



Latvia University  
of Life Sciences  
and Technologies



Pārvalde par pārtikas tehnoloģijām fakultāte



NACIONĀLAIS  
ATTĪSTĪBAS  
PLĀNS 2020



EIROPAS SAVIENĪBA  
EIROPAS INVESTĪŠANU APVIETOTS  
Eiropas Lauksaimniecības fonda  
lauku attīstībai

Atbalsta Zemkopības ministrija un Lauku atbalsta dienests

## Latvia University of Life Sciences and Technologies Faculty of Food Technology

# FOODBALT 2019 13th Baltic Conference on Food Science and Technology “FOOD. NUTRITION. WELL-BEING.” and NEEFOOD 2019 5th North and East European Congress on Food

## Abstract Book

Jelgava  
May 2-3, 2019

# FOODBALT 2019 and NEEFOD 2019

Abstract Book of FOODBALT 2019 13th Baltic Conference on Food Science and Technology “FOOD. NUTRITION. WELL-BEING” and NEEFOOD 2019 5th North and East European Congress on Food. Jelgava, LLU, 2019, 160 pages

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## FOODBALT 2019 and NEEFOOD 2019

Dear participants,

The 13th Baltic Conference on Food Science and Technology “Food. Nutrition. Well-Being” FOODBALT 2019 joined with 5<sup>th</sup> North and East European Congress on Food “NEEFood 2019” will take place from 2nd to 3rd May, 2019 in Latvia University Life Sciences and Technologies (LLU). The conference is organized by the Faculty of Food Technology. The conference is a representation of the multidisciplinary, transdisciplinarity and interdisciplinarity of food science, technology and experiential knowledge. It brings together food scientists, researchers as well as students from different countries, promoting the dissemination of new knowledge and allowing to exchange the latest research results in the area of food science and technology.

The conference plans to attract more than 120 delegates from 11 countries. The conference programme contains 4 key lectures, 37 oral and 18 e-poster presentations in 7 sessions. Additionally, a total of 68 poster presentation. The conference call received papers from a range of different topics: Health-relevant food products and issues, Quality and safety of processed foods, Trends in new food product and technology development, Food chemistry, analysis and quality assessment, Food material/packaging interaction, Sustainable processing and packaging, Consumer behaviour and sensory issues, Food chain management (raw materials, logistics, economics, information systems, etc.).

The conference could not be realized without the vital contribution of the participants who present research papers in the sessions or posters. Your participation is invaluable for both us and the conference as a whole. The Organizing Committee hope that you will find the presentation valuable, stimulating and interesting for your scientific activities. Also, we are convinced that your stay in Jelgava will be educational, scientific and socially beneficial.

Dr.sc.ing. Martins Sabovics, Dean of the Faculty of Food Technology

# FOODBALT 2019 and NEEFOD 2019

## FOODBALT 2019 13th Baltic Conference on Food Science and Technology “*FOOD. NUTRITION. WELL-BEING.*”

and

## NEEFOD 2019 5th North and East European Congress on Food Programme

**May 2, 2019**

8<sup>30</sup>-9<sup>30</sup> **Registration and Poster installation**

9<sup>30</sup>-9<sup>45</sup> **OPENING** Rector of LLU Irina Pilvere, Dean of the Faculty of Food Technology Martins Sabovics, Technical University St. Petersburg Mark Shamtsyan

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

**Moderators:** Mark Shamtsyan, Technical University St. Petersburg, Russia  
Ruta Galoburda, Latvia University of Life Sciences and Technologies, Latvia

9<sup>45</sup>-10<sup>25</sup> **KEY LECTURE** Dzintars Zacs, *Head of the gas chromatography division, Institute of food safety, animal health and environment BIOR, Latvia, New insights into the occurrence of novel and emerging persistent contaminants in food products*

10<sup>25</sup>-10<sup>40</sup> **O1** – L. Klavins, A. Viksna, J. Kviesis, M. Klavins *Berry lipids and waxes: isolation, characterisation, properties*

10<sup>40</sup>-10<sup>55</sup> **O2** – L. Dienaite, M. Pukalskiene, A. Pukalskas, P. R. Venskutonis *Antioxidant activity, phytochemical composition of lipophilic and hydrophilic fractions of guelder-rose berry pomace*

10<sup>55</sup>-11<sup>10</sup> **O3** – L. Jansone, S. Kampuse *Comparison of chemical composition of fresh cabbage and sauerkraut juice*

11<sup>10</sup>-11<sup>25</sup> **O4** – B. Medveckiene, J. Kulaitiene, E. Jariene, D. Levickiene *The changes of bioactive compounds in different genotypes of rosehips flesh*

11<sup>25</sup>-11<sup>40</sup> **O5** – I. Laukaleja, Z. Kruma *Influence of the roasting process on bioactive compounds and aroma profile in specialty coffee*

### 11<sup>40</sup>-12<sup>10</sup> **E-POSTER SESSION**

**EP1** – D. Godoladze, M. Pukalskiene, A. Pukalskas, R. Mazdzieriene, P. R. Venskutonis *Fractionation of bilberry pomace with supercritical carbon dioxide, ethanol and water*

**EP2** – K. Subbarayadu, M. Syrpas, P. R. Venskutonis *Biorefining of *Potentilla fruticosa* and *Hierochloe odorata* by means of high-pressure techniques*

**EP3** – L. Tomson, Z. Kruma *Spectrophotometric analysis of photosynthetic pigments in horseradish leaves and by-products using various extraction solvents*

# FOODBALT 2019 and NEEFOOD 2019

**EP4 – A. Keke**, I. Cinkmanis *Total phenolic and flavonoid content, antioxidant activity, and colour of honey samples from Latvian market*

**EP5 – M. Syrpas**, S. Kesminas, P. R. Venskutonis *Recovery and in vitro antioxidant capacity of valuable components from *Phaeodactylum tricornutum* biomass*

**EP6 – R. Zarins**, Z. Kruma, I. Skrabule *Changes of biologically active compound level in potatoes during storage under fluorescent light*

## 12<sup>10</sup>-13<sup>00</sup> LUNCH

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

**Moderators:** Elena Bartkiene, Lithuanian University of Health Sciences, Lithuania

Evita Straumite, Latvia University of Life Sciences and Technologies, Latvia

13<sup>00</sup>-13<sup>40</sup> **KEY LECTURE Raquel P. F. Guine**, CI&DET Research Centre, Polytechnic Institute of Viseu, Portugal, **EATMOT project – The study of eating motivations in different countries**

13<sup>40</sup>-13<sup>55</sup> **O6 – E. Bartkiene**, V. Steibliene, V. Adomaitiene, G. Juodeikiene, V. Lele, D. Cernauskas, D. Klupsaite, D. Zadeike, L. Jarutiene, V. Sakiene, R. P. F. Guine *Factors influencing consumers motivations for healthy eating and food-mood relation of people's with and without depressive disorder*

13<sup>55</sup>-14<sup>10</sup> **O7 – S. Rosenvald**, K. Peksar *The stability of gas chromatography-offlactometry (GCO) panel performance*

14<sup>10</sup>-14<sup>25</sup> **O8 – I. Kalnina**, E. Straumite *A review– How salt impacts sensory perception of snacks?*

14<sup>25</sup>-14<sup>40</sup> **O9 – V. Kocetkovs**, S. Muizniece-Brasava *Consumer awareness and attitude towards active and intelligent packaging systems and their implementation in the Latvian market*

## 14<sup>40</sup>-15<sup>10</sup> COFFEE BREAK / POSTER SESSION

### Parallel Session III **Room 293, LLU main building**

**Moderators:** Raquel P. F. Guine, CI&DET Research Centre, Polytechnic Institute of Viseu, Portugal

Inga Ciprovica, Latvia University of Life Sciences and Technologies, Latvia

15<sup>10</sup>-15<sup>25</sup> **O10 – L. Aumeistere**, I. Ciprovica, D. Zavadaska, K. Bavrins, A. Borisova *Essential elements analysis in mature breast milk*

15<sup>25</sup>-15<sup>40</sup> **O11 – M. Kriisa**, I. Stulova, S. Rosenvald, E. Viiard, R. Vilu *Optimisation of the production technology of glucose-galactose syrup and its applications in food*

15<sup>40</sup>-15<sup>55</sup> **O12 – I. Stulova**, M. Kriisa, S. Rosenvald, E. Viiard, R. Vilu *Glucose-galactose syrup applications in model products*

15<sup>55</sup>-16<sup>10</sup> **O13 – K. Zolnere**, I. Ciprovica *Enzymatic hydrolysis of lactose in concentrated whey and milk permeates*

## FOODBALT 2019 and NEEFOD 2019

16<sup>10</sup>-16<sup>25</sup> **O14** – I. Sarenkova, I. Ciprovica *The effect of concentrated whey solids on lactobionic acid production by Pseudomonas taetrolens*

16<sup>25</sup>-16<sup>40</sup> **O15** – S. Baltrukova, J. Zagorska, I. Eihvalde *Evaluation of microbiological quality of colostrum*

16<sup>40</sup>-16<sup>55</sup> **O16** – L. Marcinkoniene, I. Ciprovica *Goat milk quality in the late lactation*

### 16<sup>55</sup>-17<sup>10</sup> E-POSTER SESSION

**EP7** – M. J. R. Lima, L. Fontes, R. P.F. Guine *Fast and green method for the analysis of Serra da Estrela cheese*

**EP8** – R. Samadov, I. Ciprovica, J. Khabibullaev, I. Cinkmanis *The optimization of acid whey permeate hydrolysis for glucose-galactose syrup production*

**EP9** – J. Khabibullaev, J. Zagorska, R. Galoburda *Rheological and textural properties of lactose-free yogurt in relation to enzyme concentrations*

### Parallel Session IV

### Room 278, LLU main building

**Moderators:** Grazina Juodeikiene, Kaunas University of Technology, Lithuania

Zanda Kruma, Latvia University of Life Sciences and Technologies, Latvia

15<sup>10</sup>-15<sup>25</sup> **O17** – R. Bobinaite, P. Viskelis, C. Bobinas, P. R. Venskutonis *Recovery of high-added value fractions from beetroot and carrot processing by-products*

15<sup>25</sup>-15<sup>40</sup> **O18** – R. Kuldjarv, A. Bljahhina, E. Viiard *Turning compost material to food: Production of apple purée from industrial apple pomaces*

15<sup>40</sup>-15<sup>55</sup> **O19** – L. Ozola, S. Kampuse *Mineral and bioactive compound content in plant-based purees with increased protein amount*

15<sup>55</sup>-16<sup>10</sup> **O20** – J. Riukaite, L. Basinskiene, M. Syrpas *Bioconversion of waste bread to glucose fructose syrup as a value-added product*

16<sup>10</sup>-16<sup>25</sup> **O21** – E. M. Stefan, G. Voicu, G. A. Constantin, M. Munteanu, G. Ipate *Effect of sugar and sugar substitutes on wheat dough rheology*

16<sup>25</sup>-16<sup>40</sup> **O22** – I. Semicenkova, S. Muizniece-Brasava, A. Kirse-Ozolina, M. Sabovics *Effect of temperature change during transportation on muesli quality*

### 16<sup>40</sup>-17<sup>10</sup> E-POSTERS

**EP10** – S. Revinyte, M. Pukalskiene, A. Pukalskas, R. Baranauskiene, R. Mazdzieriene, P. R. Venskutonis *Valorisation of strawberry (Fragaria x Ananassa) pomace using different extraction techniques*

**EP11** – M. Strykaite, D. Cizeikiene, J. Damasius *Use of molasses and its effect on azotobacter growth*

**EP12** – E. Bartkiene, V. Lele, V. Sakiene, P. Zavistanaviciute, M. Ruzauskas, E. Zokaityte, J. Bernatoniene, V. Jakstas, P. Viskelis, D. Zadeike, G. Juodeikiene *Possible uses of food industry by-products compositions with antimicrobial lactic acid bacteria for antimicrobial ingredients preparation*

**EP13** – A. Aav, H. Mootse *Not only table potato – other possible approaches in potato processing industries*

# FOODBALT 2019 and NEEFOOD 2019

**EP14** – I. Joudu, P. Paaso, R. Bhat ERA chair for food by-products valorisation technologies of the Estonian University of Life Sciences (VALORTECH)

**EP15** – S. Muizniece-Brasava, **A. Kirse-Ozolina**, I. Gramatina, A. Gorbatovskiy, S. Sazonova, E. Straumite, Z. Kruma, I. Ciprovica, M. Sabovics, D. Kunkulberga, J. Kivite, T. Kinca, J. Zagorska *Innovative structured fish mass products from Baltic sprat (*Sprattus sprattus balticus* Schneider)*

## 19<sup>00</sup> CONFERENCE DINNER

**May 3, 2019**

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

**Moderators:** Ivi Joudu, Estonia University of Life Sciences, Estonia

**Martins Sabovics**, Latvia University of Life Sciences and Technologies, Latvia

8<sup>30</sup>-9<sup>10</sup> **KEY LECTURE** **Jorg-Thomas Morsel**, GmbH UBF, Germany, **Seabuckthorn – a unique of value added natural products**

9<sup>10</sup>-9<sup>25</sup> **O23** – H. Danilcenko, **D. Televiciute**, N. Vaitkeviciene, M. Lasinskas *The effect of plant extracts on the synthesis of biologically active compounds in germinated leguminous*

9<sup>25</sup>-9<sup>40</sup> **O24** – **J. Dorozko**, D. Kunkulberga, I. Sivicka, Z. Kruma *The influence of various drying methods on the properties and quality of edible flowers` petals*

9<sup>40</sup>-9<sup>55</sup> **O25** – **A. Kirse-Ozolina** *Comparison of free-range, barn and caged hens` eggs commercially available in Latvia*

#### 9<sup>55</sup>-10<sup>15</sup> E-POSTERS

**EP16** – **I. Misina**, A. Valdovska, J. Zagorska, E. Urvaka, K. Juhnevica-Radenkova, P. Gornas *Physicochemical characteristic of two cold-pressed seed oils: Japanese quince vs. sunflower*

**EP17** – B. Cindik, **E. Yalcin** *Effect of fermentation on phytic acid and fructan contents of cornelian cherry tarhana*

**EP18** – **E. Sosyura**, E. Romanenko, M. Selivanova, T. Aysanov, N. Esaulko, M. German *The technology of obtaining extracts of fruit and berry raw materials for functional beverage production*

## 10<sup>15</sup>-10<sup>45</sup> COFFEE BREAK

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

**Moderators:** Ene Viiard, Center of Food and Fermentation Technologies, Estonia

**Asnate Kirse-Ozolina**, Latvia University of Life Sciences and Technologies, Latvia

10<sup>45</sup>-11<sup>00</sup> **O26** – **R. P. F. Guine**, L. Fontes, M. J. Lima *Evaluation of colour in Serra da Estrela cheese produced in different dairies along maturation time*

11<sup>00</sup>-11<sup>15</sup> **O27** – **M. J. R. Lima**, L. Fontes, A. M. Peres, R. P. F. Guine, E. T. Lemos *Fatty acid profile in Serra da Estrela cheese: An overview*

## FOODBALT 2019 and NEEFOD 2019

11<sup>15</sup>-11<sup>30</sup> **O28 – D. I. Abdikoglu**, G. Unakitan *Determining important factors on fish consumption with conjoint analysis in Tekirdag, Turkey*

11<sup>30</sup>-11<sup>45</sup> **O29 – J. Ozolins, I. Pilvere**, A. Nipers, M. Silovs, L. Proskina *Economic base scenario assessment of innovative product manufacturing from Baltic sea sprats*

11<sup>45</sup>-12<sup>00</sup> **O30 – S. Muizniece-Brasava, A. Kirse-Ozolina**, I. Gramatina, S. Sazonova, J. Kivite, M. Sabovics, I. Ciprova, E. Sturmovica, A. Gorbatovskiy *Development of new cost-efficient and ready-to-cook fish products with higher nutritional value*

12<sup>00</sup>-12<sup>15</sup> **O31 – M. Shamtsyan** Biological activities of mushroom beta-glucans and prospects of their utilization to develop functional food products

12<sup>15</sup>-13<sup>00</sup> **LUNCH**

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

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

Daina Karklina, Latvia University of Life Sciences and Technologies, Latvia

13<sup>00</sup>-13<sup>40</sup> **KEY LECTURE Ene Viiard**, *Centre of Food and Fermentation Technologies, Estonia, Human gut microbiome analysis as an innovative tool for designing healthy foods and enhanced services*

13<sup>40</sup>-13<sup>55</sup> **O32 – E. Bartkiene, V. Lele, V. Sakiene, P. Zavistanaviciute, E. Zokaityte**, I. Varinauskaite, G. Pileckaite, L. Paskeviciute, G. Rutkauskaite, T. Kanaporis, L. Dmitrijeva, P. Viskelis, M. Ruzauskas *Compositions from the different origin compounds for multifunctional nutraceuticals preparation*

13<sup>55</sup>-14<sup>10</sup> **O33 – V. Vilimaite, V. Kitryte**, M. Syrpas, P. R. Venskutonis *Isolation of valuable constituents from hops (*Humulus lupulus* L.) by supercritical carbon dioxide extraction*

14<sup>10</sup>-14<sup>25</sup> **O34 – I. Misina, E. Urvaka, M. Rudzinska, P. Gornas** *Changes in the composition of the lipophilic fraction of Japanese quince (*Chaenomeles Japonica*) seed oil during the fruit development*

14<sup>25</sup>-14<sup>40</sup> **O35 – L. Sernaite**, D. Urbonaviciene, C. Bobinas, P. Viskelis *Optimisation of supercritical carbon dioxide extraction of rosehips lipophilic fraction*

14<sup>40</sup>-14<sup>55</sup> **O36 – E. Bartkiene, V. Lele, V. Sakiene**, P. Zavistanaviciute, M. Ruzauskas, A. Stankevicius, J. Grigas, A. Pautienius, J. Bernatoniene, V. Jakstas, D. Zadeike, P. Viskelis, G. Juodeikiene *Bovine colostrum as functional ingredient: changes in antimicrobial properties and immunoglobulins content during the technological treatment*

14<sup>55</sup>-15<sup>10</sup> **O37 – D. Karklina, A. Guillen Vaquero**, E. Straumite, M. Sabovics *The aroma profile and sensory properties of Latvian black currant wine*

15<sup>10</sup>-15<sup>25</sup> **CLOSING OF CONFERENCE**

Poster Programme  
May 2-3, 2019

Poster No.	Author, Title of Poster
<i>Health-relevant food products and issues</i>	
P1.	E. Raits, A. Kirse-Ozolina <b>Modern dietary patterns based on territorial origin –A review</b>
P2.	J. Bujaka, R. Riekstina-Dolge <b>Food allergy knowledge and practice of restaurant staff</b>
P3.	V. Bradauskiene, L. Vaiciulyte-Funk, E. Mazoniene, D. Cernauskas <b>Fermentation with <i>Lactobacillus</i> strains for elimination of the immunogenicity of gluten in wheat (<i>Triticum aestivum</i>) processing products</b>
P4.	E. Antontceva, T. Belyakova, I. Zabolalova, M. Shamtsyan <b>Fortification of yogurt with <math>\beta</math>-glucans of oyster mushroom</b>
P5.	D. Zadeike, R. Vaitkeviciene, M. Lipkyte, G. Juodeikiene, J. Bendoraitiene, P. Viskelis, E. Bartkiene, V. Lele, V. Jakstas <b>Concept for the valorisation of rice dietary fiber fraction in combination with whortleberries press-cake and essential oils into nutraceuticals</b>
P6.	S. Karasu-Yalcin, K. Eryasar-Orer <b>Screening of some foodborne yeasts for xylitol production</b>
<i>Quality and safety of processed foods</i>	
P7.	S. Kampuse, L. Tomsona, D. Klava, L. Ozola, R. Galoburda <b>The influence of processing and storage conditions on quality parameters of pumpkin puree</b>
P8.	S. Kampuse, Z. Kruma, D. Klava, L. Ozola, R. Galoburda, E. Straumite <b>The evaluation of organically grown apple cultivars for special diet puree production</b>
P9.	A. Blija, Z. Stepanovica <b>Dynamics of microbial contamination of fish products during cooking</b>
P10.	H. Andreson, K. Kerner, M. Tepper, I. Joudu <b>Food mashing prior <i>Sous vide</i> processing lowers the risk of microbiological contamination</b>
P11.	I. Augspole, T. Kince, L. Skudra <b>Effect of NATURESEAL® AS5 and packing materials on the microbiological safety of shredded carrots during storage</b>
P12.	R. Riesute, J. Salomskiene, M. Reminaite, A. Rezgiene, S. Gustiene <b>Effect of anolyte on <i>Salmonella</i> and <i>Listeria monocytogenes</i> growth on meat surface at 0–4 °C</b>
P13.	L. Skudra, K. Loba, D. Kunkulberga <b>Shelf life prediction of meat pies</b>
P14.	I. Gramatina, R. Krasnobajs, L. Skudra, S. Sazonova <b>Change of physically chemical parameters of meat during wet ageing</b>

## FOODBALT 2019 and NEEFOD 2019

Poster No.	Author, Title of Poster
P15.	S. Gustiene, G. Zaborskiene, A. Rokaityte, R. Riesute <b>The usage of antioxidants for improvement of hot-smoked sausages quality indicators</b>
P16.	O. Chernikova, I. Piturina, A. Terentev <b>Assessment of heavy metals content in cereal products using the voltametric analyzer</b>
<i>Trends in new food product and technology development</i>	
P17.	S. Jezniene, A. Sipailiene <b>Encapsulation of probiotic bacteria: The influence of biopolymer on the encapsulation effectiveness</b>
P18.	I. Jasutiene, M. Kersiene, D. Leskauskaite, V. Eisinaite <b>Encapsulation of water and fat soluble vitamins using double emulsions matrix</b>
P19.	P. Zutautas, V. Eisinaite, D. Leskauskaite <b>Microencapsulation of black chokeberry extract in double emulsions with different biopolymers by emulsification and spray drying</b>
P20.	N. Khrapatov, A. Ivanova, A. Hludin, B. Kolesnikov, M. Shamtsyan <b>Obtaining of hydrophobin-type proteins from fungal culture trichoderma viride</b>
P21.	E. Sosyura, E. Romanenko, M. Selivanova, T. Aysanov, N. Esaulko, M. German <b>Development of formulation and production technology of bitter tincture</b>
P22.	Z. Kruma, M. Sabovics, T. Kince, R. Galoburda, E. Straumite, L. Tomson, I. Sturite, A. Kronberga <b>Influence of germination temperature and time on phenolic content and antioxidant properties of cereals</b>
P23.	V. Sterna, D. Kunkulberga, E. Straumite, K. Bernande <b>Naked barley influence on wheat bread quality</b>
P24.	E. Gannochka, B. Kolesnikov, A. Salamahina, M. Shamtsyan <b>The milk-clotting enzyme from fungal culture <i>Funalia</i> sp.</b>
P25.	D. Zadeike, R. Vaitkeviciene, Z. Gaizauskaite, G. Juodeikiene, E. Bartkiene, V. Lele, Z. Valatkeviciene <b>The strategies for the utilization of rice processing by-products to reuse as value-added additives</b>
<i>Food chemistry, analysis and quality assessment</i>	
P26.	G. Krumina-Zemture, I. Beitane, I. Cinkmanis, A. Kirse-Ozolins, M. Sabovics <b>Digestibility of buckwheat starch</b>
P27.	B. Ozola, I. Augspole, M. Duma, V. Kreicbergs <b>Bioactive compounds in ginger tea</b>
P28.	A. Velicka, Z. Taraseviciene, E. Hallmann, A. Paulauskiene, I. Cechoviciene <b>Total phenols, phenolic acids and flavonoids content of different mint species</b>
P29.	L. Dienaite, M. Pukalskiene, A. Pukalskas, P. R. Venskutonis <b>Phytochemicals and antioxidant capacity of sea buckthorn berry pomace extracts</b>

## FOODBALT 2019 and NEEFOOD 2019

Poster No.	Author, Title of Poster
P30.	I. Cinkmanis, V. Mikelsone, A. Keke, L. M. Fisere <b>Juglone content in leaf, stem, nut shells and pulp of Latvian black walnut and butternut</b>
P31.	I. Cinkmanis, I. Augspole, S. Vucane, F. Dimins <b>Analysis of organic acids in herbal and fruit syrups by liquid chromatography</b>
P32.	B. Ozola, I. Augspole, M. Duma <b>Pigments content in different processed edible wild plants</b>
P33.	L. Tomsone, Z. Kruma <b>Evaluation of pre-treatment and juice extraction methods for optimal horseradish juice production</b>
P34.	D. Seglina, I. Krasnova <b>Preliminary results of the Japanese quince fruit storage extension possibilities</b>
P35.	I. Urbanaviciute, P. Viskelis <b>Osmotic dehydration in Japanese quince (<i>Chaenomeles japonica</i> Thunb.) fruit processing</b>
P36.	E. Karademir, E. Yalcin <b>Utilization of wholegrain hull-less barley flour in traditional cornelian cherry tarhana soup</b>
P37.	N. Gailane, I. Jakobsone, S. Zute, M. Bleidere, I. Kantane, V. Bartkevics <b>Lignans in oats and barley bred in Latvia depending on cultivar, environment and agricultural practice</b>
P38.	M. Sabovics, S. Ishiyazova, L. Tomsone, S. Kampuse, H. Tilavov, T. Ostonakulov <b>Environmental assessment of quality indicators of local melon varieties grown in Uzbekistan</b>
P39.	E. Sipailaite, M. Liaudanskas, J. Viskelis, N. Uselis, P. Viskelis, D. Kviklys <b>Impact of fruit place in the fruit tree to variance of quantitative composition of triterpenic compounds</b>
P40.	M. Duma, I. Alsina, L. Dubova, I. Augspole, I. Erdberga <b>Suggestions for consumers about suitability of differently colored tomatoes in nutrition</b>
P41.	A. Adomeniene, R. Baranauskiene, P. R. Venskutonis <b>Enzyme inhibitory activity and total phenolic content of yam extracts</b>
P42.	L. Varnaite, M. Pukalskiene, P. R. Venskutonis <b>Fractionation of white lupin seeds (<i>Lupinus albus</i>) by supercritical carbon dioxide and ethanol</b>
<b><i>Food material / packaging interaction</i></b>	
P43.	S. Muizniece-Brasava, A. Kirse-Ozolins, J. Veipa <b>Effect of various packaging solutions on the quality of nut and dried fruit mixes</b>
<b><i>Sustainable processing and packaging</i></b>	
P44.	I. Sepelevs, I. Nakurte, R. Galoburda <b>Biologically active compound stability in the industrial potato processing by-products</b>
P45.	E. Ragauskaitė, D. Cizeikiene <b>Sugar beet molasses and apple caviar application for invertase production using yeast belonging to <i>Kluyveromyces</i> genus</b>

## FOODBALT 2019 and NEEFOD 2019

Poster No.	Author, Title of Poster
P46.	R. P. F. Guine, L. Fontes, M. J. Lima <b>Evaluation of drying kinetics and mass transfer in convective drying of <i>Cynara cardunculus</i></b>
P47.	L. Tamkute, B. Melero Gil, J. Rovira Carballido, M. Pukalskiene, P. R. Venskutonis <b>Defatted cranberries pomace extract improves the quality of pork burgers</b>
<b>Consumer behaviour and sensory issues</b>	
P48.	Z. Meliha Tengiz, Y. Orman <b>The evolution of the students' attitudes and behaviour towards fast food consumption</b>
P49.	S. Iriste, I. Beitane, I. Millere, G. Krumina-Zemture, E. Mengote <b>Restaurant meals nutritional value impact on customers' eating habits</b>
P50.	G. Krumina-Zemture, S. Iriste, I. Beitane, L. Lipina <b>Evaluation of the quality of catering service</b>
P51.	I. Millere, R. Riekstina-Dolge, L. Medne <b>Factors impacting special diet's preparing in Riga's pre-schools</b>
P52.	I. Beitane, M. Nevarzavska <b>Pupil's fruit and vegetable consumption in Latvian schools with various training programs about healthy diet</b>
P53.	R. Riekstina-Dolge, I. Beitane, S. Iriste, S. Melbarde <b>Study of food waste in schools of Vidzeme region</b>
P54.	I. Rasskazova, A. Kirse-Ozolina <b>Snack consumption patterns of Latvian consumers</b>
P55.	E. Aplocina, E. Straumite, R. Galoburda <b>Effect of feeding on the sensorial quality of lamb and goat kid meat</b>
P56.	G. Juodeikiene, E. Bartkiene, D. Zadeike, D. Klupsaite, D. Cernauskas, V. Lele, V. Steibliene, V. Adomaitiene <b>Prediction of depression disorders based on face emotional expressions of different foods tastes</b>
P57.	M. Sabovics, A. Kirse-Ozolina, I. Gramatina, Z. Kruma, S. Sazonova, G. Krumina-Zemture, J. Kivite, A. Keke, E. Sturmovica, S. Muizniece-Brasava, I. Sepelevs <b>Development of products from Baltic sprat (<i>Sprattus Balticus</i>) as an analogue to traditional Italian anchovy preserves</b>
P58.	B. Basaran, Y. Orman <b>Traditional confectionery products in Turkey: A literature review</b>
<b>Food chain management</b>	
P59.	J. Ozolins, M. Silovs, I. Pilvere, A. Nipers, L. Proskina <b>Optimistic scenario economic evaluation of innovative product manufacturing from Baltic sea sprats</b>
P60.	B. Basaran, Y. Oraman <b>Processing methods of table olive in households in Turkey</b>

## FOODBALT 2019 and NEEFOOD 2019

<b>Poster No.</b>	<b>Author, Title of Poster</b>
P61.	A. Ziukaite, D. Cizeikiene, J. Damasius <b>Azotobacter with molasses mixture effect on wheat grain growth</b>
P62.	J. Viskelis, S. Nevidomskis, C. Bobinas, D. Urbonaviciene, R. Bobinaite, R. Karkleliene, P. Viskelis <b>Modeling and optimization of beetroot storage process</b>
P63.	G. Gulbinas, A. Sipailiene <b>Influence of rigor state on the quality of salted rainbow trout</b>
P64.	J. Poberezny, E. Wszelaczynska, M. Szczepanek <b>The discolouration potential of carrot roots depending on biostimulants and storage</b>
P65.	I Augspole, A. Linina, A. Rutenberga-Ava, A. Svarta <b>Effect of organic and conventional production systems and cultivars on the winter wheat grain gluten quantity and quality</b>
P66.	D. Kunkulberga, A. Linina, A. Ruza <b>Winter Wheat wholemeal rheological properties depending on nitrogen fertilizer</b>
P67.	D. De Angelis, D. Di Rella, M. Costantini, F. Caponio, A. Pasqualone, C. Summo <b>Physicochemical properties of flours of Desi and Apulian black chickpeas as affected by proximate composition</b>
P68.	M. Costantini, D. De Angelis, C. Summo, V. M. Paradiso, A. Pasqualone <b>The quality of legume extruded products as influenced by the processing parameters: An overview</b>

## **FOODBALT 2019 and NEEFOD 2019**

**ORAL PRESENTATIONS**

### NEW INSIGHTS INTO THE OCCURRENCE OF NOVEL AND EMERGING PERSISTENT CONTAMINANTS IN FOOD PRODUCTS

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Governments throughout the world are intensifying their efforts to improve food safety. These efforts come as a response to an increasing number of food-safety problems and increasing consumer concerns. The variety of toxic residues in food is continuously increasing as a consequence of industrial development, new agricultural practices and environmental pollution. Emerging contaminants are not necessarily new substances. They can be substances that have been around for a long time for which: 1) new information has been obtained; 2) test methodology has improved so a known contaminant can be tested for; 3) environmental contamination is now being found in the food; 4) changes in consumption of a substance result in recognition of an issue. Among the most prominent groups of emerging food contaminants, are compounds of industrial origin such as brominated flame retardants (BFRs). BFRs applied to consumer products to make them less flammable, are highly persistent in the environment and cause multi-organ toxicity in human. Based on the review of BFRs presence in food published recent years, it is clear that such pollutants are not ideally controlled as the surveys are too restricted, legislation inexistent for some classes, the analytical methodologies diversified, and several factors as food processing are generally overlooked. Since recent studies have shown that dietary intake constitutes a main route of human exposure to BFRs, it is of major importance to review and enhance these features, since some of food products (e.g. fish and seafood) constitutes a chief pathway for human exposure and biomagnification of priority environmental contaminants.

**Keywords:** food safety, emerging contaminants, brominated flame retardants

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## EATMOT PROJECT – THE STUDY OF EATING MOTIVATIONS IN DIFFERENT COUNTRIES

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The EATMOT Project is a multinational study that is being carried out in 16 countries about different eating motivations, given their recognized importance in the definition of people's dietary patterns. Eating is not only determined by physiology, but also by many other factors that interact in a complex way to shape individual eating habits. Hence, the aim of this project is to undertake a study about the different psychic and social motivations that determine people's eating patterns, either in relation to their choices or eating habits. To do this, factors linked to food choices will be evaluated in the following main areas: health motivations; economic factors; emotional aspects; cultural influences; marketing and commercials or environmental concerns. The study is based on a questionnaire that was prepared purposely for the project, and therefore adequate to evaluate the aspects that determine the objectives highlighted. The countries involved are: Argentina, Brazil, Croatia, Egypt, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal (Coordinator), Serbia, Slovenia, Romania and United States of America.

From the obtained results so far it was possible to validate the EATMOT scale and to evaluate the influence of the sociodemographic variables on the studied eating motivations. Variables like age, marital status, country, living environment, level of education or professional area were found to importantly influence all the types of eating motivations analysed. Conversely, gender showed no significant effect on economic & availability as well as marketing & commercial motivations. Furthermore, ANN modelling indicated that the strongest positive influencers of the eating motivations were age for health, country for emotional, gender for economic & availability, country for social & cultural, country for environmental & political, and finally country also for the marketing & commercial motivations.

**Keywords:** food choice, geographical influence, health, emotional eating

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## SEABUCKTHORN – A UNIQUE OF VALUE ADDED NATURAL PRODUCTS

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Seabuckthorn is a highly valuable crop. During the last 20 years Seabuckthorn became an important factor in agriculture in Europe. Especially production of berries and final products play an important role in rural areas. Many people today grow Seabuckthorn beside other agricultural crops.

One of the most important facts from growing international trade with Seabuckthorn raw materials as well as the semi-products is identity and quality of products. European market is characterised by a high level of food safety and quality control.

Comparing international standards with requirements in European Community, we see that there is a difference in understanding. Missing standardisation can be one barrier for international trade.

The aim of this work was to collect data on SBT carotenoids composition. Especially dependence on varieties and occurrence of capsanthin was on focus. Samples were taken from 13 Russian varieties in Barnaul directly from orchard of Lisavenkow institute. 4 German varieties were in addition also investigated. Fatty acid composition varies between different brands investigated. Also differences in sterols were observed. Never the less the main sterol is beta-sitosterol.

Carotenoid composition agrees with findings of Russian scientists, e.g. Novruzew et al. We can not conclude that capsanthin is a typical component in Seabuckthorn pulp oil. We conclude that capsanthin found in seabuckthorn pulp oil or products containing this is an indicator of alteration.

Differences in tocopherol composition, as well as other vitamins in the berries were observed. Especially in Vitamin C shows great differences.

**Keywords:** seabuckthorn, production, healthy nutrition

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## HUMAN GUT MICROBIOME ANALYSIS AS AN INNOVATIVE TOOL FOR DESIGNING HEALTHY FOODS AND ENHANCED SERVICES

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In collaboration with an online nutrition counselling provider Dietless (<https://www.dietless.co.uk/>), we carried out a study in which we monitored the changes in human gut microbiome during adaptation of a new healthier diet. It was determined, that although the subjects lost weight and significant improvements occurred in their microbiome, the diet did not provide a sufficient amount of dietary fiber as it lacked most abundant fiber sources, such as bread and other cereal based foods.

As a next step, it was decided to develop a rye bread high in dietary fiber and with a diverse fiber profile, while being low in digestible carbohydrates. The ingredients were selected directly based on the gut microbiome analyses' results. Rye and oat flours were used as main ingredients. Both of these flours are excellent fiber sources. To increase fiber content, but keep the overall carbohydrate content low, pure concentrated fibers were included in the recipe.

As a result, a new gut friendly bread was introduced to the market - a rye bread containing 40% less absorbable carbohydrates (only 22 g 100 g<sup>-1</sup>) and high in diverse dietary fiber (16 g 100 g<sup>-1</sup>) to provide valuable nutrients for the gut microbiome.

**Keywords:** gut microbiome, rye bread, dietary fiber

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**BERRY LIPIDS AND WAXES: ISOLATION,  
CHARACTERISATION, PROPERTIES****Linards Klavins<sup>1</sup>, Arturs Viksna<sup>2</sup>, Jorens Kviesis<sup>1</sup>, Maris Klavins<sup>1</sup>**<sup>1</sup> Department of Environmental Science, University of Latvia, Raina blvd 19, Riga, Latvia<sup>2</sup> Faculty of Chemistry, University of Latvia, Raina blvd 19, Riga, Latvia

Production, consumption and processing of different berries nowadays is growing, considering taste properties and health benefits. In northern countries of especial importance are berries belonging to *Vaccinium* species (cranberries, bilberries, blueberries, lingonberries and others) and many of these berries are considered as superfruits. Value of the berries determine presence many biologically active and valuenbe substances and amongst them special role have berry lipids. Lipids of *Vaccinium* berries include not only triglicerides, but also fatty acids, alcohols but also sterols, terpenes and other substances. A separe group of substances are berry waxes forming shinu cover of berries. The aim of the research was to study *Vaccinium* berry lipid extraction possibilities, their composition and evaluate application possibilities. Lipid extraction possibilities were studied using comparing different solvents, including environmentally friendly extraction options and different extraction methods. Lipid composition was analysed using GC-MS and GC-MS/MS. The lipid fraction contained compound classes like fatty acids, sterols, triterpenoids, alkanes, phenolic and carboxylic acids and carotenoids. All fresh berries contained high amounts of C18 unsaturated fatty acids (for example, up to 102 mg 100 g<sup>-1</sup> of blueberries) and phytosterols (86 mg of  $\beta$ -sitosterol 100 g<sup>-1</sup> of blueberries), and high amounts of benzoic acid were found in lingonberries (164 mg 100 g<sup>-1</sup>). The analysed berry lipid profiles were compared using the principal component analysis and hierarchical cluster analysis. The two analyses showed that the lipid profiles of the studied berries reflect their taxonomy. Considering the composition of berry lipids they can find wide application at development of functional food.

**Keywords:** lipids, waxes, *Vaccinium* berries, GC-MS

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## ANTIOXIDANT ACTIVITY, PHYTOCHEMICAL COMPOSITION OF LIPOPHILIC AND HYDROPHILIC FRACTIONS OF GUELDER-ROSE BERRY POMACE

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Guelder-rose berry (*Viburnum opulus*) pomace remaining after juice pressing is valuable raw material for development new products for foods and other application. In addition, effective pomace utilization would reduce waste treatment and disposal costs. Consequently, developing biorefining processes for berry pomace well fitting into the concept of – circular economy. The aim of this study was to determine antioxidant activity and chemical composition of extracts obtained from *V. opulus* berry pomace. The study showed that better recoveries of lipophilic fractions from the pomace is achieved by the extraction with hexane, while higher yields of hydrophilic fractions were obtained using ethanol as a solvent. Analysis of lipophilic extract by GC-MS revealed that the main volatile constituents were alkanes; they also contained some strong fat-soluble antioxidants tocopherols. Palmitic, oleic and linoleic acids were the main constituents in berry pomace oil. Antioxidant capacity of lipophilic fractions was evaluated in Oxipres and Rancimat apparatus using 0.5, 1.0 and 1.5% concentrations of *Virbulum opulus* in majoneze. However, some antioxidants effect was observed only at the highest concentrations applied. Twenty five compounds were identified in the water-soluble fractions of berry pomace extracts by UPLC-QTOF-MS. The main constituents in guelder-rose berry pomace fractions were proanthocyanidin B, chlorogenic acid, rutin and malic acid. Polyphenolic antioxidants are recognized as health beneficial bioactive phytochemicals; therefore, the extracts obtained from *V. opulus* berry pomace may be further considered as promising ingredients for the development of functional foods, nutraceuticals and cosmetic preparations.

**Keywords:** *V. opulus*, chromatography, antioxidant activity, berry pomace

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### COMPARISON OF CHEMICAL COMPOSITION OF FRESH CABBAGE AND SAUERKRAUT JUICE

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White cabbage (*Brassica oleracea* var. *capitata*) is affordable and available vegetable in local markets around the globe. It is a source of vitamins, micro and macro nutrients. Sauerkraut is traditional condiment of many countries. Fermentation process is one of the oldest techniques to preserve food as well as it brings beneficial properties. Chemical composition is influenced by seed material, variety, agrotechnology, fertilizer, weather conditions and starter culture for sauerkraut. The aim of this study was to compare fresh cabbage juice chemical composition to sauerkraut juice. Three cabbage varieties were tested. Sauerkraut was made from the same varieties. Vitamin C content, antiradical activity, total phenols, carotinoids were determined. Fresh cabbage juice showed significant ( $p < 0.05$ ) influence of variety on vitamin C ( $511.8\text{--}807.7$  mg  $100$  g<sup>-1</sup> dry wight (DW)) so does fermentation process with interaction on variety ( $591.9\text{--}672.4$  mg  $100$  g<sup>-1</sup> DW). There were no significant differences between varieties ( $p > 0.05$ ) in antiradical activity (by DPPH method) in fresh cabbage juice, ( $95.9\text{--}98.5$  mg  $100$  g<sup>-1</sup> DW). Fermentation process significantly increased the antiradical activity ( $138.7\text{--}189.5$  mg  $100$  g<sup>-1</sup> DW) and there were significant differences between varieties, too ( $p < 0.05$ ). Fermentation process of fresh cabbage variety showed significant influence ( $p < 0.05$ ) on total phenolic compounds ( $3264.9\text{--}374575$  mg  $100$  g<sup>-1</sup> DW) as well as significant differences in variety of fresh cabbage juice ( $2212.65\text{--}2352.23$  mg  $100$  g<sup>-1</sup> DW). Results showed that white cabbage or sauerkraut is not a beneficial source of carotinoids.

**Keywords:** fermented cabbage, antiradical activity, total phenolic compounds

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## THE CHANGES OF BIOACTIVE COMPOUNDS IN DIFFERENT GENOTYPES OF ROSEHIPS FLESH

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Rosehips are generally known to contain high levels of health-promoting compounds such as carotenoids and polyphenols. Differences in content may exist due to genetic variation, degree of ripening, variations within and between years, climate, growing and storage conditions, and analytical method.

The aim of this study was to determine bioactive compounds of five different rosehip species (*R. rugosa*, *R. rugosa* 'Rubra', *R. rugosa* 'Alba', *R. canina*, *R. villosa*), growing in Pakruojis area in Lithuania. Content of carotenoids in the flesh of rosehips species were determined by the method described by Helsper et al., as well phenolic compounds – by Hertog et al., with some modifications. The results showed large variations of the content of carotenoid compounds in all investigated rosehips species. It was found that *R. villosa* were significantly rich in  $\beta$ -carotene, lutein and lycopene (respectively 31.40, 6.06 and 5.63 mg 100 g<sup>-1</sup> DW). The total phenolic acid content varied from 89.23 to 121.81 mg 100 g<sup>-1</sup> DW and total flavonoids – 34.23–41.59 mg 100 g<sup>-1</sup> DW.

The results demonstrated that the significantly highest concentrations of polyphenols were identified in the *R. canina* species (157.42 mg 100 g<sup>-1</sup> DW). The rosehip flesh of species *R. villosa* accumulated by on average 55.5% significantly higher contents of lutein, 65.8% mg 100 g<sup>-1</sup> – of lycopene and 66.1% –  $\beta$ -carotene, compared with the other species.

**Keywords:** flesh, species, carotenoids, phenolic compounds

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## INFLUENCE OF THE ROASTING PROCESS ON BIOACTIVE COMPOUNDS AND AROMA PROFILE IN SPECIALTY COFFEE

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The coffee roasting process is one of the most important parts of coffee aroma composition formation. The roasting process can influence differently the aroma compound and the biologically active compound composition in coffee. It is essential to understand the point in the roasting process when the pleasant specialty coffee aroma compounds and health-beneficial bioactive compound composition is at the best ratio. The aim of the review was to evaluate the balance point in the roasting process between aroma profile and bioactive compound composition in specialty coffees. The loss of aroma compounds with fruity, floral and sweet acidic notes in roasting process happens slower, then the loss of chlorogenic acid. Meanwhile strong aroma compounds like melanoidins with anti-oxidative properties and chlorogenic acid lactones mostly forms in medium roasting level, but due to their bitter sensory characteristics they have low cupping score. Both, the aroma compounds and bioactive compound value starts rapidly decreasing by medium-dark roast. It is proven, that antioxidant activity stays at the highest point in light-medium roast level, when coffee melanoidins start to form and the chlorogenic acid is still at high concentration with good cup quality. By knowing the roasting process influence to chemical properties of coffees aroma and bioactive compound composition it is possible to maintain high coffee cupping score without losing the valuable bioactive compounds.

**Keywords:** specialty coffee, roasting process, aroma composition, phenolic compounds

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## FACTORS INFLUENCING CONSUMERS MOTIVATIONS FOR HEALTHY EATING AND FOOD-MOOD RELATION OF PEOPLE'S WITH AND WITHOUT DEPRESSIVE DISORDER

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The aim of this study was to evaluate relation between the consumers gender, age, education, civil state, profession and its field with their perception, emotional motivations and selection of information sources about a healthy eating. In addition, to evaluate possible relation of the food choice and people's mood, the initial study about the emotions induced by the different tastes of food for people's with and without depressive disorder was performed. It was established that the gender is significant factor on the most of the emotional motivations. Also, participants age have a significant influence on motivation "food makes me feel good", as well as education have a significant influence on perceptions about a healthy eating. Most of the analysed perceptions were significantly influenced by civil state, profession and professional field of the participants. The results obtained by using *FaceReader* technic showed higher sensibility, than the evaluation by using hedonic scale, which can be influenced by participants previous emotions, which were induced by memory about food uses in the past, and it was established that the mood has a link with the choice of food. Finally, *FaceReader* is very promising technique to detect differences in facial emotion expressions induced by different taste of food for different mood people's groups, but more research is needed to see how this technology performs in more complex testing procedures, simulated or "real life" environments.

**Keywords:** food choice, questionnaire, emotions, mood, *FaceReader* technic

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## THE STABILITY OF GAS CHROMATOGRAPY-OLFACTOMETRY (GCO) PANEL PERFORMANCE

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The interim results of the study on the stability of assessors of gas chromatography-olfactometry (GC-O) are presented. The aim of the study was to understand the fluctuations in the sensitivity of GC-O assessors and test the possibility to use calibration solution to account the differences in sensitivity as a part of data analysis. Calibration solution was put together by considering multiple factors like chemical and physical properties of molecules (7 compounds in total). Apple juice was used as a test matrix. The study is carried out by using 11 panellists in multiple sniffing sessions (10 by the end of the study). In each of the session, panellists had to sniff a calibration solution followed by the sniffing of the sample. Posterior intensity method was used with scale range 0–5. Assessors had to fill in a questionnaire prior the sniffing with the main attention on their emotional status. The data was analysed by using PCA and PLS to find correlation between intensities in calibration solution and test matrix. The performance of each panellist was measured by using standard deviations and MSE values. The intensities of the compounds in the calibration mix were rather stable throughout the test period and no big fluctuations in the sensitivity were observed. Therefore, in general no correlations were found between the results of sniffing the calibration mix and apple juice. The stability of the results in analysing the apple juice had more fluctuations and was dependant on each specific panellist.

**Keywords:** GC-O, sensory calibration, data analysis

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**A REVIEW– HOW SALT IMPACTS SENSORY PERCEPTION OF SNACKS?****Ilze Kalnina, Evita Straumite**

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Consumers have growing concerns regarding healthy eating habits which can lead to healthier food choices in both choosing meals and snacking. With growing society's understanding of healthy foods, changing motivation of food preferences towards healthier, producers are obligated to transform their products with balanced nutrition value. One of greatest worries is salt intake as it is connected to increasing risks of cardiovascular diseases. The challenge for producers is to decrease salt amount and at the same time to maintain the good taste of snack or any other product in order to make sure that consumer liking remains at the same level.

Objective of the review is to analyse scientific literature, describe the possibilities of salt reduction on potato, corn or vegetable snacks and to understand how it could impact sensory characteristics of the snacks. Review outlines the current situation of progress that has been made in salt reduction and indicates main priorities and problems in the salty snacks sector.

Salt as well as spices makes a great impact on sensory profile because they determine taste of product which is directly linked to overall level of liking. Researchers have found out that it is possible to substitute salt with different salt replacers (KCl, MgCl<sub>2</sub> and others) in combination with flavour enhancers. Salt reduction or replacing not always directly affects consumer perception of product.

**Keywords:** salt reduction, snacks, sensory properties

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### **CONSUMER AWARENESS AND ATTITUDE TOWARDS ACTIVE AND INTELLIGENT PACKAGING SYSTEMS AND THEIR IMPLEMENTATION IN THE LATVIAN MARKET**

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Packaging is designed to preserve foods against damage and contamination and prolong storage times. It provides isolation (product hold), protection (quality, safety, freshness), information (graphics, labels) and usefulness or convenience. However, packaging offers much more than these benefits for the manufacturer and the consumer.

Changes in consumer preference for safe food have led to innovation in packaging technology. Active and intelligent packaging is packaging technology which offers to deliver safe and quality products. Active packaging refers to the inclusion of additives in the package in order to maintain or extend the quality and shelf life of the product. Intelligent systems are those that monitor the state of packaged food to provide information on the quality of packaged food during transportation and storage. These technologies are designed to increase the demand for safer foods that provide better shelf life. The market for active and intelligent packaging systems is expected to have a promising future by integrating them into packaging materials or systems.

A survey was conducted to study consumer awareness and attitudes towards active and intelligent packaging and their introduction to the Latvian market. 900 respondents from different regions of Latvia answered 19 questions about how well they were informed about smart packaging, how much they would be willing to pay for it, as well as an analysis of consumer confidence about the impact of smart packaging on product quality during storage. As the results show, the majority of respondents have insufficient knowledge and understanding of smart packaging.

**Keywords:** active packaging, intelligent packaging, shelf life, consumers, market

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**ESSENTIAL ELEMENTS ANALYSIS IN MATURE BREAST MILK**

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Breast milk is recognised as the best source of essential elements for the infant in the first months of life.

Objective – to determine the content of calcium, iron, magnesium, potassium and selenium in mature breast milk. To evaluate possible relation with maternal (age, parity, breastfeeding pattern, dietary intake) and infant's (age, birth weight, sex) attributes.

In the study participated 65 lactating women from Latvia (at least one month postpartum). Elements' content in breast milk was analysed using ICP-MS (Agilent 7700x, Japan). Dietary data (72-hour food diary) were evaluated using the Fineli Food Composition Database (<https://fineli.fi>). Data analysis were carried out using IBM SPSS Statistics, version 22.0. Spearman's correlation, partial correlation and Mann-Whitney U test were used to evaluate how maternal & infant characteristics influence essential elements' content in breast milk.

Average content for calcium, magnesium and potassium in breast milk was  $28.40 \pm 7.06$ ,  $3.85 \pm 0.64$  and  $59.60 \pm 8.29$  mg  $100 \text{ mL}^{-1}$ , respectively. Iron content in 97% of samples ( $n=63$ ) was below detection limit ( $<0.1$  mg  $100 \text{ mL}^{-1}$ ). Selenium content in all samples was below detection limit ( $<0.002$  mg  $100 \text{ mL}^{-1}$ ). Calcium content in breast milk was higher for women practising exclusive breastfeeding comparing to partial breastfeeding ( $30.51 \pm 7.31$  vs  $25.41 \pm 5.43$  mg  $100 \text{ mL}^{-1}$ ,  $p=0.003$ ). Our obtained values for calcium, magnesium and potassium in breast milk were in accordance with other studies. Dietary intakes of essential elements among participants were within recommended intakes. Low values for iron and selenium indicate that infants in Latvia may not receive sufficient intake of these elements via breast milk but further research is necessary to draw conclusions.

**Keywords:** breast milk, essential elements

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## OPTIMISATION OF THE PRODUCTION TECHNOLOGY OF GLUCOSE-GALACTOSE SYRUP AND ITS APPLICATIONS IN FOOD

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Whey disposal represents serious problem from both economical and an environmental point of view and cannot be directly discharged without an adequate treatment. Center of Food and Fermentation Technologies and Smiltenes Piens AS, the third largest cheese producer in Latvia, have combined their knowledge and skills for valorization of whey and utilization of whey by-product – lactose, which is used to produce glucose-galactose syrup (GGS). The aim of this project is to optimise the production process for receiving high-quality syrup as a base for further introduction into various drinks and food products.

During this study we have focused on the optimisation of the laboratory-scale GGS production for improving its taste and quality. This has involved the installation and optimisation of membrane filtration system processes for removing excess proteins and minerals from the starting solution. Also, different enzymes and their hydrolysis conditions have been compared, and most suitable evaporation parameters chosen. In parallel, the produced syrups and their suitability for different model products has been tested.

As a result, GGS with improved taste and aroma was achieved. The final syrups were honey-like, clear and the colour was light-yellow or yellow. The taste was sweet, slightly salty and sour. GGS offers a possible alternative to sucrose and glucose-fructose syrup in production of bread or preparing an ice cream. Further model recipe developments would give compact portfolio for GGS commercialization.

**Keywords:** whey valorization, glucose-galactose syrup, sugar syrup, product development

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**GLUCOSE-GALACTOSE SYRUP APPLICATIONS IN MODEL PRODUCTS****Irina Stulova<sup>1</sup>, Marie Kriisa<sup>1</sup>, Sirli Rosenvald<sup>1</sup>, Ene Viiard<sup>1</sup>, Raivo Vilu<sup>1,2</sup>**<sup>1</sup>Center of Food and Fermentation Technologies, Akadeemia tee 15A, Tallinn, Estonia<sup>2</sup>Department of Chemistry and Biotechnology, Tallinn University of Technology, Akadeemia tee 15, Tallinn, Estonia

Sugar in food is an increasingly important topic. More and more are looking for possibilities to reduce sugar concentrations and alternatives to replace e.g., sucrose, fructose or glucose-fructose syrups in different products. In this study the aim is to demonstrate the applicability of glucose-galactose syrup (GGS), which is sweet honey-like product produced from whey by using  $\beta$ -galactosidases, in different product developments.

There can be many uses for GGS, while our focus has been on finding the applications in dairy products, growth media formulations, variations of pastry and confectioneries, and production of soft drinks. For thorough comparison, model recipes have been developed, syrup concentrations optimised, and different properties (e.g., rheological, sensorial) of model products evaluated. During this study the initial investigation has focused on pastry products such as different buns and bread, but also ice-cream. In general, the GGS substituted products were comparable to control products with only minor differences. For example, in pastry products, the buns prepared with GGS had crunchier and slightly darker crust. Also, the next day they were softer inside than the control buns. Although the main purpose of the GGS is the sweetening effect, then another advantage of this syrup is, that it is produced from a by-product of dairy industry and thus using it as an alternative has also an environmental impact.

**Keywords:** glucose-galactose syrup, sugar syrup, product development

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## ENZYMATIC HYDROLYSIS OF LACTOSE IN CONCENTRATED WHEY AND MILK PERMEATES

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Dairy permeates contain almost original amount of lactose, small fraction of other solid compounds and water. For complete lactose hydrolysis and glucose-galactose syrup production it is essential to ensure the optimal substrate concentration and conditions to improve product quality and save energy, water and material cost.

The aim of this study was to investigate  $\beta$ -galactosidase preparates for fermentation capability using concentrated whey and milk permeates with 20, 30 and 40% (w/w) of total solids.

Commercial  $\beta$ -galactosidase preparates (Ha-Lactase 5200 produced by *Kluyveromyces lactis* and NOLA Fit5500 produced by *Bacillus licheniformis*, Chr.HANSEN; GODO-YNL2 produced by *Kluyveromyces lactis*, Danisco, Denmark) at dosage 500 NLU L<sup>-1</sup> (Ha-Lactase 5200, GODO-YNL2) and 500 BLU L<sup>-1</sup> (NOLA Fit5500) were used for lactose hydrolysis. The concentration of each permeate was 20, 30 and 40% (w/w) of total solids. 10% KOH was used to adjust optimal pH for fermentation media. Samples were hold in water bath for 4 hours at 42 °C. Lactose, glucose and galactose concentrations were determined by HPLC (Shimadzu LC-20 Prominence, USA).

Nola Fit5500 and Ha-Lactase 5200 preparates were able to increase lactose hydrolysis rate more than 90% in all permeates at 20% solids concentration. GODO-YNL2 preparate showed the highest conversion of glucose in acid whey permeate at 40% solids concentration and the lowest conversion of galactose in milk permeate at 30% solids concentration.

The results indicate that substrate type and solids concentration have an effect on the relative activity of commercial enzymes. The study results give a greater understanding about permeates suitability for glucose-galactose syrup production.

**Keywords:** lactose hydrolysis, glucose-galactose syrup, permeate

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## THE EFFECT OF CONCENTRATED WHEY SOLIDS ON LACTOBIONIC ACID PRODUCTION BY *PSEUDOMONAS TAETROLENS*

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Nowadays lactobionic acid production via microbial synthesis gain a high awareness. Lactobionic acid productivity by microbial pathway can be affected by various factors among them total solids in concentrated whey. The aim of the study was to determine the appropriate content of total solids for an effective lactose oxidation by *Pseudomonas taetrolens* DSM 21104 and NCIM 9396.

The acid whey was used as the study object. The total solids in acid whey was concentrated by the pilot scale FT22 Rising Film Evaporator (Armfield, UK) at 10%, 20%, 30% and 40%. *Pseudomonas taetrolens* NCIM 9396 (NCTC, England) and *Pseudomonas taetrolens* DSM 21104 (DSMZ, Germany) were used for the study. The content of lactobionic acid in the concentrated whey samples was determined using the high performance liquid chromatography (Shimadzu LC 20 Prominence, Japan). The content of lactose in the acid whey and concentrated whey samples was determined using MilcoScan™ Mars (Foss, Denmark) and the high performance liquid chromatography.

The results showed that lactose is converted faster into lactobionic acid if the substrate has 20% of total solids. If total solids in the substrate is more than 20%, the process is slower due to the influence of minor whey compounds as minerals and their salts. The study results will help to improve effective production of lactobionic acid by microbial pathway.

**Keywords:** lactobionic acid, whey, *Pseudomonas taetrolens*, lactose oxidation

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## EVALUATION OF MICROBIOLOGICAL QUALITY OF COLOSTRUM

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Bovine colostrum is important source of different biologically active compounds: immunoglobulins, lactoferrin, lysozyme, lactoperoxidase etc., therefore vital to a dairy calf's ability to survive. There is the lack of information about microbiological quality of colostrum. Still it is very important parameter, which can be significant for calf mortality and antibodies absorption rate, the aim of the study was to evaluate microbiological quality of colostrum obtained from cows.

Colostrum samples ( $n=20$ ,  $50 \text{ mL}^{-1}$ ) were collected in Research Study Farm "Vecauce" (Latvia University of Life Sciences and Technologies, Latvia) during December 2018 to January 2019 one hour after calving. Samples were immediately frozen ( $-19 \pm 1 \text{ }^\circ\text{C}$ ) and delivered to the laboratory. The colony forming units (LVS EN ISO 4833-1:2013) and presence of coliforms (LVS EN ISO 16649-2:2007) were detected in colostrum samples. Descriptive statistics were used for data analysis. The average total plate count of colostrum was  $447333 \text{ mL}^{-1}$ , colony forming units ranged from 4.97 to 5.11 log CFU  $\text{mL}^{-1}$  in analysed samples. Research results associated with low antibodies absorption rate by calfs and high risk of diarrhoea in the farm.

**Keywords:** colostrum, total plate count, antibodies

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**GOAT MILK QUALITY IN THE LATE LACTATION**

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Improving application of goat milk to cheese production is an up-to-date issue in Latvia, therefore more information is needed about the chemical composition and renneting properties of goat milk during the lactation stages. The aim of the study was to analyse the circumstances of goat milk composition and quality in the late lactation, as well as the impact of breed was studied, too. Milk fat, protein, lactose, dry matter, solids non fat and freezing point were measured by MilcoScan Mars™ (Foss, Denmark). In total, 95 samples were tested which represent four goat breeds. Latvian Native (n=44), Saanen (n=16), milking crosses XP (n=21) and crosses XX (n=14). All XX and XP goats were in the first lactation, Latvian Native average were – 1.8 lactation, and for Saanen goats average lactation were – 5.3. All animals were kept in the same condition and received the same feed by feeding scheme. The bulk milk was analysed (n=4) for understanding of average milk chemical composition and its influence on cheese production. Fat and protein ratio was analysed in individual goat milk samples, as well as in bulk milk samples, and the results were 1.10 and 0.87. Milk fat and protein (%) were higher in XP goats compare to Latvian Native, respectively 4.75 vs 4.50 and 3.91 vs 4.23. No significant difference was found between lactose (%) in first, second and older lactations summary 4.43, 4.43 and 4.23. Overall means for bulk milk fat, protein, lactose, solid non fat were 4.95%, 4.28%, 4.41% and 8.90%, respectively.

**Keywords:** goat milk, lactation, quality

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## RECOVERY OF HIGH-ADDED VALUE FRACTIONS FROM BEETROOT AND CARROT PROCESSING BY-PRODUCTS

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Disposal of plant food processing by-products creates serious environmental pollution problems. On the other hand, they are a rich source of nutritionally valuable compounds, which may find various applications in foods and food supplements. In this study freeze dried beetroot and carrot pressing by-products were consecutively extracted using supercritical carbon dioxide (SFE-CO<sub>2</sub>) and pressurized liquids (PLE). Chemical composition and antioxidant properties of the extracts obtained were evaluated.

The SFE-CO<sub>2</sub> yields of lipophilic fractions obtained from beetroot and carrot by-products were low (<1%), whereas PLE applied to the SFE-CO<sub>2</sub> residues enabled to obtain up to 46% (carrots) and 61% (beetroot) of extractable substances, respectively. The major fatty acid in SFE-CO<sub>2</sub> extracts of carrot and beetroot by-products was linoleic acid, which constituted 55 and 48%, respectively. The concentrations of carotenoids in carrot and beetroot by-products SFE-CO<sub>2</sub> extracts were 36.3 and 12.2 mg g<sup>-1</sup>, respectively. Depending on the extraction temperature, the total betalain content in PLE-H<sub>2</sub>O extracts of red beetroot by-product varied from 4.4 to 11.9 mg g<sup>-1</sup>. The total phenolic content in PLE extracts of carrot by-product, depending on the extraction solvent, varied from 3.7 to 52.7 mg GAE g<sup>-1</sup> extract. Polar PLE extracts were remarkably stronger antioxidants compared to the respective lipophilic extracts.

SFE-CO<sub>2</sub> and PLE are promising techniques for recovery of natural food colorants with high antioxidant activity from beetroot and carrot processing by-products.

**Keywords:** carrot, red beetroot, by-products, extraction, colorants

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## TURNING COMPOST MATERIAL TO FOOD: PRODUCTION OF APPLE PURÉE FROM INDUSTRIAL APPLE POMACES

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Apples and apple products are one of the main products consumed all over the world. Therefore, the amount of waste generated by apple processing industries is significant. The solid residue of apple industry is known as “apple pomace”. A smaller amount of apple pomace (about 20%) goes to animal feed; the rest is used as a waste for landfills or compost. At least half of this could be used for the production of apple purée.

The aim of our work was to use different industrial apple pomaces to produce apple purées. Variables in the study were apple cultivars, the use of enzyme, and pressing conditions. Physicochemical analysis included pH, dry weight, sugar and acid profile, rheology, and vitamin analysis. A professional sensory panel was used to establish sensory profiles of obtained apple purées.

The overall yield of apple purée from apple pomace was about 50–65%. Results showed that the use of enzyme has no negative effect and rather makes production of apple purée more efficient. Cultivar selection is important mainly because of the sensory properties. Desirable texture of purée can be obtained with a suitable sieve.

The study showed that at least half of industrial apple pomace can be further used for human food with good nutritional value. Using this approach can reduce food waste.

**Keywords:** apple purée, industrial apple pomace, food waste, chemical composition, sensory analysis

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### MINERAL AND BIOACTIVE COMPOUND CONTENT IN PLANT-BASED PUREES WITH INCREASED PROTEIN AMOUNT

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Adequate, well balanced and diverse diet together with regular physical activity is considered to be the key elements for good health. The intake of macroelements and microelements play an enormous part in normal function of our bodies, ensuring enzymatic reactions, nerve impulses and other processes. However overly increased amounts of certain vitamins and minerals in the diet can be toxic. So the amount of certain nutrients needs to be taken accordingly to your age, gender and health condition.

The aim of the research was to create new plant-based purees with increased protein amount, detect bioactive compound and mineral content and compare the mineral content with the recommended daily mineral intake for Latvians. For this research three recipes of new plant-based purees were created and laboratorically made using organically grown ingredients from Latvia. Additional ingredients as whey-protein isolate, cod liver oil and sugar were added. Products were processed using cook-vide. All samples were tested on their mineral content (Na, K, Ca, P, Mg, Fe, Zn, Cu, Se), total carotene (TC) and total phenol content (TP), antiradical activity (DPPH).

The obtained data in all samples showed only trace amounts on Se per 100 g of product, on average the content of Na was only 1.2% from recommended daily intake (RDI) per 100 g of product. The highest RDI was obtained with Fe in sample Sp1 for men 11.8%, however for women only 7.1% RDI. No significant differences between samples were found in content of TC and TP. However, Sp2 on average showed 16% higher antiradical activity.

**Keywords:** total carotene, total phenols, DPPH, cook-vide

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## BIOCONVERSION OF WASTE BREAD TO GLUCOSE FRUCTOSE SYRUP AS A VALUE-ADDED PRODUCT

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Bread is one of the most wasted products of all food in many countries around the world. Bread waste is a resource of carbohydrates, proteins and lipids which can be reused in order to get value-added products. In this study, bread residues were converted into a glucose syrup via two stage enzymatic hydrolysis. The optimization process and response surface methodology were used to find the optimal substrate, water and enzyme ratio to produce the highest yields of fermentable sugars. The effects of bread (11.34–28.66 g 100 g<sup>-1</sup>),  $\alpha$ -amylase (0.013–0.047 KNU g<sup>-1</sup> bread) and glucoamylase (0.23–0.57 AGU g<sup>-1</sup> bread) loadings were investigated at liquefaction and saccharification stages. Results indicated that the amount of both enzymes was significant and determines the final glucose yield. The highest yield obtained after hydrolysis was 84.95% bread dry matter or 98.7% carbohydrate. Isomerization was performed for glucose conversion to fructose using optimal amounts of materials determined in hydrolysis experiments. Another optimization process was performed to determine the most effective amount of glucose isomerase enzyme (2.59–5.41 IGIU g<sup>-1</sup> syrup) and pH (6.79–8.21). The increase in enzyme loading and pH up to 8 accelerated isomerization reaction. With the optimal process parameters, the highest fructose yield was achieved (40.32%). Hydrolysis and isomerization processes show bread waste potential of being a resource for the bioproduction of higher value products.

**Keywords:** bread waste, bioconversion, enzymatic hydrolysis, isomerization

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## EFFECT OF SUGAR AND SUGAR SUBSTITUTES ON WHEAT DOUGH RHEOLOGY

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High intake of added sugars has many negative effects on human health. This is the reason why in recent years the replacement of sugar (sucrose) in food and drinks by natural and artificial sweeteners (low-calorie) has increased significantly. The sugar plays an essential role in technology of bakery and pastry products. The purpose of this research is to evaluate the effect of sugar and sugar substitutes on rheological properties of wheat dough. Fructose (non-nutritious sweetener) and stevia (nutritious sweetener) have been used as sugar substitutes. The sugar and sweeteners were added in white wheat flour at levels of 0–5% (the rheological properties of 100% white wheat flour was determinate for comparison). Effect were seen on the dough rheology, which were evaluated by farinographic characteristics with Brabender Farinograph-E with electronic measuring system, according to AACC No. 54-21, ICC No. 155/1. Water absorption decreased with the increase of sweetener ratio because the protein and complex carbohydrates contents is reduced. Regarding the dough development time, it is observed a non-significantly variation with addition of sweeteners (from 2.2 to 2.3%). The dough stability time increased significantly from 3.7. to 7 min in case of fructose adding. The degree of softening values increased for the first two samples (1–2% level) from 46 to 75 BU and decreased significantly up to 24 BU with the supplementation of fructose. The Farinograph Quality Number values increased significantly with sweeteners supplementation. The obtained results are important for the specialists of the bakery technological process.

**Keywords:** sugar, sweeteners, fructose, dough rheology

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## EFFECT OF TEMPERATURE CHANGE DURING TRANSPORTATION ON MUESLI QUALITY

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The quality of the product is related to the choice of the correct packaging material and type of packaging. Muesli are packed in various types of packages however it can be seen that mostly they are packed in pre-made stand-up pouches and flowpacks. There are different storage and packaging that are based on the change in composition of the storage atmosphere. Modified atmosphere packaging (MAP) significantly prolongs the shelf life of product as it affects biochemical, enzymatic and microbiological changes in them. When it comes to food product transportation around 9% of complaints are for wet cargo which is second most common problem in freight transportation and causes greatest losses during logistics. A sudden drop in temperature during transportation can cause condensation, causing moisture migration in the product, reducing its quality and promoting its deterioration. The aim of this study was to determine optimal muesli packaging solution to eliminate the possibility of deterioration of product quality due to changes in temperature during muesli transportation. Samples with muesli were packed in 3 different types of packaging – multilayer stand-up pouches and biodegradable material in air and MAP environment. Samples were stored in ambient temperature ( $20\pm 1$  °C temperature) for 14 days. After two-week storage samples were stored in  $-6\pm 1$  °C,  $0\pm 1$  °C and  $30\pm 1$  °C temperature for 4 days after what they were stored in ambient temperature for 1 day, it was done twice. During temperature change muesli physicochemical, microbiological and organoleptic properties were evaluated in analysed muesli samples.

**Keywords:** muesli, packaging, MAP, temperature change

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## THE EFFECT OF PLANT EXTRACTS ON THE SYNTHESIS OF BIOLOGICALLY ACTIVE COMPOUNDS IN GERMINATED LEGUMINOUS

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The aim of this study was to evaluate the impact of aqueous extracts of field horsetail (*Equisetum arvens* L.) and stinging nettle (*Urtica dioica* L.) plants on the synthesis of compounds with antioxidant properties in germinating seeds. The seeds of adzuki bean (*Vigna angularis*), alfalfa (*Medicago sativa* L.), white clover (*Trifolium repens* L.) were germinated for 72 hours. Germinating seeds were imbibed and daily soaked in aqueous field horsetail and stinging nettle plant extracts.

We studied the influence of elicitation on the amount of dry matter, vitamin C, total polyphenols and total phenolic acids in germinated seeds.

During germination, more intense synthesis of polyphenols occurred in all seeds treated with field horsetail 1% extract solutions compared with those treated with water only. The highest content of total polyphenols was found in the alfalfa seeds (91.19 mg 100 g<sup>-1</sup>) treated with the field horsetail extracts. Under the influence of extracts, the content of vitamin C significantly increased, but more affected by stinging nettle extract (alfalfa and white clover seed; 8.64 and 7.88 mg 100 g<sup>-1</sup>, respectively). When plant extracts were used, there was a tendency for biologically active substances to increase in all variants of the experiment.

**Keywords:** plant extracts, antioxidant compounds, germination

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## THE INFLUENCE OF VARIOUS DRYING METHODS ON THE PROPERTIES AND QUALITY OF EDIBLE FLOWERS` PETALS

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Edible flowers are used in many different styles of cuisine and can be found on menus all over the world. They are receiving renewal interest as rich sources of bioactive compounds. In culinary, edible flowers can be used fresh, dried, candied etc. The drying prolongs expiration date and shelf life as well as enable the transporting, packaging and use of edible flowers.

The aim of this research was to analyse the influence of various drying methods on the properties and quality of edible flowers` petals. The study was carried out at the scientific laboratories of the Faculty of Food Technology at Latvia University of Life Sciences and Technologies. Such drying methods as drying in a hot-air oven, microwave oven and freeze-drying were used in this research. Edible petals of garden marigold (*Calendula officinalis* L.), common daisy (*Bellis perennis* L.) and true lavender (*Lavandula angustifolia* L.) from collection of the Laboratory of Horticulture and Apilogy, attached to the Faculty of Agriculture of Latvia University of Life Sciences and Technologies, were used as plant material.

Theoretical and experimental results were compared as well as the biologically active compounds such as total phenolics content were determined in this research. All three drying methods had adverse effects on total phenolics content of the analyzed edible flowers` petals.

**Keywords:** total phenolics, drying, edible flowers

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### COMPARISON OF FREE-RANGE, BARN AND CAGED HENS' EGGS COMMERCIALY AVAILABLE IN LATVIA

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Eggs are an excellent source of nutrients; furthermore, consumers often consider free-range eggs to be superior to eggs from caged hens. The aim of the study was to identify whether different hen housing systems had an influence on egg quality in Latvia.

Free-range ("FREE RANGE eggs"), barn ("Farmer-Barn eggs") and caged hens' eggs ("Eggs in boxes") commercially available in Latvia were obtained at the production facility of Balticovo JSC. Forty eggs of each type were analysed at the laboratories of Faculty of Food Technology, Latvia University of Life Sciences and Technologies and J.S. Hamilton Baltic JSC. Such parameters as nutritional and energy value, fatty acid profile, cholesterol, vitamins A, E, D, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, B<sub>7</sub>, B<sub>9</sub>, B<sub>12</sub>, minerals Na, K, Ca, Mg, Fe, Cu, Zn, Se, I, P, Cl, heavy metals Pb, Cd and microbiological quality were assessed. Comparison to reference intakes and possible indication of nutrient claims was evaluated according to published nutrient recommendations and EU regulations.

The results show that all three analysed egg types are a valuable source of nutrients ('high protein', 'high omega-3 fatty acids', 'high monounsaturated fat', 'source of vitamin A', 'source of vitamin E', 'source of vitamin B<sub>2</sub>', 'source of phosphorus', 'source of selenium'), which are microbiologically safe and do not contain heavy metals. Free-range eggs are also a 'source of iodine'. Based on chemical composition, the quality of free-range, barn and caged hens' eggs commercially available in Latvia varies insignificantly.

**Keywords:** egg quality, nutritional value, population reference intakes

**Acknowledgments.** This research was supported by Balticovo JSC.

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## EVALUATION OF COLOUR IN SERRA DA ESTRELA CHEESE PRODUCED IN DIFFERENT DAIRIES ALONG MATURATION TIME

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“Serra da Estrela” cheese is a Portuguese traditional cheese with Protected Designation of Origin (PDO), and with a major importance in the national cheese making history. Due to its particular sensory characteristics, namely intense flavour, taste and aroma allied with a smooth texture, it is nowadays one of the most valued products both in Portugal and also abroad.

The objective of this work was to compare the colour of Serra da Estrela Cheese manufactured in different dairies and to evaluate the changes that take place along the production season. The samples used for the study were obtained from 6 dairies situated in PDO region for this cheese. The colour measurements were made with a colorimeter in CIELAB coordinates:  $L^*a^*b^*$ . To evaluate the colour change during milking season, the colour difference was also calculated.

The results obtained in this work indicated that the colour characteristics of the Serra da Estrela Cheeses are slightly different between samples coming from different dairies where the cheeses are manufactured. Nevertheless, in the first moment of the evaluation period, the values of the colour coordinates varied in a limited range, which means that the variations could be considered acceptable attending to the nature of the traditional manufacture process associated with this PDO product. Furthermore, the results showed that along season very important changes in colour took place, which might be expected having in mind the nature of the physical-chemical changes produced in the pastures along time. However, these changes were found very much dependent of the dairy, as the results of total colour change demonstrated.

**Keywords:** colour properties, lightness, maturation, traditional cheese

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## FATTY ACID PROFILE IN SERRA DA ESTRELA CHEESE: AN OVERVIEW

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Milk and dairy products are of major importance in the human diet, since they are an excellent source of well-balanced nutrients which are consumed in large amounts and are easy to manufacture. Most cheeses present in the market are made from cow's milk, with ewe's and goat's cheeses being considered delicacies derived from the unavailability of goat's and ewe's milk in certain periods of the year, proleading to a final product with high prices that consumers tend to value given the quality of the final products. Serra Estrela (SE) cheese, a traditional variety manufactured in the center region of Portugal, is part of the national ancient cultural heritage. Made from raw sheep milk it is assumed as an iconic gourmet cheese, when compared with other Portuguese cheeses. In the present work, the evolution of the lipid fraction, namely unsaturated fatty acids such as monounsaturated and polyunsaturated (omega 3 fatty acids and omega 6 fatty acids), was evaluated for a period of 9 months. Chemically it was possible to verify differences in terms of the fatty acid profile between the analysed cheese samples. SE cheese was characterized by a relatively high content of monounsaturated fatty acids (MUFA) and the evaluation of the lipid profile of SE cheese allowed possible future work in determining bioactive lipid compounds with possible health promoting functions.

**Keywords:** Serra da Estrela cheese, fatty acids, flavour, health

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## DETERMINING IMPORTANT FACTORS ON FISH CONSUMPTION WITH CONJOINT ANALYSIS IN TEKIRDAG, TURKEY

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In the world, there is an increasing consumption trend from red meat to white meat, especially to the fish. Despite the known benefits of fish consumption on human health, it is still not at the desired level in Turkey. The average fish consumption is 5.58 kg per capita in Turkey, and it is below the World (14.9 kg) and the EU (16.89 kg) average fish consumption. The aims of this study are to determine the factors affecting the fish consumption trends of consumers and to make suggestion increasing fish consumption. In this study, surveys were conducted with 270 consumers. Conjoint analysis was used to determine the most important factors that influence consumers while purchasing fish.

According to the results, fish consumption per capita in Tekirdag is 14.69 kg per year. In conjoint analysis results for all consumers, the most important factors in fish consumption are price (34.217%), processing type (31.361%), culture type (26.960%) and purchase place (7.461%). The factors that consumers are influenced, change according to income groups. While price is the most important factor for consumers with a monthly income 3500 TL or less, consumers with monthly income 3500 TL and above pay attention to processing type factor.

For increasing fish consumption per capita, considering the factors that consumers care in fish consumption, it is important to increase the variety of processed fish for all tastes and to offer it to the consumers at reasonable prices. Marine fisheries and aquaculture should be supported, storage and marketing conditions should be regulated.

**Keywords:** conjoint analysis, fish consumption, consumer behavior, income levels

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## ECONOMIC BASE SCENARIO ASSESSMENT OF INNOVATIVE PRODUCT MANUFACTURING FROM BALTIC SEA SPRATS

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Fisheries have a long history and tradition in Latvia. In recent years, the fish processing subsector has been challenged by the development and introduction of new and innovative products manufactured from Baltic Sea sprats (minced fish), which serve as an alternative to canned sprat production. Therefore, the aim of the present research is to perform an economic assessment of the establishment of a potential factory for the production of innovative fish products from sprats caught in the Baltic Sea. To achieve the aim, two specific research tasks were set: 1) to perform a financial and efficiency analysis of the investment project for the industrial production of the newly developed innovative products; 2) to determine the economic effect from the establishment of the factory. The research base scenario established the minimum amount of necessary investment to start up a factory and estimated processing capacity at 408 tons of sprats a year to pay back the investment in time by producing two new innovative products from Baltic Sea sprats: fish buns and fish meatballs (jelly). The research established main economic and financial performance indicators for the investment in the factory project, calculated the number of employees needed for the factory and identified the economic benefits the factory would provide. The research found that setting up a factory within one year could reach the planned fish processing capacity in the third year of operation, reaching 4.7 million euro in turnover and 2 million euro in net profit with a 44% net margin in year 3 and onwards.

**Keywords:** sprats, innovative products, economic assessment

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## DEVELOPMENT OF NEW COST-EFFICIENT AND READY-TO-COOK FISH PRODUCTS WITH HIGHER NUTRITIONAL VALUE

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Such fish as rainbow trout (*Oncorhynchus mykiss* Walbaum), Baltic cod (*Gadus morhua callarias* L.) and mackerel (*Scomber scomber* L.) are common in the Baltic region, either as a part of aquafarming or catch. They are a good source of protein,  $\omega$ -3 fatty acids, various vitamins and minerals. However, these fish are mainly used in the diet as smoked fish.

The project aims to develop technological process solutions and recipes for an innovative, cost efficient ready-to-cook (convenience food) fish fillet (whole muscle) products of different price categories with high added and nutritional value for daily consumption from fish available in Latvia.

The main tasks addressed in this project are the development of cost-optimizing production processes focusing on the mass market, and solutions to extend shelf-life of the new products. In addition, the development of an innovative product will create added value to fish in Latvia, which are currently exported as a raw material.

Planned activities within the framework include selection of fish raw materials taking into account the cost, biochemical composition and organoleptic parameters; experimental tests and analyses in order to develop a new fish product and evaluate its qualitative parameters (incl. nutritional value and economic feasibility); assessment and testing of the product in the industrial environment, development of technological instructions and conditions for industrial production.

**Keywords:** cod, trout, mackerel, fish fillet

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## BIOLOGICAL ACTIVITIES OF MUSHROOM BETA-GLUCANS AND PROSPECTS OF THEIR UTILIZATION TO DEVELOP FUNCTIONAL FOOD PRODUCTS

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Mushrooms are a promising source of variety of biologically active compounds which can be used as pharmaceuticals, functional food supplements, plant protection products against pathogens and cosmeceutical preparations. According to approximate estimates, medicinal mushrooms have about 130 therapeutic functions. Among the biologically active substances released from mushrooms, special attention is given to polysaccharides and polysaccharide-protein complexes. It is believed that among all fungal polysaccharides for the implementation of several activities, primarily  $\beta$ -glucans are respond. Depending on the type of basidiomycetes, the structure of  $\beta$ -glucans is differently, what also leads to a change in its biological activity. Our studies demonstrate, that  $\beta$ -glucans of basidiomycetes have the following activities: Immunological, antitumour, antimicrobial, antiallergic, anti-inflammatory, anti-atherogenic, antiobesity, hypoglycemic, cardiovascular, antihypercholesterolemia and anti-diabetic effects. We also demonstrate, that mushroom  $\beta$ -glucans can be successfully used to fortify common food products to give them additional functionality.

**Keywords:** mushrooms, bioactivity, beta-glucans, functional food

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## COMPOSITIONS FROM THE DIFFERENT ORIGIN COMPOUNDS FOR MULTIFUNCTIONAL NUTRACEUTICALS PREPARATION

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In this study, nutraceuticals in chewing tablets form, based on antimicrobial ingredients (*Artemisia absinthium* water extract and essential oil (EO), antimicrobial properties showing *Lactobacillus uvarum* LUHS245 strain multiplied in a whey media and blackcurrants juice preparation by-products were developed. In addition, two texture forming agents for nutraceutical preparations were tested – agar and gelatine. Finally, antimicrobial and antioxidant properties showing nutraceuticals formulation in chewing tablets form, based on *Artemisia absinthium* EO (concentration  $\leq 0.1$  inhibited methicillin-resistant *Staphylococcus aureus* M87fox, *Enterococcus faecium* 103, *Bacillus cereus* 18 01, *Streptococcus mutans*, *Staphylococcus epidermis*, and *Pasteurella multocida*), *Lactobacillus uvarum* LUHS245 encapsulated in a whey media and blackcurrants juice preparation by-products can be prepared in sustainable manner, and the best formulation consist of the *Artemisia absinthium* EO, *Lactobacillus uvarum* LUHS245 encapsulated in a whey media and blackcurrants juice preparation by-products immobilised in agar, as this formulation showed higher TPC content (by 2.1% higher), as well as higher overall acceptability (by 17.7% higher), in compare with formulation prepared with gelatin. Finally, compositions developed from the different origin of antioxidant properties showing compounds can be very attractive for nutraceuticals formulations, as well as can lead to the dose reducing and other activities, such as antimicrobial, increasing.

**Keywords:** nutraceuticals, antimicrobial ingredients, *Artemisia absinthium*, lactic acid bacteria, blackcurrants

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## ISOLATION OF VALUABLE CONSTITUENTS FROM HOPS (*HUMULUS LUPULUS* L.) BY SUPERCRITICAL CARBON DIOXIDE EXTRACTION

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Hops (*Humulus lupulus* L.), belonging to the family of Cannabaceae, are used for centuries as bittering, flavouring and stability agents in brewing industry. In addition, various secondary hop metabolites (aroma compounds, bitter acids, prenylflavonoids) exert a broad spectrum of beneficial pharmacological effects (antioxidant, immunomodulatory, anticancerogenic, antimicrobial, antifungal, anti-inflammatory, ect.), indicating its potential as an effective herbal remedy. Due to the unstable nature of bioactive constituents and thus poor shelf life of hop inflorescences, hops are typically processed into various products (powders, pellets, extracts, isomerised extracts, hop oil, ect.). Supercritical carbon dioxide extraction (SFE-CO<sub>2</sub>), allowing selective higher-added value lipophilic ingredient isolation from hop cones or pellets, has been employed to produce hop CO<sub>2</sub> extracts with broad commercial applications.

This study investigates biorefining of Ella variety hops (T90 pellets) into valuable aroma and bitter acid fractions by SFE-CO<sub>2</sub> under different experimental conditions. The obtained results showed that SFE-CO<sub>2</sub> at the low pressure (10–15 MPa) yields 9.3–22.1% pale to dark yellow fraction of varying volatile compound composition. SFE-CO<sub>2</sub> was further optimized for the isolation of  $\alpha$ - and  $\beta$ -bitter acid fractions (humulones and lupulones, respectively) from hop pellets by response surface methodology (RSM) and central composite design (CCD). Under different experimental conditions (25–45 MPa, 40–60 °C, 30–90 min), 13.9–27.6 g 100 g<sup>-1</sup> of non-polar constituents were obtained, containing different amounts of target constituents (hop bitter acids) and demonstrating particular *in vitro* antioxidant capacity.

**Keywords:** hops, supercritical CO<sub>2</sub>, aroma compounds, hop bitter acids

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## CHANGES IN THE COMPOSITION OF THE LIPOPHILIC FRACTION OF JAPANESE QUINCE (*CHAENOMELES JAPONICA*) SEED OIL DURING THE FRUIT DEVELOPMENT

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To better understand Japanese quince (*Chaenomeles japonica*) physiology and maximize the use of harvested plant material the profile of lipophilic compounds in Japanese quince seed oil during the fruit development was studied. For this purpose, the fruits of three genotypes 'Darius', 'Rondo' and 'Rasa' of Japanese quince were harvested every two weeks starting from half of June till nearly half of September. The oil yield in the seeds increased rapidly at the first stage of fruit development and only slightly in the final stage, while the concentration of minor lipophilic compounds such as carotenoids, tocopherols, and sterols in the extracted oil it decreased with the similar rate as was recorded for the oil yield. The concentration of minor lipophilic compounds in oil samples was negatively correlated with the oil yield in the seeds of Japanese quince. During the fruit development, was observed significant changes in the composition (%) of fatty acids, particularly noticeable was the reduction in the level of palmitic acid (C16:0) and linoleic acid (C18:2), and the increase in the level of oleic acid (C18:1), in Japanese quince seed oil. Similar results were observed for all three studied genotypes. The present study shows that the profile of lipophilic compounds in Japanese quince seed oil is significantly affected by the stage of fruit maturity.

**Keywords:** Japanese quince (*Chaenomeles japonica*) seed oil, fruit development stage, fatty acids, sterols, tocopherols

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## OPTIMISATION OF SUPERCRITICAL CARBON DIOXIDE EXTRACTION OF ROSEHIPS LIPHOPHILIC FRACTION

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The rose hips (*Rosa canina*) contain biological active compounds, such as carotenoids, tocopherol, polyphenolics, and fruit acids. Carotenoids are widespread pigments in plants in which they are involved in photosynthesis and photoprotection, but they are also found in human's tissues where they may act as antioxidants or as immunomodulating, antimutagenic and tumor-preventing agents. Rosehip lipophilic fraction was extracted with supercritical carbon dioxide (SC-CO<sub>2</sub>). The main benefit of extraction with SC-CO<sub>2</sub> is the solvent free lipophilic fraction while in the case of other extractions (traditional solvent extraction Soxhlet, extraction with ultrasound or microwave) evaporation of the solvent is needed. Carotenoids have been extracted from rosehip fruits using supercritical CO<sub>2</sub> at various extraction conditions.

The aim of the work was to optimize the extraction process for isolating lipophilic fraction from rosehips and to evaluate the biologically active, high valued compounds carotenoids (particularly lycopene and  $\beta$ -carotene).

Dried rosehips with seeds were submitted to SC-CO<sub>2</sub> extraction using pressures from 15 to 45 MPa, temperatures from 40 to 80 °C and extraction time from 60 to 180 min. The content of carotenoids (lycopene and  $\beta$ -carotene) in extracts was analyzed by high-performance liquid chromatography. The optimum conditions in terms of lipophilic fraction yield were obtained at a temperature of 75.2 °C, a pressure of 44 MPa and a time of 115 min allowed the recovery of 65% of the lipophilic fraction yield. The extraction yields and the amounts of carotenoids in the lipophilic extracts depend on the experimental conditions.

**Keywords:** optimisation, supercritical fluid extraction, rosehips, carotenoids

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## **BOVINE COLOSTRUM AS FUNCTIONAL INGREDIENT: CHANGES IN ANTIMICROBIAL PROPERTIES AND IMMUNOGLOBULINS CONTENT DURING THE TECHNOLOGICAL TREATMENT**

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The aim of this study was to evaluate the influence of fermentation with *Lactobacillus plantarum* LUHS135 and *Lactobacillus paracasei* LUHS244, ultrasonication, as well as different methods of dehydration on the content of immunoglobulins IgG, IgA and IgM in bovine colostrum (BC). In addition, the antimicrobial activity against 15 pathogenic strains of the treated and fresh BC samples was analysed by using agar well diffusion and minimum inhibitory concentration (MIC) methods. The MIC method showed that the fermented BC samples has the broadest antimicrobial spectrum (of 15 tested pathogenic strains, BC<sub>LUHS135vacdried</sub> and BC<sub>LUHS135lyoph</sub> inhibited 13; BC<sub>LUHS244vacdried</sub> inhibited 12; and BC<sub>LUHS135</sub>, BC<sub>LUHS244</sub> and BC<sub>LUHS244lyoph</sub> inhibited 11). Based on the inhibition zones, BC<sub>LUHS135lyoph</sub> exhibited the broadest inhibition spectrum (inhibited the growth of 12 pathogenic strains). To ensure a broad antimicrobial spectrum and high IgG content, fermentation with LUHS135 can be recommended (IgG concentration in BC<sub>LUHS135</sub> was retained), whereas fermentation with LUHS244 provided a high IgM concentration (IgM concentration increased by 48.8% and 21.6% in BC<sub>LUHS244</sub> and BC<sub>LUHS244lyoph</sub> samples, respectively). However, IgA is very sensitive for fermentation, and further studies are needed to increase IgA stability in BC. Finally, fermented BC can be recommended as a food/beverage ingredient.

**Keywords:** bovine colostrum, fermentation, lactic acid bacteria, antimicrobial activity, ultrasonication

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## THE AROMA PROFILE AND SENSORY PROPERTIES OF LATVIAN BLACK CURRANT WINE

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Black currants are one of the most used berries for fruit wines producing in Latvia, which gives a special and interesting flavour for product. Wine traditionally made from the *Cabernet Sauvignon* grape variety is often characterised by nuances of black currant flavour and taste. The aim of the research was to investigate Latvian black currant wine volatile profile and sensory properties. Four different black currant wine samples produced in Latvia are used for experiments. *Gran Castillo* (2014) Spanish medium sweet wine made from *Cabernet Sauvignon* grapes was used as control sample. The aroma compounds in wine samples were extracted using solid-phase microextraction (SPME) in the combination with gas chromatography/mass spectrometry. Panellists used computers equipped with FIZZ software to rate the sensory properties intensity on unstructured 5-point line scales (1 – weak; 5 – very strong).

Obtained results show that non-significant ( $p > 0.05$ ) influence is on evaluated wine sour taste intensity, but control sample has very intense red colour and astringent taste compared to black currant wine samples. Black currant flavour intensity ( $p < 0.05$ ) was weaker in the control sample and sample from producer *Zilver* than other analysed samples. In all wine samples were totally detected 27 volatile compounds which were classified into main four groups (esters, alcohols, acids and aldehyde) and others. The highest amount of volatile compounds was detected in wine made from *Cabernet Sauvignon* grapes, but it didn't show the highest total peak area of volatile compounds compared to wine samples from black currant.

**Keywords:** black currant wine, aroma profile, sensory properties

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**E-POSTERS**

## **FOODBALT 2019 and NEEFOD 2019**

## FRACTIONATION OF BILBERRY POMACE WITH SUPERCRITICAL CARBON DIOXIDE, ETHANOL AND WATER

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Bilberry (*Vaccinium myrtillus* L., *Ericacea*) is as a half-breasted widely distributed in nature plant. Bilberry fruits have been used for foods and medicinal proposes since long time ago. The aim of this study was to fractionate bilberry pomace by 3-step consecutive extraction – with supercritical carbon dioxide (SC-CO<sub>2</sub>); with ethanol (EtOH) and with water (H<sub>2</sub>O). The dried pomace was ground to obtain 2, 1, and 0.5 mm particle size fractions. Antioxidant potential of extracts and solid plant material was evaluated by DPPH\*/ABTS\*\* scavenging and ORAC assays, total phenolic content (TPC) was determined by Folin-Ciocalteu method. Triacylglycerols and anthocyanins were analysed by ultra-performance liquid chromatography – quadrupole time-of-flight mass spectrometry (UPLC-Q-TOF-MS).

The highest SC-CO<sub>2</sub> extraction yields were obtained at 45 °C temperature, 40 MPa pressure, 3 h extraction time: 11.9, 10.1, and 8.8% (w/w) of oily substances were recovered from 0.5, 1 and 2 mm particle size fractions, respectively. SC-CO<sub>2</sub> extraction residues were re-extracted with EtOH, yielding 6.8; 5.0 and 4.4% of extracts, and further with H<sub>2</sub>O, yielding 2.3, 2.2, and 2.2% of extracts, from 0.5, 1 and 2 mm particle size fractions, respectively. Fifteen anthocyanins were identified and quantified in EtOH and H<sub>2</sub>O extracts, namely delphinidin-3-; cyanidin-3-; petunidin-3-; peonidin-3-; and malvidin-3-galactosides, glucosides and arabinosides. The total concentration of anthocyanins ranged from 350 to 585 mg 100 g<sup>-1</sup> DW of pomace. Bilberry pomace extracts and solid material possessed strong antioxidant potential. The highest antioxidant capacity values of solid material and extracts were 40.8 and 220.3 μmol trolox equivalents g<sup>-1</sup>, respectively. This study revealed that bilberry pomace extracts might be promising ingredients for increasing nutritional value of foods and developing health beneficial nutraceuticals.

**Keywords:** bilberry pomace, extraction, triacylglycerols, anthocyanins, antioxidant potential

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**BIOREFINING OF *POTENTILLA FRUTICOSA* AND *HIEROCHLOE ODORATA* BY MEANS OF HIGH-PRESSURE TECHNIQUES****Kiran Subbarayadu, Michail Syrpas, Petras Rimantas Venskutonis**

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Chubby cinquefoil (*Potentilla fruticosa* L.) is a shrubby perennial plant, native to Northern areas of America and Europe. It is commonly consumed as herbal tea and exhibits strong antioxidant potential as well as antifungal, antibacterial and anti-inflammatory properties. Sweet grass (*Hierochloe odorata* L.) is an aromatic perennial grass, widely distributed in West Asia and Europe, whose roots and aerial parts exhibit a sweet odour. *H. odorata* extracts have been shown to possess high antioxidant activity and insect-repellent properties. The aim of this work was to isolate and characterise bioactive components from these two plants by means of conventional and high-pressure techniques.

The yield of non-polar extracts obtained after supercritical fluid extraction with carbon dioxide (SFE-CO<sub>2</sub>) was 2.46±0.12% and 2.10±0.23% for *P. fruticosa* and *H. odorata*, respectively. Defatted plant residues were subjected to pressurized liquid extraction, optimized *via* response surface methodology, with increasing polarity solvents. Overall, high-pressure techniques resulted in significantly higher yields as compared to their conventional counterparts. The *in vitro* antioxidant capacity of obtained extracts was evaluated with the Folin-Ciocalteu reagent, ABTS<sup>•+</sup> and DPPH<sup>•</sup> scavenging assays. Total phenolic content ranged from 36.78±2.72 to 172.8±3.3 mg gallic acid equivalents (GAE) g<sup>-1</sup> extract, whereas the antioxidant capacity ranged from 60.21±1.19 to 184.5±10.9 mg Trolox equivalents (TE) g<sup>-1</sup> and from 39.61±6.31 to 173.4±32.9 mg TE g<sup>-1</sup> for ABTS<sup>•+</sup> and DPPH<sup>•</sup> scavenging, respectively.

**Keywords:** sweet grass, Chubby cinquefoil, antioxidant potential, supercritical carbon dioxide extraction, pressurized liquid extraction

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## SPECTROPHOTOMETRIC ANALYSIS OF PHOTOSYNTHETIC PIGMENTS IN HORSERADISH LEAVES AND BY-PRODUCTS USING VARIOUS EXTRACTION SOLVENTS

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Plant pigments has wide range of nutritional benefits. Chlorophyll has antioxidant, anti-inflammatory, heavy metal chelating etc. Properties. Carotenoids exhibited significant antioxidant activities. The aim of the current research was to determine the content of chlorophyll *a*, chlorophyll *b* and total carotenoids of fresh horseradish leaves and horseradish leaves by-products depending on used extraction solvent. For experiments, fresh horseradish leaves and by-products were extracted with four different solvents (acetone, diethyl ether, methanol and ethanol). Chlorophyll *a*, chlorophyll *b* and total carotenoids were determined spectrophotometrically at various wavelength 470, 645 and 662 nm. Additionally, total chlorophyll content and ratio between chlorophyll *a* and *b* were calculated. Results showed that content of photosynthetic pigments were significantly ( $p < 0.05$ ) differed between analysed sample and type of pigments. The degree of extraction of these pigments is greatly influenced by their different chemical structure. For extraction of chlorophyll *a* and total carotenoids the best solvent was methanol in both case (horseradish leaves and by-products). But acetone was the best solvent for extraction of chlorophyll *b*. Generally, chlorophyll *a* was detected in larger amounts in the all analyzed samples. Overall the better solvent was acetone and the highest content of photosynthetic pigments were observed in the horseradish by-products.

**Keywords:** horseradish, chlorophylls *a*, chlorophylls *b*, extraction solvents

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## TOTAL PHENOLIC AND FLAVONOID CONTENT, ANTIOXIDANT ACTIVITY, AND COLOUR OF HONEY SAMPLES FROM LATVIAN MARKET

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Honey is a sweet natural substance, which is made from the nectar of honey plants and processed by honey bees (*Apis mellifera*). Honey is a natural source of antioxidants and plays an important role in human health and food preservation. The aim of the research was to evaluate the total phenolic and flavonoid content, colour intensity, and antioxidant activity of nine honey samples, which were purchased from Latvian market. These parameters of the honey samples were determined using spectrophotometry (JENWAY 6450 UV/Vis). The content of total flavonoid was determined using aluminum chloride. The obtained results ranged from 1.52 to 4.70 mg of quercetin equivalent (QE) 100 g<sup>-1</sup> of honey. The total phenolic content was determined using the Folin-Ciocalteu reagent. The total phenolic concentration of the honey samples ranged from 14.60 to 165.10 mg of gallic acid equivalent (GAE) 100 g<sup>-1</sup> of honey. The colour intensity of the honey samples was estimated by the Pfund classifier. The antioxidant activity was evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) test for radical scavenging activity.

**Keywords:** honey, total phenols, total flavonoids, antioxidant activity

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**RECOVERY AND *IN VITRO* ANTIOXIDANT CAPACITY OF VALUABLE COMPONENTS FROM *PHAEODACTYLUM TRICORNUTUM* BIOMASS**

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Due to the biosynthesis of structurally diverse compounds, microalgae are widely recognised as one of the most promising and underexplored sources of novel natural products. *Phaeodactylum tricornutum* is a diatom that has emerged in the biotechnology field for various applications such as biofuel production and recombinant protein expression. *P. tricornutum* biomass is also considered as a rich source of high-added value metabolites with potential biotechnological, food, agrochemical and pharmaceutical applications. The present study aimed to determine the optimal extraction conditions for pressurized liquid extraction (PLE) of *P. tricornutum* biomass.

Fractionation of *P. tricornutum* biomass by means of PLE was achieved with three increasing polarity solvents, namely hexane, acetone and ethanol. Response surface methodology based on central composite design with two variables and three levels was used for optimization of the extraction processes. Extraction temperature was evaluated in the range between 40–120 °C whereas extraction time from 15 to 60 min. For non-polar extracts (hexane) three responses were considered: extraction yield, EPA and DHA content. ANOVA showed that two models were significant for extraction yield and DHA content and optimal conditions were determined for these responses. For acetone and ethanol extracts PLE optimization was performed with three response factors: total extraction yield, total phenolic content and ABTS<sup>•+</sup> scavenging value. For both solvents, optimal extraction conditions to obtain antioxidant-rich extracts with high yield were determined. In conclusion, optimization of PLE conditions *via* mathematical modelling can be successfully applied as a tool for fractionation/valorisation of diatom biomass.

**Keywords:** pressurized liquid extraction, *Phaeodactylum tricornutum*, PUFA, antioxidant

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## CHANGES OF BIOLOGICALLY ACTIVE COMPOUND LEVEL IN POTATOES DURING STORAGE UNDER FLUORESCENT LIGHT

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Potatoes (*Solanum tuberosum* L.) are globally grown and consumed crop and contains many vitally important elements benefiting human diet that makes them actual subject from scientific and food market standpoint. Potatoes naturally contain active element combination named phenolic compounds that are secondary metabolites and enrich potatoes with antioxidant, anticarcinogenic, antibacterial, etc. qualities. The aim of current paper is to evaluate changes of biologically active compound level in potatoes during storage under fluorescent light. In present reaserch 4 variety ('Imanta', 'Magdalena', 'Blue Congo', and 'Lenora') potatoes were tested. For the experiment, samples were kept under fluorescent light of 1000 lux for 3 and 7 days in climate chamber with controlled temperature of +20 °C and relative humidity of 40% imitating real shop shelf conditions. Determination was performed for potatoes total phenolic content, antioxidant activity (DPPH<sup>•</sup> and ABTS assays), moisture and hardness. In experiment was established that during all storage period potatoes hardness do not significantly change, while moisture in some cases decreased. Phenolic compound and antioxidant activity showed variety dependent variations.

**Keywords:** potatoes, phenolic compounds, antioxidant activity, storage, fluorescent light

**Acknowledgment.** Present research has been supported by the programme 'Strengthening Research Capacity in the Latvia University of Life Sciences and Technologies' project 'Effect of storage conditions and processing technology on dynamics of secondary metabolites in potatoes tubers' (Z16).

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## FAST AND GREEN METHOD FOR THE ANALYSIS OF SERRA DA ESTRELA CHEESE

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Serra da Estrela (SE) cheese is a regional product making part of the gastronomic and sociocultural heritage of Portugal. It has several aspects that make it unique, namely the manufacturing by the coagulation of raw sheep milk using the thistle flower of *Cynara cardunculus* L., obtaining a final buttery texture with an exclusive typical flavour. The aroma compounds of Serra da Estrela cheese result partially from the action of indigenous microorganisms and enzymes on lactose, lipids and proteins.

Although SE cheese production is very ancient, there are few studies concerning its nutritional composition, which assumes importance because nowadays consumers demonstrate interest in understanding the global composition of cheese, since it's a product highly appreciated. In the last decades the use of near infrared spectroscopy (FT-NIR) has become comparable with those of the classical methods, with advantages such as minimum sample preparation, fast, green (without using toxic reagents) and multiparametric.

To perform the present study a total of 26 SE cheeses were evaluated, originating from six representative producers, being analysed with a FT-NIR Master 500 standalone spectrometer with a Spectral range of 800–2500 nm and compared with reference analysis.

Cheese samples were evaluated in terms of salt, moisture, protein and fat content. In all the cheeses studied the moisture varied between 42% and 53%, the fat content between 19.6 and 33.3%, the protein content between 18.6 and 26.7% and the salt between 0.7 and 2.2%. The results showed a significant agreement between the values of the replicas obtained for the studied parameters.

**Keywords:** Serra da Estrela cheese, FT-NIR spectrometry, moisture, protein, fat

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## THE OPTIMIZATION OF ACID WHEY PERMEATE HYDROLYSIS FOR GLUCOSE-GALACTOSE SYRUP PRODUCTION

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Whey contains a lot of lactose, which can easily hydrolysed by commercial enzymes for glucose-galactose syrup production.

The aim of the study was to identify the optimal parameters for the enzymatic hydrolysis of acid whey permeate and glucose-galactose syrup production.

Acid whey permeate was hydrolysed using immobilized  $\beta$ -galactosidase preparate (NOLA Fit 5500, Chr. Hansen, Denmark) at 7200 BLU L<sup>-1</sup> concentration. As the enzyme is strongly inhibited at pH below 4.5, sodium bicarbonate was added to neutralize substrate pH till 6.0–6.3. The hydrolysis was carried out at 40 °C 6 hours. pH and monosaccharides concentration were monitored during the process of hydrolysis. The fermented substrate was concentrated in a vacuum evaporator at 40 – 60 °C, 8–4 kPa. Glucose-galactose syrup was obtained with 60, 65, 70, and 80 % of total solids. Monosaccharides were determined by HPLC.

Fermentation time influences monosaccharides composition and concentration. After 2 hours of fermentation lactose was completely hydrolysed. Continuing fermentation, the amount of glucose was decreased due to formation of novel oligosaccharides. The study results revealed that the optimal time for hydrolysis was 2 hours. It should be noted that during the process of hydrolysis the pH of the product increased till 6.5 and such changes are related to cellulase and glucoamylase activity in the immobilized enzyme preparate. With the increasing of syrup total solids, galactose concentration was changed due to galacto-oligosaccharides formation. The degree of sweetness is key factor for the durability of lactose hydrolysis and syrup concentration.

**Keywords:**  $\beta$ -galactosidase, lactose hydrolysis, glucose, galactose

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## RHEOLOGICAL AND TEXTURAL PROPERTIES OF LACTOSE-FREE YOGURT IN RELATION TO ENZYME CONCENTRATIONS

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Lactose-free yogurt is one of the main sources of useful nutrients for people who have got lactose intolerance. Therefore, preparing lactose-free yogurt is considered as an actual issue in the Republic of Uzbekistan. Many factors can affect the rheological and textural parameters of lactose-free yogurt, including enzyme concentration which is used to convert lactose in glucose and galactose. The aim of the study was to evaluate enzyme concentration influence on the rheological, textural properties of lactose-free yogurt.

Yogurt samples were made from pasteurized milk (fat content 2.5%, Ltd Tukuma piens, Latvia) using commercial frozen yogurt starter culture FD-DVS YC-X11 (Ltd Danisco, Denmark) containing *Lactobacillus delbrueckii* ssp. *bulgaricus* and *Streptococcus thermophilus* strains and different concentrations of enzyme NOLA™ Fit 5500 (Ltd Chr Hansen, Denmark) – 0; 500; 1000; 1500 and 2000 BLU L<sup>-1</sup>. Milk was pasteurized (95±1 °C, 5 min), cooled down (40±1 °C), inoculated with starter and enzyme, mixed and fermented till pH 4.8±0.1, then samples were mixed and cooled down till 5±1 °C. Textural properties and viscosity of yogurt samples were analyzed using TA.HD Plus (Stable Micro Systems, UK) and DV-III Ultra Programmable Rheometer (Brookfield, USA). Lactose, galactose, glucose contents were measured by HPLC (SHIMADZU, Prominence, The USA). The textural properties and viscosity of analyzed yogurt samples (such as firmness, consistency, cohesiveness) were significantly ( $p<0.05$ ) different for samples with higher enzyme concentration, which showed the lowest viscosity index. Results from chromatography provided no lactose presence in any sample with enzyme, the galactose was dominant monosaccharide in each of sample treated with enzyme.

**Keywords:** lactose-free yogurt, enzyme, rheology, texture

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## VALORISATION OF STRAWBERRY (*FRAGARIA X ANANASSA*) POMACE USING DIFFERENT EXTRACTION TECHNIQUES

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Our study aimed at biorefining the pomace into valuable ingredients by using multistep extraction scheme. Firstly, supercritical CO<sub>2</sub> (SC-CO<sub>2</sub>) extraction parameters (pressure, temperature and dynamic extraction time) were optimized for recovery of lipids. For this purpose, Response Surface Methodology based on Central Composite Design was applied. Afterwards defatted pomace was extracted with higher polarity solvents. Antioxidant properties of the extracts obtained and solid plant material were evaluated by the DPPH<sup>\*</sup>, ABTS<sup>\*\*</sup> scavenging and ORAC assays; total phenolic content (TPC) was determined by Folin-Ciocalteu method. The composition of anthocyanins, phenolic acids, flavonoids and triacylglycerols in the extracts was analyzed by the UPLC/Q-TOF/MS. The composition of volatile compounds of SC-CO<sub>2</sub> extracts was evaluated by headspace solid phase microextraction and GC×GC-TOF/MS. Strawberry pomace extracts possessed comparatively strong antioxidant potential. The TPC values were from 21.51 to 55.07 mg gallic acid equivalents (GAE) g<sup>-1</sup> extract. The highest values of antioxidant capacity of solid material and extracts were 28.61 and 122.5 μmol trolox equivalents (TE) g<sup>-1</sup>, respectively. Pelargonidin-3-glucoside was identified as the main anthocyanin; its recovery was up to 96.82 mg from 100 g DW plant material. The highest yield of SC-CO<sub>2</sub> extract (7.65 g 100 g<sup>-1</sup> DW) was obtained at 36 MPa, 68 °C and 154 min dynamic extraction time). The main triacylglycerols were LnLnLn, LLnLn, LLLn, LLL, OLL, OOL, OOO. The main constituents released from SC-CO<sub>2</sub> extracts into the headspace were (in GC area %) γ-decalactone (9.3%), γ-dodecalactone (7.5%), ethyl hexadecanoate (8.9%), methyl linoleate (6.3%), nerolidol (5.9%), nonacosane (5.0%), squalene (2.5%), 2*E*,4*E*-decadienal (2.7%). In conclusion, our study revealed that strawberry pomace may be processed into valuable bioactive foodgrade ingredients.

**Keywords:** strawberry pomace, antioxidant capacity, polyphenols, trigacylglycerols, fatty acids

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**USE OF MOLASSES AND ITS EFFECT ON AZOTOBACTER GROWTH**

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Molasses is a well-known by-product in food industry which is gained after refining sugar beets and sugar canes. Unlike sugar, molasses contains various vitamins such as thiamine (B<sub>1</sub>), riboflavin (B<sub>2</sub>), vitamin B<sub>6</sub> and minerals like calcium, magnesium, potassium, manganese and others. It is a nutritious raw material of food industry that could be used as a main component of growth medium for nitrogen fixing bacteria. Typical azotobacter growth medium must contain sugars, potassium, magnesium, calcium and sodium chloride. So, this study purpose was to use molasses as a medium for azotobacter and find the best conditions which are needed for the highest azotobacter biomass yield.

Medium containing different concentrations of molasses and special azotobacter medium were prepared and inoculated with azotobacter and incubated under 25 °C. Samples were taken after one, two, three and six days to count colonies. Results showed that azotobacter grows better in molasses medium than special azotobacter medium.

This study demonstrates that molasses could be used as medium for azotobacter. The highest yield of biomass of azotobacter was gained under 1:200 molasses concentration after two days of incubation. The number of colonies was  $10.3 \cdot 10^7$  CFU mL<sup>-1</sup>. The future aim is to test molasses medium with other species of bacteria and to find out if it could be used as universal medium.

**Keywords:** molasses, food industry, azotobacter

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## POSSIBLE USES OF FOOD INDUSTRY BY-PRODUCTS COMPOSITIONS WITH ANTIMICROBIAL LACTIC ACID BACTERIA FOR ANTIMICROBIAL INGREDIENTS PREPARATION

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In this study the concept of the valorization of berries/fruits (B/F) (raspberries, blackcurrants, apples, rowanberries) and dairy industry (whey) by-products, in combination with antimicrobial lactic acid bacteria (LAB), for the preparation of antimicrobial coatings was analysed. Antimicrobial activities of the B/F by-products and LAB (thirteen LAB strains were estimated against fifteen pathogenic and opportunistic strains) were evaluated, while whey substrate for the selected and the highest antimicrobial activities showing LAB cultivation was used. The broadest spectrum of pathogenic bacteria strains inhibition was shown by lyophilised blackcurrant and apple by-products, which inhibited 13 and 12 pathogenic strains of the 15 analysed, respectively. The broadest antimicrobial spectrum and the strongest inhibition of the tested pathogens were shown by the LUHS210 and LUHS245 strains and, for the abovementioned LAB strains biomass preparation, whey enriched with 2.5% glucose, 2.0% yeast extract and 0.5% saccharose is a suitable and sustainable substrate. Moreover, the B/F by-products' antimicrobial activity can be enhanced in combination with the LUHS245 and LUHS210 strains. However, it should be mentioned that the properties of the B/F by-products are also very important, as it was established that they have a significant influence on the antimicrobial activity of the coatings. B/F and dairy industry by-products, in combination with antimicrobial LAB are promising ingredients for the preparation of antimicrobial coatings.

**Keywords:** berries/fruits, lactic acid bacteria, antimicrobials, valorization

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## NOT ONLY TABLE POTATO – OTHER POSSIBLE APPROACHES IN POTATO PROCESSING INDUSTRIES

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Potato growing is laborious and very often high risk field of production, due to its need for high investments, in order to get proper yield and to stay on the cost-effective side of production. Agricultural land under potato production has decreased considerably compared to the high production years (90 000 ha in 1939) and it keeps decreasing each year (5400 ha in 2017) in Estonia. Some of the factors contributing to this continuing trend are the changing diet habits and growing consumption of alternative products (pasta, rice, buckwheat etc.) as well as high proportion of imported potato in Estonian market. In order to survive as a potato producer, some extra value has to be given to the raw material. Research on this topic was conducted in a two-year project, in which the possible potato processing methods were represented. The focus was specially on this part of the crop, which is not suitable for marketing as a table potato (too small, too large) and which are generally considered as leftovers. Three groups of products were brought out: suitable for human-, animal-, and technological consumption. The major part of the products is edible (potato fries, -chips, -flour, -starch, -feed, -juice etc.), but much more interesting are the products which can be used in the food industries as food additives (potato fibre, -protein) which are common sideproducts in starch production. It was concluded that there are several options for utilizing the “leftovers” and give more money back to the potato growers in Estonia.

**Keywords:** potato, potato processing, potato products

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### ERA CHAIR FOR FOOD BY-PRODUCTS VALORISATION TECHNOLOGIES OF THE ESTONIAN UNIVERSITY OF LIFE SCIENCES (VALORTECH)

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To realise the full potential of the Estonian University of Life Sciences (EULS) in the development of advanced zero waste/maximum utilisation and valorisation technologies related to the food value chain (and adjacent value chains using by-products and derivatives of plant and animal origin), the new ERA Chair for Food (By)Products Valorisation Technologies (VALORTECH), an inter-unit entity will be established that brings together know-how and technological base from both Institute of Agricultural and Environmental Sciences and Institute of Veterinary Medicine and Animal Sciences and has also linkages to EULS 's other structural units.

The broader vision related to the creation of the ERA Chair is that the VALORTECH Chair will develop into a leading centre of excellence in development of advanced technologies for minimum waste, maximum utilisation and valorisation of various raw materials and components used in food and also non-food value chains. Project period 01.07.2018–30.06.2023.

**Keywords:** food valorisation, Estonian University of Life Sciences, Valortech

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**INNOVATIVE STRUCTURED FISH MASS PRODUCTS FROM BALTIC SPRAT (*SPRATTUS SPRATTUS BALTICUS* SCHNEIDER)**

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Fish is very important in the diet, providing complete protein, unsaturated  $\omega$ -3 fatty acids, calcium, phosphorus and vitamin D. However, Baltic sprat (*Sprattus sprattus balticus* Schneider), one of the most abundant fish stocks in the Baltic Sea, is underutilised due to its small size. The aim of the project was to develop structured fish mass using all fish parts from the Baltic Sea small *Clupeiformes* fish for further use in finished and semi-finished fish products.

The testing of fish as raw material and the develop structured fish mass showed that all parts of fish can be used in the production as valuable ingredients. In addition, rapid freezing did not have a negative effect on the quality of structured fish mass, therefore, it is possible to use frozen fish in order to reduce raw material costs and seasonal effect, and increase the economic performance of production.

Due to the physico-chemical and organoleptic characteristics of the structured fish mass, the possibilities of using it in finished and semi-finished fish products is wide. A total of 21 recipes for seven basic product groups – sausages, terrines, frozen semi-finished products, fish meatballs and other culinary preparations, dumplings, pies, pasta and ravioli – were developed. Recommended storage conditions and shelf-life for the new products has been defined, in addition to qualitative parameters, and nutritional and energy value.

**Keywords:** structured fish mass, semi-finished products, nutritional value, processing

**Acknowledgment.** This study was supported by European Maritime and Fisheries Fund (EMFF) project (EMFF) project "Production of structured fish mass (forcemeat) from Baltic sea fish and its use in fish products", project no. 16-00-F01101-000005.

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## PHYSICOCHEMICAL CHARACTERISTIC OF TWO COLD-PRESSED SEED OILS: JAPANESE QUINCE VS. SUNFLOWER

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The cold-pressed oils are gaining popularity due to their higher nutrition value compared to refined oils, but they are less stable than refined counterparts. In the present study were obtained, by hydraulic press Farmet Duo, and compared two cold-pressed seed oils from Japanese quince (*Chaenomeles Japonica*) and sunflower (*Helianthus annuus*). The profile and level of lipophilic compounds in both seed oils were similar. The predominant fatty acid was linoleic acid (over 50%), while for minor compounds the highest levels were noted for  $\alpha$ -tocopherol and  $\beta$ -sitosterol. The antibacterial activity of seed oils was tested against the following bacteria: *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa*, *E. coli*. The seed oil of Japanese quince exhibited higher activity against *S. pyogenes* compared to sunflower, while for other bacteria similar results of both tested oils were obtained. The seed oil of Japanese quince had at least four-fold higher oxidative stability during storage at 60 °C and 20 °C compared to sunflower. Sensory analysis showed that the seed oil of Japanese quince had better sensorial acceptability than sunflower, due to the taste, aroma and the markedly yellow. Despite the similar composition of lipophilic compounds, the seed oil of Japanese quince shows better general quality and therefore it seems to be a prospective substitute for sunflower oil.

**Keywords:** Japanese quince (*Chaenomeles Japonica*), sunflower (*Helianthus annuus*), cold-pressed oil, antibacterial activity, oxidative stability

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## EFFECT OF FERMENTATION ON PHYTIC ACID AND FRUCTAN CONTENTS OF CORNELIAN CHERRY TARHANA

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Phytic acid serves as the main storage form of phosphorus in grains, legumes and oilseeds. It is known as a food inhibitor that prevents bioavailability of micronutrients, like minerals, during digestion. Fructans are naturally plant polymers ( $\beta$ -2, 1 linkages) composed of fructose molecules. Cereals have low fructan concentration (0.6–2.6%); although fructans are the major constituents of the cereal grain cell walls. Fructans are nutritionally important molecules which have prebiotic and dietary fiber properties. They stimulate the growth of healthy intestinal bacterias, like lactobacilli and bifidobacteria and promote gut health. In this study, effect of fermentation on phytic acid and fructan contents of cornelian cherry tarhana produced from different cereal/pseudo-cereal flours was investigated. Cornelian cherry tarhana is ready to cook soup product in powder form. Replacing wheat flour to buckwheat flour, clear flour as a by-product of semolina industry or wholegrain hull-less barley flour was accomplished in fermented and non-fermented production. Traditional production carried out with bread wheat flour was a control. Phytic acid contents of cornelian cherry tarhanas decreased after fermentation process on dry weight basis. Phytic acid contents of non-fermented and fermented cornelian cherry tarhanas changed in the range of 0.49–5.05 mg g<sup>-1</sup> and 0.40–4.62 mg g<sup>-1</sup>, respectively. Fructan contents of all cornelian cherry tarhanas increased after fermentation on dry weight basis. Fructan contents of non-fermented and fermented cornelian cherry tarhanas changed in the range of 0.68–1.32% and 0.81–1.43%, respectively. Consequently, fermentation can be applied for improving some nutritional properties of cornelian cherry tarhanas produced with different cereal / pseudo-cereal flours.

**Keywords:** Cornelian cherry tarhana, soup, fermentation, phytic acid, fructan

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## THE TECHNOLOGY OF OBTAINING EXTRACTS OF FRUIT AND BERRY RAW MATERIALS FOR FUNCTIONAL BEVERAGE PRODUCTION

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Drinks that are based on herbal ingredients began to receive widespread acceptance in recent years all over the world along with the production of soft drinks. The plant material is a source of large amounts of organic compounds of different structures with a variety of preventive and curative properties of food. The article presents the results of a study on the establishment of extraction parameters and modes of biologically active substances from plant material in order to obtain extracts for the preparation of beverages of a functional purpose. In the preparation of extracts used water treatment of the crushed mass of feijoa and blackberry. The extraction process was controlled by changing the mass fraction of dry substances. As a result of the conducted research, the optimal parameters and modes of the process of extraction of dry substances from feijoa and blackberry were established: the hydromodule was 1 : 1, the process duration was 24 hours; extraction temperature – 25 °C. Such conditions of the process provided the greatest extraction of dry substances without destroying the functional ingredients, made it possible to carry out the extraction for a short period of time and reduce the cost of thermal processing of the medium. The obtained extracts based on feijoa and blackberry were distinguished by high organoleptic indices due to their bright amber-green and raspberry colour and intense fruit and berry aromas inherent in this plant raw material.

**Keywords:** feijoa, blackberry, extract, temperature

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**HEALTH-RELEVANT FOOD  
PRODUCTS AND ISSUES**

## **FOODBALT 2019 and NEEFOD 2019**

## MODERN DIETARY PATTERNS BASED ON TERRITORIAL ORIGIN – A REVIEW

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There are different dietary patterns around the globe formed on account of various anthropogenic factors: cultural, economical and globalization.

Human food consumption patterns can be formulated and defined depending on habitat. For example, since Scandinavian countries are surrounded by seas, fishery was quite developed historically, and even today seafood constitutes a large part of daily Scandinavian food plate.

On the other hand, world globalization has led to the appearance of such unhealthy food consumption patterns as unbalanced nutrition or refined product excess in daily diet.

There is a strong association between unhealthy eating habits and diseases, which means that healthy eating habits could lower a wide range of disease emergence possibility. For example, there are studies that link the adherence to Nordic diet recommendations with the decrease of various chronic disease occurrence, i.e., metabolic syndrome (MetS), type 2 diabetes (T2D), cardiovascular disease (CVD).

The review summarizes types of modern dietary patterns around the globe – their origins, main principles and effects on health, compares nutrient ratios among the most popular dietary patterns and the “unhealthy” Western diet, and discusses human nutrient needs.

**Keywords:** Nordic diet, Mediterranean diet, Okinawa diet, Western diet

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### FOOD ALLERGY KNOWLEDGE AND PRACTICE OF RESTAURANT STAFF

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Nowadays we can observe the tendency to have a meal outside home. Catering companies must guarantee the availability of safe and harmless food for all consumer groups, including consumers with food allergies and intolerances. In conformity with EU Regulation (EC) No.1169/2011 on the provision of food information to consumers, as one of the mandatory items of information, the catering enterprises shall provide written information on the possible presence of allergens. According to previous research, one of the disadvantages is the staff's lack of knowledge. The aim of the work is to analyze the staff's knowledge and written information about food allergens available in restaurants to consumers.

There were 20 catering companies visited with the purpose to involve them in survey. 40 catering companies responded electronically. In total, 20 catering companies responded, out of which there were 154 valid questionnaires received. 49% of all respondents were waiters, 41% were cooks and 10% were managers. The main results show that the staff of catering companies has insufficient knowledge (the mean arithmetical =  $3.8 \pm 1.8$  out of 10). The results showed that 73% of staff misunderstood the notion of allergy and intolerance. Not all restaurants have relevant information on allergens, as well as some companies do not show it at all.

**Keywords:** knowledge, food allergies, intolerances, allergen labelling

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## FERMENTATION WITH *LACTOBACILLUS* STRAINS FOR ELIMINATION OF THE IMMUNOGENICITY OF GLUTEN IN WHEAT (*TRITICUM AESTIVUM*) PROCESSING PRODUCTS

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Recently there is an increase in the number of users with gluten intolerance that causes expanding of the demand for gluten-free products. Gluten-free diet is unbalanced and usually has a higher percentage of calories from fat, less of carbohydrates, as well as low intakes of nonstarch polysaccharides. To resolve this problem, new strategies are looked for to eliminate immunogenicity of gluten in products of wheat and other cereals and to make them more balanced. Fermentation with lactic cultures and/or enzymes enables to reduce the gluten content in wheat flour. However, this process takes a long time, is complicated to control, and hydrolysed gluten loses its technological properties. The main idea of this work is to find another way of removing gluten residues: at first remove gluten from wheat by wet fractionation, then hydrolyse gluten residues in the remaining fractions by using biotechnological tools. The fractions of starch, fibers and pentosans (arabinoxylans) had an initial gluten concentration of 60–150 ppm, 10%, and 7% (d.m. base), accordingly. For eliminating of gluten residues they were fermented with four probiotic strains separately: *Lactobacillus plantarum* P-1, *Lactobacillus brevis* R-1, *Lactobacillus acidophilus* 308, *Lactobacillus acidophilus* 336. Short (12 hours) and long fermentation (24 hours) at 30 and 37 °C was used. Gluten was degraded to below 20 ppm using *Lactobacillus plantarum* in short time, other strains performed better using long fermentation. In conclusion it could be stated that sourdough-based biotechnology could eliminate the immunogenicity of wheat processing products and to improve the quality of life of celiac patients.

**Keywords:** wheat, gluten, hydrolysis, sourdough, *Lactobacillus*

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## FORTIFICATION OF YOGURT WITH BETA-GLUCANS OF OYSTER MUSHROOM

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Mushrooms are a good source of biologically active substances. Basidiomycete *Pleurotus ostreatus* is not only widely used in food, but also have immunomodulating, antitumor, antiradical, anti-inflammatory, hypocholesterolic, hypoglycemic and other beneficial medical effects. It is considered that  $\beta$ -glucans play significant role in the biological activities of oyster mushroom. The aim of our research was to study the possibility of yogurt fortification with  $\beta$ -glucan-containing preparations obtained from the submerged biomass of *P. ostreatus*. Three preparations were obtained by successive ethanolic and aqueous extractions. Preparations were added to milk in different concentration before the introduction of starter culture. A starter containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp. bulgaricus* cultures was used for fermentation. The titrable and active acidities were controlled during the fermentation. Physicochemical, structural-mechanical properties (dynamic viscosity, viscosity loss factor, mechanical stability factor, structure recovery ratio) of the obtained samples were studied. The organoleptic properties of the products were also evaluated.

As a result, yogurt samples fortified by  $\beta$ -glucan-containing preparations were obtained. According to the data, the addition of preparations does not adversely affect the fermentation process. Structural-mechanical properties of samples depends on the preparation and its concentration. The organoleptic evaluation showed that experimental samples differed not only from the control sample, but also from each other. In order to exclude slightly negative effect of some of the introduced components on the organoleptic characteristics of the product, it seems advisable to use thickeners, structure-formers, for example, pectin.

**Keywords:** *Pleurotus ostreatus*,  $\beta$ -glucans, functional food, fermented milk product

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## CONCEPT FOR THE VALORISATION OF RICE DIETARY FIBER FRACTION IN COMBINATION WITH WHORTLEBERRIES PRESS-CAKE AND ESSENTIAL OILS INTO NUTRACEUTICALS

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Nowadays, the growing interest of consumers' interest for functional foods and nutraceuticals, focusing especially on phenolic compounds, is highlighted. The example of these components are plant phenolics which are associated with a high antioxidant capacity and antimicrobial activity thus with benefits in relation to human health. In this study the concept of the valorisation of rice grits production by-products (rice polish, RP) in combination with whortleberries press cake (WB-PC) into nutraceuticals with immobilized thyme and mint essential oils (EOs) was evaluated. For structuring of the gels combined at various RP/WB-PC ratios a low temperature (30–40 °C) high frequency ultrasound (850 kHz, pulse) treatment was used. The structuring rate and texture of RP-WB gels as well as antioxidant activity (AA) during storage at different temperatures was analysed. The results showed that ultrasound treatment for 30 min at 40 °C improved the texture of the gels reducing viscosity and cohesiveness and increasing the hardness depending on the quantitative RP/WB ratio and pH. The suitable texture showed the gels with RP/WB-PC ratios 40/60 and the best stability during storage was achieved when sodium alginate was used as a stabiliser. Results showed that such nutraceuticals based on RS and WB press cake with immobilized EOs (0.3%) can be stored for 28 days at 4 °C; the AA decreased up to 9–16% of the initial value.

**Keywords:** rice polish, berry press cake, ultrasonic cavitation, immobilization, antioxidant activity

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## SCREENING OF SOME FOODBORNE YEASTS FOR XYLITOL PRODUCTION

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Xylitol is a five carbon sugar alcohol that is used commercially in various food and pharmaceutical industries because of its high sweetening power, suitability for diabetic patients and non-cariogenic properties. The microbial conversion of xylose to xylitol by using yeasts has attracted attention worldwide because it offers economically feasible and environmentally friendly production. In this study, xylitol production of *Candida tropicalis* NBRC 0618 was investigated in three defined fermentation media. After selection of the appropriate medium, xylitol production of sixteen indigenous foodborne yeast strains belonging to *C. tropicalis*, *Candida famata*, *Candida guilliermondii* and *Debaryomyces hansenii* were screened in the medium containing 100 g L<sup>-1</sup> xylose. Maximum xylitol concentration obtained for *C. tropicalis* M2 and M43 originated from Mihalic cheese were 83.28 and 54.07 g L<sup>-1</sup>, respectively. It was found that *C. tropicalis* M55 had also potential for xylitol production with maximum concentration of 20.72 g L<sup>-1</sup>, followed by *C. famata* M92 and *C. famata* T169. Seven strains of *C. famata* isolated from Mihalic cheese produced xylitol between 1.65–8.37 g L<sup>-1</sup>. The maximum xylitol concentrations of *C. famata* originated from Erzincan tulum cheese were 4.32 and 15.93 g L<sup>-1</sup> for T52 and T169, respectively. This study revealed that yeasts originating from food sources such as cheese and honey could be efficient for xylitol production. Indigenous *C. tropicalis* strains had high potential as xylitol producers and could be used in further studies for xylitol production.

**Keywords:** xylitol, foodborne yeast, *Candida tropicalis*, *Candida famata*

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**QUALITY AND SAFETY OF  
PROCESSED FOODS**

## **FOODBALT 2019 and NEEFOD 2019**

## THE INFLUENCE OF PROCESSING AND STORAGE CONDITIONS ON QUALITY PARAMETERS OF PUMPKIN PUREE

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The aim of this research was to investigate the influence of processing technology and storage conditions on the quality parameters of organic pumpkin 'Uchiki Kuri' puree. Pumpkin puree was produced industrially from organically grown cultivar 'Uchiki Kuri' by heating it in a heat exchanger, and treating through sieves. Obtained puree was used to prepare four different samples: sterilized sample, frozen sample, vacuum-cooked stored at room temperature, and vacuum-cooked stored at  $4\pm 2$  °C. Samples were stored for 26 weeks. During the storage period samples were analysed microbiologically (yeasts, moulds, Lactic acid bacteria, and *Enterobacteriaceae*), and chemically (total carotenes, vitamin C, total phenols, DPPH<sup>•</sup>, ABTS<sup>•+</sup>, water activity, pH, and texture).

Obtained results indicated that it is possible to store pumpkin purées up to six months, if those are sterilized at 110 °C for 15 minutes; frozen and stored at  $22\pm 2$  °C, and vacuum-cooked, packed in a bag-in-box and stored at  $4\pm 2$  °C temperature, preserving their microbiological safety. The total carotenes content in all samples (except samples stored at  $22\pm 2$  °C in the bag-in-box packaging) were stable during storage for 26 weeks, while vitamin C content decreased twice already after four weeks storage. Significant decrease of antiradical activity DPPH<sup>•</sup> and ABTS<sup>•+</sup> after 26-week storage was observed, too.

**Keywords:** frozen, sterilized, vacuum-cooked, microbial quality, total carotenes, ascorbic acid, total phenols

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## THE EVALUATION OF ORGANICALLY GROWN APPLE CULTIVARS FOR SPECIAL DIET PUREE PRODUCTION

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The aim of this research was to evaluate organically grown old apple cultivars for production of puree for special diets with high content of bioactive compounds. Five organically grown extensive cultivars were chosen for evaluation within the project: 'Rudens Svitrotais', 'Antonovka', 'Sipolins', 'Nicnera Zemenu', 'Filippa'. All these apple cultivars were evaluated fresh and after processing into puree. The content of soluble solids, titratable acids, vitamin C, total carotenes, total phenols, total flavonoids, antiradical activity (DDPPH and ABTS<sup>+</sup>), and pH were determined.

The cultivars with the highest soluble solids content both fresh and puree were 'Nicnera Zemenu' and 'Sipolins' with 12.7 to 13.5%, but the lowest pH value and the highest titratable acids content were detected in apple cultivar 'Antonovka'. Fresh apples of this cultivar showed also the highest vitamin C content (14.5 mg 100 g<sup>-1</sup>), but after processing puree the vitamin C content significantly decreased and was not higher than 7.2 mg 100 g<sup>-1</sup>. Fresh apples and apple puree from cultivar 'Antonovka' had the highest content of total phenolics, total flavonoids and DPPH radical scavenging activity, whereas the lowest results showed fresh apples and puree of cultivar 'Sipolins'. Apples are not a source of carotenoids therefore the total carotenes content in fresh apples was not higher than 0.13 mg 100 g<sup>-1</sup> (cultivar 'Filippa') and after processing in puree it significantly decreased. Apple processing had a significant ( $p < 0.05$ ) influence on the bioactive compounds in product.

**Keywords:** total carotenes, vitamin C, total phenols, antiradical activity

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## DYNAMICS OF MICROBIAL CONTAMINATION OF FISH PRODUCTS DURING COOKING

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To protect the customer each food producer must take the responsibility for the end product that they are placing on the market. The aim of this research was to study the factors influencing microbiological pollution during the preparation of fish dishes. Microbiological criteria are one of the key factors for product safety and quality, especially for fish products. Fish products have high risk of being directly exposed to the danger of microbial spoilage, if proper processing is not carried out before the food preparation, as well as during cooking and distribution. An important issue is the absence of direct guidelines for each step of the production process of fish products. The research focuses on these factors to determine how appropriate or inappropriate the pre-treatment and preparation steps of the products are in a small catering company. Additionally, the risks and positive and negative aspects of such production practice are assessed. Microorganisms such as *E.coli* survive in microfractures of processing and storage surfaces regardless of the type of sanitary treatment, disinfection products and the high temperature used for equipment disinfection. Due to the heat treatment process, the concentration of microorganisms has significantly decreased, during which most microorganisms are deactivated. Unlike heat-treated trout, the process of treating cold food is subjected to the risk of contamination by microorganisms. The study has shown that their development can be delayed by salting the product, but it does not protect the product from contamination by salt pathogens.

**Keywords:** microbiological contamination, fish products, treatment, cooking

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## FOOD MASHING PRIOR *SOUS VIDE* PROCESSING LOWERS THE RISK OF MICROBIOLOGICAL CONTAMINATION

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*Sous vide* (SV) is a method of cooking in which food is vacuum-packed and placed in a hot water bath in which the cooking temperature is lower than that found in conventional ovens. Using this method food usually takes longer to cook; from a microbiological safety point of view, it is rather challenging to consume and store food prepared in this way.

The aim of this study was to evaluate the influence of SV on the microbiological status of both plant- (carrots, potatoes, pumpkin, swede and apple) and animal-based (lamb meat and liver) food involving various treatment parameters such as time, temperature and pre-or post-mashing of the raw material.

Microbiologically, the best method proved to be SV1 in which the raw food material was pre-mashed, vacuum-packed and then heat-treated at 90 °C for 45 minutes (plant-based) or at 70 °C for 5 hours (meat-based). The total number of bacteria, moulds and yeasts remained statistically significantly lower ( $p < 0.05$ ) than using SV2 in which the raw material was mashed after heat-treatment at 90 °C and then cooked for 45 minutes (plant-based) or at 70 °C for 5 hours (meat-based) and SV3 where the raw material was mashed after heat-treatment at 75 °C and then cooked for 5 hours (plant-based) or at 65 °C for 24 hours (meat-based). However, all SV methods lowered significantly the count of microbes that was in raw food.

In conclusion, mashing food material prior instead of post SV treatment has a bigger effect on a microbial count in food than temperature- or time-related processing.

**Keywords:** *sous vide*, microbiota

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## EFFECT OF *NATURESEAL*<sup>®</sup> AS5 AND PACKING MATERIALS ON THE MICROBIOLOGICAL SAFETY OF SHREDDED CARROTS DURING STORAGE

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The objective of current research was to investigate the quality changes of shredded carrots treated with *NatureSeal*<sup>®</sup> AS5 during storage in several packaging materials. Before package shredded carrots were treated with commercial 2.5% *NatureSeal*<sup>®</sup> AS5 water solution at temperature 20±2 °C for 5±0.1 min. Treated products have been packed in several materials (hermetically sealed by breathing polymer film BOPP Propafilm<sup>TM</sup> P2GAF, cellulose based biodegradable NatureFlex NVS and Polilactid BIO-PLA Containers) and stored at the temperature 4±1 °C for 12 days. Main quality parameters using standard methods have been analysed: CO<sub>2</sub> and O<sub>2</sub> concentration inside package and microbiological safety of carrots. Testing of the samples has been carried out before packaging and during storage. In the present research it has been proved that it is possible to maintain the microbiological safety of shredded carrots during storage by treatment of carrots with 2.5% *NatureSeal*<sup>®</sup> AS5 water solution; as a result, the shelf-life of such product can prolong till 10 days.

**Keywords:** carrots, *NatureSeal*<sup>®</sup> AS5, storage, treatment

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**EFFECT OF ANOLYTE ON *SALMONELLA* AND *LISTERIA MONOCYTOGENES* GROWTH ON MEAT SURFACE AT 0–4 °C**

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The research was carried out in the Microbiology Research Laboratory of KTU Food Institute. The aim of the study was to evaluate the influence of anolyte solutions (No. 1–30%, pH 6.56, and No. 2–50%, pH 5.80) on the total number of microorganisms and on the pathogenic bacteria *Salmonella* Typhimurium and *Listeria monocytogenes* growth on the surface of the lean beef meat at 0–4 °C temperature. For the contamination of meat, two cultures of pathogenic bacteria were obtained from the US collection of microorganisms: *Salmonella enterica subsp. enterica serovar* Typhimurium ATCC 14028 and *Listeria monocytogenes* ATCC 7644. These studies were performed using two large doses of *L. monocytogenes* and *S. Typhimurium* – 10 mL of  $1.5 \times 10^7$  CFU mL<sup>-1</sup> and 10 ml of  $1.5 \times 10^6$  CFU mL<sup>-1</sup> suspension for the contamination of the surface of beef piece. Then the beef pieces were treated (sprayed) with anolyte solutions No. 1 and No. 2. After treating the beef pieces with anolyte solutions, the total number of microorganisms decreased on average by 4 and 5 times, with *L. monocytogenes* by 8 and 9 times, and *S. Typhimurium* by 6 and 8 times, respectively. After storage of vacuum-packed beef for 10 days at 0–4 °C, the total number of microorganisms changed slightly, and then increased again by 18 and 89 times after 29 days. After 29 days, the number of *L. monocytogenes* decreased by 95 and 23 times, and the number of *S. Typhimurium* decreased by 36 and 24 times, respectively. There was no significant difference in the total number of microorganisms, *L. monocytogenes* and salmonella levels between 30% and 50% of anolyte solutions for spraying meat pieces. To inhibit bacterial growth on the meat surface, 30% anolyte solution was proposed for spraying of meat surface.

**Keywords:** effect, anolyte, total number of microorganisms, *Listeria monocytogenes*, *Salmonella Typhimurium*, meat surface

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**SHELF LIFE PREDICTION OF MEAT PIES**

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Demand for ready-to-use and frozen baked goods is increasing. It provides the supply of fresh products as close as possible to the final consumer. One of the traditional and popular products in Latvia is meat pies. The purpose of the study was to determine the shelf life of baked, frozen and defrost meat pies. The study analyzed two types (classical and cut) meat pies from a yeast dough with smoked meat and onion fillings of one Latvian bread producer. Each of the two types of meat pies was frozen after baking, packed in two different packaging materials and stored at -18 °C for five days. The defrosting of the pie is done at room temperature (23 °C). Tests for frozen products have been started immediately after their defrosting and every 24 hours storage. Physicochemical and microbiological indicators have been defined for meat pies. The identification of micro-organisms present in the products by species has been performed by the API CHB/E biochemical test. Potential sources of microbial contamination at the plant throughout the production process were also evaluated. The results of the studies showed that the baked, frozen and defrosted cut meat pies, the shelf life was 72 hours, for classic meat pies the shelf life does not exceed 48 hours. The study did not identify any positive effects of the selected packaging materials on the extension of the shelf life. The identified micro-organisms, which reduce the storage time of the products and food safety, were *B. subtilis* and *B. licheniformis*.

**Keywords:** meat pies; frozen, defrosting, shelf life

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## CHANGE OF PHYSICALLY CHEMICAL PARAMETERS OF MEAT DURING WET AGEING

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Fresh meat quality can be improved by its maturation. Maturation is fresh meat aging under controlled temperature condition special period of time thereby improving its sensorial and structural parameters. Aging is a natural process of meat and there are two maturation methods: wet and dry. Dry-aging produces a more flavorful product but wet aging is characterized by higher outcome of the products and the lower risk of microbial spoilage during maturation. The aim of this study was to determine the meat physically chemical quality changes during wet ageing.

In the current research longest lumbar muscle (*Musculus longissimus lumborum*) of pork, beef and lamb were used. Meat was aged in the following condition: vacuum packed in polyethylene material and stored at  $2\pm 1$  °C for 35 days. During wet ageing (at the 0, 7<sup>th</sup>, 14<sup>th</sup>, 21<sup>th</sup>, 28<sup>th</sup>. and 35<sup>th</sup> day) the following quality parameters were analyzed: moisture content (LVS ISO 1442:1997), water activity (Novasina LabSwift-aw), pH value (LVS ISO 2917:2004), hardness using TA.XT.Plus Texture Analyser (Stable Microsystems, AK) and amount of bound water by pressing method. The obtained results were shown that pH value and amount of bounded water decrease in all meat samples during aging. Water activity changed differently: significantly increase ( $p < 0.05$ ) in pork meat, but significantly decrease in beef and lamb meat ( $p < 0.05$ ). The opposite results were obtained by analyzing the hardness of the meat samples, namely, pork hardness decrease during aging, but in beef and lamb meat increase. The main conclusion of current research is ageing process is more appropriated for beef and pork.

**Keywords:** meat maturation, wet ageing

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## THE USAGE OF ANTIOXIDANTS FOR IMPROVEMENT OF HOT-SMOKED SAUSAGES QUALITY INDICATORS

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The aim of this study was to analyze selected antioxidants (extracts such as: pomegranate, rosemary, garlic, onion, green tea) and to apply bioactivating materials (protective bacterial cultures: *Staphylococcus carnosus*, *Staphylococcus vitulinus*) in hot-smoked sausage technology. Using physical chemical methods pH, colour changes, nitrite content, antioxidant activity, peroxide number, fatty acid composition were evaluated during production and storage period, and using a profile analysis method – organoleptic properties. The applied bioactive substances and their mixtures effectively reduced the total number of aerobic bacteria, *E. coli*, and yeast and mold in hot smoked sausages compared to non-antioxidant samples ( $p < 0.05$ ). These substances (of such extracts as: green tea, rosemary and pomegranate, garlic, onion) also had an effect on the reduction of nitrites, since the statistical analysis of the results of the study during the whole storage period showed a weak linear negative relationship between the amount of nitrites and the number of aerobic microorganisms in hot-smoked sausages during the storage period, respectively  $R = -0.374$  and  $R = -0.377$ . Comparing DPPH active radical (antioxidant) activity in hot-smoked sausages with and without additives, a significantly higher antioxidant activity was observed in samples with rosemary and pomegranate extracts ( $p < 0.05$  in both cases). These samples also showed a statistically significant decrease in peroxide and fatty acids. Lower pH was observed in the samples with the mixture of bioactive substances comparing with control ones without antioxidants ( $p \leq 0.05$ ). Having used protecting cultures *Staphylococcus carnosus*, *Staphylococcus vitulinus* together with antioxidants, the organoleptic properties of the products ( $p \leq 0.05$ ) and the stability of the colour were improved during the storage period ( $p < 0.05$ ). Combining these cultures with rosemary extract in the production of hot-smoked sausages, not only organoleptic properties have been improved, but also the term of use has been prolonged.

**Keywords:** hot-smoked sausages, antioxidants, bacterial cultures, protection

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## ASSESSMENT OF HEAVY METALS CONTENT IN CEREAL PRODUCTS USING THE VOLTAMETRIC ANALYZER

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One of the main problems in food safety is their chemical pollution. Food products are able to accumulate harmful substances from the environment and concentrate them in large quantities, therefore up to 70 % of pollutants enter the human body with food. Food pollutants include a number of elements that are now considered potentially hazardous to human health even in trace amounts: Pb, Cd, Cu, Zn, etc. Analysis of contamination of samples of cereals (buckwheat, rice, switchgrass) with heavy metals using the voltammetric analyzer showed, that the main contribution to the contamination of cereals makes Zn – 71%, the proportion of Cu is 15%, the contribution of Pb is 9 %, and Cd – 5 %. Studies have shown that the Pb content in the analyzed samples was in the range from 58% to 74% of the maximum permissible concentration (MPC); Pb content – in the range from 42% to 67% of the MPC; Cd content – in the range from 53% to 73% of the MPC; Cu content – in the range from 40% to 71% of the MPC.

**Keywords:** voltammetric analyzer, heavy metals, buckwheat, rice, switchgrass

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**TRENDS IN NEW PRODUCT AND  
TECHNOLOGY DEVELOPMENT**

## ENCAPSULATION OF PROBIOTIC BACTERIA: THE INFLUENCE OF BIOPOLYMER ON THE ENCAPSULATION EFFECTIVENESS

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In order to increase probiotics stability and resistance to external conditions, probiotic cells are often encapsulated using various biopolymers, such as alginate, chitosan, gelatin, pectin, cellulose derivatives and others. Although biopolymers are highly compatible with living microorganisms, encapsulation effectiveness on cells protection may vary depending on the material used. The purpose of this research was to evaluate the influence of the different biopolymeric systems used for the encapsulation, on the probiotic bacteria encapsulation efficiency, survivability in solutions of preservatives and viability during storage.

The capsules were prepared by extrusion technique using alginate, hydroxyethyl cellulose (HEC) and pectin at different ratios. Results revealed, that the encapsulation efficiency of *Lactobacillus plantarum* was similar to all biopolymeric systems and reached 96–98%. However, there was a decrease in viability by 2 to 3 lg CFU mL<sup>-1</sup> in all systems during storage, except in alginate and capsules with the lowest amount of HEC. Similar tendency was observed when capsules were exposed to the preservatives: the highest concentration (70% of biopolymeric system) of HEC resulted in the lowest viability of *L. plantarum* in solutions of preservatives and were 2.2 lg CFU mL<sup>-1</sup> in benzoic acid and 3.0 lg CFU mL<sup>-1</sup> in Sensicare® M 4200 after 72 hours. This could be due to pores size in capsules. The scanning electron microscopy showed, that the more HEC were present in polymers mixture, the bigger the pores were. Nevertheless, capsules made of HEC, alginate and pectin provided the better structural properties, such as softness, which is important for the textural properties of the final products.

**Keywords:** probiotics, encapsulation, biopolymers, efficiency, viability

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## ENCAPSULATION OF WATER AND FAT SOLUBLE VITAMINS USING DOUBLE EMULSIONS MATRIX

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Encapsulation is the best strategy for incorporation of bioactive substances into food. Water in oil in water ( $W_1/O/W_2$ ) emulsion is reported as a good matrix for the incorporation of sensitive hydrophilic bioactives such as vitamins. In this study the water soluble vitamins (C, folic acid and  $B_{12}$ ) were incorporated into the inner aqueous phase ( $W_1$ ) of emulsion, vitamin  $D_3$  and A were added into the oil phase (O) of emulsion.

Whey protein isolate and polyglycerol polyricinoleate were used as hydrophilic and lipophilic emulsifiers. Reverse phase HPLC separation technique was used for vitamins quantification. Water soluble vitamins were injected after purification by Carrez clarification reagents and filtration through 0.45  $\mu\text{m}$  pore size filter. Fat soluble vitamins were extracted from full hydrolysed sample using SPE Chromabond XTR column. The obtained n-hexane extract was evaporated to dryness and the dry residue was dissolved in the mobile phase.

Composition of inner aqueous phase was studied at the end of technological process of emulsion. It was found that homogenization did not cause the loss of vitamins. Encapsulation efficiency of water soluble vitamins was in the range of 76–87%. Because vitamins C, A and folic acid are sensitive to the heat treatment, the effect of pasteurization on the vitamins content in the emulsion was studied. The results showed that encapsulation into  $W_1/O/W_2$  emulsion was a good way to protect vitamins from thermal degradation.

**Keywords:** double emulsion, encapsulation, water and fat soluble vitamins

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## MICROENCAPSULATION OF BLACK CHOKEBERRY EXTRACT IN DOUBLE EMULSIONS WITH DIFFERENT BIOPOLYMERS BY EMULSIFICATION AND SPRAY DRYING

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Double water-in-oil-in-water emulsion that also called “colloidal delivery system” had unique morphology and could be used as potential matrix for lipophilic and hydrophilic compounds encapsulation. The objective of this study was to (I) encapsulate black chokeberry extract in the double emulsions, stabilised with different biopolymers, by emulsification and subsequent spray-drying and (II) to study the effect of the biopolymer type and emulsification technique on the physicochemical properties of the double emulsions and obtained powders.

W1 / O emulsion was formulated with black chokeberry extract solution (W1) dispersed in rapeseed oil (O) with polyglycerol polyricinoleate (6%) as lipophilic emulsifier. As outer water phases (W2) milk (7%), pea (5%) proteins or cognac glucomannan (0.1–0.3%) solutions were used. Before the spray-drying maltodextrin was added to W2 phase to obtain an oil phase to wall material ratio to 1:3.

Rheological behaviour, stability, droplet size distribution, colour and encapsulation efficiency of the double emulsions was fully studied. Powders obtained after spray drying were characterised through yield, solubility, colour, encapsulation efficiency, free oil and water activity determinations.

All double emulsions showed monomodal droplet size distribution, shear-thinning behaviour with dominant elastic properties. Double emulsions stabilised with cognac glucomannan had significantly ( $p < 0.05$ ) higher viscosity and mean droplet size in comparison with those stabilised with proteins. However, these emulsions were not suitable for the spray drying, as process yield was less than 5%.

It could be concluded that a significant effect of biopolymer type on the characteristics of the emulsified or spray-dried samples was observed.

**Keywords:** microencapsulation, emulsion, spray-dried, chokeberry

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## OBTAINING OF HYDROPHOBIN-TYPE PROTEINS FROM FUNGAL CULTURE *TRICHODERMA VIRIDE*

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Hydrophobins are low molecular weight fungal proteins with pronounced surface-active properties. Hydrophobins can be used as stabilizers for food foams and emulsions.

The aim of the work was to study the dynamics of the accumulation of hydrophobins in biomass and in native solution during cultivation of the fungus *Trichoderma viride*. It was submerged cultured for 5 days. For cultivation was used glucose-peptone medium composition: glucose – 10.0 g L<sup>-1</sup>; peptone – 2.5 g L<sup>-1</sup>; yeast extract – 2.0 g L<sup>-1</sup>; KH<sub>2</sub>SO<sub>4</sub> – 0.6 g L<sup>-1</sup>; K<sub>2</sub>HPO<sub>4</sub> – 0.4 g L<sup>-1</sup>; NaCl – 0.5 g L<sup>-1</sup>; MgSO<sub>4</sub> – 0.5 g L<sup>-1</sup>. Separation of the native solution and biomass was carried out by filtration. The native solution was treated with 96% ethanol, so that the final concentration of ethanol in the solution was 60%. The ethanol-insoluble proteins were separated by centrifugation. Ethanol from the solution was removed by evaporation under a vacuum. The protein concentration in the solution was determined by the method of Lowry. Method of measuring of the contact angle was used to assess the surface activity of the extract.

The accumulation of biomass reached a maximum after 30 hours from the beginning of cultivation and was 5.5 g L<sup>-1</sup>. The accumulation of the hydrophobin-type proteins in the native solution reached the highest value after 55 hours from the beginning of cultivation and was 1.4 mg mL<sup>-1</sup>.

Thus, the dynamics of the accumulation of hydrophobin-type proteins in the culture liquid of the fungus *Trichoderma viride* was studied.

**Keywords:** hydrophobins, emulsifier, submerged cultivation, fungi

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## DEVELOPMENT OF FORMULATION AND PRODUCTION TECHNOLOGY OF BITTER TINCTURE

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The production of products enriched with biologically active substances of plant origin is a promising direction in the production of food at present. One of the most promising plant materials for use in the food industry is unabi. This plant is grown in the South of Russia, as well as many subtropical regions of the world. A distinctive feature of unabi is a high content of vitamin C and P active compounds that determines their therapeutic and prophylactic properties. In addition, unabi contains sugar, organic acids, tannin, pectin, iodine, etc. Thus, the purpose of the research was to develop formulations and technologies of food production on the basis of unabi.

Employees of the department of production and processing of food products from of plant raw material and the technology of compounding proposed by bitter tincture, using fresh fruits unabi. Received tincture is a bitter alcoholic drink 35% vol., amber-colored, mild flavour, slightly burning, complex flavour with a slight tone of apples. Developed tincture bitter compared to other known analogs have several advantages. Firstly, the proposed infusion enriched with biologically active substances and is characterised by high nutritional value. Secondly, the tincture has high organoleptic properties due to the original taste of jujube fruit. Furthermore, the proposed formulation and the technology reduces the cost of the finished product by using a small number of ingredients tinctures, which simplifies the production process.

**Keywords:** unabi, technology, tincture, compoundings, juice

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## INFLUENCE OF GERMINATION TEMPERATURE AND TIME ON PHENOLIC CONTENT AND ANTIOXIDANT PROPERTIES OF CEREALS

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Germination improves nutritional quality of cereals due to synthesis of various phytochemicals. The aim of the current research was to evaluate changes in total phenolic compounds (TPC) and radical scavenging activity of triticale, hull-less barley, hull-less oat, wheat and rye grains at different germination stages and temperatures. Triticale (cv Inarta), hull-less barley (cv Irbe), hull-less oat (cv Lizete), rye (cv Kaupo), and wheat (cv Elvis) grains were cleaned, washed and steeped in water at the ratio of 1:2 (grains to water) for 24±1 h at 22±2 °C. After steeping, grain germination was performed for 12, 24, 36 and 48 h in the dark at 17 °C, 25 °C, 35 °C and the total phenolic content and radical scavenging activity have been determined. During germination, TPC in all analysed cereal types increased, but dynamics was cereal type dependent and it is not possible to give general tendency or the best parameters applicable for cereals in general. The most significant changes were observed in the analysed grains during germination at 25 °C and 35 °C, the most significant changes were detected in all germinated hull-less barley grains. The current study indicates that germination is effective tool for improvement of different grain nutritional value, suggesting their potential use in new product development.

**Keywords:** triticale, hull-less barley, hull-less oats, DPPH, ABTS

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**NAKED BARLEY INFLUENCE ON WHEAT BREAD QUALITY****Vita Sterna<sup>1</sup>, Daiga Kunkulberga<sup>2</sup>, Evita Straumite<sup>2</sup>, Katrina Bernande<sup>1</sup>**

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Naked barley is a rich source of dietary fibre, non-starch polysaccharides, especially  $\beta$ -glucans and other functional ingredients. Therefore, gained attention to be included naked barley in products to increase their nutritional value. Barley is not popular for bakery products because its inappropriate baking properties. High barley amount led to decrease in bread loaf volume, storage time and consumer acceptability. Since is known that using sourdough fermentation could be a possibility to obtain more acceptable products with higher nutrition value increased producers interest to include barley flour in bread making. Therefore, the aim of research was to evaluate nutritional characteristic, overall acceptability and storage possibility of bread enriched with naked barley grains or flour. As control was bread from 100% wheat flour. There were prepared 7 samples of bread, where wheat bread enriched with naked barley 'Kornelija' variety flour or grain in the amount of 30 or 40% from total flour amount. Panellists were asked to evaluate intensity of bread sensory attributes – colour, aroma, porosity, hardness and sour taste – using 7-point unstructured line scale. Moisture and hardness were evaluated 24, 60 and 72 h after bread baking. Concluded that bread samples enriched with barley grains had larger volume and porosity and smaller hardness than samples enriched with barley flour. Samples enriched with barley flour made using sourdough method had sour taste and higher hardness. Where evaluated, that all samples have maintained quality after 72 h and moisture content did not differed significantly among samples.

**Keywords:** naked barley, dietary fibre,  $\beta$ -glucans, sensory properties

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## THE MILK-CLOTTING ENZYME FROM FUNGAL CULTURE *FUNALIA SP.*

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Cheese-making is a process known since ancient times. Traditionally, cheese preparation was based on coagulation of milk using rennet. Due to the high cost of rennet, an important task of the cheese industry is finding its alternatives.

An important requirement for milk-clotting enzymes is low non-specific total proteolytic activity.

One of the promising sources of milk-clotting enzymes are basidial fungi. Earlier, we found a high milk-clotting activity (MCA) of the fungus *Funalia sp.*

The aim of our research was to find the optimal cultivation conditions for the fungus *Funalia sp.*, which ensure the maximum yield of the milk-clotting enzyme.

The fungus was submerged cultured on a glucose-peptone nutrient medium for 8 days. The MCA determination of the native solution was carried out on each day of cultivation using the Kawai-Mukai method. The highest level of MCA was observed on the 7th day of cultivation. To optimize the composition of the nutrient medium the method of full factorial experiment was used. According to the results of the study, a nutrient medium with a concentration of glucose and peptone of 15.5 and 3.6 g L<sup>-1</sup> was selected. For further concentration and purification of the enzyme the method of ultrafiltration was used.

As a result, an enzyme preparation with a high level of MCA (75.19 A mg<sup>-1</sup>) and a low level of proteolytic activity (0.087 A mg<sup>-1</sup>) was obtained. According to its characteristics, the enzyme is not inferior to commercial rennet and is promising for use in the food industry.

**Keywords:** milk-clotting, fungi, cheese making, submerged cultivation

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## THE STRATEGIES FOR THE UTILIZATION OF RICE PROCESSING BY-PRODUCTS TO REUSE AS VALUE-ADDED ADDITIVES

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The food industry by-products due to their composition can be valorised by innovative technologies leading to environmental advantages. In this work, a dual ultrasound-retrogradation technology was designed for utilization of rice polish fibre fraction to produce the resistant starch (RS). RS is a small starch fraction resistant to digestion, and being from a natural source, it is considered as a valuable supplement in the formulation of various types of functional food. In our study, low and high frequency ultrasound techniques were used for the treatment of rice processing by-products to produce the RS under low temperature conditions (30–70 °C). Treatment process was optimized according to the highest RS concentration and operating conditions. The impact of RS on lactic acid bacteria (LAB) viability at different temperatures was investigated. The results showed that the optimum parameters to increase the production of RS by 38% (up to 22.04 g 100 g<sup>-1</sup> d.w.) from rice polish using pulse ultrasound: treatment for 20 min at 40 °C and solid-to-liquid ratio 1 : 4 using low frequency (37 kHz, intensity 120%) cavitation. Higher by 29% efficiency of RS production was achieved by using a high frequency (850 kHz) pulse ultrasonic cavitation for 15 min at 40 °C and retrogradation during 24 hours at 4 °C. The tested LAB showed a greater viability in ultrasound treated rice substrate containing optimised content of RS (decrease in LAB cell count up to 0.5 log) while LAB cell viability in nontreated rice substrate decreased by 1 log after 72 h incubation at 35 °C. The developed technology brings low temperature ultrasound processing for production of RS as a substrate for cell immobilization together into final product for applied usage.

**Keywords:** rice polish valorisation, resistant starch, ultrasound, lactic acid bacteria, viability

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**FOOD CHEMISTRY, ANALYSIS  
AND QUALITY ASSESSMENT**

## DIGESTIBILITY OF BUCKWHEAT STARCH

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Not only nutritional value but also digestibility is important in the development of new functional food product. Buckwheat consists mainly of carbohydrates, most of which are starch. Various technologies such as germination or extrusion are used to improve and accelerate starch digestion in the food products. The objective of the study was to evaluate the effect of germination and extrusion on the digestibility of buckwheat starch. The digestibility of starch in buckwheat was studied using the dynamic gastrointestinal tract simulator and the HPLC (Shimadzu Prominence) method with refractive index detection (RID) was developed for individual sugar (glucose and maltose) determination in germinated and extruded buckwheat before and for up to 8 h, taking samples every hour.

A significant increase in maltose content ( $p < 0.05$ ) in buckwheat products was observed in the third hour of the experiment in the gastrointestinal tract simulator which indicated the hydrolysis of starch. In addition, for extruded buckwheat samples, the maltose content in the gastrointestinal tract simulator after 3 hours was nearly twice as high as the activated buckwheat. Combining both technologies - activation and extrusion, the highest level of maltose content in buckwheat product was obtained. A rapid increase in glucose concentration ( $p < 0.05$ ) in buckwheat products was observed after 4–5 h in the gastrointestinal tract simulator. There were no significant differences between germinated and extruded buckwheat samples ( $p > 0.05$ ). The results showed that both germination and extrusion contribute to the hydrolysis of starch in buckwheat products, which contributes to the digestibility of the product.

**Keywords:** buckwheat, starch, maltose, glucose, digestibility

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**BIOACTIVE COMPOUNDS IN GINGER TEA****Baiba Ozola<sup>1</sup>, Ingrida Augspole<sup>2</sup>, Mara Duma<sup>1</sup>, Viesturs Kreicbergs<sup>1</sup>**

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Ginger (*Zingiber officinale*) is known as an additive for food and therapeutic purposes. It can help improve memory, helps eliminate toxins from the body, lowering arterial pressure and cholesterol, and is a valuable source of vitamins, minerals and biological active compounds.

The aim of research was to evaluate which of the ginger part as well as fresh or dried ginger is more suitable for making healthier tea by usual domestic preparation technique.

The more phenolic compounds ( $104.7 \pm 4.5$  mg GAE  $100\text{ g}^{-1}$ ) in tea could be obtained using fresh ginger root; it is for 30% more than from dried root sample, but the flavonoid content was higher in the tea obtained by using fresh ginger husk ( $78.74 \pm 3.39$  mg catechin equivalent  $100\text{ g}^{-1}$ ). There were not significant differences in the use of fresh or dried ginger root ( $46.16 \pm 2.23$  mg catechin equivalent  $100\text{ g}^{-1}$  on average).

Content of vitamin C in infusions from fresh ginger root ( $4.59 \pm 0.98$  mg  $100\text{ g}^{-1}$ ) was for 21.7% higher than from fresh ginger husk, but there were not significant differences ( $p > 0.05$ ) regarding dried samples ( $3.43 \pm 0.71$  mg  $100\text{ g}^{-1}$ ).

Order of antioxidant activity by free radical scavenging activity in infusions was as follows: fresh ginger root > dried ginger root > fresh ginger husk > dried ginger husk.

The recommendation is that fresh ginger root is more suitable for obtaining a richer tea with the biologically active compound, as the drying process affects both the phenol and vitamin C content in the samples and in the tea accordingly.

**Keywords:** ginger tea, phenolics, flavonoids, vitamin C

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## TOTAL PHENOLS, PHENOLIC ACIDS AND FLAVONOIDS CONTENT OF DIFFERENT MINT SPECIES

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*Mentha* species are one of the world popular herbs that are used in cosmetic and food industry, for their medical properties. The research was conducted at Vytautas Magnus University Agriculture Academy in 2018. The research aim was to determine the total phenols, phenolic acids and flavonoids content of different mints species. Two species and five mint varieties were planted at university experimental station (field location 54° 53' 8.9" N, 23° 50' 8.02" E) on 4<sup>th</sup> of May in 2017. Plants were harvested on the blooming phase. Mint leaves after the harvests were lyophilised. Samples till the analyses were stored at the -80 °C temperature. The total phenols, phenolic acids and flavonoid content were determined by HPLC method. The results showed that *Mentha spicata* 'Moroccan' leaves had from 2 to 3-folds bigger amount of polyphenols compared to *M. spicata* 'Crispa'. *M. piperita* 'Granada' showed the highest amount of phenols and phenolic acids and *M. piperita* 'Swiss' the highest amount of flavonoids 80.37 mg 100 g<sup>-1</sup> DW. *M. spicata* 'Maroccan' accumulated the highest amount of phenols compared to *M. piperita*.

**Keywords:** aromatic plants, *Mentha spicata*, *Mentha piperita*, phenols

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## PHYTOCHEMICALS AND ANTIOXIDANT CAPACITY OF SEA BUCKTHORN BERRY POMACE EXTRACTS

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In recent years many studies investigated the possibilities of recovering valuable constituents from various berry pomace. In order to reduce the amounts of environmentally hazardous waste and the losses of valuable compounds the pomace have been converted into valuable ingredients, which were tested for their bio activities and phytochemical composition. The aim of this study was to determine antioxidant capacity of lipophilic and hydrophilic fractions as well as their chemical composition of berry pomace remaining after pressing juice of sea buckthorn (*Hippophae rhamnoides L.*) berries. Lipophilic fractions from sea buckthorn berry pomace were recovered with hexane, while ethanol was used to extract high polarity fractions. Analysis of lipophilic extract by GC-MS revealed that the main volatile constituents were alkanes; they also contained strong fat-soluble antioxidants tocopherols. Palmitoleic, stearic, linoleic and arachidic acids were the main fatty acids in sea-buckthorn pomace oil. Antioxidant capacity of lipophilic fraction was evaluated in Oxipres and Rancimat apparatus using 0.5, 1.0 and 1.5% concentrations of sea buckthorn in majoneze. Weak antioxidant effect of the extracts was observed only at the highest concentration. It may be explained by the presence of high amounts of oxidation-sensitive polyunsaturated fatty acids in pomace oil. Hydrophilic fractions were analysed by UPLC-QTOF-MS and 23 compounds were identified, quinic acid and izorhamnetin derivatives being the dominant constituents. It may be concluded, that the results obtained may serve as valuable information for the isolation of functional ingredients from sea-buckthorn berry pomace, which might find application for human nutrition and other purposes.

**Keywords:** *Hippophae rhamnoides L.*, antioxidant capacity, berry pomace phytochemicals

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## JUGLONE CONTENT IN LEAF, STEM, NUT SHELLS AND PULP OF LATVIAN BLACK WALNUT AND BUTTERNUT

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The aromatic secondary metabolite Juglone (5-hydroxy-1,4-naphthoquinone) is the major organic chemical compound of walnuts in nature with several bioactivities – antitumor, antimicrobial, antioxidant, antidiabetic, antihypertensive, hypolipidemic and liver-protective properties. The aim of the research was to determine the juglone content (leaf, stem, nut shells and pulp) of wild black walnut (*Juglans nigra*) and butternut (*Juglans cinerea*) grown in Latvia Ozolnieki and Lielvarde parish in two different years (2017 and 2018). A HPLC (Shimadzu LC-20 Prominence) method with diode array detector (DAD) at 253 nm was developed for juglone determination in walnut samples. The moisture content of the walnut leaf, stem, nut shells and pulp was determined with moisture analyzer AND MX-50. The highest content of juglone was determined in walnut leaf – 28.36 mg 100 g<sup>-1</sup> and stem – 18.36 mg 100 g<sup>-1</sup> in year 2018 and lowest leaf 4.75 mg 100 g<sup>-1</sup> and stem 0.48 mg 100 g<sup>-1</sup> in year 2017. Research shows that the content of juglone decreases over the one year during storage time in walnut leaf and stem. Juglone compound in nut shells and pulp of walnuts was not detected.

**Keywords:** black walnut, butternut, juglone, HPLC

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## ANALYSIS OF ORGANIC ACIDS IN HERBAL AND FRUIT SYRUPS BY LIQUID CHROMATOGRAPHY

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Syrups are sweetened sucrose infusions or decoctions. Syrups are usually a pleasing balance between medicinal and aromatic herbs — if the medicinal herb has a strong or bitter (or otherwise unpleasant) taste, an aromatic herb can be added in for flavor. The aim of the research was to evaluate the content of organic acids in the herbal and fruit syrups. Some of popular Latvian herbal syrups: *Plantago major*, *Chamaenerion angustifolium* flower, *Calluna vulgaris* flower, *Picea* young shoots, *Pinus* young shoots, *Pinus* cone, *Achillea millefolium*, *Syringa vulgaris* flower and fruit syrups: *Crataegus curvisepala* fruit, *Sorbus aucuparia* fruit, *Rosa canina* fruit, *Cydonia oblonga* fruit, *Aronia melanocarpa* fruit, *Pyrus malus* and *Rheum Rhabarbarum* were selected for analysis. The current research focuses on the evaluation of organic acid, pH content and dry matter in herbal and fruit syrups. The major organic acid (oxalic acid, tartaric acid, quinic acid, malic acid, ascorbic acid, citric acid, fumaric acid and succinic acid) were determined by applying the method of high performance liquid chromatography (Schimadzu Prominence HPLC).

In the present experiments it was found that there are significant differences in the organic acid content between different herbal and fruit syrups. In general, all samples tested in this study, demonstrated high content of organic acid. The highest content of organic acid was found in *Pyrus malus* syrup 17.36 g 100 g<sup>-1</sup> and *Picea* young shoots – 15.27 g 100 g<sup>-1</sup>. Whereas, the lowest total sugars content was in *Crataegus curvisepala* fruit syrup – 3.93 g 100 g<sup>-1</sup> and *Syringa vulgaris* flower – 4.24 g 100 g<sup>-1</sup>. Results of the present experiments demonstrated that pH in analysed herbal and fruit syrups was significantly different (p<0.05).

**Keywords:** herbal syrups, fruit syrups, organic acid, HPLC

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**PIGMENTS CONTENT IN DIFFERENT PROCESSED EDIBLE WILD PLANTS****Baiba Ozola<sup>1</sup>, Ingrida Augspole<sup>2</sup>, Mara Duma<sup>1</sup>**<sup>1</sup>Department of Chemistry, Faculty of Food Technology, University of Life Sciences and Technologies, Liela iela 2, Jelgava, Latvia<sup>2</sup> Institute of Soil and Plant Sciences, Faculty of Agriculture, University of Life Sciences and Technologies, Liela iela 2, Jelgava, Latvia

Natural colours of wild plants are similar to human – made pigments, for example:  $\beta$ -carotene and chlorophyll. After wild plant colour can make the first conclusion: is the plants immature, ripe, or overripe? The aim of the current research was to evaluate the effect of processing on the colour intensity and pigments content in leaves of edible wild plants grown in Latvia. Samples of stinging nettle (*Urtica dioica*), common goutweed (*Aegopodium podagraria*), dandelion (*Taraxacum officinale*) and chickweed (*Stellaria media*) were collected in May 2018 in Latvia. Pigments (total chlorophylls, chlorophyll *a*, *b* and total carotenoids) content were determined spectrophotometrically in the ethanol extracts of fresh, frozen and dried leaves, the colour was measured in CIE  $L^*a^*b^*$  system. The principal component analysis showed that significantly higher content of total chlorophylls and carotenoids in fresh ( $1.64 \pm 0.14$  and  $0.81 \pm 0.02$  mg  $g^{-1}$ ) and frozen nettle leaves ( $2.08 \pm 0.12$  and  $0.94 \pm 0.05$  mg  $g^{-1}$ ). Freezing promotes the better extraction of pigments from all plants to be analyzed. After drying the content of pigments decreases for 3 times. The ratio between chlorophyll *a/b* was higher in goutweed leaves regardless of processing. These results demonstrate that the significant differences were determined between the colour components  $L^*a^*b^*$  of fresh, frozen and dried plant leaves.

**Keywords:** pigments, colour, edible wild plantsFor further information please contact: [baiba.ozola@llu.lv](mailto:baiba.ozola@llu.lv)

## EVALUATION OF PRE-TREATMENT AND JUICE EXTRACTION METHODS FOR OPTIMAL HORSERADISH JUICE PRODUCTION

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Many biologically active substances lose their activity during technological steps of juice production. To prevent this, various pre-treatment and juice extraction methods are used. The aim of the current research was to determine the most effective pre-treatment and juice extraction method for horseradish to obtain the juice with the highest content of bioactive compounds. For experiments fresh horseradish leaves and roots were frozen by conventional method (-18 °C). Horseradish juice was obtained using four different methods:

- A. defrosting, blanching in steam (90±2 °C) for 3 min, grind and extracting of juice by basket press,
- B. defrosting, blanching in steam (90±2 °C) for 3 min, grind and extracting with low speed filter press,
- C. frozen sample grinding, and extracting of juice by basket press,
- D. frozen sample grinding, and extracting of juice by low speed filter press.

The content of total phenolic compounds and antioxidant activity were determined spectrophotometrically and vitamin C titrating. Results showed that content of biologically active compounds of horseradish juice were significant ( $p < 0.05$ ) affected by pre-treatment and juice extraction method. By-products with a higher content of flavonoids and ABTS<sup>•+</sup> scavenging activity were obtained using the juice extraction method D, but juice with a higher total phenolic and ABTS<sup>•+</sup> scavenging activity content were obtained using the juice extraction method C. The better pre-treatment and juice extraction method for obtaining optimal horseradish juice were using C. method (frozen sample grinding, and extracting of juice by basket press).

**Keywords:** horseradish, juice, pre-treatment, biologically active compounds

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## PRELIMINARY RESULTS OF THE JAPANESE QUINCE FRUIT STORAGE EXTENSION POSSIBILITIES

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For the study on the extension of fruit storage Japanese quince (*Chaenomeles japonica*) fruit cultivars: 'Darius', 'Rasa', 'Rondo', 'Ada', hybrids C-13, 9-44 and organically grown fruits of seedlings were used, harvested twice considering the maturity stage. The following tasks were planned: to determine the degree of ethylene formation during fruit maturing; test the suitability of controlled atmosphere conditions and treatment with 1-methylcyclopropene for extension of fruit storage time; analyse changes of fruit physical parameters (moisture losses, hardness and surface colour) and chemical content (soluble solids, total acids, vitamin C, total phenolic content and antioxidant activity) content during storage. Within the research, for the first time the ethylene was successfully determined for the Japanese quince fruits. Based on the results of the first year of research, by assessing different storage technologies it can be concluded that: 1) storage of Japanese quince fruits under controlled atmosphere (ultra-low oxygen) conditions is a promising technology; 2) storage of organically grown seedlings due to heterogeneity in size and different ripeness stage was the most problematic; 3) determining of ethylene in Japanese quince, especially in organically grown fruits and the change in colour (yellowness index) allows concluding that the maturation of greener fruits could be accomplished by storage of fruits under conditions with a high content of external ethylene.

**Keywords:** *Chaenomeles japonica*, ethylene, physical and chemical indices

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## OSMOTIC DEHYDRATION IN JAPANESE QUINCE (*CHAENOMELES JAPONICA* THUNB.) FRUIT PROCESSING

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Japanese quince (*Chaenomeles japonica* (Thunb.) Lindl. ex Spach) fruit were submitted to osmotic dehydration with sugar and food additives like strawberry, raspberry by-products and freeze dried coffee. This process promoted the transfer of bioactive compounds like phenolic compound, anthocyanins and flavour constituents to the osmotic solutions and quince fruit slices. For control quince fruit slices without any additives were chosen. The highest transmission of bioactive compounds has been identified to the osmotic solutions, then the osmotic dehydration is carried out with sugar and freeze dried coffee. Compared to control phenolic compounds increased three times in the osmotic solutions with freeze dried coffee, from 149.5 to 518.8 mg GAE 100 g<sup>-1</sup>. Antioxidant activity in this solution increased five and three times for DPPH and ABTS reaction systems respectively. Lower transmission was detected when the osmotic dehydration is carried out with strawberry and raspberry by-products. However, these additives enrich osmotic solutions and quince fruit slices with anthocyanins, which in the quince are simply undetectable. The osmotic dehydration process not only enriches the final products with bioactive compounds, but also decreased the water activity in the fruits and is a suitable method to increase shelf life. Water activity in quince slices ranges from 0.59 to 0.67, which indicates that various classes of microorganisms such as Gram negatives, Gram positives, most yeasts and most molds, can not grow. The present work demonstrates that the osmotic dehydration is an excellent method to produce safe products enriched with bioactive compounds.

**Keywords:** Japanese quince, osmotic dehydration, phenolic compound, water activity

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## UTILIZATION OF WHOLEGRAIN HULL-LESS BARLEY FLOUR IN TRADITIONAL CORNELIAN CHERRY TARHANA SOUP

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Cornelian cherry (*Cornus mas* L.) tarhana (CCT), which is a traditional product in powder form for making soup consumed mostly in the Black Sea region of Turkey, has a geographical mark nationwide. CCT is traditionally prepared by mixing cornelian cherry puree, bread wheat flour and salt followed by dividing into small pieces of dough, drying, sieving and second drying in sunless environment, then sieving and packaging in cloth bags. Fermentation process is not applied during traditional production. In this study, traditional bread wheat flour was replaced with wholegrain hull-less barley flour (WHBF) for increasing the nutritional properties of CCT with the health promoter phytochemicals of hull-less barley. The aim of this study is to investigate the effect of fermentation on some chemical properties, colour, titratable acidity, total phenolic compound (TPC) contents, dietary fiber (especially  $\beta$ -glucan), anthocyanin contents and antioxidant activity properties of CCT samples produced with WHBF. TPC contents of non-fermented and fermented CCT products were determined in different extraction solvents (DMSO, 50% MeOH and 80% MeOH). TPC contents of CCT produced with WHBF in both processes were higher than control CCT in all extraction conditions. The highest TPC content was achieved with the fermented one. CCT produced with WHBF had significantly higher DPPH radical scavenging activity (%) and TEAC ( $\text{mmol kg}^{-1}$ ) compared to the control one in both processes. Total dietary fiber and  $\beta$ -glucan contents also slightly increased after fermentation on dry weight basis. Vitamin C and anthocyanin contents of CCT produced with WHBF destructively affected from fermentation process.

**Keywords:** Cornelian cherry tarhana, soup, fermentation, wholegrain hull-less barley flour, quality properties

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## LIGNANS IN OATS AND BARLEY BRED IN LATVIA DEPENDING ON CULTIVAR, ENVIRONMENT AND AGRICULTURAL PRACTICE

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Cereals being rich in many nutrients and phytochemicals offer an excellent opportunity for the production of functional foods. Lignans are a group of phenolic compounds and are the biologically active antioxidants found also in grain foodstuffs reducing the occurrence of diabetes and cardiovascular diseases and preventing the progression of breast and prostate cancer. The aim of the research was to determine the variation of the concentration of lignans in the grains of different barley and oats genotypes depending on environment and agricultural practice. Grain samples of four spring barley and three oat genotypes were collected from field trials carried out in two years (2013 and 2014) and different conditions (conventional practice with three different nitrogen supplies and organic practice). The content of lignans was determined by high-performance liquid chromatography with tandem mass spectrometry detection (HPLC-MS/MS). The following lignans were used as reference standards: matairesinol (Mat), secoisolariciresinol (Seco), pinoresinol (Pino), lariciresinol (Lar), 7-hydroxymatairesinol (HMR). The highest concentration of lignans was determined in all oats' cultivars grown organically with the best results for cv Stendes Emilija ( $546.45 \pm 25.67 \mu\text{g } 100 \text{ g}^{-1}$ ). In barley samples lignans' content varied from  $375.60 \pm 66.04 \mu\text{g } 100 \text{ g}^{-1}$  to  $446.85 \pm 31.47 \mu\text{g } 100 \text{ g}^{-1}$  (cv Ansis grown organically). The concentration of lignans in grain samples obtained in 2014 was significantly ( $p < 0.001$ ) higher than in 2013 but only for barley. Cultivation practice did not affect significantly the variation of lignans for both cereal species. Content of some lignans, like Pino and HMR, was higher in oat grains while the content of Seco was higher in barley grains.

**Keywords:** oats, barley, plant lignans (Mat, Seko, Pino, Lar, HMR), HPLC-MS/MS

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## ENVIRONMENTAL ASSESSMENT OF QUALITY INDICATORS OF LOCAL MELON VARIETIES GROWN IN UZBEKISTAN

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Melon is one of the most valuable and useful products, and this forces us to look for ways of processing for long-term storage of these seasonal fruits. The easiest, cheapest and least time-consuming method of canning is drying. The aim of the work was to study the effective methods of drying local varieties of melons and determine their quality indicators in Uzbekistan.

The paper presents data on various varieties and methods of drying, considered the comparative characteristics of the traditional method of drying with the proposed method. Revealed advantages and disadvantages, factors affecting the quality of products. Residual amounts of chemically harmful contents were studied in accordance with food safety standards, as well as microbiological changes occurring in products during storage. The chemical composition of total phenols, antioxidant activity and vitamin C content in dried melon samples have been studied. Productivity at artificial drying was higher. Organoleptic, chemical and microbiological analysis of analysed products showed that the products obtained by artificial drying are better in all indicators than in the sun.

**Keywords:** melon, drying method, quality

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## IMPACT OF FRUIT PLACE IN THE FRUIT TREE TO VARIANCE OF QUANTITATIVE COMPOSITION OF TRITERPENIC COMPOUNDS

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Pentacyclic triterpenic compounds are known for their biological activity. They are found in fruits, vegetables and medicinal plants. One of the factors that influence quantitative composition of triterpenic compounds in fruit is the fruits place in the crown of the tree. The aim of this research was to determine variance of quantitative composition of triterpenic compounds in fruit from different places of the tree.

For the investigation of quantitative composition of extracts of lyophilized apples peel was used our previously developed and validated HPLC method. It was found that the biggest corosolic acid amount ( $0.67 \pm 0.02 \mu\text{g g}^{-1}$ ) in fruits picked from the top of fruit tree. As results have shown the apples from the top of the crown accumulated the biggest betulinic acid ( $0.039 \pm 0.001 \mu\text{g g}^{-1}$ ) amount as compared with fruits from other places of tree. However, the biggest amounts of oleanolic acid ( $0.57 \pm 0.02 \mu\text{g g}^{-1}$ ) and ursolic acid ( $3.96 \pm 0.001 \mu\text{g g}^{-1}$ ) were determined in apples from the inside of fruit tree crown. On other hand, the biggest total amount of triterpenic compounds ( $5.24 \pm 0.03 \mu\text{g g}^{-1}$ ) was determined in apples picked from the inside of fruit tree crown as compared to apples that had grown on the west side of tree crown. In conclusion, the place of fruit in the fruit tree is an important factor for variance of quantitative composition of triterpenic compounds in fruit.

**Keywords:** apples, fruit place in the tree, HPLC, triterpenic compounds

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## SUGGESTIONS FOR CONSUMERS ABOUT SUITABILITY OF DIFFERENTLY COLORED TOMATOES IN NUTRITION

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Tomatoes (*Solanum lycopersicum* L.) are known as very popular vegetable due to higher nutritional value and are among the most commonly used vegetables in the world. Lycopene, zeaxanthin, alpha and beta carotene, lutein and other biologically active compounds make tomatoes as super vegetable. Tomato varieties differ not only in fruit size, but also in color.

The aim of the present study was to evaluate does the colour of tomatoes change the nutritional value.

Chemical composition (vitamin C, lycopene,  $\beta$ -carotene, soluble solids, total acids) and taste index were determined in 27 tomato cultivars cultivated in greenhouse. Red, pink, brown, orange and yellow tomatoes fruits were used in experiments.

The obtained results showed that there were significant differences in the mean values between analysed parameters according to the colour of fruit.

The content of lycopene changes as follows: pink>red>brown>orange>yellow, but content of  $\beta$ -carotene: orange > pink > brown > red > yellow. The highest content of total acids ( $855.7 \pm 234.2$  mg 100 g<sup>-1</sup>) as well as vitamin C ( $18.43 \pm 4.74$  mg 100 g<sup>-1</sup>) was observed in orange tomatoes, but regarding taste index the regularity is as follows: brown > orange > pink > red > yellow. The smaller and bigger size tomatoes are recommended for consumers as more tasty comparing with medium size tomatoes.

**Keywords:** tomato, colour, chemical composition, consumers

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## ENZYME INHIBITORY ACTIVITY AND TOTAL PHENOLIC CONTENT OF YAM EXTRACTS

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Yam is the common name for some plant species in the genus *Dioscorea*. Several cultivars of yams are cultivated in temperate and tropical world regions as starchy vegetables, whereas wild species have been valuable sources of foods in the countries suffering from famine. Some *Dioscorea* spp. have been used for drugs both in traditional Chinese and Western medicine. Modern studies have discovered that yam herbs possess antitumor, antiinflammatory, antidiuretic, analgesic, panting-calming and phlegm-dispelling activities, along with the enhancing immune function and improving cardiovascular health. The aim of this study was to evaluate phenolic content and enzyme inhibitory activities of ethanolic extracts of *D. nipponica* Makita and *D. caucasica* Lipsky leaves.

Dried plant leaves (obtained from Kaunas Botanical Garden) were ground and extracted with 70% ethanol. The solvents were removed at 40 °C in a rotary vacuum evaporator and freeze-dryer. The  $\alpha$ -amylase inhibitory activity of extracts was evaluated using 3,5-dinitrosalicylic acid (DNSA) method. The total phenolic content (TPC) was determined using slightly modified Folin-Ciocalteu method and expressed as mg gallic acid equivalents (GAE) in g of extract (edw) and plant material (pdw) dry weight.

In the present study hydroethanol extracts prepared from the both yam species inhibited  $\alpha$ -amylase: for instance, at a concentration of 2.5 mg mL<sup>-1</sup> (1:4) it was 47.97% and 45.31% for *D. nipponica* and *D. caucasica*, respectively. The TPC values were also quite similar, 178.3±4.0 (*D. caucasica*) and 186.2±4.2 (*D. nipponica*) mg GAE g<sup>-1</sup> edw. However, due to a higher total extract yield the amount of recovered phenolics was higher for *D. nipponica* than for *D. caucasica*, 46.12±1.05 vs 31.85±0.71 mg GAE g<sup>-1</sup> pdw.

**Keywords:** yams,  $\alpha$ -amylase, enzyme inhibitory activity, total phenolic content

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**FRACTIONATION OF WHITE LUPIN SEEDS (*LUPINUS ALBUS*) BY SUPERCRITICAL CARBON DIOXIDE AND ETHANOL**

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Some legumes are among important staple foods in human diet of different world regions. Lupin has been used for human food and animal feed since early Roman times. The seeds of lupin are an alternative source of dietary fibre and proteins, which may partially replace soybeans. Lupin protein has good functional characteristics, i.e., emulsifying power, water binding, and foaming properties. Consequently, lupin could be used as a source of protein or fibre in the development of new and reformulation of existing products.

Our study aimed at obtaining lipophilic and higher polarity fractions from white lupin (*Lupinus albus*) seeds by using 2-step extraction: (1) with supercritical carbon dioxide (SC-CO<sub>2</sub>) and (2) with ethanol (EtOH). The seeds were ground to obtain 1- and 2-mm particle size powder. SC-CO<sub>2</sub> extraction at 50 °C temperature, 40 MPa pressure during 3 h recovered 7.6–7.8% (w/w) of oil, whereas maceration in EtOH yielded 3.2 and 4.5% (w/w) of extracts from 2- and 1-mm fractions, respectively. The composition of triacylglycerols of obtained oils was determined by ultra-performance liquid chromatography – quadrupole time-of-flight mass spectrometry (UPLC-Q-TOF-MS), while the composition of fatty acids was analyzed by gas chromatography with a flame ionization detector (GC-FID). PLL OLnL L(OH)LnLn, L(OH)LLn, LLLn were the main triacylglycerols, linolenic (C18:3, n3), linoleic (C18:2, n6), stearic, palmitic and oleic acids were major fatty acids. Proximate analysis of ground seeds before and after CO<sub>2</sub> extraction was performed. The content of proteins, fat and ash was determined in the initial material and after SC-CO<sub>2</sub> extraction by standard AOAC (1990) methods.

**Keywords:** lupin, supercritical carbon dioxide extraction, ethanol extraction, triglycerols, fatty acids

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**FOOD MATERIAL / PACKAGING  
INTERACTION**

## EFFECT OF VARIOUS PACKAGING SOLUTIONS ON THE QUALITY OF NUT AND DRIED FRUIT MIXES

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Nut and dried fruit mixes are a nutritious snack which can be consumed throughout the year. However, moisture migration, which occurs between components with higher moisture content (dried fruit) and lower moisture content (cereals, nuts), can lead to undesirable physico-chemical changes during storage.

The aim of this study was to identify optimal storage packaging solutions for various types of nut and dried fruit mixes in order to maintain product quality. Experiments were carried out at the laboratories of the Faculty of Food Technology, Latvia University of Life Sciences and Technologies and quality control laboratories of Grindeks JSC.

A total of nine packaging conditions were tested: three types of packaging – polyethylene terephthalate / metallised polyethylene terephthalate / low density polyethylene (PET/metPET/LDPE), biodegradable PLA and biaxially oriented polypropylene / ethyl vinyl alcohol / low density polyethylene (BOPP/EVOH/LDPE), and three packaging environments – air ambiance, modified atmosphere packaging (30% CO<sub>2</sub>, 70% N<sub>2</sub>) and active packaging with oxygen absorbents.

The results of moisture content, pH, hardness, colour, water activity and peroxide value testing during 8-month storage showed that the most suitable packaging materials to ensure quality of nut and dried fruit mixes was biodegradable PLA and BOPP/EVOH/LDPE packaging. With regards to the effect of packaging technologies on product quality the best results were obtained when modified atmosphere packaging or active packaging was used.

**Keywords:** nuts, dried fruit, biodegradable packaging, active packaging, storage

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**SUSTAINABLE PROCESSING  
AND PACKAGING**

## **FOODBALT 2019 and NEEFOD 2019**

## BIOLOGICALLY ACTIVE COMPOUND STABILITY IN THE INDUSTRIAL POTATO PROCESSING BY-PRODUCTS

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Biologically active compound extraction from the potato peel by-products is an actual topic that is targeted not only to the new product development but also provides an important insight in industrial by-product recycling possibilities. As an actual information on the extractable biologically valuable compound stability during the industrial potato peel by-products storage is scarce, the aim of present research had been to analyse phenolics and glycoalkaloids degradation tendencies in potato processing by-products (peels from different abrasion peeling lines), imitating an actual industrial storage conditions. In present study, glycoalkaloids ( $\alpha$ -solanine and  $\alpha$ -chaconine) were the most stable among the analysed compounds. Chlorogenic acid concentration showed slower decrease rates in large and middle size peel pieces during the first days of storage, when compared to small size samples (possibly due to ongoing chlorogenic acid synthesis from phenylalanine). The peel material that does not contain whole cells (ground peel) is not recommended for extracting purposes due to rapid phenolic compound oxidation and degradation. Alternatively, peel material that consists of large and middle size peels can be used for extraction purposes during the first two days of peel storage under industrial storage conditions, without major decreases in the yield. Deeper studies on biologically active compound degradation dynamics are necessary to maximise the extraction yield of phenolics and glycoalkaloids from the industrial potato processing wastes.

**Keywords:** potato peel, by-product recycling, glycoalkaloids, phenolics

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## SUGAR BEET MOLASSES AND APPLE CAVIAR APPLICATION FOR INVERTASE PRODUCTION USING YEAST BELONGING TO *KLUYVEROMYCES* GENUS

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Biomass obtained from sugar and apple juice production are rich in nutrients therefore could be reused for microbial fermentation and biologically active compounds production.

The aim of research was to apply waste obtained from food processing, such as sugar beet molasses and apple caviar for invertase production using yeast strains belonging to *Kluyveromyces* genus and to evaluate the influence of various factors on extracellular invertase production and stability.

Invertase production increased by 5.33 and 9.99 times, respectively, using *Kluyveromyces marxianus* and *Kluyveromyces lactis* var. *lactis* in molasses medium in comparison with traditional yeast propagation medium (YPD medium made by 10 g of yeast extract, 20 g of peptone and 20 g of glucose). Whereas invertase production increased by 5.91 and 4.40 times, respectively, using *K. marxianus* and *K. lactis* in apple caviar comparing with traditional YPD medium. The highest activity of invertase was observed at 55 °C and pH 4.5. Effectors such as  $Mg^{2+}$ ,  $Ca^{2+}$ ,  $Cu^{2+}$ ,  $Zn^{2+}$ ,  $Na^{+}$  ions significantly decreased invertase activity.

The results confirmed that sugar beet molasses and apple caviar are suitable as nutrients source for invertase producing yeast propagation and invertase production.

**Keywords:** *Kluyveromyces*, invertase, yeast, sugar beet molasses, apple caviar

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## EVALUATION OF DRYING KINETICS AND MASS TRANSFER IN CONVECTIVE DRYING OF *CYNARA CARDUNCULUS*

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The dried thistle flower of *C. cardunculus* L., is widely used in the manufacture of various cheeses, in the Mediterranean regions and also in Portugal, where it is used for example to manufacture the traditional cheese owing the PDO (Protected designation of Origin) *Serra da Estrela*.

In the present work the mass transfer properties of thistle flower (*Cynara cardunculus* L.), were evaluated for the convective drying at temperatures between 35 and 65 °C with and air flow of 0.5 m s<sup>-1</sup>. The calculations followed two different algorithms, based on mathematical models derived from the thin layer drying equation and the Fick's second law of diffusion. The results obtained indicated that the different methodologies resulted in different values of the mass transfer properties, which is an alert that care must be taken when choosing which calculation method might be more appropriate in a specific practical application. Regarding the values of the moisture diffusion and mass transfer coefficients, in all cases were found to increase with increasing operating temperature. The values of diffusivity increased from 2.7866×10<sup>-9</sup> to 1.4027×10<sup>-8</sup> m<sup>2</sup> s<sup>-1</sup> when using the thin layer model based algorithm and from 1.9256×10<sup>-10</sup> to 1.2033×10<sup>-9</sup> m<sup>2</sup> s<sup>-1</sup>, if based on the Fick's equation model. The values of the mass transfer coefficient increased from 8.4335×10<sup>-8</sup> to 8.4400×10<sup>-7</sup> m s<sup>-1</sup> and from 5.8277×10<sup>-9</sup> to 7.2398×10<sup>-8</sup> m s<sup>-1</sup>, respectively for the thin layer or Fick's law based models.

**Keywords:** activation energy, convective drying, diffusivity, mass transfer coefficient

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## DEFATTED CRANBERRIES POMACE EXTRACT IMPROVES THE QUALITY OF PORK BURGERS

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Cranberry pomace is a by-product of cranberry juice production and is comprised of seeds, skins and stems of the fruit. A large fraction of bioactive compounds such as polyphenolic antioxidants and antimicrobials remains in the pomace after pressing. Cranberry phytochemicals are known for their potential in inhibiting several bacteria (*E. coli*, *L. monocytogenes*, etc.); however, the studies on the possibilities of using of cranberry extracts in meat product are still scarce. A number of studies on recovery of bioactive components from fruit/berry/vegetable processing by-products has increased. In recent years such innovative method as pressurized liquid extraction (PLE) has gain the popularity for the recovery of bioactives from berry pomace. This extraction method is fast, consumes relatively low amount of solvent and may produce valuable ingredients for foods. The aim of this study was to determine antimicrobial activity of cranberry pomace ethanol extract against some spoilage/pathogenic bacteria and psycho-chemical characteristics of pork burgers. The results showed that 2% of ethanol extract reduced the growth of *L. monocytogenes*. The burgers with 2% cranberries extract also had higher amount of MetMB, most likely, due to a lower pH. Therefore, its redness ( $a^*$  value) was higher than in control samples without any additives. Cranberry pomace extract also inhibited the formation of malondialdehyde, which is linked to product oxidation. Consequently, the use of cranberry pomace extract in meat products may be considered as promising means of increasing product safety and enriching it with functional ingredients, which might provide health benefits.

**Keywords:** cranberry pomace extract, pork burgers, antimicrobial properties, spoilage bacteria, oxidative stability

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**CONSUMER BEHAVIOUR AND  
SENSORY ISSUES**

## THE EVOLUTION OF THE STUDENTS' ATTITUDES AND BEHAVIOUR TOWARDS FAST FOOD CONSUMPTION

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People have different lifestyles that cause different needs and desires. Lifestyles influence people's purchasing behaviour. Conditions affecting lifestyles, such as long working hours, short break times, lack of cooking time and no cooking place for employees and students have an impact on changing their eating habits. This situation has led consumers to prefer products that can be consumed faster. The purpose of this study is; to determine whether there is a relationship between the lifestyle and the reasons for choosing fast food of university students. The data were collected by conducting a survey with 347 students in Tekirdag Namik Kemal University. The data was analysed statistically in terms of descriptive and inferential statistics. In this direction, factors related to fast food consumption are 4 factors (product features, space, accessibility, personal satisfaction) and life styles are collected under 6 factors (thinkers, experiencers, achievers, believers, innovators, makers). The relationship's existence is explained by using factor scores calculated by factor analysis in a *multiple regression model*. According to research findings, product features and accessibility variables are effective in choosing fast food products by thinkers. Product features, accessibility and personal satisfaction variables are affective in choosing fast food products on people who have Experiencers life style; space and personal satisfaction are affective on Achievements. Product features and space are effective in choosing fast food products on Innovators. When the findings are generally evaluated; the effects of lifestyle on the causes of fast food consumption seem to be significant.

**Keywords:** fast food, life style, consumption, consumer behaviour, Vals2 model

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## RESTAURANT MEALS NUTRITIONAL VALUE IMPACT ON CUSTOMERS' EATING HABITS

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Nowdays people are following a healthy lifestyle, including their diet. Various catering companies are also adapting to these trends. One of the tools that restaurants can use to facilitate healthy eating is to indicate the nutritional value of food in menus. The objective of the study was to find out nutritional value influence on clients eating habits in restaurant. The survey method has been used to determine: 1) the most important criteria for restaurant selection; 2) the food selection criteria regarding the indicated nutritional value of the food in the menu.

The most important criteria for choosing a restaurant were: quality of food; services quality; food price; information about product - it must be provided in a precise, genuine and client-friendly manner. While according to the survey more than 50% of respondents choosing food based on its nutritional value and prices. This can be explained by both the economic condition in the country and the topicality of a healthy diet. Besides women pay more attention to nutrition value (80%) than men (25%) particularly in case of pasta dishes and desserts. The results of the study showed that a great part of the restaurant customers had a basic or insufficient understanding of the nutritional value of the food.

**Keywords:** nutritional value, eating habits, customer

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## EVALUATION OF THE QUALITY OF CATERING SERVICE

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Hospitality including catering is a very highly competitive business segment. To stand out from the crowd, there is a need for continuous development, new solutions as well as keep track of the quality of service provided. The objective of the study was to evaluate the quality of catering service in the cafe.

The survey method of clients and the method of expert evaluation were used to determine quality of catering service in the cafe.

Several quality criteria for catering services were set: exterior image of the cafe (advertisement, information at the entrance); cleanliness (cafe, WC); atmosphere (room lighting, interior, tableware); food and beverage offer and quality (assortment, design, taste, serving temperature); quality of guest service (appearance of staff, professionalism).

According to the answers of the clients, the cleanliness of the cafe was evaluated at a high and very high level in 67% of the questionnaires, the atmosphere of the cafe – 64%, food and beverage offer and quality – 61%, quality of guest service – 62%. Therefore, in all quality criteria, customer ratings at a high and very high level were above 60%.

According to experts, the standard deviation and the coefficient of variation was close to 0, it means that there was relationship between the assessments given by different experts (there was unanimity among the experts), namely the quality of the food service provided was of a high level. There were created suggestions for the improvement of certain quality criteria.

**Keywords:** service quality, catering, hospitality

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## FACTORS IMPACTING SPECIAL DIET`S PREPARING IN RIGA`S PRE-SCHOOLS

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The children`s needs for health and growth and for avoidance of allergies and intolerances require for attention and involvement. Based on national regulation pre-schools should provide a wholesome diet for children, including children with special diets recommend by doctor. Child`s disability to eat regular pre-school meal propose to look for specific substitutions. There are needs for various menus in pre-schools which should be introduced additionally to the main menu. For providing special diets pre-school canteens have to prepare separate meals for small groups of children using a limited numbers of products. Various diets preparing may imply complexity of technological processes, needs for specific training, costs, and investments for additional equipment.

The aim of this study was to evaluate the factors that affect of special diets preparing on the physical and social environment of pre-schools. To achieve the aim, the following objectives were set: 1) to define and analyse factors implementing special diets preparing in pre-schools; 2) to examine the relationship between the special diets demand and additional resources.

The researchers will apply quantitative research methods which include primary data collection using online survey. 136 Riga`s pre-schools filled out the questionnaire, including 121 pre-schools which have children with food allergies or intolerances.

The results showed that the three major groups of internal factors have been identified, which include personnel, physical environment and production capacity. The value and features of each factor impact should be evaluated in further studies that would allow to solve the problems of special diet providing in pre-schools.

**Keywords:** special diet, pre-school, production factor

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## PUPIL'S FRUIT AND VEGETABLE CONSUMPTION IN LATVIAN SCHOOLS WITH VARIOUS TRAINING PROGRAMS ABOUT HEALTHY DIET

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Fruit and vegetable recommendations for pupils in the world and in Latvia are similar, that is, at least 5 servings per day, but this is not the case most often. The objective of this study was to assess the contribution of the schools with various training programs about healthy diet to raising the fruit and vegetable consumption among pupils. The study involved pupils in grades 6, 9, 10 and 11 from Latvian schools with various training programs for healthy diet in order to analyse students' theoretical knowledge about the role of fruits and vegetables in diet and practical experience.

Students' knowledge and understanding of the consumption and importance of fruit and vegetables in the diet was strongly influenced by gender ( $p < 0.05$ ), and in some cases by age, while school training program about healthy diet did not have a significant impact ( $p > 0.05$ ). Pupils lacked understanding about the amount of the required fruit and vegetable consumption because one third of the pupils thought that eating 5 servings of fruit and vegetables was unnecessary. The pupils did not understand the essence of a healthy diet because the portion of fried potatoes was indicated as one vegetable portion. Uniformity was observed in the pupils' diet, cucumbers, tomatoes and carrots were the most consumed vegetables, while fruits – apples and bananas. Improving a pupils' healthy diet program should take into account the different interests of the sex and age and the pupils' desire to acquire knowledge in practice.

**Keywords:** fruits, vegetables, consumption, knowledges, pupils

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**STUDY OF FOOD WASTE IN SCHOOLS OF VIDZEME REGION****Rita Riekstina-Dolge<sup>1</sup>, Ilze Beitane<sup>1</sup>, Sandra Iriste<sup>1</sup>, Sabine Melbarde<sup>2</sup>**<sup>1</sup>Department of Nutrition, Faculty of Food Technology, Latvia University of Life Sciences and Technologies, Rigas iela 22, Jelgava, Latvia<sup>2</sup>Faculty of Veterinary Medicine, Faculty of Food Technology, Latvia University of Life Sciences and Technologies, K. Helmana iela 8, Jelgava, Latvia

The amount of food waste in schools is a topical issue because it shows the effectiveness of school catering system, dietary quality, pupils' attitudes and satisfaction with the offered food. The objective of this study was to determine the types of food waste, their amounts in schools of Vidzeme region and to analyse pupils' attitude towards school meals. The study was carried out in 5 schools in the Vidzeme region, making one week waste food weighing. The survey method was used to determine pupils' satisfaction with school meals. Three kinds of food waste can be distinguished in school canteens, depending on where they are generated: food waste in preparation process, in distribution process and food waste from the left food portion which accounted for 39%, 21% and 40% respectively. The amount of food waste in preparation process which is influenced by seasonality, quality of food products, staff experience and working conditions, can be reduced by rational organization of the production process. The amount of food waste from the left food portion was influenced by the individual wishes of the pupils, family eating habits, the quality of food, the atmosphere in the school canteen, the way of serving dinners and the participation of teachers. Whereas a large amount of waste is due to the fact that children prefer novel foods rather than traditional ones, the possible solutions could be: adapting meals to pupils' habits, changing the way of serving, motivating and educating pupils and their parents.

**Keywords:** food waste, school's catering, pupils

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## SNACK CONSUMPTION PATTERNS OF LATVIAN CONSUMERS

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With snacking being a steady part of our busy lifestyle and because almost half of Latvian population (48%) chooses fast foods, the aim of the study was to determine the type of a new snack which Latvian consumers would consider as necessary in the market.

A 15-question survey was conducted online to analyse Latvian consumer attitudes towards snack consumption (n=460 respondents, 85% women, 15% men). Majority of respondents were within the age group of 21–55 years.

The results show that the majority of surveyed consumers take 3 (51%) or 4 (35%) meals and 2 (51%) snacks per day. The three most frequently consumed products *on the go* are foods associated with high caloric and low nutritional value – flour pastries, butterbreads etc. (17%), cookies and sweets (incl. pralines, chocolate, bars etc.) (15%), fast food restaurant menu (13%) by almost half of the respondents (46%).

Latvian consumers recognise such fast food items as wraps, hotdogs or hamburgers (29%) as most convenient type of snacks, followed by smoothies (17%) and muesli bars (15%). When checking the label of snacks, consumers pay attention to energy value (14%) and sugar and salt content (14%).

Obtained results suggest that fast food restaurant items such as wraps, hotdogs or hamburgers would be a good choice in new snack development, as they are considered convenient; however, their composition must be improved to introduce a product with lower caloric and higher nutritional value.

**Keywords:** snacks, consumer patterns, fast food

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## EFFECT OF FEEDING ON THE SENSORIAL QUALITY OF LAMB AND GOAT KID MEAT

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Goat kid and lamb meat is highly appreciated by the consumers and, in certain cases, may even replace mutton or beef. Sheep meat has a more intense aroma, it is more tender, contains less fibrous tissue residue and the species flavour is more pronounced (typical) than that of goat meat. Several factors can affect the quality characteristics of goat kid and lamb meat, and the feeding of livestock is one of them. The aim of this study was evaluate the effect of feeding on the lamb and goat kid meat physical, textural and sensorial quality.

Four Boer goat kids as feed supplement received oats (G1), four kids – fodder beans (G2), four lambs – a mix with fodder beans (L1), four lambs – a mix with beans and peas (L2). For sensory evaluation as a control was used beef meat (BM). For all five samples tenderness and intensity of sensory properties (aroma, texture, taste and aftertaste) were analysed. No significant ( $p>0.05$ ) influence was recorded in meat tenderness irrespective of additives used in concentrated feed. There was no significant difference ( $p>0.05$ ) in aroma and taste between samples, but there was significant difference in the samples texture and aftertaste ( $p<0.05$ ). Goat kid and lamb meat taste were characterised as very specific, which is not always liked by consumers. The results of the sensory evaluation showed that the taste intensity of the evaluated meat samples was expressed from moderate to slightly. The aftertaste is weak for beef meat (BM) sample, but there were no significant differences ( $p>0.05$ ) in the intensity of aftertaste with both goat kid meat samples. However there was a significant difference ( $p<0.05$ ) between both lamb meat samples.

**Keywords:** lamb meat, goat kid meat, quality, sensory properties

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## PREDICTION OF DEPRESSION DISORDERS BASED ON FACE EMOTIONAL EXPRESSIONS OF DIFFERENT FOODS TASTES

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Depressive disorder (DD) is a common, often progressive and recurrent disorder. This research was focussed on the development of computer based diagnostic method using FaceReader5 software (Noldus, The Netherlands) for the recognition of facial emotional expressions of different food tastes for the prediction of depression disorder. The results of the experiment showed that seven categories of emotional response (neutral; angry; disgusted; happy; sad; scared; surprised) to different tastes (neutral; acid; sweet; salt; bitter) have been strongly correlated with clinical symptoms of DD as evaluated using clinical diagnostic instruments and depression severity rating scales (Montgomery and Asberg Depression Rating Scale MADRS). Has been also proofed that a patient's facial expression of emotions to different tastes of food can be used as a diagnostic moderator for the development of a new contactless, computer-based diagnostic method and support the creation of algorithm for DD diagnosis. The benefits of this method are evidence from several perspectives (I) patients can use a self-rating instrument to assess DD symptoms; this may act as an incentive to seek professional help; (II) family and community can use an instrument for early recognition of DD symptoms and suicidal tendencies, making it possible to encourage the individual to seek professional health care; (III) general practitioners have a reliable instrument for preliminary diagnosis of DD in primary care, thus saving the time and resources; (IV) public health benefits include early diagnosis and treatment of DD and better outcomes, reductions in disability-adjusted life years and the global burden of the disease. Finally, this method may perspective predict DD at an early stage and may ensure a higher quality of the patients' primary care in the public health system.

**Keywords:** depressive disorder, facial expression, food taste

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## DEVELOPMENT OF PRODUCTS FROM BALTIC SPRAT (*SPRATTUS BALTICUS*) AS AN ANALOGUE TO TRADITIONAL ITALIAN ANCHOVY PRESERVES

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There are several products similar to anchovy preserves made from Baltic sprat (*Sprattus sprattus balticus* Schneider) and Baltic herring (*Clupea harengus membras* L.) on the market, yet, they are not made using the traditional anchovy preparation technology and do not have equal flavour features.

The project aims to develop new recipes for fish products for daily consumption with high nutritional and added value from the Baltic Sea fish – an analogue to traditional Italian anchovy preserves “Anchovy in oil” and “Anchovy paste”.

The potential use of the new products on the market is replacement of traditional Italian canned food "Anchovy in oil" with an analogous product of identical organoleptic parameters (taste, aroma, color, structure) prepared from the Baltic Sea small *Clupeiformes* fish (Baltic sprat); and development of a new product from Baltic Sea small *Clupeiformes* fish (Baltic sprat) to replace traditional sprat preserves (“Sprat in oil”), the use of which has rapidly reduced due to significant changes in the market.

Within the project, all technological information for production and quality control will be developed.

**Keywords:** Baltic sprat, fish preserves, sensory quality

**Acknowledgments.** This study was supported by European Maritime and Fisheries Fund (EMFF) project “Development of technologies and recipes for “Baltic anchovy in oil” preserves (savoury produce) and “Baltic anchovy” paste spread from Baltic sprat (*Sprattus balticus*) as an analogue to traditional Italian preserves “Anchovy in oil”, and mechanization of their production technological processes”, project no. 17-00-F01101-000004.

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## TRADITIONAL CONFECTIONERY PRODUCTS IN TURKEY: A LITERATURE REVIEW

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There are many factors that have a long-term influence on the diet of the population of an established nation or society, factors which typically vary significantly from country to country. These include, amongst others, climate, economic conditions, customs, traditions, and a nations' history.

This literature review specifically addresses confectionery products in Turkey, where they hold an important place within traditional Turkish food. Confectionery is a significant part of the Turkish cuisine. The most well-known confectionery products and dishes include different types of Baklava, Helva, Turkish delight, Cezerye, and different types of dessert made from milk and dairy products (cream, cheese, etc.).

As a result of this significant role, Turkish universities and other research institutions place a priority on conducting research into traditional Turkish confectionery products, especially with regard to microbiology, chemicals, and food safety, and these studies play a key role in published literature. In the light of this, there is a clear need for a well-organised schedule of future research and literature requirements, which this review hopes to go some way to satisfy.

This research is a library research-based paper in which the framework. Datas that will be used in the studies will be much depended from the most recent paper reported by science direct, web of science Euromonitor etc few other web sites. This study covering the commercial and manufacturing sectors, and factors such as nutritional value, microbiology, chemicals, taste, food security, consumer level of knowledge, attitudes and perceptions, and the review compiles statistics regarding studies and literature findings, and identifies key areas of research that are currently missing and must be conducted with a high priority.

**Keywords:** confectionery products, literature review, Baklava, Helva, Turkish delight

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**FOOD CHAIN MANAGEMENT**

## OPTIMISTIC SCENARIO ECONOMIC EVALUATION OF INNOVATIVE PRODUCT MANUFACTURING FROM BALTIC SEA SPRATS

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The added value generated by the fisheries sector in 2017 was only 0.15% of the total value added in Latvia, in the meantime its significance in external trade was higher, the sector accounted for 1.8% of the total value of export production (EUR 206 million). Canned fish form 35% of the Latvian exports but this product group faces challenges of product and market reorientation due to decreased buying power and trade restrictions in some former key Latvian canned fish export markets. It is particularly important to create new innovative products from the Baltic Sea sprats, as their catch in 2017 accounted for 53% of the total catch in the Baltic Sea and the Gulf of Riga. Therefore, the aim of this study is to carry out an economic assessment of the plant investment project potential to manufacture new innovative structured fish mass fish products from sprats captured in the Baltic Sea. To achieve this goal, two tasks have been set: 1) to develop financial model to evaluate industrial manufacturing investment project of new innovative products from Baltic Sea sprats' structured fish mass; 2) to evaluate the economic effect of the plant establishment. The optimistic scenario foresees to process about 13% of Latvia's Baltic Sea sprats, which were exported in 2017, or 3736 tons, which would be possible to sell successfully to large foreign markets. Research and calculations were carried out to estimate the necessary investments in plant establishment, the main investment economic and financial performance indicators, required number of employees and the effect of manufacturing plant set up to the Latvian economy. The study found that in the optimistic scenario working in two shifts, both the simple and the discounted payback period is only 5 years. In this case, the output of the production exceeds the capacity of the Baltic States market considerably. Project investment efficiency is high, net present value over 10 years exceeds EUR 20 million, Internal Rate of Return (IRR) value is 34%.

**Keywords:** sprats, new products, economic assessment

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**PROCESSING METHODS OF TABLE OLIVE IN HOUSEHOLDS IN TURKEY**

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Turkey is among the most important countries in terms of world production of table olives. Olives are produced in 41 cities of 81 cities and grown more than 50 various in Turkey. An important part of the olive producing enterprises are small-scale enterprises. Produced olives are processed as olive oil and table olives. Table olives are processed regularly "The Turkish Food Codex Table Olives Notice" and marketed through cooperatives and private sector enterprises.

Olive can be consumed at each meal of the day, especially for breakfast, due to its nutritious nature. Olive producers make a portion of the table olives that separate to consume in their households and sometimes to generate income. Separated olives are processed varied in different regions.

These forms of processing include pickled olives, crushed olives, scratched olives, sele olives. Unlike these forms of processing, only in two the region, green olives in wood cinder and patented kuzine olives be attracted attention. In particular, kuzine olives are becoming increasingly widespread as a form of processing which is more environmentally friendly, ready to consume more quickly and more healthier in terms of health. In this study, the studies on the table olives and processing methods and the news on this subject will be the material of the research.

**Keywords:** table olives, consumption, households, kuzine olives

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## AZOTOBACTER WITH MOLASSES MIXTURE EFFECT ON WHEAT GRAIN GROWTH

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There are a lot of by-products in food industry and not all of them are used for further conversion. Molasses is one of them and it could be used as a raw material for azotobacter growth medium preparation. Nitrogen fixing bacteria such as azotobacter produces thiamin, riboflavin, indole acetic acid, gibberellins and other biologically active compounds which are crucial for plant growth and productivity of crops. Applying biological fertilizers in organic agriculture is one of the efficient ways to provide mineral nutrients for plants. This study purpose was to prepare azotobacter with molasses mixture and compare its effect on wheat grain growth with commercial biological fertilizers.

Wheat grains were processed with prepared mixtures and were grown in filter paper and on agar medium. Roots and stems of wheat were measured after 5 days. Results showed that wheat processed with azotobacter and molasses mixture grows better than processed with commercial biological fertilizers.

This study demonstrates that food industry by-product molasses could be used as a growth medium for nitrogen fixing bacteria. Mixture of azotobater and molasses showed that it has a potential as a biological fertilizer.

**Keywords:** azotobacter, wheat grain, molasses

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**MODELING AND OPTIMIZATION OF BEETROOT STORAGE PROCESS**

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To produce high quality processed products, it is necessary not only to grow new, promising beetroot varieties, but also to preserve their quality during storage. This requires advanced storage technologies, such as storage in a controlled and ultra-low oxygen atmosphere. In these conditions, beetroots retain their quality until the new harvest. This not only maximizes the quality of vegetables, reduces storage losses, but also extends the use of vegetables, which is very important for farmers to profitably produce their produce.

The aim of the work was to evaluate and optimize the process of storing various varieties of beetroot and evaluate their suitability for processing.

Beetroot varieties 'Detroit 2', 'Boro H', 'Boltardy', 'Kestrel H', 'Pablo H', 'Bona', 'Wodan H', 'Rhonda H', 'Subeto H', 'Action H', 'Joniai' was investigated.

Increasing the carbon dioxide content from 0.03% up to 3%, 5% or 8% and reduced oxygen content from 21% to 10% or 5% positively impacts the chemical composition of the stored beetroots. Some of the chemical composition parameters after storage in one or another composition in the controlled atmosphere were unchanged, but others remained stable and the degradation of betacyanins was clearly reduced.

After the evaluation of various varieties of beetroots after storage, the following varieties were found to be the most suitable for storage and subsequent processing: 'Kestrel H', 'Joniai', 'Pablo H' and 'Rhonda H'.

The optimal composition of controlled atmosphere for beetroot storage is 5% carbon dioxide, 5% oxygen and 90% nitrogen.

**Keywords:** beetroot, chemical composition, controlled atmosphere, storage

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## INFLUENCE OF RIGOR STATE ON THE QUALITY OF SALTED RAINBOW TROUT

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The fish *rigor mortis* state is one of the important factors determining the spoilage of freshly caught fish. The fish stays rigid for a period that can vary from an hour to three days. The fish species, its physical condition, the degree of exhaustion before death, its size, the amount of handling during rigor and the temperature of storage have influence on the duration of this process.

The aim of this study was to investigate the influence of *rigor mortis* on the quality of salted rainbow trout (*Salmo gairdneri*).

The salt uptake, pH, hardness of fillets, protein and moisture content were measured in four different trout raw materials: at the beginning of *rigor mortis*, in *rigor mortis* after 10 min and 20 min of *rigor* outset and at *post rigor mortis*. The lowest amount ( $2.88 \pm 0.20\%$ ) of salt in the rainbow trout was determined when fish was at the beginning of *rigor mortis*. However, the salt content was almost the same at the end of the *rigor* and *post rigor* state of fish filet, respectively  $4.22 \pm 0.40$  and  $4.30 \pm 0.20\%$ .

In conclusion, the state of *rigor mortis* of rainbow trout is important when processing very fresh fish, especially in the appearance of pH and salt uptake.

**Keywords:** salting, trout, *rigor mortis*

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## THE DISCOLOURATION POTENTIAL OF CARROT ROOTS DEPENDING ON BIOSTIMULANTS AND STORAGE

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Acceptance of carrots on the market by consumers is based not only on estimation of their taste and aromatic value, but also on their colour and susceptibility to darkening. The flesh of carrot roots in commercial varieties is usually orange, which is directly affected by genetic, environmental factors and fertilization. Susceptibility of carrot roots to darkening is a serious issue since it causes considerable loss in processing, preparation for consumption and storage. The aim of the study was to determine the influence of biostimulant preparations and storage condition and time in carrot cv Karotan cultivar production technology on the tendency to discoloration potential of roots flesh.

The study was based on a field experiment with carrot cv. Karotan, conducted in three successive growing seasons and after six months of storage (air temperature +1 °C and RH 95%) each vegetation seasons. The biostimulants were applied during the growing season in a foliar form. Cv Kelpak SL (cont. *Ecklonia maxima*) was supplied at the total rate of 0, 2, 3, 4, 5, 6 and 7 dm<sup>3</sup> ha<sup>-1</sup>, while Asahi SL (nitrophenols) – 1 dm<sup>3</sup> ha<sup>-1</sup>. The carrot cultivar Karotan under study can be classified as vegetable with low susceptibility to darkening of raw roots (AU<sub>475</sub>: 0.107 – after harvest, 0.114 –after storage). The application of the biostimulators reduced the discoloration potential of the carrots following the harvest and while after storage of roots. As regards discoloration potential, FRAP, total polyphenols and chlorogenic acid contents, it appeared that a twice application in 4-leaf stage (3 or 2 dm<sup>3</sup> ha<sup>-1</sup>) and after 14 days (2 dm<sup>3</sup> ha<sup>-1</sup>) of the preparation Kelpak SL was the most advantageous. Long-term storage significantly reduces FRAP and increases chlorogenic acid thereby increasing the tendency to discoloration potential of tubers flesh.

**Keywords:** biostimulant, blackspot, carrot, chlorogenic acid, poliphenols, storage

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## EFFECT OF ORGANIC AND CONVENTIONAL PRODUCTION SYSTEMS AND CULTIVARS ON THE WINTER WHEAT GRAIN GLUTEN QUANTITY AND QUALITY

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Cereal crops are cultivated worldwide in diverse environments, ranging from warm lowlands to temperate highlands, including Latvia. Wheat (*Triticum aestivum* L.) production according to quality food requirements is a relevant problem for wheat growers, grain handlers, millers and bakers. Gluten quantity and quality are important properties for technological processing of wheat. The objective of this study was to determine effects of organic and conventional production systems and five winter wheat (*Triticum aestivum* L.) cultivars on grain wet gluten and quality. Field experiments with winter wheat cultivars 'Fredis', 'Edvins', '94-5-N', 'Skagen' and 'SW Magnific' were carried out at the Institute of Agronomy (in Skrīveri) of Latvia University of Life Sciences and Technologies (LLU), in 2017/2018. All investigated winter wheat technological properties were significantly ( $p < 0.05$ ) affected by the agricultural production systems and cultivars. Statistically significant differences between agricultural production systems were found. Organic winter wheat grain had significantly lower gluten content and water binding capacity, while gluten was significantly stronger, compared with the conventional. A statistically significant ( $p < 0.01$ ) positive correlation was found between winter wheat gluten content and water-binding capacity ( $r = 0.999$ ) for both production systems. Cultivars Fredis and Edvins had better technological properties that make them more suitable for the organic production systems, compared to others cultivars.

**Keywords:** winter wheat, wet gluten content, gluten index, water-binding capacity

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## WINTER WHEAT WHOLEMEAL RHEOLOGICAL PROPERTIES DEPENDING ON NITROGEN FERTILIZER

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Winter wheat (*Triticum aestivum* L.) in Latvia occupies a significant part of the agricultural land. Grain harvesting of high quality winter wheat is a topical problem in grain production. Growing consumer demands for healthier foods are increasingly consuming whole-grain products that use wholemeal. Our objectives were to evaluate the effect of nitrogen fertilizer rate, on winter wheat protein content and wholemeal rheological properties of dough. A field trial was carried out in the Study and Research farm "Peterlauki" of the Latvia University of Life Sciences and Technologies (LLU) during a three-year period: 2009/2010, 2010/2011, and 2011/2012. The trial included two winter wheat cultivars: 'Bussard' and 'Zentos' (Germany). Grain crude protein content was determined by Kjeldahl method (LVS 277), in the Scientific Laboratory of Agronomic Analysis of LLU. The rheological properties of wheat wholemeal dough – water absorption, dough development time, dough stability time, degree of softening – were determined (ICC 115/1) in the Laboratory of Food Analysis of the Faculty of Food Technology, LLU. Average data in our investigation (three years) show that nitrogen fertilizer significantly ( $p < 0.05$ ) affected protein content, farinograph water absorption and mixing properties of winter wheat wholemeal dough. The cultivar 'Bussard' wholemeal was strong, with a high mixing value with weaker flour, but 'Zentos' wholemeal was medium strong and could be used for direct bread baking. In order to achieve the grain quality suitable for food wheat and obtain high-quality wholemeal, 120 kg ha<sup>-1</sup> of nitrogen fertilizer should be used for cultivar 'Bussard', and 150 kg ha<sup>-1</sup> – for 'Zentos'.

**Keywords:** winter wheat, farinograph, water absorption, dough development time

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## PHYSICOCHEMICAL PROPERTIES OF FLOURS OF DESI AND APULIAN BLACK CHICKPEAS AS AFFECTED BY PROXIMATE COMPOSITION

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Owing to their economical and nutritional value, chickpeas are object of a growing interest by the food processing industry. Commonly, chickpeas are grouped in two types: *desi* and *kabuli*; moreover, in Apulia region (Southern Italy) is traditionally cultivated an uncommon type, named *Apulian black* chickpea, that shows peculiar genetic and phenotypical traits. Few studies characterized the flour of *desi* chickpeas, and no studies evaluated the flour obtained from Apulian black types. To overcome this gap, we studied the physicochemical properties of a wide collection of *desi* (DC) and *Apulian black* chickpea (AC) flours, and their correlation with the proximate composition.

Bulk density (BD) was positively and significantly correlated with proteins, ashes and dietary fiber content. AC flours were characterized by a lower BD than DC flours, that makes them suitable for the preparation of weaning foods. Higher value of BD positively affected the water absorption capacity (WAC), that was also positively influenced by the presence of hydrophilic constituents such as dietary fibers. Higher WAC was found in DC flours, indicating that these flours could help to maintain a soft texture in bakery products. Oil absorption capacity (OAC) was positively correlated with protein content. OAC involves capillary interactions and is desirable in food recipes requiring oil incorporation. Water absorption and solubility indices explain the physical state of starch granules and were negatively correlated among them. On the whole, proximate composition significantly influenced the physicochemical properties of flours, highlighting the potentiality of AC and DC flours as functional ingredient for bakery products.

**Keywords:** chickpea, flour, correlation, physicochemical properties, proximate composition

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## THE QUALITY OF LEGUME EXTRUDED PRODUCTS AS INFLUENCED BY THE PROCESSING PARAMETERS: AN OVERVIEW

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Consumers demand for ready-to-eat products is increasing due to their capacity to accomplish the time-saving needs of modern lifestyle. Extrusion process is a technique used for the production of different products, such as snacks, breakfast products and ready-to-eat foods especially made from cereal grains. However, in recent years, several studies have based their attention on the introduction of legumes (e.g. lentils, peas, chickpeas, faba beans, etc.) as an important source of protein, starch, dietary fiber and bioactive compounds to produce extruded snacks. These studies were carried out by setting up different values of the main extrusion parameters, such as die and barrel temperature, feed moisture, pressure, screw speed.

The data available in letterature shown as high expansion values and low bulk density are obtained at low feed moisture and high screw speed. Hardness of extruded products is positively influenced by moisture and negatively affected by screw speed and barrel temperature, as well as crispness. Barrel temperature negatively affects also some color parameters, such as lightness (L\*) and yellowness (b\*). Moreover, high temperature values, as well as intense mechanical stress during extrusion process, lead to the reduction of different antinutritional compounds, such as phytic acid, tannic acid, antitrypsin activity; increasing protein digestibility and phenolic content, which may explain the improvement in antioxidant activity.

**Keywords:** extrusion process, legumes, snacks, processing parameters

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## AUTHORS LIST

- Aav A. 71  
Abdikoglu D. I. 47  
Adamberg K. 19  
Adomaitiene V. 25; 142  
Adomeniene A. 123  
Alsina I. 122  
Andreson H. 90  
Antontceva E. 82  
Aplocina E. 141  
Augspole I. 91; 109; 113; 114; 122;  
152  
Aumeistere L. 29  
Aysanov T. 76; 102  
Baltrukova S. 34  
Baranauskiene R. 68; 123  
Bartkevics V. 16; 119  
Bartkiene E. 25; 51; 55; 70; 83;  
106; 142  
Basaran B. 144; 147  
Basinskiene L. 39  
Bavrins K. 29  
Beitane I. 108; 135; 136; 138; 139  
Belyakova T. 82  
Bendoraitiene J. 83  
Bernande K. 104  
Bernatoniene J. 55; 70  
Bhat R. 72  
Bleidere M. 119  
Blija A. 89  
Bljahhina A. 37  
Bobinaite R. 36; 149  
Bobinas C. 36; 54; 149  
Borisova A. 29  
Bradauskiene V. 81  
Bujaka J. 80  
Caponio F. 154  
Cechoviciene I. 110  
Cernauskas D. 25; 81; 142  
Chernikova O. 96  
Cindik B. 75  
Cinkmanis I. 62; 66; 108; 112; 113  
Ciprova I. 29; 32; 33; 35; 49; 66; 73  
Cizeikiene D. 69; 130; 148  
Constantin G.A. 40  
Costantini M. 154; 155  
Damasius J. 69; 148  
Danilcenko H. 42  
De Angelis D. 154; 155  
Di Rella D. 154  
Dienaite L. 21; 111  
Dimins F. 113  
Dmitrijeva L. 51  
Dorozko J. 43  
Dubova L. 122  
Duma M. 109; 114; 122  
Eihvalde I. 34  
Eisinaite V. 99; 100  
Erdberga I. 122  
Eryasar-Orer K. 84  
Esaulko N. 76; 102  
Fisere L. M. 112  
Fontes L. 45; 46; 65; 131  
Gailane N. 119  
Gaizauskaite Z. 106  
Galoburda R. 67; 87; 88; 103; 129; 141  
Gannochka E. 105  
German M. 76; 102  
Godoladze D. 59  
Gorbatovskiy A. 49; 73

## FOODBALT 2019 and NEEFOOD 2019

- Gornas P. 53; 74  
Gramatina I. 49; 73; 94; 143  
Grigas J. 55  
Guillen Vaquero A. 56  
Guine R. P. F. 17; 25; 45; 46; 65; 131  
Gulbinas G. 150  
Gustiene S. 92; 95  
Hallmann E. 110  
Hludin A. 101  
Ipate G. 40  
Iriste S. 135; 136; 139  
Ishiyazova S. 120  
Ivanova A. 101  
Jaagura M. 19  
Jakobsone I. 119  
Jakstas V. 55; 70; 83  
Jansone L. 22  
Jariene E. 23  
Jarutiene L. 25  
Jasutiene I. 99  
Jezniene S. 98  
Joudu I. 72; 90  
Juhnevica-Radenkova K. 74  
Juodeikiene G. 25; 55; 70; 83; 106; 142  
Kalnina I. 27  
Kampuse S. 22; 38; 87; 88; 120  
Kanaporis T. 51  
Kantane I. 119  
Karademir E. 118  
Karasu-Yalcin S. 84  
Karkleliene R. 149  
Karklina D. 56  
Keke A. 62; 112; 143  
Kerner K. 90  
Kersiene M. 99  
Kesminas S. 63  
Khabibullaev J. 66; 67  
Khrapatov N. 101  
Kince T. 73; 91; 103  
Kirse-Ozolina A. 41; 44; 49; 73; 79; 108; 126; 140; 143  
Kitryte V. 52  
Kivite J. 49; 73; 143  
Klava D. 87; 88  
Klavins L. 20  
Klavins M. 20  
Klupsaite D. 25; 142  
Kocetkovs V. 28  
Kolesnikov B. 101; 105  
Krasnobajs R. 94  
Krasnova I. 116  
Kreicbergs V. 109  
Kriisa M. 30; 31  
Kronberga A. 103  
Kruma Z. 24; 43; 61; 64; 73; 88; 103; 115; 143  
Krumina-Zemture G. 108; 135; 136; 143  
Kulaitiene J. 23  
Kuldjarv R. 37  
Kunkulberga D. 43; 73; 93; 104; 153  
Kviesis J. 20  
Kviklys D. 121  
Lasinskas M. 42  
Laukaleja I. 24  
Lele V. 25; 51; 55; 70; 83; 106; 142  
Lemos E. T. 46  
Leskauskaite D. 99; 100  
Levickiene D. 23  
Liaudanskas M. 121  
Lima M.J. R. 45; 46; 65; 131  
Linina A. 152; 153  
Lipina L. 136  
Lipkyte M. 83

## FOODBALT 2019 and NEEFOD 2019

- Loba K. 93  
Marcinkoniene L. 35  
Mazdzieriene R. 59; 68  
Mazoniene E. 81  
Medne L. 137  
Medveckiene B. 23  
Melbarde S. 139  
Meler Gil B. 132  
Meliha Tengiz Z. 134  
Mengote E. 135  
Mikelsone V. 112  
Millere I. 135; 137  
Misina I. 53; 74  
Morsel J. T. 18  
Mootse H. 71  
Muizniece-Brasava S. 28; 41; 49; 73;  
126; 143  
Munteanu M. 40  
Nakurte I. 129  
Nevarzavska M. 138  
Nevidomskis N. 149  
Nipers A. 48; 146  
Oraman Y. 134; 144; 147  
Ostonakulov T. 120  
Ozola B. 109; 114  
Ozola L. 38; 87; 88  
Ozolins J. 48; 146  
Paaso P. 72  
Paradiso V. M. 155  
Paskeviciute L. 51  
Pasqualone A. 154; 155  
Paulauskiene A. 110  
Pautienius A. 55  
Peksar K. 26  
Peres A. M. 46  
Pileckaite G. 51  
Pilvere I. 48; 146  
Piturina I. 96  
Poberezny J. 151  
Proskina L. 48; 146  
Pukalskas A. 21; 59; 68; 111  
Pukalskiene M. 21; 59; 68; 111;  
124; 132  
Ragauskaite E. 130  
Raits E. 79  
Rasskazova I. 140  
Reminaite M. 92  
Revinyte S. 68  
Rezgiene A. 92  
Riaukaite J. 39  
Riekstina-Dolge R. 80; 137; 139  
Riesute R. 92; 95  
Rokaityte A. 95  
Romanenko E. 76; 102  
Rosensvald S. 26; 30; 31  
Rovira Carballido J. 132  
Rudzinska M. 53  
Rutenberga-Ava A. 152  
Rutkauskaite G. 51  
Ruza A. 153  
Ruzauskas M. 51; 55; 70  
Sabovics M. 41; 49; 56; 73; 103; 108;  
120; 143  
Sakiene V. 25; 51; 55; 70  
Salamahina A. 105  
Salomskiene J. 92  
Samadov R. 66  
Sarenkova I. 33  
Sazonova S. 49; 73; 94; 143  
Seglina D. 116  
Selivanova M. 76; 102  
Semickenkova I. 41  
Sepelevs I. 129; 134  
Sernaite L. 54

## FOODBALT 2019 and NEEFOOD 2019

- Shamtsyan M. 50; 82; 101; 105  
Silovs M. 48; 146  
Sipailaite E. 121  
Sipailiene A. 98; 150  
Sivicka I. 43  
Skrabule I. 64  
Skudra L. 91; 93; 94  
Sosyura E. 76; 102  
Stankevicius A. 55  
Stefan E.M. 40  
Steibliene V. 25; 142  
Stepanovica Z. 89  
Sterna V. 104  
Straumite E. 27; 56; 73; 88; 103;  
104; 141  
Strykaite M. 69  
Stulova I. 30; 31  
Sturite I. 103  
Sturmovica E. 49; 143  
Subbarayadu K. 60  
Summo C. 154; 155  
Svarta A. 152  
Syrpas M. 39; 52; 60; 63  
Szczepanek M. 151  
Tamkute L. 132  
Taraseviciene Z. 110  
Televiciute T. 42  
Tepper M. 90  
Terentev A. 96  
Tilavov H. 120  
Tomsone L. 61; 87; 103; 115; 120  
Unakitan G. 47  
Urbanaviciute I. 117  
Urbonaviciene D. 54; 149  
Urvaka E. 53; 74  
Uselis N. 121  
Vaiciulyte-Funk L. 81  
Vaitkeviciene N. 42  
Vaitkeviciene R. 83; 106  
Valatkeviciene Z. 106  
Valdovska A. 74  
Varinauskaite I. 51  
Varnaite L. 124  
Veipa J. 126  
Velicka A. 110  
Venskutonis P. R. 21; 36; 52; 59; 60;  
63; 68; 111; 123; 124; 132  
Viiard E. 19; 30; 31; 37  
Viksna A. 20  
Vilimaite V. 52  
Vilu R. 30; 31  
Viskelis J. 121; 149  
Viskelis P. 36; 51; 54; 55; 70; 83; 117;  
121; 149  
Voicu G. 40  
Vucane S. 113  
Wszelaczynska E. 151  
Yalcin E. 75; 118  
Zabodalova L. 82  
Zaborskiene G. 95  
Zadeike D. 25; 55; 70; 83; 106; 142  
Zagorska J. 34; 67; 73; 74  
Zarins R. 64  
Zavadzka D. 29  
Zavistanaviciute P. 51; 55; 70  
Zacs Dz. 16  
Ziukaite A. 148  
Zokaityte E. 51; 70  
Zolnere K. 32  
Zutautas P. 100  
Zute S. 119

## **FOODBALT 2019 and NEEFOD 2019**