples. The largest reduction of total acid content was observed in the control sample apples, while treatment of apple with 1-MCP and storage in the reduced oxygen environment of ULO chambers slows down the enzyme activity, resulting in lower changes of total acid content. Comparing data between storage types statistically, significant ($p > 0.05$) differences for the total phenolic content (excluding ULO1 storage technology option) were not identified. Vitamin C and pectin content of apples stored in different conditions during 6 months changed differently.

This research examines the influence of 1-methylcyclopropene treatment and Ultra-low oxygen conditions on the changes of chemical parameters of apple fruits while long-term storage.

Keywords: chemical composition, 1-methylcyclopropene (1-MCP), ultra low oxygen (ULO)

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COMPARISON OF VOLATILE AND PHENOLIC COMPOSITION OF COMMERCIAL AND EXPERIMENTAL CIDERS

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Nowadays in Latvia small wine and cider producing companies developing rapidly and it is important to develop best technological conditions. For evaluation it is necessary to compare the quality parameters of experimental and commercial ciders available in retailing. The aim of current research was compare the qualitative and quantitative content of phenolic and volatile compounds in commercial and experimental ciders.

In experiment five ciders produced in Latvia, three in France, and one sample from Ireland, Finland, South Africa were tested. From experimental ciders the best 10 samples were selected differing by raw materials, fermentation and maturation technology. For samples the total phenolic concentration was determined spectrophotometrically and volatiles using SPME followed by GC / MS. The total phenols content in commercial ciders is from 324.24 to 3831.33 mg L⁻¹, and in the experimental ciders the total phenols content was similar: from 793 to 3399 mg L⁻¹. The phenols content among commercial ciders is significantly higher in ciders produced in France. A lower content of volatile substances was identified in French ciders, while the highest content in the cider produced in Latvia. The main classes of were alcohols (6.53–74.05%), and esters (18.81–73.61%), with the most characteristic ones being ethyl carpylate, hexyl acetate, ethyl hexanoate, 3-methylbutyl acetate and ethyl decanoate. Experimental ciders matured with lactic acid bacteria *Oenococcus oeni* and oak chips show a content of volatile compounds similar to that of French ciders. The crab variety 'Kerr' experimental cider sample, in turn, shows a profile of volatile compounds similar to Latvian ciders.

Keywords: experimental cider, commercial cider, total phenols, volatile compounds

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CHEMICAL COMPOSITION AND STABILITY OF CAMELINA (*CAMELINA SATIVA*) SEED OIL OBTAINED BY CONVENTIONAL AND HIGH-PRESSURE EXTRACTIONS

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Camelina (*Camelina sativa*) is an annual oilseed crop, belonging to *Brassicaceae* family. Camelina seeds contain 30–40% of oil, which is a good source of unsaturated fatty acids and natural antioxidants with high potential for nutritional, medical and technical applications. The aim for this study was to compare the efficiency of conventional Soxhlet, supercritical carbon dioxide (SFE-CO₂) and pressurized liquid extraction (PLE) techniques for oil extraction from seeds of *Camelina sativa*, grown in Lithuania.

The results of this study showed that 31.4–46.5 g 100 g⁻¹ DW of oil were obtained by Soxhlet extraction. The yield of SFE-CO₂ varied from 21.6 to 43.4 g 100 g⁻¹ DW. PLE with hexane was optimized using central composite design and response surface methodology to determine the effect of temperature (80–120 °C), extraction time (10–20 min) and solvent volume (70–130%) on the total extraction yield. The highest hexane fraction yield of 44.8 g 100 g⁻¹ DW was obtained at 120 °C temperature, 20 min extraction time and 130% solvent volume. Also fatty acid composition and tocopherols content was determined in all lipophilic fractions obtained in experiment. *In vitro* antioxidant properties of *Camelina sativa* seed oil were assessed as oxygen radical scavenging capacity and TEAC_{ORAC} values ranging from 44.5 to 317.4 mg Trolox g⁻¹ were obtained. Peroxide value correlating to the lower oxidative oil stability in Oxipres method, were increasing as follows: SFE-CO₂ (IP 1.1–2.4 h) < Soxhlet (IP 2.7–3.1 h) < PLE (IP 1.5–4.0 h). Antioxidant potential of starting plant material (TPC = 13.4 mg GAE 100 g⁻¹, TEAC = 13.8–77.8 mg TE 100 g⁻¹) and seed press-cakes after oil extraction (TPC = 7.9–21.8 mg GAE 100 g⁻¹, TEAC = 11–83.1 mg TE 100 g⁻¹) was determined by QUENCHER approach, indicating that these by-products could be further biorefined into valuable antioxidant fractions.

Keywords: *Camelina sativa* seed oil, high pressure fractionation, fatty acids, tocopherols, antioxidant activity

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ANTI-AGING COMPOUNDS IN LATVIAN WILD GROWING PLANT OF *FALLOPIA JAPONICA*

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Fallopia japonica (Japanese knotweed) native to Japan is an aggressively invasive plant in the world, but also it contain a biological active natural compounds. Most important compounds of anti-aging by which can activate responsible gene sirtuin in nature is stilbenes resveratrol (3,4',5-trihydroxy-trans-stilbene), piceid (resveratrol-3- β -mono-D-glucoside), flavonoid – butein (1-(2,4-dihydroxyphenyl)-3-(3,4-dihydroxy-phenyl)-2-propen-1-one), flavones – fisetin (3,3',4',7-tetrahydroxyflavone, 5-deoxyquercetin) and quercetin (2-(3,4-dihydroxyphenyl)-3,5,7-trihydroxy-4H-1-benzopyran-4-one). The aim of this study was to determine the anti-aging compounds of Latvian wild growing plant of *Fallopia japonica* (Japanese knotweed). Before extraction roots of *Fallopia japonica* was convective dried at 60 °C. For the extraction of the anti-aging compounds from fallopian japonica roots as ethanol/water solution with the concentration 70% (v/v) was used. High performance liquid chromatography (HPLC) method were used for analysis of anti-aging compounds: resveratrol, piceid, butein, fisetin and quercetin. The obtained results showed, that the main anti-aging compounds detected by HPLC method in *Fallopia japonica* were stilbenes: resveratrol and piceid. Flavone – fisetin was detected in significantly lower concentrations than resveratrol and piceid. The remaining compounds, quercetin and butein, were detected in trace amounts.

Keywords: anti-aging, *Fallopian japonica*, Japanese knotweed, resveratrol, HPLC

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QUALITY OF TOMATOES DURING STORAGE

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Tomatoes (*Solanum lycopersicum*) are well known antioxidants, vitamins and other health beneficial compounds containing vegetable. Different qualitative and quantitative changes of chemical composition take place during tomato fruit ripening. Research with the aim to evaluate the chemical composition (soluble solids, titratable acidity, vitamin C, total phenols) of tomatoes stored under ambient conditions was set up during year 2016.

The study involved five tomatoes varieties cultivated and collected from greenhouse at green stage of ripening, then stored at room air temperature from 18.0 to 19.0 °C and relative humidity from 40.2% to 50.6% for 36 days. Collected data showed that the highest increase (in average for 12.6%) of total soluble solids content was observed till 24 days of storage. It was found that content of vitamin C during ripening increases till the 24 day of the storage and it significantly depends on tomato variety (from 4.21% variety Sakura F1 till 33.72% variety Black Cherry F1). Further the content of vitamin C decreases and after 36 days of storage it was less than 7% compared with the beginning of experiment. The titratable acidity was significantly ($p < 0.05$) different among the tomato varieties and the stage of ripening. It varied from 0.841 ± 0.012 g 100 g⁻¹ (Sakura F1) at harvest till 0.302 ± 0.009 g 100 g⁻¹ (Golden Nudget F1) at the end of storage. According to results the content of phenols during storage is variable and therefore the correlations were not observed.

Keywords: tomatoes, bioactive compounds, storage

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INFLUENCE OF SELENIUM, COPPER AND ZINC ON PHENOLIC COMPOUNDS IN RYE MALT

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The natural phenolic compounds have received increasing interest in the last years due to their role in plants; phenolic compounds in our diet provide health benefits associated with reduced risk of chronic diseases. The aim of this study was to determine the influence of microelements (selenium, copper and zinc) on content of phenolic compounds in rye malt. To obtain rye malt, grains were soaked in water with addition of three mineral salts – sodium selenate (Na_2SeO_4), copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) and zinc sulphate ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$) at different concentrations and different combination of salts. Total and individual phenolic compounds in rye malt were determined by spectrophotometric and HPLC methods. It was identified 19 of phenol-type compounds, of which 14 were phenolic acids (7 benzoic acid and 7 cinnamic acid derivatives) four flavonoids and one catechin. The obtained results showed that the majority of determined phenolic compounds were in amount less than $0.1 \text{ mg } 100 \text{ g}^{-1}$ and only four of them (α -resorcylic acid, protocatechuic acid, catechin and kaempferol) were higher than $1 \text{ mg } 100 \text{ g}^{-1}$. Two methods (HPLC, spectrophotometric) were compared for determination of total phenolic content. Individual and total phenolic content in rye malt was higher than in non-germinated rye grain. Protocatechuic acid and catechin were not observed in rye samples, but they were present in all malt samples, indicating formation of mentioned substances in germination process.

Keywords: microelements, phenolic compounds, rye malt

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EFFECT OF GERMINATION TO THE CONTENT OF B VITAMINS IN CEREAL FLAKES

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Germination is effective technology for improving cereal nutritional quality. The aim of current study was to evaluate influence of germination to the content of B vitamins in different cereal flakes. Triticale (variety 'Inarta'), hull-less barley (variety 'Irbe'), hull-less oat (variety 'Emilija'), rye ('Kaupo'), and wheat ('Ellvis') grains cultivated at experimental fields of the Institute of Agricultural Resources and Economics in 2015 were used in experiment. All the grains soaked in water at the ratio of 1 : 2 (seeds to water) for 24 ± 1 h at 22 ± 2 °C. After soaking, grains were allowed to germinate in the climatic chamber ICH110 (Memmert, Germany) at controlled temperature (35 ± 1 °C) in the dark for 24 hours. Germinated cereal grains were flaked and a microwave-vacuum dried. B-group vitamins were determined by the following methods: vitamin B₂ (riboflavin) – AOAC Official Method 970.65, vitamin B₃ (niacin) – AOAC Official Method 961.14., vitamin B₅ (pantothenic acid) – AOAC Official Method 992.07, vitamin B₆ – AOAC Official Method 985.32. All tested samples are source of B₂ vitamin, but no significant increase in germinated samples were detected. The highest content of B₃ vitamin in hull-less oats and wheat samples were detected and they could be labelled as high in vitamin B₃. In germinated flakes content of B₃ vitamin was lower compared to cereal grains. Vitamins B₅ and B₆ were not presented in samples in significant amounts, but comparing to cereal grains for vitamin B₅ the highest increase in germinated samples were detected. Germinated cereal flakes are good source of vitamins B₂ and B₃.

Keywords: germination, B-group vitamins, grains

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INVESTIGATION OF FRUCTANS INCREASING POSSIBILITIES IN RYE BREAD

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Nowadays, consumer's great attention is drawn to food with high nutritional value and its functional significance, and as we know the bread is one of the products consumed in the diet. The regular intake of prebiotics such as fructans, improves a few physiological features of human. Fructans concentration in rye flour is not sufficient to have a functional value for bread, but it is possible to add raw materials that contain a high fructans concentration in bread production process. Therefore, the aim of the research was to evaluate and increase the fructans content in rye bread using *Jerusalem artichoke*, chicory powder and sourdough with *Gluconobacter nephelii* acetic acid bacterium. During the research it was found that using *Gluconobacter nephelii* acetic acid bacterium, *Jerusalem artichoke* and chicory powder it is possible to increase the amount of fructans in rye bread. Obtained new rye bread samples have the same energy value as rye bread samples from Latvia market. But for functional products obtaining 12% *Jerusalem artichoke* powder and 9% chicory powder could be used in rye bread prescription, as a result the amount of fructans per 100 g of product could be 5 g. Sourdough is the appropriate substrate to improve the use of bacterium (*Gluconobacter nephelii*) for increasing the content of fructans in the bread. Obtained products were not only with elevated nutritive value, it also has an appealing look, good texture, aroma and taste, customers like it and it is considered as a potentially functional product in the future.

Keywords: rye, fructans, *Gluconobacter nephelii*, *Jerusalem artichoke*, chicory

Acknowledgement. Research has been supported by the National research programme "Agricultural Resources for Sustainable Production of Qualitative and Healthy Foods in Latvia" (AgroBioRes) (2014–2017), project No. 4 "Sustainable use of local agricultural resources for qualitative and healthy food product development" (FOOD) in cooperation with joint-stock company "Hanzas maiznica".

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THE CHEMICAL COMPOSITION OF TWO COMMERCIAL FISH SPECIES – PIKEPERCH (*SANDER LUCIOPERCA*) AND RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) CULTIVATED IN ARTIFICIAL CONDITIONS

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Fish is a nutrient rich food and possesses many components that have positive impact on human health. Nowadays, the fish come to the market from wild-capture fisheries and aquaculture. Latter becomes increasingly global for human consumption, thus total finfish aquaculture includes over 300 species farmed in ponds, floating net cages and recirculating aquaculture systems (RAS). It is reasonable to assume that the chemical composition of farmed fish will vary compared to wild-caught ones due to the different rearing conditions and artificial diets used for feeding the fish.

This study gives an overview of basic chemical composition of pikeperch (*Sander lucioperca*) and rainbow trout (*Oncorhynchus mykiss*). There was analyzed the muscle flesh composition of fresh and frozen pikeperch obtained from the local commercial tank-based RAS together with rainbow trout obtained from river-based net cage farming system. It was determined that fresh pikeperch contained 78.27±0.34% moisture, 18.95±2.45% protein, 1.34±0.18% fat and 1.62±0.21% ash, while frozen ones had 78.26±0.44%, 20.91±0.62%, 0.77±0.15% and 0.99±0.09%, respectively. Statistically significant differences were found for fat and ash content ($p < 0.05$). In both cases artificially cultivated pikeperch has high nutritional value and fit for human consumption.

The chemical composition of trout was the following: 69.61±1.33% moisture, 17.78±0.48% protein, 11.41±2.24% fat and 0.88±0.01% ash. After reviewing the literature, it was found that farmed trout has considerably higher fat content than wild trout. This primarily can be explained by use of lipid-rich diets and lower mobility in cages.

Keywords: aquaculture, fish species, body composition, pikeperch, rainbow trout

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**FOOD MATERIAL / PACKAGING
INTERACTION**

FOODBALT 2017

MIGRATION OF IRON, ALUMINIUM, CALCIUM, MAGNESIUM AND SILICIUM FROM CERAMIC MATERIALS INTO ACETIC ACID FOOD SIMULANT

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Ceramics are widely used as kitchen ware. Pottery in contact with food can be a source of various compounds from clay and glazing. The potential migration of toxic lead and cadmium from ceramic is well-known and is evaluated by the specific maximum migration levels (acceptable limits being set by the Food Contact Materials Regulation (EC) 1935/2004). Besides lead and cadmium other elements have been detected in glazed ceramic ware that could migrate during food processing.

Migration experiments were performed on 10 commercially available glazed and unglazed stewing potteries (produced in Latvia and China).

The migration of iron, aluminium, calcium, magnesium and silicium from the ceramics was carried out in 4% (v / v) acetic acid water solution (24, 48 and 72 h at 20 °C; 30, 60 and 90 min at 180 °C). The concentrations of elements which had migrated into the test solutions were measured by absorption spectrometry (Fe, Al and Si) and titration (summary Ca and Mg).

The migration of iron, aluminium, calcium, magnesium and silicium was observed in all tested ceramics samples. Overall, the migration of studied elements was higher in unglazed stewing potteries and increased the temperature. Migration was decreased in repeatedly used ware.

Keywords: glazed and unglazed ceramics, migration, food contact

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SHELF LIFE DETERMINATION OF THERMALLY PROCESSED POTATO MAIN COURSE IN RETORT PACKAGING

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Consumer interest in health and wellness prompted the food industry to develop alternative processing technological solutions for preserving low-acid shelf-stable foods. The study aim was to determine expiration date and quality determining factors of potato main course in retort packaging.

The study was conducted at Latvia University of Agriculture, Faculty of Food Technology and Faculty of Veterinary Medicine. In the study four different potato main course types with amaranth (33% amaranth, 66% potato, 1% spices and salt), quinoa (33% quinoa, 66% potato, 1% spices and salt), bulgur (33% bulgur, 66% potato, 1% spices and salt) and chicken (49.5% chicken, potato 49.5%, 1% spices and salt) were used. All main courses were packaged in two different packaging materials, two-layer laminated transparent polyamide/polyethylene package (PA / PE), and four-layer opaque, laminated polyethylene terephthalate / aluminium / polyamide / polypropylene (PET / ALU / PA / PP) packaging. During the 22 month storage, once a month mesophilic aerobic and facultative anaerobic microorganisms (MAFAM), pH and color L*a*b* changes in all potato main courses were tested.

The results obtained in the study demonstrate that the expiration date of potato main course that are packaged in PA / PE package is 8 months, while potato main course packaged in PET / ALU / PA / PP expiration date reaches 22 months.

Keywords: potato main course, expiration date, retort packaging

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**SUSTAINABLE PROCESSING
AND PACKAGING**

FOODBALT 2017

ANALYSIS OF WASTE MANAGEMENT IN LATVIAN RESTAURANTS

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Nowadays, the number of catering companies is rapidly increasing followed by increased amount of produced waste. It is necessary to reduce the waste produced in manufacturing in order to reduce its negative impact on the environment. The aim of current research was to evaluate waste management in the restaurants and to develop proposals for efficient waste management. The research consisted of five parts. A survey was made to find out the current situation in waste management in restaurants located in Riga. Waste structure and amount was determined by sorting, weighing and tracking of wastes in four restaurants in Riga for a one week. Additionally four chefs working at the restaurants included in the waste profiling research were interviewed. Evaluating the restaurant's technological processes, were identified critical points in waste management.

The main results showed that in catering establishments 68% are food wastes, followed by glass (18%), cardboard / paper (10%), metallic (2%) and plastic (2%) waste. The average amount of waste per guest accounted for 0.7 kg, of which 0.4 kg was food waste. The main reason for obstructing full waste sorting in catering companies are the large amount of work for their employees, the lack of space in manufacturing premises, and disorganized waste management system in Latvia. Based on the study results and the practices of the best waste management, proposals were developed for reducing waste in all technological processes of the restaurants.

Keywords: restaurants, waste management, food waste, sorting

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BIOCONVERSION OF AGRO-INDUSTRIAL BY-PRODUCTS TO LACTIC ACID APPLYING BY ENZYMATIC HYDROLYSIS AND LACTIC ACID BACTERIA FERMENTATION

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Recently, considerable interest has been arisen in the biorecycling of agro-industrial by-products into the valuable chemicals such as lactic acid. The chemical route produces a racemic mixture of DL-lactic acid, while optically pure L(+)- or D(-)-lactic acid can be obtained by microbial fermentation. Moreover, biotechnological recycling of agro-industrial by-products could effectively reduce the costs of lactic acid production which is widely used in the food and beverage sector, pharmaceutical, cosmetic and chemical industries. The aim of research was to investigate the usability of agro-industrial by-products, such as wheat bran and wheat straw in the production of L-lactic acid via fermentation applying by newly isolated lactic acid bacteria strains (LAB). Agro-industrial by-products were fermented with LAB belonging to *Lactobacillus* and *Pediococcus* genera. Before fermentation enzymatic treatment of by-products was carried out using carbohydrases. An enzymatic test K-DLATE 08/11 (Megazyme Int. Ireland, Wicklow, Ireland) was used for lactic acid and D/L-lactates determination. The influence of magnesium, calcium and sodium salts on enzymatic hydrolysis efficiency was evaluated. The addition of 50 mg mL⁻¹ of CaCl₂, 100 mg L⁻¹ of MgSO₄·7H₂O in straw medium increased enzymatic hydrolysis efficiency, whereas the addition of NaCl in range 50–175 mg L⁻¹ decreased cellulase activity. *Lactobacillus delbrueckii* subsp. *bulgaricus* strains produced the highest amount of lactic acid in the wheat straw (up to 93.6 g kg⁻¹), whereas other LAB strains produces less content of lactic acid in straw medium. The results confirm that tested agro-industrial by-products could be used for L-lactic acid production using selected enzymes and lactic acid bacteria strains.

Keywords: lactic acid; lignocellulose, *Lactobacillus*, hydrolysis

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**CONSUMER BEHAVIOUR AND
SENSORY ISSUES**

FOODBALT 2017

BREAD CHOICE AND CONSUMPTION TRENDS

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The consumption of bread per capita has been declining in Latvia for several decades. What could change the consumption behaviour of residents to increase the consumption of bread? The research aim is to identify trends in the choice and consumption of bread by consumers in Latvia. To achieve the aim, two specific research tasks were set: to identify the trends in the consumption of bread and to ascertain the opinions of Latvia's residents on determining factors in their choice of bread. An Internet survey of Latvia's residents on bread quality and consumer choice was conducted in November 2016. The survey involved 919 respondents aged 15–74. The main results showed that the consumption of bread declined, yet a stabilisation trend emerged. The reasons for the consumer choice, which were related to the quality and price of bread as well as the confidence and behaviour of consumers, were diverse for different kinds of bread. In choosing wheat bread, the determinant factor was price, while the choice of rye bread was determined by previous experience, i.e. the producer of the bread consumed. Consumers believed that an increase in bread consumption could be achieved by producing tastier breads.

Keywords: bread choice, consumption, Latvia

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INFLUENCE OF EATING HABITS ON PEOPLE'S WELLBEING AND LIFE QUALITY

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A human health, largely influenced by food quality and eating habits, indicates and conditions life quality. The consumption of healthy food is connected not only with the quality standards of food available, but also largely due to social, economic and cultural factors, and in separate cases physiological, innate or acquired over the course of time those peculiarities that are typical of a certain age group. Respecting those peculiarities, for example, new-borns' food, intolerance of separate products or substances that foodstuffs may contain, or the presence of a disease, determines the consumption of a kind of food. Eating habits have been analysed in conjunction with other components of a healthy lifestyle, and together with the impact of physical, social factors, and those factors from the media of education that influence physical and psychological wellbeing. For a long time, researchers have been studying eating habits and the factors influencing those habits that constitute life quality that led to a scientific basis for clarifying the dynamics of the change in habits, and also doing the quantitative and qualitative comparative data analysis. The empirical data base includes different age groups, starting with the study of the factors influencing new-borns' life quality from 2007 and continuing in the preschool and primary school age group from 2008 and the secondary school age group from 2011, as well as the subjective evaluation of food quality, which is revealing about eating habits from the perspective of the patients at regional hospital (repeated studies in 2007, 2008, 2009, 2016). Conclusions and recommendations for the change in unhealthy habits can be established in a complex approach by directing the attention to continually improved educational aspects together with institutional solutions thus ensuring the availability of healthy food and the restriction of unhealthy factors.

Keywords: life quality, healthy lifestyle, food quality, eating habits, education

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FOOD CHAIN MANAGEMENT

THE SURVEY OF THE ECONOMIC VALUE AND MEAT QUALITY INDICATORS OF BEEF CATTLE BREEDS IN LITHUANIA

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The paper analyses economic characteristics of popular beef breeds as well as researches eight meat quality indicators of the crossbred LimousinxAngus (LixAN) that are compared to the Limousine (LI) and Angus (AN) breed indicators. The study is carried out by examining the economic value requirements for the beef cattle and by applying the latest meat quality research methods in the Food quality laboratory of University of Applied sciences. The analysis of the economic value of the most popular beef breeds such as Limousin, Charolais, Angus and Hereford revealed that the tallest animals (the height at the withers 134–165 cm), the biggest newborn calves (41–46 kg), the highest daily gains (1000–1300 g) and the heaviest adult animals (850–1250 kg) belong to the Charolais beef breed. Angus cattle have the highest fat replacement carcass yield – 70%. The cattle of Limousin, Charolais and Hereford breeds are crossbred with dairy and beef cattle in Lithuania. The investigation of the meat quality indicators of LimousinxAngus crossbreed cattles and their comparison to the purebred beef cattle parental breeds Limousins (LI) and Anguses (AN) suggests that the meat of the crossbreed cattle is of a higher energy value (602 kJ 100 g⁻¹), ash content (1.18%) and cooking loss (27%) than of the purebred cattle; the fat content (1.67%) and the water content (1.67%) is lower in the meat of the crossbreed cattle; while the protein content (22.05 %) and meat firmness (2.02 kg cm⁻²) occupied an intermediate position between the meat indicators of parental purebreed cattle.

Keywords: breed, beef cattle, economic characteristics, meat quality indicators

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GRAIN QUALITY OF RYE VARIETIES GROWN IN LATVIA

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Rye (*Secale cereale* L.) has been cultivated in Europe since ancient times and is second only to wheat among the grains most commonly used in the production of bread. Rye is traditionally consumed as wholemeal products in Baltic countries. In Latvia, rye bread is rich with traditions, and is one of the more favourite types of bread. Our objectives were to determine the grain quality and suitability of the most popular rye varieties in Latvia for wholegrain flour production and bread baking. Three conventional rye varieties 'Kaupo', 'Amilo', 'Dankowskie Amber' and three hybrid rye varieties 'Brasetto F1', 'Su Drive F1', 'Su Mephisto F1' used for evaluation were obtained from research field trials (2014/2015, 2015/2016) at the Institute of Agricultural Resources and Economics in Priekuli, Latvia. Rye grain quality indices were analysed at the Latvia University of Agriculture, in Grain and Seed Research laboratory using standards methods. Average data in our investigation (two years) show that variety, environment and variety × environment interaction significantly ($p < 0.05$) affected 1000 kernel weight, volume weight, protein content, starch content and Hagberg falling number. The results of the current research show that the quality of all the studied varieties meet the requirements for high-grade rye grains for food consumption and are suitable for the wholegrain flour production and bread baking.

Keywords: rye, grain quality, rye varieties

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CULTIVAR, WEATHER CONDITION AND NITROGEN FERTILISER IMPACT ON WHOLEMEAL RHEOLOGICAL PROPERTIES

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Winter wheat (*Triticum aestivum* L.) is an important cereal in Latvia national economy providing human population with bread. The aim of this investigation was to determine of cultivar, year weather condition and nitrogen fertiliser factors influence (η^2) on winter wheat wholemeal water absorption and rheological properties. Field trials with winter wheat cultivars 'Bussard' and 'Zentos' were carried out in the Latvia University of Agriculture, Study and Research farm Peterlauki during a three year period (from 2009/2010 to 2011/2012). Nitrogen (N), was applied (N60, N90, N120, N150 kg ha⁻¹) in spring after resumption of vegetative growth. Average data in our investigation show that water absorption was mostly affected (η^2) by the cultivar (54%), the year (22%) and year \times cultivar factor was also remarkable (24%), while nitrogen fertiliser influence is small (0.1%). The year weather conditions in the investigations years, cultivars and year \times cultivar interaction had a significant ($p < 0.05$) impact on the wholemeal rheological properties. Dough development time was more affected by the cultivar (41%) than by the year (29%), nitrogen fertiliser influence is 13%, and lowest impact belonged to interaction cultivar \times year (8%). Dough stability time was most markedly affected by the year (48%) but influence of a cultivar was also reliable (31%), nitrogen fertiliser influence is 9%, while the influence year \times cultivar interaction was small 3%. Degree of softening mostly depending on cultivar (56%), influence of a year was 23%, while nitrogen fertilizer and year \times cultivar interaction was – 2%.

Keywords: wheat, wholemeal rheological properties, factors influence

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EVALUATION OF OAT GRAIN PERTINENCE TO PRODUCTION OF FLAKES AND PORRIDGE PREPARING

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Oats for human consumption are primarily used as oat flakes and breakfast mixes. Although cultivar differences in the parameters directing oat breeding and cultivation such as seed size, yield, lodging resistance, and nutritional attributes – protein, lipids, are widely studied, knowledge concerning the suitability of cultivars for production of flakes and other oat products is limited. The aim of present investigation was to study chemical composition of new oat genotypes and its pertinence to needs of producers.

Twelve oat genotypes VP2, VP3, VP4, VP5, VP6, VP8, VP9, VP10, VP11, VP12 and two millers recognized varieties - ‘Laima’ and ‘Peppi’ were the materials used in study. In the studied samples content of protein, lipids, β -glucans same as grain outcome, damaged and dark grain were determined. Oat flakes were made and prepared porridge. Colour difference of oat porridges between varieties was tested. The obtained results showed that protein content in samples of oat grain ranged from 10.7% to 13.9%, lipids 5.7% to 7.7% and β -glucans 2.0 to 3.3% depending of varieties. More perspective breeding lines from nutritional point of view are VP4 and VP3, but from the higher outcome and grain quality perspective VP8. Colour analysis of porridge reveals that each of analysed oat genotype can be equal in colour with products, which are on the market.

Keywords: hulled oats, nutrition value, production, quality, outcome

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FUNCTIONAL PROPERTIES OF LUPINE (*LUPINUS ANGUSTIFOLIUS* L.) PROTEIN HYDROLYSATES AND POSSIBLE USE IN GLUTEN-FREE PRODUCTS

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Lupine is increasingly used as a protein source for replacement of potentially genetically modified soya products. Lupine seeds are rich in protein and have a good nutritional balance of essential amino acids. Besides, lupine does not contain gluten thus it could be used as a functional ingredient in gluten-free foods. The main objectives of our study were to determine the effect of enzymatic hydrolysis with some commercial peptidases and proteases on narrow-leaved lupine (*Lupinus angustifolius* L.) protein functionality and to evaluate the effect of lupine protein addition on the quality of gluten-free muffins. Protein isolates were prepared from lupine seed flours by two different methods, i.e. by alkaline water extraction / isoelectric precipitation (PI) and by micellisation (MI), and studied with regard to functional properties. Lupine isolate-PI had higher total and soluble protein contents than the isolate-MI, but no significant differences were found between these isolates in their hydrolysis efficiency. Enzymatic hydrolysis for 3 h yielded degrees of hydrolysis ranging from 8% to 15%. The highest degree of hydrolysis was reached using peptidase and protease complex from *Aspergillus oryzae* (Flavourzyme, Novozymes), the lowest – protease from *Bacillus licheniformis* (Alcalase, Novozymes). The protein hydrolysates showed better functional properties such as foam capacity and stability, emulsifying activity, and but less emulsion stability than the protein isolates. Moreover, lupine protein hydrolysate as an egg protein substitute had bigger influence on rice muffins texture characteristics than protein isolate. Thus, lupin seed protein hydrolysates have improved functional properties and could be used in the elaboration of higher nutritional value products.

Keywords: lupine protein, hydrolysis, functionality, gluten-free muffins

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THE INFLUENCE OF FREEZE-DRIED CELERY JUICE ON THE COLOR FORMATION OF DRY-FERMENTED SAUSAGES

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Nitrites are used as meat product additives to increase their microbiological safety and for color stabilisation via formation of nitrosomyoglobin (NOMb); however, at low pH and high temperature (130–170 °C) they can form carcinogenic N-nitrosamines. Hence, on the one hand, nitrite is essential for meat products properties, while on the other hand it is categorized as a synthetic preservative, which is rather unwanted by the consumers. A lot of studies were performed to replace synthetic sodium nitrite / nitrate and it was suggested that one of such alternatives might be vegetable products, as a natural source of nitrate.

The aim of this study was to determine the influence of freeze-dried celery juice and different starter cultures (*St. xylosus* and the mixture of *St. xylosus* with *P. pentosaceus*) on the myoglobin changes and formation of NOMb during ripening of dry fermented sausages. The results showed that the highest amount of NOMb in the all samples occurred during first four days of fermentation. Metmyoglobin (MetMb) content was similar in all analysed samples, while the highest content of oxymyoglobin (OxyMb) was in the sausages with *St. xylosus* cultures. No significant differences were found between lightness (L*) values of the sausages without and with freeze-dried celery juice additives, while the highest value of redness (a*) was recorded for the dry-fermented sausages with the mixture of starter cultures.

Keywords: freeze-dried celery juice, nitrosomyoglobin, colour

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VFWV WHEEL: AN INTERACTIVE MODEL ILLUSTRATING POTENTIAL VALORISATIONS OF VEGETABLES & FRUITS WASTES

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Industrial processing of vegetables and fruits generated huge amounts of wastes which remained globally unvalorised despite their potential economic value. In order to illustrate innovative valorisations of such wastes set-up by EUBis network members (Food Waste Valorisation for Sustainable Chemicals, Materials and Fuels – COST Action TD 1207), a visual and interactive 3D model called "Veggies & Fruits Wastes Valorisation Wheel" will be set up. Inspired by the one created for sensory descriptions of waters, wines, beers, whisky, coffees, ciders, marples, chocolates,... the VFWV wheel will allow a triple representation: originated fruit or vegetable – corresponding waste – valorised extracts / molecules, with tactile and sensorial attributes (real / copy fruits and veggies, real dried wastes, samples of aromatic extracts, powders, materials). This poster reports the 5 steps of this dissemination action project: idea generation, concept definition based on 8 fruits and 8 vegetables, surveys among EUBis network members, design and up-grade of VFWV wheel models (V.1 (prototype), V.2 (final version)).

Keywords: fruits and vegetables wastes, global valorisations, interactive model

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