

5<sup>th</sup> International Technical  
Symposium on

**Food Processing,  
Monitoring Technology in  
Bioprocesses  
and Food Quality  
Management**

**Book of Abstracts**

Aug 31<sup>st</sup> - Sept 2<sup>nd</sup>, 2009  
Potsdam, Germany



**Bornimer Agrartechnische Berichte**

Heft 70

Potsdam-Bornim 2009

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August 2009

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Andrea Gabbert

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## Preface

Following the successful 1<sup>st</sup> International Symposium on Bioproducts Processing and Food Safety held in Beijing in October 2004, the 2<sup>nd</sup> International Symposium on Future of Food Engineering in Warsaw in April 2006, the 3<sup>rd</sup> International Symposium on Food and Agricultural Products: Processing and Innovations in Naples in September 2007, and the 4<sup>th</sup> International Symposium on Food and Bioprocess Technology in Foz do Iguaçu, Brazil, CIGR Section VI is organising the 5<sup>th</sup> International Technical Symposium on Food Processing, Monitoring Technology in Bioprocesses and Food Quality Management in Potsdam, Germany in 31<sup>st</sup> August - 2<sup>nd</sup> September 2009. This publication contains all the papers presented at this conference.

CIGR (International Commission of Agricultural and Biosystems Engineering) established in 1930 is an international, non-governmental, non-profit organisation regrouping, as a networking system, Regional and National Societies of Agricultural Engineering as well as private and public companies and individuals all over the world. The Section VI of CIGR deals with the engineering principles and technologies in postharvest and processing of agri-food products. It is devoted to follow the trends, promote the advancement and enhance the dissemination and the transfer of technology in postharvest and processing at a global scale, with its mission being as follows:

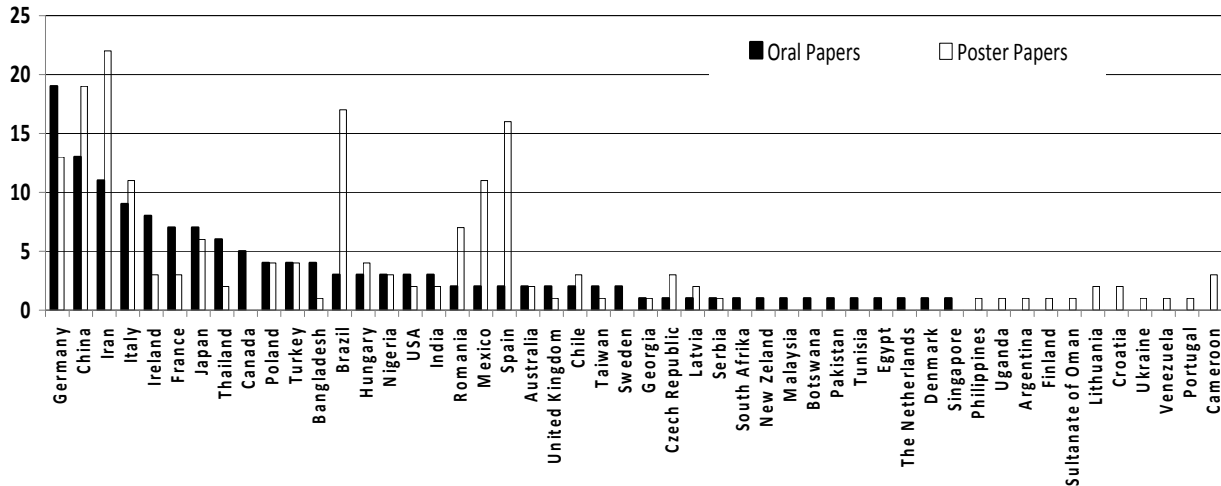
- to bring together all those that are working in postharvest and processing;
- to enhance international experiences, exchange and cooperation, for the advancement of knowledge in this area worldwide;
- to stimulate participation in CIGR activities, especially Congresses;
- to define the areas that are in need of research and /or of transfer of technology; and
- to advance in knowledge for the assurance of safety of all products for human consumption.

The theme of this conference is on food processing, monitoring technology in bioprocesses and food quality management, and covers the following topics:

- Modern production and postharvest handling of raw materials;
- Food chemical analyses in the supply chain;
- Food processing with respect to product quality and safety;
- Emerging technologies in food processing;
- Monitoring technologies for in-situ analyses in bioprocesses; and
- Modelling as a tool for process management.

Today, the food processing industry strives to provide a wide variety of products with enhanced shelf-life, functionality and quality attributes, and to develop new technologies in order to meet the demands of people from different cultural and working backgrounds. In particular, excellent progresses have been made in the development of novel processing methods, advanced monitoring technology, and effective and efficient quality management

systems, leading to the insurance of product safety, enhancement of nutritional value, and minimisation of environmental impacts. In spite of these technological advances, many fundamental issues remain, and the interest is high, as indicated by the large number of papers submitted to this conference.



In total, the conference has attracted 321 papers from 50 countries. The following figure shows the distribution of these papers among different countries. In the conference period of two and a half days, 4 keynote lectures and 138 oral presentations have been arranged in 1 plenary and 16 parallel sessions, with 179 posters displayed in two poster sessions. I hope that the conference and this publication will provide the platform for bringing together those involved in food processing worldwide to explore the frontiers of knowledge in the art, science and engineering of all types of processing methods, monitoring technologies, and quality management systems; and the opportunity for participants and the public to learn about the latest developments in the respective fields, to improve communication and to increase cooperation and coordination of research efforts among researchers.

Organising such an international conference is only possible with the dedication of many colleagues and in particular through active collaboration between ATB (Leibniz-Institute for Agricultural Engineering Potsdam-Bornim) and CIGR Section VI, and by support from IAEF - International Association of Engineering and Food, EFFoST - European Federation of Food Science and Technology, ASABE - American Society of Agricultural and Biological Engineers, and EurAgEng - European Society of Agricultural Engineers.

Finally, as the Chairman of the Conference, I would like to take this opportunity to sincerely thank the contribution from the authors, the reviewers and the editors. I would also like to express my special appreciation to the Co-chairs Dr Manuela Zude and Dr Oliver Schlüter for their delicate and invaluable organising work.

Professor Da-Wen Sun, National University of Ireland, Dublin  
 Honorary Vice-President of CIGR; Chairman of the Conference  
 Editor-in-Chief, Food and Bioprocess Technology: An International Journal (Springer)

**Organised by**

Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB),  
Department for Horticultural Engineering  
CIGR Section VI (Postharvest Technology and Process Engineering)

**Supported by**

ASABE - American Society of Agricultural and Biological Engineers  
EFFoST - European Federation of Food Science and Technology  
EurAgEng - European Society of Agricultural Engineers  
IAEF - International Association of Engineering and Food

**Symposium Committee****Chairman**

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National University of Ireland, Dublin  
Honorary Vice-President of CIGR;  
Editor-in-Chief of Food and Bioprocess Technology – An International Journal

**Co-Chairs**

Prof. Dr. Manuela Zude, ATB, Potsdam, Germany  
Dr. Oliver Schlüter, ATB, Potsdam, Germany

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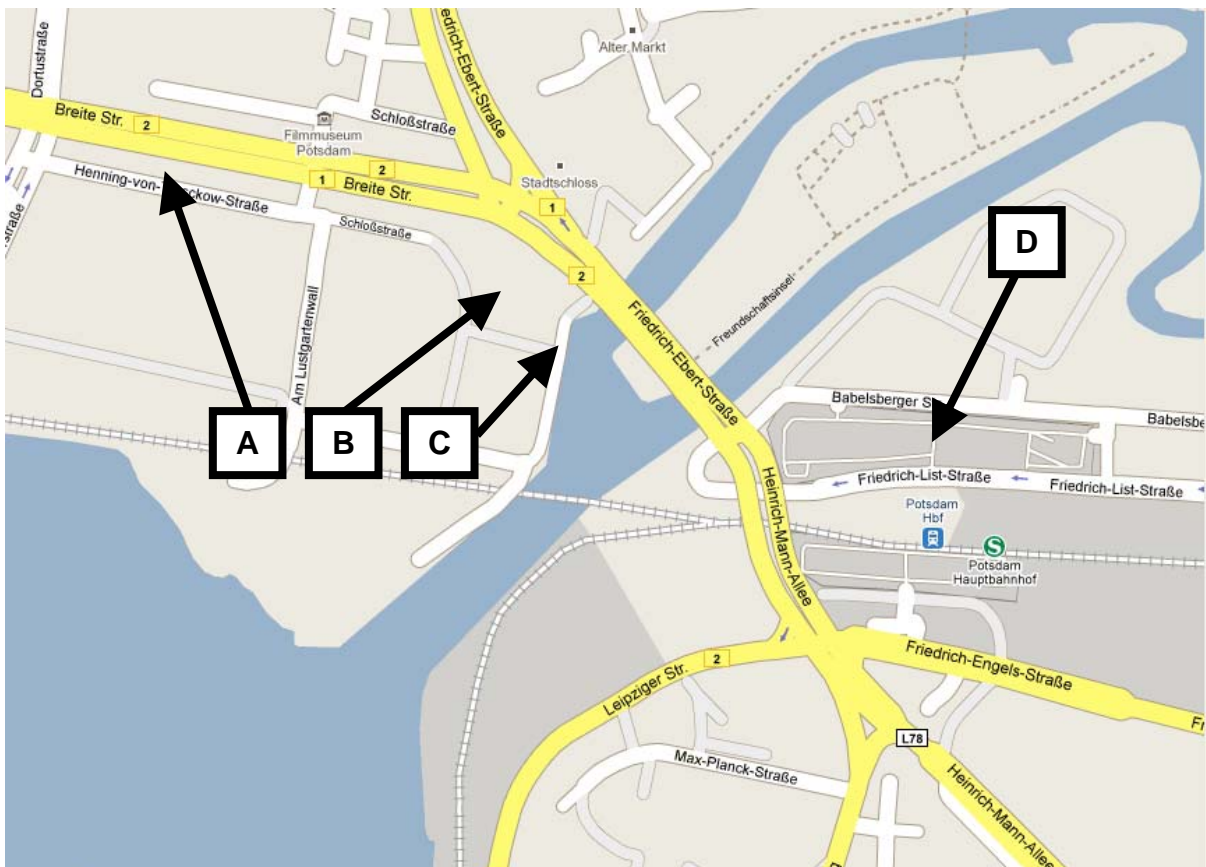
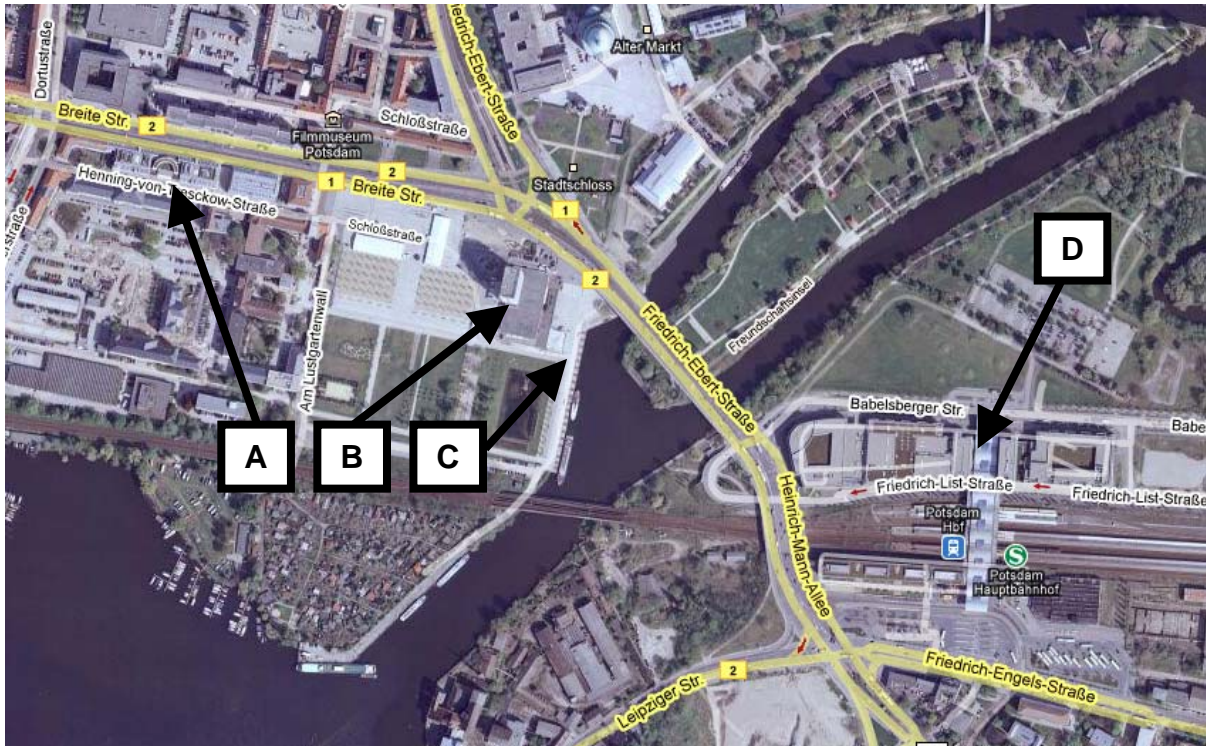
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Prof. Kiyohiko Toyoda, Japan  
Prof. Dr. Manuela Zude, Germany

## Maps of the symposium area

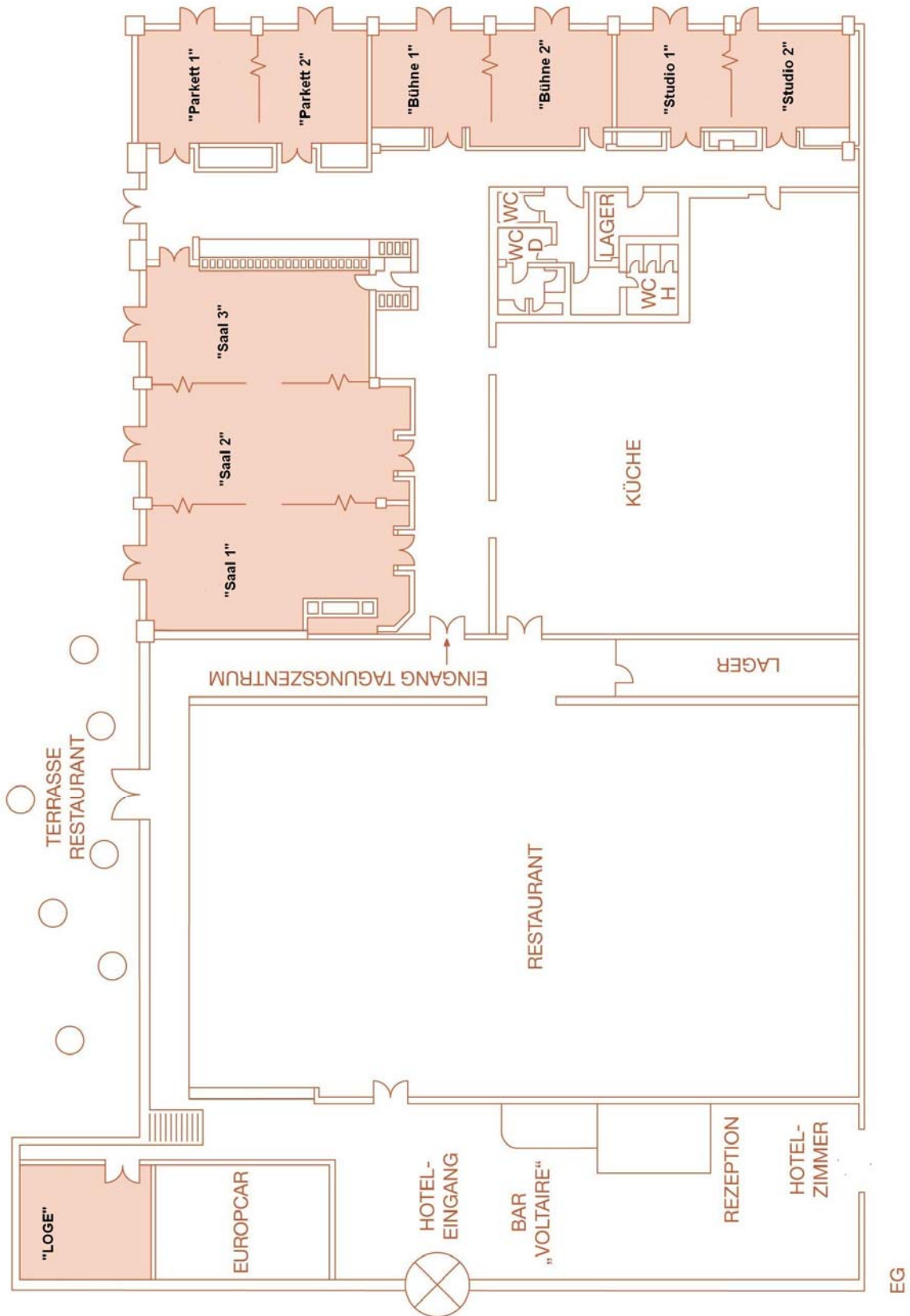


**A) IHK: Opening Session; B) Hotel Mercure: Registration and Technical Sessions;**  
**C) Start Conference Dinner Boat landing place at Mercure; D) Main railway station**  
**Potsdam**

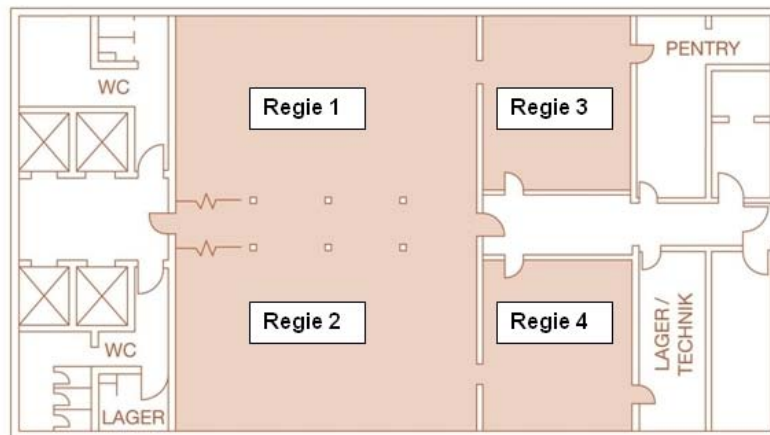


### Map of Symposium Rooms in Mercure Hotel

(Technical Sessions, Oral Presentations)



## Poster Room in Mercure Hotel (17<sup>th</sup> Floor)



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## Oral Programme & Poster Programme

Aug 31<sup>st</sup> to Sep 2<sup>nd</sup>, 2009

Potsdam, Germany

<b><u>Sunday, August 30</u></b>		<b>Room</b>
16:00 – 18:00	Registration	<b>Mercure</b> <i>Rezeption</i>
09:00 – 14:00	Presidium Meeting	<i>Atelier</i>
15:00 – 17:00	Executive Board Meeting	<i>Loge</i>
18:00 – 20:00	Get-together	<b>Mercure</b> <i>Bankettfoyer</i>
<b><u>Monday, August 31</u></b>		
08:30 – 09:30	Registration	<b>Mercure</b>
09:30 – 10:00	Opening Ceremony	<b>IHK</b>
<b>10:00 – 12:00</b>	<b>Plenary Lectures</b>	<b>IHK</b>
<i>Chair: Linus U. Opara, Sultanate of Oman</i>		
10:00 – 10:30	Nanotechnology in food industry <i>Suresh Neethirajan, Digvir S. Jayas, Canada</i>	
10:30 – 11:00	Drying technology: trends and applications in postharvest processing <i>Arun Sadashiv Mujumdar, Chung Lim Law, Singapore</i>	
11:00 – 11:30	Emerging Technologies in Food Processing <i>Dietrich Knorr, Germany</i>	
11:30 – 12:00	Hyperspectral imaging for food quality evaluation <i>Da-Wen Sun, Ireland</i>	
<b>12:00 – 13:00</b>	<b>Lunch</b>	<b>Mercure</b> <i>Restaurant</i>
<b>13:00 – 14:00</b>	<b>Poster Session I</b>	<i>Regie 1 + 2</i> <i>(Floor 17)</i>

**Mon 14:00 – 17:40      Session 1: Spectroscopy**

Saal 2 + 3

*Chair: Paolo Menesatti, Italy*

- 14:00 – 14:20      Non-invasive analyses of anthocyanins and carotenoids in cherry by means of continuous wave and time-resolved spectroscopy  
*Manuela Zude, Michael Pflanz, Carsten Dosche, Lorenzo Spinelli, Alessandro Torricelli*
- 14:20 – 14:40      Application of near infrared spectroscopy for monitoring osmo-air dehydration processes of blueberries  
*Nicoletta Sinelli, Gabriella Giovanelli, Ada Brambilla, Stefania Barzaghi, Ernestina Casiraghi*
- 14:40 – 15:00      Monitoring of the moisture content during dehydration of parsley with near infrared spectroscopy  
*Giuseppe Romano, Martin Böhner, Albert Heindl, Joachim Müller*
- 15:00 – 15:20      Determine pH and soluble solids content of morus juice using Vis-NIR spectroscopy with interval partial least squares and successive projections algorithm  
*Fang Cao, Di Wu, Yong He*
- 15:20 – 15:40      Classification of bee pollen using visible near infrared spectroscopy based on genetic algorithm  
*Ping Lin, Yongming Chen, Yong He*
- 15:40 – 16:00      *Coffee Break*
- 16:00 – 16:20      *In-situ* analysis of meat by applying Raman diode-laser spectroscopy  
*Heinar Schmidt, Martin Maiwald, Kay Sowoidnich, Bernd Sumpf, Heinz-Detlef Kronfeldt*
- 16:20 – 16:40      Evaluation of fatty acid profile of Wagyu beef by ATR-FTIR spectroscopy  
*Kiyohiko Toyoda, Minoru Yamanoue, Ikko Ihara, Xiaopin Hu, Kazumi Yoshida, Kaori Nakai*
- 16:40 – 17:00      Discrimination of time effect of high voltage electric field to oilseed using near infrared spectroscopy  
*Fei Liu, Yong He*
- 17:00 – 17:20      Quality assessment of Turkish butter using FTIR spectroscopy and chemometrics  
*Ramazan Kizil, Omer Gulyurt, Ilknur Sener,*
- 17:20 – 17:40      Fast determination of melamine content in milk powder base on NIR /MIR spectroscopy method  
*Yuan Shilin, Yong He*

**Mon 14:00 – 17:40****Session 2: Food Safety****Saal 1***Chair: Dietrich Knorr, Germany*

- 14:00 – 14:20 Acrylamide mitigation in potato chips by using NaCl  
*Franco Pedreschi, Kit Granby, Jørn Risum*
- 14:20 – 14:40 Wheat bread with hull-less barley grain additive: its quality and microbiological safety  
*Tatjana Rakcejeva, Lija Dukalska, Ruta Galoburda, Liga Skudra, Loveta Robezniece, Linda Legzdina*
- 14:40 – 15:00 Effect of hypolipidemic on extracellular polysaccharide from the submerged fermentation of *Agaricus braziliensis*  
*Pomin Li, I-Ping Su, Yun-Rong Li*
- 15:00 – 15:20 The effect of penetration depth and UV dose on the performance of UV-C disinfection process of white grape juice inoculated with *Escherichia coli* K-12  
*Bengi Hakguder, Sevcin Unluturk*
- 15:20 – 15:40 Product quality and safety in HoReCa sector  
*E. Czarniecka-Skubina, Józef Grochowicz, Dorota Nowak*
- 15:40 – 16:00 *Coffee Break*
- 16:00 – 16:20 Use of an *in-situ* tamperproof sampling device for enhanced feed chain security  
*Barry Mc Inerney*
- 16:20 – 16:40 Production of pesticide-free dry fish through box and ring tunnel dryer: an innovation to improve product quality & safety and reduce risks for the consumers  
*Nowsad Akm Alam, Reazul Md Islam*
- 16:40 – 17:00 Improving the antibacterial activity of lysozyme by conjugation with polysaccharides  
*Mahmoud Aminlari, Roghayeh Ramezani Ali Abadi*
- 17:00 – 17:20 Development of bacteriocin based biopreservative for preservation of paneer (an Indian soft cheese)  
*Ravinder Malik, K.N. Rao, Ulrich Schillinger, Arun Bhardwaj, Naresh Kumar*

**Mon 14:00 – 17:40      Session 3: Emerging Technologies and Sensors      Bühne 1 + 2**

*Chair: Oliver Schlüter, Germany*

- 14:00 – 14:20      The impact of high pressure on the antioxidant activity of yellow mombin pulp  
*Julia Hauck Tiburski, Amauri Rosenthal, Rosires Deliza, Fernanda Branco Shinagawa*
- 14:20 – 14:40      Combination of high pressure and temperature as an alternative sterilization process  
*Kai Reineke, Alexander Mathys, Volker Heinz, Dietrich Knorr*
- 14:40 – 15:00      Impregnation techniques for aroma enrichment of apples: a preliminary study  
*Patrizia Comandini, Giampaolo Blanda, Hugo Mújica Paz, Aurora Valdez Fragoso, Tullia Gallina Toschi*
- 15:00 – 15:20      Processing to control plant dispersion particle morphologies and their rheological properties  
*Li Day, Sofia Oiseth, Leif Lundin*
- 15:20 – 15:40      Online-Monitoring of physiological fitness of *Lb. plantarum* during fermentation and identification of optimal harvest points  
*Antje Schulz*
- 15:40 – 16:00      *Coffee Break*
- 16:00 – 16:20      Sensor technology for the identification of mycotoxine producing fungi in the processing of wheat grain  
*Claudia Rasch, Michael Kumke, Hans-Gerd Löhmannsröben*
- 16:20 – 16:40      Monitoring of food freezing process by using ultrasonic method  
*Takahiro Sugiyama, Takahisa Nishizu, Kiyokazu Goto, Jile Xin, Naoshi Kondo, Hiroshi Shimizu*
- 16:40 – 17:00      Microwave sensor response in relation to durian fruit maturity  
*Saisunee Suttapa, Jatuphong Varith, Chanisara Noochuay, Jakraphong Phimpimol, Monai Krairiksh*
- 17:00 – 17:20      Characterizing the product quality attributes of extrudates of selected crops from a locally developed extruder  
*Agboola Simeon Ogunlowo, Folasayo Fayose*
- 17:20 – 17:40      Extrusion characteristics of cassava and defatted soyflour blended extrudates  
*Jaffar Thajudhin Sheriff, Moothandassery Sankarakutty Sajeev, G. Padmaja, Subramony Narayana Moorthy*

<b>Mon 14:00 – 17:40</b>	<b>Session 4: Modelling I</b>	<i>Parkett 1 + 2</i>
<i>Chair: László Baranyai, Hungary</i>		
14:00 – 14:20	Approaches to modelling packaging ventilation performance in fresh food handling: a comparative review <i>Umezuruike Linus Opara</i>	
14:20 – 14:40	Modelling post-harvest colour development in limes and tomatoes <i>Richard Love, Charles Jenkins, John Mawson</i>	
14:40 – 15:00	Strange attractor in the chlorophyll difference model of Longjing tea <i>Yongming Chen, Ping Lin, Yong He</i>	
15:00 – 15:20	Numerical simulations of pulsed electric field processing for chamber design and optimisation <i>Roman Buckow, Stefanie Schroeder, Kai Knoerzer, Kees Versteeg</i>	
15:20 – 15:40	Combined mathematical and finite element modeling to simulate firmness of linearly solid potatoes <i>Hoseyn Ashrafi, Mahdi Kasraei</i>	
15:40 – 16:00	<i>Coffee Break</i>	
16:00 – 16:20	Computational methods and experimental measurements <i>Nicolas Meneses, Henry Jaeger, Jeldrik Moritz, Dietrich Knorr</i>	
16:20 – 16:40	Steam deacidification of model fatty systems: experimental and simulation <i>Thiago Taham, Simone Silva, Klicia Araújo Sampaio, Roberta Ceriani, Antonio J.A. Meirelles</i>	
16:40 – 17:00	Mathematical modeling of lipid peroxidation reaction of vegetable oil with phytochemical antioxidant treatment during frying <i>Irwandi Jaswir</i>	
17:00 – 17:20	Modeling techniques for the control of thermal exchanges in mixed continuous-discontinuous flow food plants <i>Gustavo Belforte, Lorenzo Comba, Paolo Gay, Davide Ricauda Aimonino</i>	
<b>18:00 – 21:00</b>	<b>CIGR Section VI Technical Board Meeting</b>	<i>Regie 3 (Floor 17)</i>

**Tuesday, September 01****Tue 09:00 – 12:40****Session 5: Bioprocessing****Saal 2 + 3***Chair: Venkatesh Meda, Canada*

- 09:00 – 09:20 Wireless magnetoelastic biosensors for the simultaneous detection of *Salmonella typhimurium* and *Bacillus anthracis*  
*Shichu Huang, Suiqiong Li, Howard C. Wikle, Zhongyang Cheng, Bryan A. Chin*
- 09:20 – 09:40 Online, rapid and portable microcantilever biosensors for food safety monitoring  
*Carlo Ricciardi, Giancarlo Canavese, Riccardo Castagna, Gabriella Digregorio, Ivan Ferrante, Francesco Geobaldo, Alessandro Ricci*
- 09:40 – 10:00 The acoustic impedance – an indicator for concentrations in alcoholic fermentation and cleaning progress of fouled tube heat exchangers  
*Thomas Becker, Mohamed Hussein, Eva Wallhäußer*
- 10:00 – 10:20 The impact of bioprocessing on rice nutritional quality  
*Anca Nicolau, Luminita Anca Georgescu, Rodica Segal*
- 10:20 – 10:40 Detection of deoxynivalenol using excitation-emission matrix  
*Junichi Sugiyama, Kaori Fujita, Mizuki Tsuta, Mito Kokawa*
- 10:40 – 11:00 *Coffee Break*
- 11:00 – 11:20 Monitoring of CO<sub>2</sub> during fermentation process by means of impedance spectrometry sensor  
*Miguel A. Perez, Rocio Muñiz, Cristina De la Torre, Beatriz Garcia, Carlos E. Carleos, Raul Crespo, Luis Miguel Carcel*
- 11:20 – 11:40 Monitoring wine alcoholic fermentation using a resistivity sensor  
*Luis Miguel Cárcel, Raúl Crespo, Miguel Ángel Pérez-García, Ignacio Nevares, María Del Álamo*
- 11:40 – 12:00 Analysis of mixing degree of granular products using microtracers  
*Józef Grochowicz, Kazimierz Zawislak, Paweł Sobczak, Marian Panasiewicz, Jacek Mazur*
- 12:00 – 12:20 Researches regarding bioethanol yield increasing  
*Sonia Gutt, Georg Gutt*



Tue 09:00 – 12:40

**Session 6: Thermal Processing**

Parkett 1 + 2

*Chair: András Fekete, Hungary*

- 09:00 – 09:20 Process development of premium quality canned Thai red curry paste  
*Pimpen Pornchalaempong, Kanokwan Teptakhob, Kanjana Lertamondireak, Kraisuwit Srisawat*
- 09:20 – 09:40 Characteristics in cell wall structure of green bean during control freezing point storage  
*Ying Ma, Guo Li*
- 09:40 – 10:00 Effect of freezing and cooking processes on the texture of Atlantic salmon (*Salmo salar*) fillets  
*Ebrahim Alizadehdoughikollae, Nicolas Chapleau, Marie de-Lamballerie, Alain LeBail*
- 10:00 – 10:20 The thermal stability of onion (*Allium cepa* L.) flavonols – Influence of crop production and food processing  
*Sascha Rohn*
- 10:20 – 10:40 Influence of shaking on heat penetration during retort processing  
*Samak Rakmae, Methira Thawornsuksiri, Walaiporn Rakpudsa*
- 10:40 – 11:00 *Coffee Break*
- 11:00 – 11:20 Mechanical and thermal treatments of crushed tomatoes or carrot purées: Effects on In vitro accessibility of antioxidants and on structure/consistency  
*Cecilia Svelander*
- 11:20 – 11:40 Influence of fat and protein contents on the thermo-physical properties of milk -application to the standardisation of milk-  
*Sophie Galland, Eric Peyrol*
- 11:40 – 12:00 Identification of an optimal set of parameters for the process of pasteurization of beverages by using dense gases  
*Gabriele Di Giacomo, Luca Taglieri*
- 12:00 – 12:20 Investigation of macro-structure of gluten-free rice cakes baked in infrared-microwave combination over  
*Elif Turabi, Gulum Sumnu, Serpil Sahin*

**Tue 09:00 – 12:40      Session 7: Functional Food and Health      Saal 1**

*Chair: Amauri Rosenthal, Brazil*

- 09:00 – 09:20      Impact of micronization on rapidly digestible, slowly digestible and resistant starch contents in different barley varieties  
*Shahram Emami, Venkatesh Meda, Robert T. Tyler, Mark Pickard*
- 09:20 – 09:40      Increasing of biodegradability and digestibility of dairy sludge by microwave treatment  
*Sándor Beszédes, Zsuzsanna László, Gábor Szabó, Cecília Hodúr*
- 09:40 – 10:00      Application of novel soybean varieties to Tofu (soybean curd) and utilization of the Tofu byproduct for functional food development  
*Toshinori Kimura, Atsuko Tsujino, Mugiho Yokota, Shuso Kawamura, Naoto Shimizu, Natsu Nakanishi, Noriko Tsuji*
- 10:00 – 10:20      Functional components in traditionally consumed foods from Botswana  
*Jideani Afam, Selalelo Mpotokwane, Malebogo Ralefala, Motlalepula Mokotedi, Kabo Moseitlha, Anna Nkwe-Mosele, Malaki Kamakama, Juda Bogopa*
- 10:20 – 10:40      Controlling the nutrient profile of fruits and vegetables during prolonged storage prior to processing  
*James Robertson, Claudia Niemann, Marie Alminger*
- 10:40 – 11:00      *Coffee Break*
- 11:00 – 11:20      Identification and quantification of betalains, carotenoids and chlorophylls in prickly pear fruit  
*Elhadi Yahia, Elena Castellanos*
- 11:20 – 11:40      Evaluation of 11 pesticide residues in dried figs from Estahban region in Iran  
*Majid Javanmard*

Tue 09:00 – 12:40

**Session 8: Physico-Chemical and Microbiological Properties**

Bühne 1 + 2

*Chair: Yong He, China*

- 09:00 – 09:20 Interactions of a novel monoglyceride-stabilized oil in water emulsion with wheat flour, starch, and gluten  
*Brittany Huschka, Carolyn Challacombe, Alejandro G. Marangoni, Koushik Seetharaman*
- 09:20 – 09:40 Properties of MPC and WPC-stabilized O/W emulsions as influenced by oil droplet surface composition  
*Brygida Dybowska*
- 09:40 – 10:00 Effect of atmospheric pressure plasma treatment on the stability of flavonoids  
*Franziska Grzegorzewski, Jörg Ehlbeck, Lothar W. Kroh, Oliver Schlüter, Sascha Rohn*
- 10:00 – 10:20 Studies on physico-chemical characteristics and preservation of cultivated mushrooms  
*Sarfraz Hussain, Salim-Ur-Rehman, Qaisar Raza*
- 10:20 – 10:40 Physicochemical change and protein oxidation in porcine longissimus muscle as influenced by different freeze-thaw cycles  
*Baohua Kong, Xiufang Xia, Youling Xiong*
- 10:40 – 11:00 *Coffee Break*
- 11:00 – 11:20 Evaluation of Escherichia coli inactivation and quality attributes in apple juice subjected to pulsed electric fields in combination with high intensity light pulses  
*Irene Miriam Caminiti, Izabela Palgan, Francesco Noci, Arantxa Muñoz, Paul Whyte, Denis A. Cronin, Desmond J. Morgan, James Lyng*
- 11:20 – 11:40 Spatial distribution, attachment and growth of bacteria on fruit and vegetable tissues  
*Tim Brocklehurst*
- 11:40 – 12:00 Changes of aldehydes in essential oil during postharvest treatment of red pepper (*Capsicum annuum* L.) for paprika production  
*Žarko Kevrešan, Ksenija Kuhajda, Neda Mimica-Dukic*
- 12:00 – 12:20 Fermentation of spherical bacterial cellulose product by shaking culture  
*Sixin Liu, Quanwei Wang, Congfa Li*
- 12:20 – 12:40 Chemical, nutritional and microbiological quality of fluid milk available in chittagong metropolitan area of Bangladesh  
*A.K.M. Humayun Kober, G.K. Debnath, G.C. Chanda*

<b>12:40 – 14:00</b>	<b>Lunch</b>	<b>Mercure Restaurant</b>
<b>14:00 – 15:00</b>	<b>Poster Session II</b>	<b>Regie 1 + 2 (Floor 17)</b>
<b>Tue 15:00 – 18:00</b>	<b>Session 9: Modelling II</b>	<b>Saal 2 + 3</b>
<i>Chair: Elisabeth Dumoulin, France</i>		
15:00 – 15:20	Modeling of microparticulation process of whey proteins: development and validation of a novel model based on the phenomena of their thermal denaturation <i>Alexander Tolkach, José Toro, Ulrich Kulozik</i>	
15:20 – 15:40	Multi-objective optimization of pervaporation process for food products <i>Graziano De Palma, Roberto Rizzo, Giuseppe Vignali</i>	
15:40 – 16:00	Computational fluid dynamics modelling and simulation of maltodextrin solutions spray drying to control stickiness <i>Alessandro Gianfrancesco, Christelle Turchiuli, Denis Flick, Elisabeth Dumoulin</i>	
16:00 – 16:20	Effect of temperature on water activity of Dutch type semi-hard cheese: computation and prediction on the basis of heat of sorption <i>Jiri Stencl, Vorlova Lenka, Bohumira Janstova, Michaela Drackova, Hana Pridalova</i>	
16:20 – 16:40	<i>Coffee Break</i>	
16:40 – 17:00	Quantification of nitrogen status in rice by least-squares support vector machines and reflectance spectroscopy <i>Yongni Shao</i>	
17:00 – 17:20	A predictive model to compare the factors influencing oat and barley $\beta$ -glucan levels in harvested grain <i>Uma Tiwari, Enda Cummins</i>	
17:20 – 17:40	Fast quantitative analysis of soluble solids content in cherry based on statistical analysis of PLS-LSSVM and genetic algorithm <i>Jia-Jia Yu, Yong He</i>	
17:40 – 18:00	Prediction of viscosity changes in rainbow trout skin gelatin, produced at different pre-treatment time using artificial neural network model <i>Hoda Shahiri Tabarestani, Yahya Maghsoudlou, Ali Motamedzadegan, Alireza Sadeghi Mahoonak</i>	

**Tue 15:00 – 18:00      Session 10: Image Processing I      Saal 1***Chair: Manuela Zude, Germany*

- 15:00 – 15:20      *In-situ* observation of high pressure induced changes of food materials using neutron radiography  
*Oliver Schlüter, Werner Herppich, Stefan Boguslawski, Dietrich Knorr, Nikolay Kardjilov*
- 15:20 – 15:40      Use of lacunarity for characterization of pork ham slice surfaces from digital binary images  
*Nektarios A. Valous, Fernando Mendoza, Da-Wen Sun*
- 15:40 – 16:00      Thermoluminescence detection of irradiated crustaceans: comparison between two methods for extracting minerals  
*Maria Cinzia Cammilleri, Antonio Bartolotta, Maria Cristina D'Oca, Sandra Antonella Giuffrida, Aldo Parlato*
- 16:00 – 16:20      Prediction of consumer panel assessment of beef palatability from digital image features  
*Patrick Jackman, Da-Wen Sun, Paul Allen, Karen Brandon, Anna-Marie White*
- 16:20 – 16:40      *Coffee Break*
- 16:40 – 17:00      Early prediction of rice leaf blast based on multi-spectral image  
*Kaisheng Yang, Lei Feng, Yong He*
- 17:00 – 17:20      Fish size estimation and sorting using laser light sectioning  
*Taweepol Suesut, Navaphattra Nunak*

**Tue 15:00 – 18:00      Session 11: Packaging***Parkett 1 + 2**Chair: Richard Love, New Zealand*

- 15:00 – 15:20      Packaging properties of cassava starch nanocomposite films  
*Ana Cristina Souza, Ewerton S. P. Ferrão, Fernanda Montelato, Antonio Carlos Coelho, Carmen Cecilia Tadini*
- 15:20 – 15:40      Monitoring of the vibration damage for packaging mangos in a corrugated fiberboard box during transportation  
*Hung-Yen Chan, Chung-Kee Yeh*
- 15:40 – 16:00      Development of web-based software for packaging design  
*Pramod Mahajan, Maria Sousa-Gallagher, Jorge Oliveira*
- 16:00 – 16:20      Analysis of microwave distribution for ready-to-cook fresh-cut Asparagus packaging  
*Chanisara Noochuay, Jatuphong Varith, Wannee Chinsirikul, Monai Krairiksh*
- 16:20 – 16:40      *Coffee Break*
- 16:40 – 17:00      Water vapour permeability, mechanical and thermal properties of carboxymethyl cellulose-based edible films containing potassium sorbate  
*Babak Ghanbarzadeh*
- 17:00 – 17:20      The effect of calcium alginate coating on the storability of strawberry at the refrigerator  
*Nasrin Moayednia, Mohamad Reza Ehsani, Zahra Emam-Djomeh, Amir Farokh Mazaheri*
- 17:20 – 17:40      Effects of modified atmosphere packaging on the quality of barberry  
*Neptune Bidely, Shohreh Nik khah*
- 17:40 – 18:00      Effect of pretreatment by ethyl oleate and packaging on qualitative characteristics of stored dried mulberry  
*Mehdi Davoodi, Shohreh Nik khah, Amin Seyed yaghoubi*

<b>Tue 15:00 – 18:00</b>	<b>Session 12: Extraction</b>	<i>Bühne 1 + 2</i>
<i>Chair: Ying Ma, China</i>		
15:00 – 15:20	An innovative process for extraction of fruit juice using microwave heating <i>Aurélie Cendres, Farid Chemat, Jean François Maingonnat, Catherine Renard</i>	
15:20 – 15:40	Pulsed electric field assisted extraction of plant raw materials <i>Henry Jaeger, Nicolas Meneses, Dietrich Knorr</i>	
15:40 – 16:00	Ultrasound accelerated maceration for direct aromatisation of olive oil with basil <i>Sébastien Veillet, Valérie Tomao, Farid Chemat</i>	
16:00 – 16:20	Precipitation of ethyl cellulose by solution enhanced dispersion by supercritical fluids <i>Lan Chen, Guangtian Li, Zhepeng Liu</i>	
16:20 – 16:40	<i>Coffee Break</i>	
16:40 – 17:00	Pressurized low polarity water extraction kinetics of trans-resveratrol and trans- $\epsilon$ -viniferin in grape canes <i>Erkan Karacabey, Levent Bayğndörlü, Giuseppe Mazza</i>	
17:00 – 17:20	Effects of whole fat rapeseed expanding on the pre-pressing cake oil residue <i>Lanfang Zhang, Shaohua Li, Shujun Li, Ziming Li, Hai Xiang, Jinqiang Guo, Jiajia Ren</i>	
17:20 – 17:40	Antioxidant properties of various solvent extracts of some food processing by-products <i>Adel Mohdaly, Iryna Smetanska, Mohamed Atef Sarhan, Awad Mahmoud</i>	
17:40 – 18:00	Effects of supercritical CO <sub>2</sub> fluid parameters on chemical composition and yield of carotenoids extracted from pumpkin <i>John Shi, Sophia Xue, Yueming Jiang</i>	
<b>Tue 18:30 – 22:00</b>	<b>Symposium Dinner</b> (Start 18:30, Boat landing place at Mercure)	<b>Boat trip</b>

**Wednesday, September 02****Wed 09:00 – 12:40****Session 13: Engineering and Development****Saal 2 + 3***Chair: Jozef Grochowicz, Poland*

- 09:00 – 09:20 A study of the effect of micro and nano-bubbles in the dynamic properties of water  
*Fernanda Yumi Ushikubo, Seiichi Oshita, Ryou Nakagawa, Takuro Furukawa, Yoshio Makino, Yoshinori Kawagoe*
- 09:20 – 09:40 Ultrasonic assisted microencapsulation of cardamom essential oil  
*Masoud Najaf Najafi, Rassoul Kadkhodae, Seyed Ali Mortazavi*
- 09:40 – 10:00 Effects of the salting step conditions on Tunisian Kaddid meats: kinetics and quality  
*Mériem Chabouh, Ali Sahli, Sihem Bellagha, Abdelhamid Farhat*
- 10:00 – 10:20 Concentration and formulation of elder berry anthocyanins using membrane process and PGSS(TM) technology  
*Zsuzsanna Molnár, Mojca Škerget, Željko Knez, Gyula Vatai*
- 10:20 – 10:40 Obtention of gels from *Brama Australis* and biaxial extensional viscosity characterization  
*Fernando Osorio, Javier Enrione, Jennifer Crisostomo, Sergio Baeza*
- 10:40 – 11:00 *Coffee Break*
- 11:00 – 11:20 Exploring metabolic responses of potato tissue Induced by electric pulses  
*Federico Gómez Galindo, Lars Wadsö, António Vicente, Petr Dejmek*
- 11:20 – 11:40 Implementation of water jet cut in cutting and peeling processes of agricultural products  
*Rene Carreno Olejua, Werner Hofacker, Oliver Hensel*
- 11:40 – 12:00 Optimal shape design of holding tubes configuration in aseptic processing  
*Fabrizio Sarghini, Paolo Masi*
- 12:00 – 12:20 Design and performance evaluation of a multi-crop slicing machine  
*Leo Ayodeji Sunday Agbetoye, Abdul-Lateef Balogun*



**Wed 09:00 – 12:40      Session 14: Image Processing II      Saal 1**

*Chair: Da-Wen Sun, Ireland*

- 09:00 – 09:20      Cold neutron radiography for non-destructive analysis of food water status  
*Uzuki Matsushima, Nikolay Kardjilov, André Hilger, Eberhard H. Lehmann, Anders Kaestner, Werner B. Herppich*
- 09:20 – 09:40      Variation in carrot texture under different storage conditions  
*Timea Kaszab, Ferenc Firtha, Andras Fekete*
- 09:40 – 10:00      Pork and turkey hams classification from colour and textural features using computer vision  
*Abdullah Iqbal, Nektarios A. Valous, Fernando Mendoza, Paul Allen, Da-Wen Sun*
- 10:00 – 10:20      Near-infrared spectral imaging for the evaluation of food additive effects on prawn properties  
*Mizuki Tsuta, Takehiro Sugiyama, Tetsuya Araki, Yasuyuki Sagara, Junichi Sugiyama*
- 10:20 – 10:40      Evaluation of white shrimp freshness during Iced storage using texture analyzer and machine vision  
*Navaphattra Nunak, Taweepol Suesut*
- 10:40 – 11:00      *Coffee Break*
- 11:00 – 11:20      Digital image analysis for the optimal control of bread and rolls baking  
*Mario Jeckle, Dörte Solle, Bernd Hitzmann, Thomas Becker*
- 11:20 – 11:40      Microscopic analysis of particle caking of corn distillers dried grains with solubles  
*Klein Ileleji, Rose Prabim Kingsly*
- 11:40 – 12:00      Image processing applied to classification of avocado variety hass (*Persea americana* Mill) during their ripening process  
*Israel Arzate, Maria De Jesus Perea, Marco Antonio Moreno, Salvador Godoy, Gustavo Fidel Gutiérrez, Jose Jorge Chanona*

**Wed 09:00 – 12:40****Session 15: Drying***Parkett 1 + 2**Chair: Arun S. Mujumdar, Singapore*

- 09:00 – 09:20 Reuse of sucrose solutions in the production of osmotically dried peach  
*Sílvia Pimentel Marconi Germer, Marlene Rita de Queiroz, José Maurício Aguirre, Neliane Ferraz de Arruda Silveira, Daniele de Carvalho*
- 09:20 – 09:40 Drying characteristics of ginger rhizome (*Zingiber officinalis*)  
*Bilash Kanti Bala, M.A. Hoque, Md. Ayub Hossain, M. Borhan Uddin*
- 09:40 – 10:00 Optimization of drying parameters of saskatoon berries (*Amelanchier alnifolia*) using a combined microwave and vacuum method  
*Pranabendu Mitra, Venkatesh Meda*
- 10:00 – 10:20 Colour degradation of lemon balm (*Melissa officinalis* L.) as affected by the drying process  
*Dimitrios Argyropoulos, Joseph Kudadam, Joachim Müller*
- 10:20 – 10:40 Determine maximum permissible temperature for drying rapeseed and sunflower seed  
*Mehdi Baghi*
- 10:40 – 11:00 *Coffee Break*
- 11:00 – 11:20 Polyphenol degradation mechanisms during soaking and drying of apples  
*Emilie Devic, Sylvain Guyot, Jean Dominique Daudin, Catherine Bonazzi*
- 11:20 – 11:40 Mathematical modelling of solar assisted hybrid dryer for banana  
*Md. Ayub. Hossain, Baher Mahmoud Ahmed Amer, Klaus Gottschalk*
- 11:40 – 12:00 Development and evaluation of a solar assisted hybrid dryer for spices  
*Ayubl Hossain, Arshadul Hoque*

**Wed 09:00 – 12:40      Session 16: Food Quality and Measurement Techniques      Bühne 1 + 2**

*Chair: Kiyohiko Toyoda, Japan*

- 09:00 – 09:20      Definition of a new post-harvesting treatment of paddy rice; characterization of final product  
*Cong Duong Thai, Sabah Mounir, Isaac Pilatowski, Karim Allaf*
- 09:20 – 09:40      On the usage of ultrasound for online dough evaluation techniques  
*Hala Elfawakhry*
- 09:40 – 10:00      Non-destructive electromagnetic pecan analysis  
*Carol Jones, Josh Grundmann, Niels Maness, Paul Weckler*
- 10:00 – 10:20      Measuring and Steering vacuum in the milk tube to avoid vacuum maxima at the teat end  
*Ulrich Ströbel, Sandra Rose-Maierhöfer*
- 10:20 – 10:40      Geographical origin, cultivar, harvesting year verification of European and non-European olive oils using proton transfer reaction mass spectrometry with multivariate data analysis  
*Saskia van Ruth, Wies Akkermans, Rafa Perez Garcia, Alex Koot, Enzo Perri, Massimiliano Pellegrino, Jose Manuel Moreno Rojas, Claude Guillou, Anne Rossignal-Castera*
- 10:40 – 11:00      *Coffee Break*
- 11:00 – 11:20      The implementation and verification of advanced traceability system in the Polish fish processing plant  
*Olga Szulecka*
- 11:20 – 11:40      Sensory quality assurance for process optimization of cheese production  
*Julie Lundtoft Johnsen, Mette Marie Løkke, Christian Dehlholm*
- 11:40 – 12:00      Effect of spice oleoresin and powder on the quality and microbial shelf life of white bread  
*Taofik Shittu, Abosede Abioye*
- 12:00 – 12:20      Food quality and monitoring and bioprocessing in Georgia  
*Kakha Nadiradze, Nana Phirosmanashvili*
- 12:20 – 12:40      Quality characteristics of aonla pulp as affected by ohmic heating pretreatment  
*Santosh Patil, Anupama Singh, Manoj Kulshrestha, B.K Kumbhar, Hryidesh Pandey*

**Wed 12:40      End of the Symposium**

**Poster Session 1 (Monday 12:00 – Tuesday 12:00, Room:  
Regie 1 + 2, Floor 17)**

**Section 1: Modern Production and Postharvest Handling of Raw Material**

**P1-01**

Machine vision for automatic sorting and cultivar identification of rice grains

*Jose Domingo Guzman*

**P1-02**

Prediction of potato damage under impact loading with nonlinear model

*Hamed Afshari*

**P1-03**

Evaluation of adulterated caramel colour in commercial apple juices

*Calin Jianu, Ionel Jianu, Ileana Cocan, Cristina Rujescu, Ciprian Rujescu*

**P1-04**

Changes of chlorophylls,  $\beta$ -carotene and lutein during storage of lettuce of control plants and  $\text{CaCl}_2$  pre-harvest treatment.

*Irena Perucka, Katarzyna Olszówka*

**P1-05**

Reduction of gray mould on strawberries by acetic acid vapour and quality analysis of produce

*Karin Hassenberg, Martin Geyer, Werner B. Herppich*

**P1-06**

Enzymatic hydrolyze of soy oil using lipase by *Geotrichum candidum*

*Rafael Resende Maldonado, Felipe Massiero Fogaça, Gabriela Giolo Ramos, Gabriela Alves Macedo, Maria Isabel Rodrigues*

**P1-07**

Feasibility of a simplified handheld optical system for blueberries ripeness field evaluation

*Roberto Beghi, Riccardo Guidetti, Roberto Oberti, Luigi Bodria*

**P1-08**

Marketing of pomegranate in Iran: Difficulties and recommendations

*Shohreh Nik khah*

**P1-09**

Acoustic analysis for non-destructive detection of quality defects in fruits and vegetables

*Julia Foerster, Martin Geyer, Oliver Schlüter, Werner B. Herppich, Michael Kiefer, Christoph Lauer, Dietrich Knorr*

**P1-10**

Effect of calcium applications and storage condition in apples on calcium and polyphenol content related with physiological disorder of bitter pit in apples

*Rebeca Torres-Muñoz, Armando Quintero-Ramos, Esteban Sánchez-Chávez, Juan Manuel Soto Parra, Erika Salas-Muñoz*

**P1-11**

Improvement of fruit storage in the supply chain with modified atmosphere packaging

*Nicole Giuggioli, Francesco Geobaldo, Raffaella Ceccarelli, Cristiana Peano*

**P1-12**

Increased level of flavonoids in fermentation solution of dyers woad leaf

*Tao Han, Ruo-hong Zhang, Li-ping Li, Bo-lin Zhang*

**P1-13**

Anthocyanin producing from grape pomace (*Vitis* sp) and barberry

*Neptune Bidely, Abbas Hemmati Kakhky*

**Section 2: Food Processing with respect to Product Quality and Safety****P2-01**

Development of quality small – scale agricultural processing enterprises in Uganda

*Obedi Nsubuga*

**P2-02**

Design and test of solar dryer for leafy vegetable

*Ebrahim Ebrahimi*

**P2-03**

Production of virusless potato seed for Georgian potato farmers

*Maia Kukhaleishvili, Kakha Nadiradze, Nana Phirosmanahsvili*

**P2-04**

Influence of temperature on quality of red pepper (*Capsicum annuum*, L. var. Hungarian) during dehydration: colour, texture and antioxidants properties

*Antonio Vega-Gálvez, Margarita Miranda, Karina Di Scala*

**P2-05**

Changes of rheological behaviour of wheat flour by archaic wheat varieties addition

*Ivan Švec, Marie Hrušková, Michala Kubalová, Markéta Bachanová*

**P2-06**

Lupin addition effect on wheat flour, dough and bread properties

*Marie Hrušková, Ivan Švec, Michala Kubalová, Markéta Bachanová*

**P2-07**

Simulated in-transit vibration damage to watermelons

*Feizollah Shahbazi, Ali Rajabipour, Saeed Mohtasebi, Shahin Rafie*

**P2-08**

Extraction and Identification of the hepatoprotective bio-active components of the root of *A. deliciosa*

*Bai Xinpeng, Guo Zhiyong, Liu Xiaoqin, Qiu Aiyong*

**P2-09**

Hygiene and waste and wastewater management of fresh-cut vegetables

*Marja Lehto, Ilkka Sipila, Maarit Mäki, Terhi Suojala-Ahlfors, Jenni Maatta, Risto Kuisma, Anna-Maija Sjoberg*

**P2-10-**

Influence of osmotic pre-treatment and microwave power on the volatile profile of dried cherry tomatoes

*Ana Heredia, Irene Pardo, Estela Rosa, Ana Andrés Grau, Isabel Escriche*

**P2-11**

Effect of proteins on lactose-induced stickiness in dairy powders

*Donal O'Callaghan, Sean Hogan*

**P2-12**

Soy milk residue ("okara") dried in flash dryer - uses as food ingredient

*Regina Kitagawa Grizotto, José Mauricio Aguirre, Sílvia Pimentel Marconi Germer, Luciana Miyagusku, Eunice Akemi Yamada*

**P2-13**

Quality and development of organic juice of assai and passion fruit enriched with unripe banana pulp

*Gisele Anne Camargo, Julian Mieli, Rita de Cassia Ormonese, Flávio Schimdt*

**P2-14**

Antioxidant activity and polyphenols of the whole pulp cagaita (*Eugenia dysenterica*, D.C.)

*Lucia Maria Jaeger de Carvalho, Ediane Maria Gomes Ribeiro, Mirian Ribeiro Leite Moura, Eduardo Lopes Motta, Nancy Barbi, Daniela Soares Viana, Veronica Figueiredo, Alcides Ricardo Gomes Oliveira*

**P2-15**

Comparative study on nutritional and morphological aspects of lychees (*Litchi chinensis* Sonn.) after osmotic pre-treatment and conventional dehydration

*Lucia Maria Jaeger de Carvalho, Eduardo Lopes Motta, Mirian Ribeiro Leite Moura, Nancy Barbi, Ana Claudia de Macedo Vieira*

**P2-16**

Determination of the antioxidant capacity and polyphenols in acid lime (*Citrus latifolia*, Tanaka), cv. Tahiti, clarified by microfiltration: a preliminary study

*Lucia Maria Jaeger de Carvalho, Gisela Maria Dellamora Ortiz, Daniela Soares Viana, Ediane Maria Gomes Ribeiro, Eduardo Lopes Motta, Mirian Ribeiro Leite Moura*

**P2-17**

State diagram of deglet nour dates by differential scanning calorimetry

*Nejib Guizani, Ghalib Said Al-Saidi, M. Shafiur Rahman, Salwa Bornaz*

**P2-18**

Optimization of combined microwave-hot air roasting for malt based on energy consumption and neo-formed contaminants (NFCs) content

*Suthida Akkarachaneeyakorn, Jean Claude Laguerre, Jirarat Tattiyakul, Benjamin Neugnot, Francisco Morales, Ines Birlouez-Aragon, Patrick Boivin*

**P2-19**

Combined effect of glycerol and oleic acid on the physical and thermal properties of carboxymethyl cellulose based edible films

*Babak Ghanbarzadeh, Hadi Almasi*

**P2-20**

Effect of gellan gum as the fluid gel forming agent, on particle size distribution, turbidity and rheological properties of orange juice

*Leila Bagheri, Babak Ghanbarzadeh, Mohamd Musavi*

**P2-21**

Effect of superchilled storage on the freshness and quality of pork

*Jing Xie*

**P2-22**

The effects of different hydrocolloids on staling of gluten free cakes baked in different ovens

*Filiz Koksel, Gulum Sumnu, Serpil Sahin, Venkatesh Meda*

**P2-23**

Effect of storage and processing on reducing and non-reducing sugar content in potatoes

*Daina Karklina, Ruta Galoburda, Irisa Murniece*

**P2-24**

Influence of blanching and drying treatment on total polyphenols and antioxidant activity in apple pomace

*Maria Elena Heras-Ramírez, Armando Quintero-Ramos, Ricardo Talamás-Abbud, Rene Renato Balandrán-Quintana, Alejandro Camacho-Dávila, Ruben Márquez-Meléndez, Erika Salas-Muñoz, Jose Vinicio Torres-Muñoz*

**P2-25**

Lycopene solubility and its extraction from tomatoes and their by-products

*Dalia Mieliauskaite, Pranas Viskelis, Rimas Noreika*

**P2-26**

Quality of raspberry fruits after frozen storage

*Ramune Bobinaite, Pranas Viskelis*

**P2-27**

Fast determination of titanium dioxide content in juice powder based on Vis/NIR spectroscopy technique

*Min Duan, Yong He, Shi-lin Yuan*

**P2-28**

Screening of *Aspergillus niger* strains for the biotransformation of the solid residues of manioc processing for obtain glucose syrup

*Andrea Matos, Marina Becker, Thiago Nogueira, Edna M. M. Oliveira, Selma C. Terzi, Sônia Couri*

**P2-29**

The instant controlled pressure drop (DIC) technology as a manufacturing process of high quality snacks and expanded granule powders of onion and super-fruits

*Sabah Mounir, Nsren Albitar, Karim Allaf*

**P2-30**

Combination use of gravity separator and optical sorter for decontamination deoxynivalenol of wheat

*Hideyuki Takenaka*

**P2-31**

Determination of protein content of *Auricularia Auricula* using near infrared spectroscopy and least square-support vector machine

*Fei Liu, Guangming Sun, Yong He*

**P2-32**

Fast measurement of soluble solid content in mango based on visible and infrared spectroscopy technique

*Jia-jia Yu, Yong He*

**P2-33**

New preservation procedure for liquid egg

*Csaba Németh, László Friedrich, Klára Pásztor-Huszár, Csilla Vén, Ildiko Zeke, Csaba Balla*

**P2-34**

The effect of composition on the physical properties of compressed candy  
*Sven Karlovic, Dunja Horzic, Drazenka Komes, Ana Belcak, Damir Jezek, Branko Tripalo, Damir Karlovic, Mladen Brncic, Tomislav Bosiljkov*

**P2-35**

Morphological characterization of powder milk and their relationship with rehydration properties  
*Maria de Jesús Perea, Israel Arzate, Eduardo Terres, Liliana Alamilla, Gustavo Fidel Gutierrez, Vicente Garibay, Jose Jorge Chanona*

**P2-36**

Studies of cryogenic freezing of multilayer confectionery products  
*Ildikó Zeke, Csaba Balla, Csilla Vén, Csaba Németh, Klára Pásztor-Huszár, László Friedrich*

**P2-37**

How to assure the safety and high quality of canned food products processed in water-cascade and water-spray retorts  
*Boguslaw Pawlikowski*

**Section 3: Emerging Technologies in Food Processing****P3-01**

Development and performance evaluation of a machine for removing essential oil from orange rind  
*Leo Ayodeji Sunday Agbetoye, Abraham O. Oloye*

**P3-02**

Studies on the system parameters of a locally developed extruder at different extrusion conditions  
*Folasayo Fayose, Agboola Simeon Ogunlowo*

**P3-03**

Biosensors and their applications in biology  
*Hamed Afshari*

**P3-04**

Iran strategy for using nanotechnology in packaging industry  
*Hamed Afshari*

**P3-05**

Physical properties of ultrasound treated whey protein suspensions with and without hydrocolloids addition  
*Anet Režek Jambrak, Vesna Lelas, Marija Badanjak*

**P3-06**

A new, low-cost, on-line RGB colorimeter for wine industry based on optical fibers  
*Cristina De la Torre, Rocio Muñiz, Beatriz Garcia, Miguel A. Perez*

**P3-07**

Application of optical fibers to true on-line turbidimeter for wine and other food industries  
*Miguel A. Perez, Rocio Muñiz, Cristina De la Torre, Beatriz Garcia, Luis Miguel Carcel, Raul Crespo*



**P3-08**

High hydrostatic pressure enhancement of isoamyl acetate biosynthesis in ionic liquid-alcohol biphasic system

*Michael Eisenmenger, José Reyes-De-Corcuera*

**P3-09**

Can the wine store container be part of the winemaking process?

*Ignacio Nevares, María del Álamo, Luis Miguel Cárcel, Laura Gallego, Raúl Crespo*

**P3-10**

Recovery of aroma compounds from model solution using pervaporation membrane

*Laszlo Hornyak, Edit Márki, Gyula Vatai*

**P3-11**

The original technology processing vegetative mass of buckwheat

*Anatoliy Kosyan, Nataliya Taran, Oksana Sytar*

**P3-12**

Shelf-life investigation of whey protein concentrate-rice bran oil coated kiwifruit (*Actinidia deliciosa*)

*Majid Javanmard*

**P3-13**

Shelf-life of whey protein concentrate-gellan coated apricots (*Prunus armeniaca* L.)

*Majid Javanmard*

**P3-14**

Pulsed electric fields to control microbial growth in raw milk

*Henry Jaeger, Dietrich Knorr*

**P3-15**

Three-dimensional measuring technique of bubble size distributions in ice cream

*Gabsoo Do, Yasuyuki Sagara, Hirofumi Kawanishi, Yeonghwan Bae*

**P3-16**

Infrared assisted microwave tempering of frozen foods

*Nadide Seyhun, Hosahalli Ramaswamy, Gulum Sumnu, Serpil Sahin, Jasim Ahmed*

**P3-17**

Temperature mapping of deep fried chicken strips using magnetic resonance imaging

*Isil Barutcu, Michael J. McCarthy, Young-Seob Seo, Serpil Sahin*

**P3-18**

Highbush blueberry (*Vaccinium Corymbosum* L, cv. C97-390) peroxidase: characterization and kinetics of thermal and high pressure inactivation

*Netsanet Shiferaw Terefe, Antoine Delon, Cornelis Versteeg*

**Section 4: Monitoring Technologies for in-situ Analyses in Bioprocesses****P4-01**

Comparison of two impact detecting devices to measure mechanical load on potatoes

*Feizollah Shahbazi, Martin Geyer, Ulrike Praeger, Claudia Konig, Bernd Herold*

**P4-02**

Applicability of chemiluminescence spectroscopy on the quality change of brown rice

*Motoyasu Natsuga, Kanichiro Yoshida, Chiaki Kanesawa, Wataru Matsuno, Hiroshi Ishii, Kazuo Tsukino*

**P4-03**

Estimation and on-line measurement of cow milk parameters to improve nutritional facts and quality of milk from farm side

*Rocio Muñiz, Miguel A. Perez, Carlos E. Carleos, Jesus A. Baro*

**P4-04**

Detection of oxidation processes in bovine raw milk using fluorescence spectroscopy

*Julia Durek, Björn Surowsky, Janina Saskia Wulf, Oliver Schlüter*

**P4-05**

Mastitis detection and prevention during milking process

*Antje Fröhling, Manuela Wienke, Sandra Rose-Meyerhöfer, Heide-Marie Lochotzke, Oliver Schlüter*

**P4-06**

Calibration models for online monitoring of syneresis in a cheese vat using broad-spectrum NIR reflectance over a range of milk fat level and gel firmness at cutting

*Maria Jose Mateo, Donal O'Callaghan, Colm O'Donnell*

**Section 5: Modelling as a Tool for Process Management****P5-01**

Application of weibull model for describing osmotic dehydration of mamey strips

*Otoniel Corzo, Nelson Bracho, Oscar Ramirez*

**P5-02**

An incremental adaptive procedure to modeling of viscoelastic contact problems in solid spherical fruits

*Mahdi Kasraei, Hoseyn Ashrafi*

**P5-03**

Mathematical modeling of the time-dependent poisson's ratio in linear viscoelastic solid fruits

*Mahdi Kasraei, Hoseyn Ashrafi*

**P5-04**

Mathematical model for microwave-assisted extraction used for the isolation of Platycodin from Platycodon radix

*Quancheng Zhou*

**P5-05**

Mathematical modeling of vacuum drying of Kabkab date paste

*Zahra Ashraf, Mohammad-Ali Sahari, Zohreh Hamidi*

**P5-06**

Non-destructive on-tree monitoring of *Prunus domestica*

*Janina Saskia Wulf, Michael Neumüller, Dieter Treutter, Manuela Zude*

**P5-07**

Application of different PLS methods for variable selection on Vis-NIR spectroscopy to determine pH and soluble solid content of syrup of plum

*Di Wu, Fang Cao, Yong He*

**P5-08**

Decision support system for osmotic dehydration process of tomatoes

*Gisele Anne Camargo, Mariângela Amendola, Nádia Schiavon Veiga*

**P5-09**

Simulation of malt roasting during microwave heating

*Suthida Akkarachaneeyakorn, Jean Claude Laguerre, Jirarat Tattiyakul*

**Section 6: Chemical Food Analyses in the Supply Chain****P6-01**

Chemical analysis of soybean methyl ester as biodiesel

*Hamid Mashhadi Meighani, Morteza Almasi, Hosein Bakhoda, Mehdi Mohsenifar*

**P6-02**

Comparison of physical and chemical properties of soybean methyl ester as biodiesel and diesel fuel

*Hamid Mashhadi Meighani, Morteza Almasi, Hosein Bakhoda, Mehdi Mohsenifar*

**P6-03**

Structural and rheological properties of Barijeh (*Ferula galbaniflua*) gum

*Jafar Milani, Zahra Emam-Djomeh, Manoochehr Hamed*

**P6-04**

Decision making about banana storage conditions based on the effect of temperature on quality

*Eva Domenech, Sebastian Martorell, Isabel Escriche*

**P6-05**

Study of volatile compounds in cagaita

*Lucia Maria Jaeger de Carvalho, Eduardo Lopes Motta, Nancy Barbi, Ediane Maria Gomes Ribeiro, Daniela Soares Viana, Mirian Ribeiro Leite Moura, Veronica Figueiredo*

**P6-06**

Migration from cap-coating material into liquid food via package headspace

*Gholamhassan Asadi*

**P6-07**

Deformation and impregnation properties of whole red and golden Delicious apples

*Hugo Mújica-Paz, Bertha Anabel Urquidi-Meléndez, Cynthia Mireya Sáenz-Hernández, Aurora Valdez-Fragoso*

**P6-08**

The change of phenolic substance distribution of rowanberry fruit during ripening

*Cem Baltacoglu, Sedat Velioglu, Ali Esin*

**Poster Session 2 (Tuesday 12:40 – Wednesday 12:40,  
Room: Regie 1 + 2, Floor 17)**

**Section 1: Modern Production and Postharvest Handling of Raw Material**

**P1-14**

Regulation and metabolic analysis for the fermentation of succinic acid from crop straw hydrolyte

*Shaotong Jiang, Xingjiang Li, Iijun Pan, Jiusong Sun, Zhaojun Wie*

**P1-15**

Controlling textural, microbiological and biochemical attributes of fruits and vegetables during prolonged storage prior to processing

*Jim Robertson, Elizabeth Sagers, Tim Brocklehurst, Klaus Wellner, Keith Waldron*

**P1-16**

Drying characteristics of scallop

*Yoshiki Muramatsu, Akio Tagawa, Eiichiro Sakaguchi*

**P1-17**

Production of cellulases by filamentous fungi and characterization of the crude enzyme

*Sonia Couri, Selma da Costa Terzi, Antonio Xavier Farias, Marcelo Fraga, Vanessa Cristina Peixoto, Mônica Caraméz Triches Damaso Damaso*

**P1-18**

Screening of lipolytic filamentous fungi and study of lipase production using three different reactors

*Carolina Gomes Moreira, Mônica Caraméz Triches Damaso Damaso, Romulo Cardoso Valadão, Sonia Couri*

**P1-19**

Sensory study of astringency threshold in persimmon after tannin removing treatment

*Daniela De Grandi Castro Freitas, Augusto Cesar Vieira Neves JR, Antonio Gomes Soares, Marcos J. Oliveira Fonseca, Regina Celi Cavestré Coneglian*

**P1-20**

Nutritional and antioxidant characteristics of tomato fruit during ripening

*Elhadi Yahia, Dulce Maria Rivera*

**P1-21**

Nutritional content and anti-oxidant capacity in ten cultivars and lines of prickly pear cactus fruit

*Elhadi Yahia, Candelario Mondrago-Jacobo*

**P1-22**

Mechanical system control in biological farming for protected crops

*Lorenzo Maria M. Abenavoli, Giuseppe Sciarrone*

**P1-23**

Effect of moisture content on physical properties of canadian flaxseed

*Rama Chandra Pradhan, Venkatesh Meda, Satya Narayan Naik*

**P1-24**

Interactive effects of genotype and fertilizer application on the flour making properties of cassava roots

*Taofik Shittu, Lateef Sanni, Samuel Awonorin, Bussie Maziya-Dixon, Alfred Dixon*

**P1-25**

Effects of essential oils on sprout suppression and global quality of potatoes cv Monalisa

*David Gomez-Castillo, Cristina Arroqui, Paloma Virseda*

**Section 2: Food Processing with respect to Product Quality and Safety****P2-38**

Microstructure and flowability parameters of starches

Mateusz Stasiak, Marek Molenda, Jozef Fornal, Wioletta Błaszczak

**P2-39**

Antioxidant and free radical-scavenging activities of rapeseed protein hydrolysates

*Mu Pan, Shaotong Jiang, Lijun Pan*

**P2-40**

Methods of funding for the industrial application of experimental food production and conservation techniques

*Kharla Segovia Bravo, Ismael Almazan, Oonagh Mc Nerney*

**P2-41**

Application of NMR & MRI in food quality and stability improvement

*Yun Li, Xiangyang Lin, Yuhuan Liu, Yiqin Wan, Paul Chen, Roger Ruan*

**P2-42**

Solar drying of food materials: developments and potentials

*Bilash Kanti Bala, Serm Janjai*

**P2-43**

A novel method of Pattern recognition for honey source base on visible/near infrared spectroscopy

*Yan Yang, Yong He, Hai-Qing Yang, Peng-Cheng Nie*

**P2-44**

Aeration behavior evaluation in a horizontal silo utilizing CFD tool

*Gabriel Henrique Horta de Oliveira, Fábila Martins Carvalho, Márcio Arêdes Martins*

**P2-45**

Analysis of residual Bisphenol A, Bisphenol F and their epoxy derivatives in food cans coating by high performance liquid chromatography

*Lanfang Zhang, Hong Zhang, Ming Xue, Jia-zheng Miao*

**P2-46**

Characterization of collagen from the skins of Anglerfish (*Lophius litulon*) and other species fish: a comparative study

*Lanfang Zhang, Hong Zhang, Suzhen Zhuo*

**P2-47**

Simultaneous determination of 13 quinolones in fish tissue by high-performance liquid chromatography with fluorescence

*Lanfang Zhang, Xiaoli Bao, Hong Zhang*

**P2-48**

Non-destructive monitoring procedure based on qPCR for the estimation of aerobic microbial load on minimally processed lettuce

*Perla Gomez, Magali Pagnon, Marcos Egea-Cortines, Francisco Artes Calero, Julia Weiss*

**P2-49**

Adjusting steam deacidification parameters for oil quality improvement

*Simone Monteiro Silva, Klicia A. Sampaio, Thiago Taham, Silvana A. Rocco, Roberta Ceriani, Antonio J. A. Meirelles*

**P2-50**

Effect of microwave pasteurization on orange juice color and carotenoid pigments

*Luciano Cinquanta, Alessandra Fratianni, Lucia Stoduto, Gianfranco Panfili*

**P2-51**

Effect of homogenisation of milk on physico – chemical properties of Kunda

*L Mahalingaiah, S. Kulkarni, B.V. Venkateshaiah, K. Jayaraj Rao*

**P2-52**

Extraction and chemical characterization of mucilage from mesquite, aloe vera, maguey and prickly pear cactus cladodes (nopal) and evaluation of its prebiotic effect on the growth of 2 probiotic bacteria

*Elhadi Yahia*

**P2-53**

The antioxidant capacity in 40 horticultural commodities and correlation with the content of phenolic compounds and carotenoids

*Elhadi Yahia, Azucena Barrera*

**P2-54**

Textural characteristics of probiotec yoghurt produces by transglutaminase addition

*Jelena Šarovic, Spasenija Milanovic, Mirela Ilićic, Katarina Durakovic, Mladenka Pestoric*

**P2-55**

Effect of *Lactobacillus casei* on fatty acids in models of ripening cheese slurry

*Anna Bzducha-Wróbel, Mieczysław Obiedziński*

**P2-56**

Durum wheat bread: old Sicilian landraces and new varieties

*Giulia Gallo, Marisol Lo Bianco, Rosaria Bognanni, Giuseppe Saimbene, Anna Orlando, Oscar Grillo, Rossella Saccone, Gianfranco Venora*

**P2-57**

Sourdough effects on the crumb texture and shelf-life evaluated with dynamometer and Image analysis measurements in the Dittaino Pagnotta P.D.O., a durum wheat bread produced by a Sicilian bakery industry

*Mohammad Ali Doust, Benedetto Rizzo, Biagio Pecorino, Oscar Grillo, Rossella Saccone, Gianfranco Venora*

**P2-58**

The path of food safety in tuna production chain

*Giuseppe Sciarrone, Lorenzo Maria M. Abenavoli*

**P2-59**

Studies upon the influence of some macro elements on the quality and durability of yogurt

*Florina Radu, Aurica Borozan, Vasile Gherman*

**P2-60**

Effect of F0-value and retort temperature on quality in Thai red curry pate

*Pimpen Pornchalermpong, Sudathip Inchuen, Samak Rakmae*

**P2-61**

Changes on dough rheological properties and bread quality as result of addition soy isolate and starter acidity on sour dough bread

*Josue Peñaloza-Espinosa, Rosalva Mora-Escobedo, Georgina Calderón-Domínguez*

**P2-62**

Sweet bread crumb structure characterization and their relation with fractal texture evaluated by image analysis

*Reynold Farrera-Rebollo, Jorge Chanona-Pérez, Gustavo Gutiérrez-López, Georgina Calderón-Domínguez*

**P2-63**

Extra virgin olive oil phenolic concentration as a function of mixing speed during malaxation: preliminary results

*Piernicola Masella, Alessandro Parenti, Paolo Spugnoli*

**P2-64**

Effects of short-term and long-term changes in water status on produce texture

*Werner B. Herppich, Sandra Landahl, Martin Geyer, Bernd Herold, Oliver Schlüter*

**P2-65**

Application of digital imaging to evaluate slicing quality on fresh cut produce

*Werner B. Herppich, Martin Geyer, Bernd Herold, Oliver Schlüter, Bela Borsa, Zoltan Gillay*

**P2-66**

Antimicrobial activity of whey protein based edible films with essential oils incorporated

*Idoya Fernández-Pan, Maite Royo, Juan Ignacio Maté*

**P2-67**

Comparison between defatted and non defatted grape seeds extracts

*Gabriel Davidov, Iñigo Arozarena, Remedios Marín*

**P2-68**

Study of two parameters of cooking quality in rice

*Marta Gazolaz, Inigo Zarena, Paloma Virseda*

**P2-69**

Influence of organic matter on sanitation during vegetable washing

*Martin Geyer, Karin Hassenberg, Oliver Schlüter*

**P2-70**

Isohalic sorption isotherms of codfish

*Regina Nabais, Rui Costa, Joana Dias*

**P2-71**

Determination of the potential of essential oils of *Clausena anisata* and *Plectranthus glandulosus* to ensure the post harvest keeping and safety quality cereal grains

*Carl Mbofung*

**P2-72**

Evaluation of the potential of bambara groundnut (*Voandzea subterranea*) powders as ingredient for the preparation of Koki

*Carl Mbofung*

**P2-73**

Taro (*Colocasia esculenta*) powder and pudding quality as influencing by processing methods

*Carl Mbofung*

**P2-74**

Effects of pulsed electric field and elicitors on productions of phenolic acids and anthocyanins from grape (*Vitis vinifera*) cell culture

*Zhenzhen Cai, Heidi Riedel, Nay Min Min Thaw Saw, Kavitha Ravichandran, Inga Mewis, Iryna Smetanska*

**Section 3: Emerging Technologies in Food Processing****P3-19**

Functional properties of protein hydrolysates from poultry by-products produced by Alcalase

*Ali Taheri, Ali Motamedzadegan, Abdolmohammad Abedian*

**P3-20**

Prediction of oil content in tortillas chips using computer vision

*Silvia Matiacevich, Monica Inostroza, Domingo Mery, Franco Pedreschi*

**P3-21**

High pressure effect on papaya purée antioxidant activity

*Fernanda Branco Shinagawa, Amauri Rosenthal, Rosires Deliza, Julia Hauck Tiburski, Maria Alice Zarur Coelho*

**P3-22**

Detection of xenon gas hydrate formation in onion tissue for the application to chilling temperature storage

*Hiroko Ando, Toru Suzuki, Yoshinori Kawagoe, Yoshio Makino, Seiichi Oshita*

**P3-23**

Effect of active ultrasound treatment on the tenderness of beef during the aging process

*Csilla Vén, Laszlo Friedrich, Krisztina Horti, Csaba Balla*

**P3-24**

Production of the lactic acid by *Rhizopus oryzae* using semi-continuous fermentation

*Shaotong Jiang, Xuefeng Wu, Lijun Pan, Jing Liu, Wei Du, Qiaolan Zhang*

**P3-25**

Use of hydrolysates from yellowfin tuna (*Thunnus albacares*) heads as a complex nitrogen source for lactic acid bacteria

*Ali Motamedzadegan, Mahmoudreza Ovissipour, Reza Safari, Asbjorn Gildberg, Barbara Rasco, Joe M. Regenstein*

**P3-26**

Comparative study of the separation of eleven selected quinolones on three HPLC columns and one UPLC column

*Lanfeng Zhang, Hong Zhang, Si Chen*

**P3-27**

Small-scale wet expanded preservation key technology of rice bran

*Lanfeng Zhang, Shaohua Li, Shujun Li, Ziming Li, Hai Xiang, Haijun Zhou, Shuzhen Hu*

**P3-28**

Detection of fungal infestation in citrus fruits using hyperspectral imaging

*Jose Blasco, Juan Gomez-Sanchis, Nuria Aleixos, Sergio Cubero, Florentino Juste, Enrique Molto*



**P3-29**

Crispness detection by the evaluation of force-displacement characteristics - correlation to pore size distributions

*Marc Regier*

**P3-30**

Effect of ultrasonic waves on flux enhancement of milk microfiltration

*Toraj Mohammadi, A Mirzaie*

**P3-31**

Inactivation of *Bacillus atrophaeus* spores and Pixuna Virus by a combination of high pressure, heat and chemical reagents

*Thomas Wiezorek, Alexander Mathys, Bärbel Niederwöhrmeier, Hans Jürgen Marshall, Dietrich Knorr*

**P3-32**

One step partial purification of  $\beta$ -galactosidase from *Kluyveromyces lactis* using microemulsion droplets

*Bekir Gökçen Mazi, Stephanie R. Dungan, David M. Ogrydziak, Haluk Hamamcı*

**P3-33**

Bovine cathepsin D activity under high pressure

*Roman Buckow, Binh Quong Truong, Kees Versteeg*

**P3-34**

Comparative study of different antibrowning treatments in fresh-cut potato (cv. Monalisa)

*Gloria Bobo, Cristina Arroqui, Paloma Virseda*

**P3-35**

Application of planetary roller extruders for food and non-food processing

*Jürgen Volk*

**Section 4: Monitoring Technologies for in-situ Analyses in Bioprocesses****P4-07**

Determination of polyphenols by means of nondestructive fluorescence analysis in oil inside olive genetic breeding programmes

*Aurelio Gracia, Manuela Zude, Lorenzo León Moreno*

**P4-08**

Differentiation of Spanish honeys by potentiometric electronic tongue

*Melinda Kádár, Luis Gil, Eva Domenech, Juan Soto, Isabel Escriche*

**P4-09**

Effect of deviation in storage temperature on the shelf life of a food product

*Kevin Cronin, Pramod Mahajan*

**P4-10**

Device for composition, concentration, and volume batching of food liquids

*Georg Gutt, Sonja Gutt*

**P4-11**

Contributions in wines quality determination by a modular portable spectroscopic system

*Sonia Gutt, Georg Gutt*

**P4-12**

Detection of milk coagulation using ultrasonic technique

*Takahisa Nishizu, Sae Okabe, Kiyokazu Goto*

**P4-13**

Optoelectrical systems for fresh-cut salads evaluations. a preliminary study

*Antonia Lai, Federico Pallottino, Maria Sighicelli, Paolo Menesatti*

**P4-14**

Graphical representation method of discharging profile of agro-food bulk solids extracted with geometric variable design screw feeders

*Daniel Calin Ola, Christian Füll*

**Section 5: Modelling as a Tool for Process Management****P5-10**

Optimizing conditions of smoked operation to obtaining chipotle peppers

*Cynthia Berenice Gómez-Moriel, Armando Quintero-Ramos, Alejandro Camacho-Dávila, Ricardo Talamás-Abbud, Ramón Olivas-Vargas*

**P5-11**

Selecting the most suitable packaging technology for liquid foods using an analytic network process model

*Eleonora Bottani, Roberto Rizzo, Giuseppe Vignali*

**P5-12**

The extraction of essential oils by instant autovaporization

*Colette Besombes, Karim Allaf*

**P5-13**

Heat transfer modeling in soft foods inline processes by fractals meteorology

*Juan Antonio Cañumir-Veas, Rudi Radrigán*

**P5-14**

Kinetics of CO<sub>2</sub> production of blueberries (*Vaccinium corymbosum* L.) 'Elliott' harvested from conventional and organic orchard

*Juan Antonio Cañumir-Veas, Jans Rivas-Goudet*

**P5-15**

Study on chlorophyll distributing rule of rice and its nitrogen status quantification using Vis/NIR spectroscopy

*Yongni Shao*

**P5-16**

Fast discrimination of varieties of liquorice using visible and near infrared spectroscopy based on principal component analysis and back propagation neural network model

*Peng-Cheng Nie, Yong He, Ke Zhao, Wie Zhang*

**P5-17**

Steam deacidification of the model system of refined palm stearin + refined palm olein + oleic acid

*Klícia Araújo Sampaio, Thiago Taham, Simone Monteiro Silva, Roberta Ceriani, Antonio J.A. Meirelles*

**P5-18**

Application of Monte Carlo simulation in estimation of anisotropy of fruit tissue

*László Baranyai, Christian Regen, Martin Geyer, Manuela Zude*

**Section 6: Chemical Food Analyses in the Supply Chain****P6-09**

Characterization of Cupuaçu (*Theobroma grandiflorum*) pulp  
*Ana Cristina Souza*

**P6-10**

Determination of tannin and total amino acid contents in tea for taste assessment by a fluorescent analyzer  
*Tzong-Jih Cheng, Yueh-Tzu Hung, Po-Chung Chen, Chen Richie L.C.*

**P6-11**

Influence of feed on meat quality of broiler chicken  
*Kristine Ramane, Ruta Galoburda*

**P6-12**

Assessment of oxidases activities in different parts of cereals  
*Daniela Balan, Florentina Israel-Roming, Gabriela Luta, Evelina Gherghina, Gheorghe Campeanu*

**P6-13**

Influence of hydric stress on some valuable biocompounds in cereals grains  
*Gabriela Luta, Evelina Gherghina, Florentina Israel Roming, Daniela Balan, George Musat, Gheorghe Campeanu*

**P6-14**

ISEKI\_Mundus – a base to foster international exchange of expertise in food safety research  
*L. McIntyre, Andrew Hudson, Craig Billington, Antje Fröhling, Oliver Schlüter*

**P6-15**

Investigation of internal gas in apple tissue  
*Hana Opatová, Jana Schovánková, David Balcar*

**Oral**  
**Session 1 – 16**

## Nanotechnology for the Food and Bioprocessing Industry

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Several engineering and scientific challenges in the food and bioprocessing industry for manufacturing high quality and safe food through efficient and sustainable means can be solved through nanotechnology. Bacteria identification and food quality monitoring using biosensors; intelligent, active, and smart food packaging systems; nanoencapsulation of bioactive food compounds are few examples of emerging applications of nanotechnology for the food industry. We review the background about the potential of nanotechnology; provide an overview of the current and future applications of nanotechnology relevant to food and bioprocessing industry; and identify the societal implications for successful implementation of nanotechnology.

**Keywords:** Nanotechnology. Food. Bioprocessing. Nanosensors. Antimicrobial packaging. Nanoencapsulation

## Drying technology: trends and applications in postharvest processing

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Thermal drying technologies have attracted significant R&D effort owing to the demands for improved product quality and reduced operating cost as well as diminished environmental impact. Drying materials may appear in the form of wet solid, liquid, suspension or paste, which require drying for extended period for storage, ease of transportation and for downstream processing to produce value added products and higher value addition. Most of these materials are heat sensitive and thus require careful drying technique; conventional hot air drying can be detrimental to bio-active ingredients aside from the fact that these techniques often are more energy-intensive. It is well known that higher temperatures tend to damage and denature the product, destroy active ingredients, cause case hardening and discoloration etc. In this presentation we will discuss briefly some of the emerging drying methods and recent developments applicable in postharvest processing. These include heat pump-assisted drying with multi-mode and time-varying heat input, low and atmospheric pressure superheated steam drying, modified atmosphere drying, intermittent batch drying, osmotic pretreatments, adsorbent drying, MW-vacuum drying etc. Areas requiring further R&D will also be identified including large scale utilization of renewable energy for dehydration.

## Emerging Technologies in Food Processing

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This presentation will concentrate on the impact and the potential of gentle processing techniques such as high hydrostatic pressure (HP) or high intensity pulsed electric field treatment (PEF) and ultrasound (US) along the entire food chain.

It will review the position of the European Technology Platform: Food for Life, a European research vision until 2020 and beyond and will present the Berlin/Brandenburg Center for Preventive Foods as a German example for food chain integrated research activities.

The role of process induced stresses will demonstrated their impact on secondary metabolite production in fresh fruits, vegetables and oilseeds.

The effect of PEF and US for the recovery of proteins will be shown. Examples for process developments such as HP blanching, HP pasteurization, PEF pasteurization, HP sterilization and HP - low temperature freezing and thawing will be provided.

Examples for structure engineering of food systems via HP and US as well as combination process and the use of PEF for sludge treatment will be given. The research challenges and needs for these technologies will be discussed and finally sustainability issues such as energy preservation and water reduction in food processing will be presented.

## Hyperspectral imaging technology for food quality and safety evaluation and inspection

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Over the years, optical sensing technologies have been investigated as potential tools for non-destructive evaluation and inspection for food quality and safety. In particular, methods based on two mature technologies of imaging and spectroscopy have been widely studied and developed, resulting in many successful applications in the food industry. However further development of these conventional imaging and spectroscopy techniques is limited by their inability to obtain sufficient information from individual food items. Therefore by taking the most useful characteristics of these two mature technologies: imaging and spectroscopy, hyperspectral imaging (or imaging spectroscopy) has emerged as a technology with great potential for effective and non-destructive quality and safety evaluation and inspection in the area of food processing. A conventional imaging system or more specifically computer vision is a common technique for detecting surface features. The system normally consists of lighting and an area detector, with the light source providing illumination to the sample and the area detector capturing mixed spectral contents from the sample. Spatial information of the sample is obtained in the forms of monochromatic or colour images, therefore conventional imaging system is used for colour, shape, size, surface texture evaluation of food products and for surface defects detection in food inspection, however it cannot identify or detect chemical properties or characteristics from a food product. On the other hand, conventional spectroscopy system is a technique for evaluating chemical properties or characteristics of food products. Such a system generally includes a light source, a wavelength dispersion device, and a point detector. In this system, light is dispersed into different wavelengths after interaction with the sample in order for the point detector to collect the dispersed light to obtain spectral information from the sample. As the point detector has its size limitation, conventional spectroscopy system cannot cover a large area or a small area with high spatial resolution. Therefore the technique does not provide the spatial information which is regularly required for and is critical in food inspection. With the integration of the main features of imaging and spectroscopy, hyperspectral imaging can simultaneously acquire both spatial and spectral information that is critical to the detection of food safety and evaluation of food quality attributes. A typical hyperspectral system consists of a light source, a wavelength dispersion device, and an area detector. The images are acquired over the visible and near-infrared (or infrared) wavelengths to specify the complete wavelength spectrum of a sample at each point in the imaging plane. These images are then combined and form a three dimensional hy-



perspectival cube, with two dimensions for describing spatial information and the third one for spectral information. In this hypercube, each spectral pixel corresponds to a spectral signature (or spectrum) of the corresponding spatial region, recording the entire measured spectrum of the imaged spatial point. Therefore the measured spectrum indicates the ability of the sample in absorbing or scattering the exciting light, representing the inherent chemical properties of a sample. As a result, the technology provides us with unprecedented detection capabilities, which otherwise cannot be achieved with either imaging or spectroscopy alone. If conventional imaging is to provide the answer to the question of where and conventional spectroscopy is to provide the answer to the question of what, hyperspectral imaging is a technique to provide the answer to the question of where is what. Hyperspectral imaging techniques have received much attention for food quality and safety evaluation and inspection. Many approaches and applications have shown the usefulness of hyperspectral imaging in the food industry. These applications include meat quality assessment, automated poultry carcass inspection, quality evaluation of fish, bruise detection of apples, quality analysis and grading of citrus fruits, bruise detection of strawberry, visualization of sugar distribution of melons, measuring ripening of tomatoes, defect detection of pickling cucumber, and classification of wheat kernels. Interested readers are advised to refer to the following list of publications for further information.

## Non-invasive analyses of anthocyanins and carotenoids in cherry by means of continuous wave and time-resolved spectroscopy

Manuela Zude<sup>1</sup>, Michael Pflanz<sup>1</sup>, Carsten Dosche<sup>2</sup>, Lorenzo Spinelli<sup>3</sup>,  
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In high-value cherry (*Prunus avium*), the red color - determined by the anthocyanins and carotenoids contents - is correlated with the fruit ripeness stage. Presently applied color readings are, however, exclusively feasible in fruits developing marginal amounts of chlorophylls as well as stable ratio of anthocyanins and carotenoids influencing the apparent signal. Non-invasive spectroscopy has been introduced in practice for some years now and may serve as a more reliable method for measuring the ripeness-related pigment development. From the fruit spectrum, the carotenoids, chlorophylls, and anthocyanins contents can be analyzed separately at their specific absorbance wavelengths. A drawback of the method is the need for recalibration due to changes in the optical properties of the fruit tissue during ripening. In the present study, the influencing factors on the fruit remittance spectrum (cw) regarding coinciding absorptions of the pigments and varying fruit scattering coefficient were addressed. Additive effects of pigment absorptions were analyzed by means of iterative multiple linear regression, while the influence of scattering coefficient was corrected with the effective pathlength in the fruit tissue obtained with distribution of time-of-flight (DTOF) readings as well as total internal reflectance (TIRF) analysis. Pigment analyses according to Lambert-Beers law taking into account the effective pathlength was validated on a test-set of economically important cherry cultivars. The measuring uncertainty when analyzing phantoms with non-invasive spectroscopic method in comparison with combined application of cw, DTOF, and TIRF measurements showed a bias reduction by 56% and  $r^2=0.99$ . The improved results were confirmed in pigment analysis of real-world samples.

## Application of near infrared spectroscopy for monitoring osmo-air dehydration processes of blueberries

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Osmo-air dehydration treatments are widely applied to fruits in order to prolong shelf-life, reduce packaging and logistic costs, and to maintain both sensory and nutritional quality of the end products. In this work osmo-air dehydration was applied to blueberries (*Vaccinium corymbosum*), a fruit that is gaining increasing attention due to its high content of dietary antioxidants, which have been proven to be associated with reduced risk of heart disease, cancer, and other chronic diseases. In particular, the aim of this study was to investigate the performance of NIR spectroscopy as a tool for monitoring blueberries osmo and air dehydration processes. Blanched blueberries were dipped in sucrose and fructose+glucose osmotic solutions for 24 hours, and the osmotic exchanges were determined by mass balances (water loss, solid gain, sugar intake, changes in total phenolics and anthocyanins); NIR spectra were collected in order to study molecular modifications due to the osmotic treatments. Untreated and osmo-dehydrated berries were subsequently air-dried at 70°C to final moisture content of 10-14%. During drying chemical, nutritional and structural changes were monitored and NIR spectra were acquired on whole berries during drying, using an optic probe working in diffuse reflectance. Spectral data were standardised, transformed into first derivative and processed by using principal component analysis. Results show that NIR spectroscopy was able to follow the drying process and to discriminate untreated and osmo-dehydrated berries, identifying the main molecular modifications associated with water absorption bands due to OH stretch + OH bending and sugar absorption bands due to CH stretch + CH bending, OH stretch + OH bending. In order to investigate the variation of main constituents (sugars and water) involved in the dehydration process, two-dimensional correlation analysis of spectral data was also carried out. Furthermore, spectral data were correlated with chemical data to obtain calibration models suitable for in-line process control.

## Monitoring of the moisture content during dehydration of parsley with near infrared spectroscopy

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Dried leaves of parsley (*Petroselinum crispum*) with optimal levels of moisture content are widely required by food industries to produce convenient food like instant soups. Near Infrared Spectroscopy (NIRs) offers potential to control the quality of finished products. For this study a conveyor belt dryer for medicinal and spice plants was used. The objective of this research was to prevent overdrying and resulting energy and quality loss during dehydration process of parsley bulk. To reach this goal, air temperature and velocity sensors were placed at various positions across the width of each belt inside the dryer in order to monitor the dehydration over time and to determine the influence of air velocity and temperature on the moisture content. Moreover, two NIR instruments were mounted on the dryer. One at the center of the feeder to measure the moisture content of the fresh incoming material, which was between 75% and 85% (w.b.) and the other one mounted at the exit of the drier, which gave readings of moisture content between 3% and 5% (w.b.) To protect the instrument from the high temperatures present at the dryer output, the NIR was equipped with a cooling system. Calibration was necessary to determine the relationship between the ratio of the absorbance of “near-infrared” radiation at 1450 nm and 1950 nm and the moisture content of the bulk. Additionally these non-destructive measurements of moisture content of parsley bulk during drying were high when correlated with those obtained using the destructive oven drying technique. Validation of NIR calibration for moisture determination and the predicted standard error were evaluated. We conclude that the NIR technique could have the potential for rapid and effective control of moisture content when dehydrating medicinal and spice plants.

## Determine pH and soluble solids content of morus juice using Vis-NIR spectroscopy with interval partial least squares and successive projections algorithm

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Visible and near infrared (Vis-NIR) spectroscopy was investigated to analyse the pH and soluble solids content (SSC) of morus juice. Sgolay smooth with span of five and degree of one combined with multiplicative scattering correction (MSC) was selected as the best pretreatment based on least square-support vector machine (LS-SVM)) with full-spectra. Successive projections algorithm (SPA) is a forward variable selection algorithm for multivariate calibration. The main purpose of this algorithm is to select wavelength variables which their information content is minimally redundant, in order to solve the collinearity problems. However, with intensities of full-spectra as input variables, the training procedure of SPA was time-consuming. As some wavelengths or wavelength bands in full spectral regions may contain irrelevant information, which can worsen the predictive ability of the whole model, it was necessary to select effective wavelength bands before SPA. Interval partial least square (iPLS) was used to achieve this purpose. Its principle is to split the spectra into smaller equidistant regions and, afterwards, develop PLS regression models for each of the sub-intervals and find out the best sub-interval wavelength band. In this study, full-spectral wavelength band was separated into five sub-intervals, and the wavelength bands from 375 to 517 nm and from 518 to 660 nm were selected as the best wavelength band for pH and SSC, respectively. SPA was then operated based on the selected wavelength band, and finally eight and nine wavelength variables were selected for pH and SSC, respectively. The selected wavelength variables were used to establish calibration models based on least square-support vector machine (LS-SVM). Prediction result of iPLS-SPA-LS-SVM was better than those of LS-SVM model with full-spectral wavelengths as inputs, iPLS-LS-SVM and SPA-LS-SVM. Its coefficient of determination,  $r^2 = 0.92$  and residual predictive deviation, RPD = 6.2 for pH, and  $r^2 = 0.91$  and RPD = 5.8 for SSC. High RPD values show the ability of the models to predict pH and SSC are good. Moreover, as the input variable number was reduced from 1025 to less than ten, the calculation process was simplified. The good performance showed a potential application using iPLS-SPA to select effective wavelengths. iPLS-SPA can both speed up the calculation and improve the predicted results. The results indicated that it was feasible to fast determine pH and SSC of morus juice using Vis-NIR spectroscopy.

## Classification of bee pollen using visible near infrared spectroscopy based on genetic algorithm

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The potential of visible and near infrared reflectance spectroscopy (Vis/NIRS) was investigated for its ability to non-destructive ly classify bee pollen varieties. A total of 90 bee pollen samples were used for Vis/NIRS on 325-1075 nm using a field spectroradiometer. Noise reduction, standard normal variate transformation and multiplicative scatter correction were applied for pre-processing of original spectral data. Genetic algorithm was used to search for features in mass spectrometry data, finally 15 characteristic wavelengths were obtained by genetic algorithm. The chemometrics of partial least squares regression analysis was performed on the 15 characteristic wavelengths spectral data abstracted by genetic algorithm. Through full cross validation, 7 principal components presenting important information of spectra were confirmed as the best number of principal components. Then, these 7 principal components were taken as the input of back propagation (BP) neural network. Through the training and prediction, 3 different kinds of bee pollen were classified according to outputs of BP neural network. With these results, it demonstrates that Vis/NIRS technique combined with chemometrics is promising for fast and non-destructive classify the varieties of bee pollen. It is also very useful in the field of food chemistry and further research on other materials.

## ***In-situ* analysis of meat by applying Raman diode-laser spectroscopy**

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As an optical method, Raman spectroscopy is well suited for non invasive and non-destructive analysis. The spectra provide deep information about the molecular structure and composition of the matter due to their fingerprinting nature. Here, we have applied Raman spectroscopy for the characterization of the ageing of meat. For this purpose pork chops (*musculus longissimus dorsi*) were stored refrigerated at 5°C and time-dependent Raman spectra were measured daily one day up to four weeks post mortem. For the development of portable in-situ Raman equipment small, stabilized and energy efficient laser sources are vital. In this project a prototype Raman probe for meat was constructed featuring a miniaturized optical bench combined with a customized diode laser in a handheld device. This laser was realised as micro-system external cavity diode laser (ECDL) emitting at 671 nm with a total dimension of (13 x 4 x 1) mm<sup>3</sup>. The ECDL system includes a broad area gain material, micro-optics for beam shaping and a reflecting Bragg grating for wavelength stabilization. As results of the time-dependent investigations with this prototype laser scanner, the Raman spectra preserve their basic spectral features which identify the samples as meat throughout the entire period of one month. However, small changes of the protein Raman signals occur during maturation and ageing. The time correlation of the complex spectra was analysed with multivariate statistical methods such as principal components analysis. Thus a distinction of spectra was found on the time scale between day 8 and 10 on average. This corresponds to the transition from ripened meat to meat at and beyond the limit of edibility. The changes of the Raman spectra are related to the physical and chemical changes during maturation and ageing. The potential usefulness of portable Raman spectroscopy for in-situ food control will be discussed.

## Evaluation of fatty acid profile of Wagyu beef by ATR-FTIR spectroscopy

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Characteristics of beef fat affect taste, flavor and mouth-feel of beef. Fat characteristics are chiefly originated from the marbling and fatty acids composition of triacylglyceride, fat. Japanese black wagyu beef has the characteristics of its excellent marbling and high percentage of oleaginous unsaturated fat which produce a high market value. Information about fatty acids of beef fat is signified for not only grading of carcass but also genetically breeding and feeding. The objectives of this study are to develop a non-destructive and quick measurement method of fatty acid composition and the content of fatty acids by attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy. Spectra of fatty acid regents such as oleic, linoleic and linolenic acids and beef fat (intramuscular, intermuscular and subcutaneous fat) of Wagyu beef were measured with an ATR-FTIR instrument, Bomem MB3000 at wave number range of 600 to 4000  $\text{cm}^{-1}$ . Resolution in wave number and the number of scans (the accumulation of scans) were set as 2  $\text{cm}^{-1}$  and 32 respectively. Specific spectra of fatty acids and fat were found at the region A of 2900 - 3050  $\text{cm}^{-1}$  and at the region B of 1400 - 1900  $\text{cm}^{-1}$ . Four peaks at the region A and distinct shifts of spectra peaks were found and the peak shift depended on the number of carbon-carbon double bond of fatty acid molecular. A similar relationship was also found at the region B. Spectra of fat were found between the peaks of the above fatty acid. Specific relationship between peaks of fatty acids and fat were recognized. Therefore, those peak shifts could provide information about the variety of main fatty acid component and could estimate the content of fatty acids in beef fat.



## Discrimination of time effect of high voltage electric field to oilseed using near infrared spectroscopy

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The time effect of high voltage electric field to oilseed was discriminated using near infrared spectroscopy combined with different calibration methods. The treatment of high voltage electric field influences the internal chemical compositions of oilseed, and high voltage electric field also influences the characteristics of oilseed rape during the growth. The effect was related to the time used for treatment. The voltage for processing was 5000 V, and the time used was 0, 2, 4, 8 min. Near infrared spectroscopy was used to discriminate the different time effect of high voltage electric field. A total of 240 samples were prepared with 60 samples for each time processing. The calibration set was composed of 180 samples (45 samples for each time), and the remaining 60 samples were used as validation set. Different preprocessing methods were used for performance comparison, such as smoothing, standard normal variate (SNV), first and second derivative. The calibration method was least squares-support vector machine (LS-SVM). In the LS-SVM model, three problems should be first settled, and these were the inputs, kernel function and determination of model parameters. In this paper, the inputs were settled by the principal component analysis (PCA) and successive projections algorithm (SPA). PCA could provide the scores of PC which could represent the most relevant information of original spectral data. SPA could select several effective wavelengths with least collinearity and redundancies. The kernel function was radial basis function (RBF). The model parameters of  $\gamma$  and  $\sigma^2$  were determined by a two-step grid search technique. The correct discrimination ratio was used as performance evaluation indices. Finally, the discrimination models were developed by PCA-LS-SVM and SPA-LS-SVM. The expected discrimination ratio could be more than 85%. The results indicated that near infrared spectroscopy combined with chemometrics could be applied for the discrimination of time effect of high voltage electric field to oilseed. This study provided a new way for the effect study of high voltage electric field to oilseed and the growing status of oilseed rape.

## Quality assessment of Turkish butter using FTIR spectroscopy and chemometrics

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Quality of butter is important to traditional Turkish food, especially for baklava. This study explores the potential of wet chemical along with FTIR spectroscopic techniques to authenticate and classify baklava grade butter. Baklava experts at Güllüoğlu, Karaköy Food Company made the sensory evaluation of butters to classify baklava grade butters. Fatty acid profile and level of unsaturation were analyzed using gas chromatography and peroxide value methods. FTIR was employed to obtain fingerprint information of baklava grade butter. Information from wet chemical techniques and FTIR fused together to develop a multivariate pattern recognition model to classify baklava grade Turkish butter. C=C and ester bonds were picked as the markers to classify butters. Margarine adulterated butters were also classified based on the percentage of adulterant using FTIR and chemometrics. Canonical variate analysis was applied to develop a classification rule to discriminate butter samples according to the extent of adulteration. This study has shown the potential of FTIR in rapid assessment of the quality of butter for two practical reasons: i) detection of butter adulteration, and ii) classification of baklava grade butter.

## Fast determination of melamine content in milk powder base on NIR /MIR spectroscopy method

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The melamine is bad to human health, because isocyanate and melamine reaction will create the crystals which hinder the kidney function. In 2008, there were emerging multi-baby cases of gallstone disease in China, as the investigation revealed that the baby ate a low-grade infant milk powder, and the poor-quality milk powder contained melamine. In order to quickly and accurately detect the adulteration of melamine in milk powder, the spectra of milk powder within near infrared (NIR) and mid-infrared (MIR) spectral region was studied in this paper. The milk powder was obtained from the market, and the milk powder had been authenticated by China National Quality Inspection Bureau. Different portion of melamine was adulterated into pure milk powder, and the adulterated milk powder was dissolved, mixing round the sample to make the melamine distribute in the milk powder uniformity, and then the samples were dried. A total of 100 samples were prepared and the spectra were collected by a FT/IR-4000 Fourier transform infrared spectrometer. Different preprocessing methods were carried on the spectrum data, such as standard normal variate (SNV), multivariate scatter correction (MSC) and smoothing of moving average. Different calibration models were established and the performance of these models were compared with different preprocessing methods. After comparison, SNV was found to be the most appropriate spectral preprocessing method. 75 samples were randomly selected from 100 samples to be the calibration set, the remaining 25 samples were used as validation samples. Two discriminant analysis models were developed using partial least squares (PLS) method and least squares-support vector machine (LS-SVM) method respectively. The performance was validated by the samples in the validation set. The correlation coefficients ( $r^2$ ) between the real values and predicted ones by discriminant analysis models were 0.8802 (PLS), 0.9109 (LS-SVM), respectively. The root mean standard error of prediction (RMSEP) by PLS and LS-SVM were 0.9786 (PLS), 0.9526 (LS-SVM), respectively. The result indicated that NIR/MIR method could provide rapidly and accurately determination for melamine in milk powder.

## Acrylamide mitigation in potato chips by using NaCl

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Acrylamide is known to cause cancer in laboratory animals but there is no direct evidence that this substance causes cancer in humans. In April 2002, Swedish researchers shocked the world when they presented preliminary findings on the presence of acrylamide in fried and baked foods, most notably potato chips and French fries, at levels of 30–2300 ppb. The objective of this research was to study the effect of immersing potato slices in a NaCl solution over acrylamide formation in the resultant potato chips. Potato slices (Verdi variety, diameter: 40 mm, width: 2.0 mm) were fried at 170°C for 5 min (final moisture content of 2.0%). Prior to frying, potato slices were treated in one of the following ways: (i) Blanching in hot water at 90°C for 5 min; (ii) Immersion in a 3% NaCl solution at 25°C for 5 min; (iii) Blanching in hot water at 90°C for 5 min plus immersion in a 3% NaCl solution at 25°C for 5 min; (iv) Blanching in hot water at 90°C for 5 min plus immersion in a distilled water at 2°C for 5 min. Raw potato slices were used as control. Blanching reduced acrylamide content of potato chips in 12%. On the other hand, when potato slices were immersed in salt solution, acrylamide formation decreased only in 3%. Interestingly, when blanched potato slices were immersed in NaCl solution and then fried, acrylamide concentration of potato chips decreased in 66%. Blanching seems to make easier NaCl diffusion in potato tissue leading to a significant acrylamide concentration the potato slices after frying.

## Wheat bread with hull-less barley grain additive: its quality and microbiological safety

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In food industry hull-less barley is acknowledged as more valuable and more economical comparing with covered barley. The hull-less barley flour has a little darker colour, comparing with flour from soft wheat because it has a higher ash value, higher protein and  $\beta$ -glucan's content. Soluble dietary fiber, mainly  $\beta$ -glucans, provides better viscosity; as a result, digestion, cholesterol and fat absorption were decreased. A higher content of natural antioxidants such as tocopherol and tocotrienols, as well as vitamin E, was established in barley grain, comparing with wheat and rye grain. Albumen content in hull-less barley grain is from 9 to 20%. The main purpose of the current research was to develop a new type of wheat bread with splitted hull-less barley grain additive and to investigate the quality and microbiological safety of the new product immediately after baking and during its storage. The standard methods<sup>1</sup> were used to determine the amino acids profile, fatty acid composition, the vitamin content (B<sub>1</sub>, B<sub>2</sub>, C, E), albumins, fats, sugars, possible contamination with fungi and produced mycotoxins. Bread samples were placed in plastic pouches with barrier properties in air ambience (a control sample), modified atmosphere ambience (MAP) (CO<sub>2</sub> 30% + N<sub>2</sub> 70%) and in air ambience with ethyl alcohol vapour addition (0.03%). The bread samples were stored at temperature +22±2°C and the shelf life was determined. During storage the following properties were analyzed: hardness of bread soft part, moisture content of bread soft part and crust, and changes of titrated acidity. During the experiments it was detected, that it is possible to replace 30% of wheat flour with splitted hull-less barley grains. A recipe for the new product preparation and technological scheme was developed. The presence of mould fungi *Fusarium* spp. was not detected in wheat dough with grain additive. The new bread with splitted hull-less barley grain additive has increased nutritive value. The bread samples (control sample and sample with grain additive) were not contaminated with mould fungi *Fusarium* spp., and the content of mycotoxins. DON, ZEN and T-2 were under the permissible level. The minimal changes of moisture content was detected in wheat bread with splitted hull-less barley grain additive packed in plastic bags with air and ethyl alcohol ambience as well as in MAP (CO<sub>2</sub> 30% + N<sub>2</sub> 70%). The change of titrated acidity of bread samples in plastic bags with various ambiences was not relevant. The minimal changes of hardness of bread soft part were found in bread packed in air ambience with ethyl alcohol vapour addition within the storage period.

## Effect of hypolipidemic on extracellular polysaccharide from the submerged fermentation of *Agaricus braziliensis*

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With the development of science and changes of lifestyle, it can be often seen that people are more apt to feel exhausted due to busier life, higher pressures and dining out more frequently, here is Taiwan. Besides, due to the more and more non-balanced nutrition, people are more likely to be overweighted and with higher cholesterol. According to statistics, cardiovascular disease is the world's leading cause of death. With the rise of health awareness, except diet control, supplement of health food is a trend to strengthen body function and keep in good health. *Agaricus braziliensis* contain a lot of  $\beta$ -glucan. Thus the main purpose of this study is to explore the *Agaricus braziliensis* liquid fermentation of mycelium submerged culture caused by hypolipidemic and cholesterol-lowering mechanism.  $\beta$ -glucan is a mixture of high molecular weight as much as polysaccharide, and it could decrease the body's cholesterol, lower blood lipids and delay the fatigue occurred, and to enhance the function of the body movements, as well as to speed elimination of fatigue. *Agaricus braziliensis* fermentation broth in production by liquid fermentation manufacturing, there is no issues on pollution of metal contamination, and no need to about security, meanwhile, by fixing factors on control and the environment, the quality can always remained stable. *Agaricus braziliensis* fermentation broth deployment into high, medium and low-dose concentration (100%, 50%, 20%), and to feed the mouse, the weight has gradually decreased. It can be referred that, after 14 days of the experimental, the weight of the mouse decreased 24.62% if high doses is used, which is more significant, followed by 24.01% of low-dose group, middle dose group 12.51%, and 6.72% in control group. The study results showed that *Agaricus braziliensis* fermentation broth help to reduce the weight of the mouse. If the fermentation broth can be treated as functional food capable of reducing the blood lipid, enhancing of immune function, as well as rapid recovery of the advantages of fatigue, maybe it will arouse people's more demanding on health.

## The effect of penetration depth and UV dose on the performance of UV-C disinfection process of white grape juice inoculated with *Escherichia coli* K-12

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In recent years increased requirements for fresh like food products and health concerns about unpasteurized fruit juice consumptions force the researchers to investigate new technologies which provide safe products, preserve the nutritional and sensorial quality of the foods. As an alternative to conventional heat pasteurization, treatment of fruit juices by UV-C is a cost effective operation. Besides, this new non-thermal technique eliminates the disadvantages of thermal treatments. The mechanism of the UV-C radiation includes the inhibition of transcription and replication of DNA molecules because of the formation of cross linked nucleic acids after the UV light exposure. USFDA has allowed the use of UV-C radiation in the processing of apple juice and recommended minimum a 5-log reduction in the most pertinent microorganism to the public health concern. Although, the technique has some limitations: the presence of suspended particles, penetration depth, absorbance of the liquid and UV dose. UV dose is the product of UV intensity and exposure time. The aim of this study was to investigate the effects of 2 different levels of penetration depth (0.153 cm and 0.5 cm) at 2 different UV intensity levels (1.32 mW/cm<sup>2</sup> and 0.38 mW/cm<sup>2</sup>) and 2 different exposure times (3 minutes and 10 minutes) in white grape juice samples inoculated with *E. coli* K-12 (ATCC 25253) (107-108 CFU/ml) using collimated beam apparatus. After the irradiation process serially diluted samples were inoculated onto the TSA medium by using spread plate technique. Plates were incubated at 37°C for 24 h. Microbial log reductions were determined by calculating the plate counts. All the experiments were performed within a UV dose range of 0-524.3 mJ/cm<sup>2</sup> and done in triplicate. The best result for the inactivation study was 5.07 log reduction of *E. coli* K-12 which was achieved at the minimum sample depth after the exposure to the highest UV dose value (524.3 mJ/cm<sup>2</sup>). When the sample depth was increased to 0.5 cm, maximum 4.49 log reduction was observed. This indicates that log survival number ascends as the penetration depth increases. A decline in the UV intensity value and the exposure time resulted in lower inactivation rate. Statistical analysis showed that penetration depth, exposure time and UV intensity are significantly effective factors on the inactivation of *E. coli* K-12 in white grape juice at 95% confidence level. It can be concluded that UV-C treatment is a promising method for decontamination of white grape juices.

## Product quality and safety in HoReCa sector

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HoReCa is a business term which refers to a sector of the food service industry. The problems of assuring quality of food serving in HoReCa sector is particularly important, because of constant increase of the number of consumers and notification the significant number of food poisoning cases after consuming meals in this sector. According to the research, 14 to 36% of general number of food poisoning occurred as a result of eating in HoReCa sector. The following factors were indicated as the major reasons of food-borne diseases: improper meal temperature, inappropriate quality of raw material, improper food storage and unsatisfactory hygiene in catering establishments. The issue of assuring food hygiene safety gains special importance in catering establishments, which serve dishes for large groups of consumers. The majority of food poisoning is caused by ignorance in abide of elementary production and food serving rules. The aim of this work is a review of issues concerning factors which ensures quality and health safety of dishes produced by modern food service industry, introduce into new technologies as well as performance of quality assurance systems used in HoReCa sector. The review takes into consideration specificity of gastronomic production in different food service market's subsystems. The problems with quality of products produced by individual and special gastronomy will be presented. Dishes production in these subsystems bases on complete technological processes. The product is usually produced from raw material delivered from different suppliers. The raw material is characterized by lack of repeatable quality very often. Provision of gastronomic systems bases on constantly controlled semi-finished products, delivered by accepted suppliers, which fulfil strictly defined quality requirements. Organizational structure of establishment in a given subsystems, as well as level of knowledge and consciousness of employees, significantly influence quality and safety of food products. In system and special gastronomy subsystems well educated personnel of Quality Assurance Sections take care on proper performance of establishments. The biggest problems occurred in individual gastronomy because of the tendency to eliminate costs of trainings. Low level of knowledge and responsibility of employees as well as owners is often a huge problem. The best quality systems do not give expected results without personnel's responsible cooperation.



## Use of an *in-situ* tamperproof sampling device for enhanced feed chain security

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Experience has shown that a key link in the “farm-to-fork” food chain, where potential product contamination can occur, is the feed input to the system. High profile examples include the BSE crisis of the 1990’s, the Belgian dioxin crisis of 1999 and more recently the pork dioxin scare in Ireland of November 2008. There is a need to enhance the security of the feed input to the poultry food chain. Because of globalisation, poultry feeds are now sourced on worldwide accessible markets, and are therefore more prone to contamination, be it inadvertent or malicious. Whether feed samples are taken by independent companies or the competent authority, the security, traceability and chain of custody of that sample needs to be assured. Furthermore, should another contamination scare occur again at any point of the long geographical food chain, the need for immediate and effective traceback to the feed of origin is of vital importance. Researchers at University College Dublin (Ireland) have recently developed, as part of the Avian BioTrack project, a tamperproof feed sampler that includes real time traceability technology (RFID, barcodes) within a GS1 framework. The latest trials have shown the sampler to be robust, easy to use and secure. They have also examined the feasibility of incorporating traceability technologies such as barcodes and RFID tags in an industrial setting. Ongoing trials are now examining the sampler’s ability to collect uniform samples over continuous production cycles, across various feed formulations and production settings. Analysis of the results will examine how variations from one production cycle to another, such as line speed, recipe changes, etc. affect sample collection. It is anticipated that this system of secure sampling and effective traceability will form an integral part of the complete poultry chain traceability model that is Avian BioTrack. It is anticipated that this system of secure sampling and effective traceability, mapped on international standards and framework (GS1), will form an integral part of the complete poultry chain traceability model that is Avian BioTrack.

## **Production of pesticide-free dry fish through box and ring tunnel dryer: an innovation to improve product quality & safety and reduce risks for the consumers**

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Bangladesh produces about 0.12 million metric tons of dry fish annually for domestic consumption and export. Poor quality raw material and insect infestations are the major causes of low quality products, while most of the dry fish are treated with harmful organochlorine and organophosphorous pesticides to deter insect infestations. DDT deposition rate in the body of dried fish eating people of Bangladesh was found to be 500 times higher than that of WHO/FDA allowable limit. Cases of serious illness and death have been noticed due to consumption of traditional dried fish. Considering such life-slaying situations, box and ring tunnel dryers were developed with low-cost local materials to produce pesticide-free dried fish. A protocol was developed to produce pesticide-free dried fish in new drying devices. Dried Bombay duck, ribbon fish, pomfret, jewfish and minor carps were packaged and stored for 12 months in different conditions and their qualities were evaluated. Efficacy of the dryers was field-tested with the beneficiaries at farm level. The devices were found to be low-cost, easy-operatable, environment-friendly and insect protecting, while the products were dust, sand and pesticide free organic one. Drying rate of fish with the new devices was much higher compared to traditional process and almost equal to Hohenheim type solar fish dryer developed in Germany. Physico-chemical parameters of dried fish after 12 months of storage were found to be in acceptable limits. Cost and profit analysis and sustainability indices showed that the box and ring tunnel fish dryers were very effective in small-scale commercial operation with rural women for alternate income generation.

## Improving the antibacterial activity of lysozyme by conjugation with polysaccharides

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A widespread trend in many countries is the movement toward natural food products. In an effort to meet this demand, the food industry has expressed increased interest in using antimicrobial preservatives that are perceived as more “natural”. Lysozyme is well-known enzyme that has the ability to lyse bacterial cells. Lysozyme is found abundantly in nature and is produced by bacteria, fungi, plants, birds, and mammals. It has antibacterial effect towards G-positive bacteria but is not effective against G-negatives due to the presence of the LPS layer in outer membrane of the latter. The purpose of this research was to glycosylate lysozyme with dextran, dextran sulfate and beta-glucan, the polysaccharide found in barely, and to extend its antimicrobial properties. Lysozyme and polysaccharides were allowed to react under Maillard conditions (60°C for one week), the glycosylated products were separated by different chromatographic methods and the identity of the products was confirmed by elctrophoresis. Under optimum conditions 3.0 moles dextran, 1.2 moles dextran sulfate and 3.6 mmoles beta-glucan were coupled to 1 mole lysozyme. Glycosylated lysozymes exhibited increased solubility at different temperatures and pH's. Evaluation of the lysozyme–polysaccharide conjugates against test microorganisms (*S. aureus* and *E. coli*) in culture media indicated an increase in antimicrobial activity in a concentration-dependent manner. The lysozyme–dextran conjugate was also effective against *E. coli* in a cheese curd as it reduced the bacterial count by 3 log cycles. The antimicrobial action of lysozyme against *S. aureus* was not improved by conjugation with dextran in both in vitro and in vivo tests. These results might increase the applicability of lysozyme as a natural antimicrobial ingredient against a broader spectrum of bacteria in different food products.

## Development of bacteriocin based biopreservative for preservation of paneer (an Indian soft cheese)

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Food safety has become an issue of increasingly important international concern. The application of bacteriocins (antimicrobial peptides) from lactic acid bacteria that target food pathogens and spoilage bacteria without toxic or other adverse effects has received great attention. The present study deals with the production of pediocin 34 in standardized skim milk based medium and the development of the skim milk fermentate as a biopreservative for extending the shelf life of paneer, an Indian soft cheese. A highly potent bacteriocin producing organism *Pediococcus pentosaceus* 34 was isolated from Cheddar cheese. Pediocin 34 was found to be active against a large number of food spoilage and pathogenic organisms including *Listeria monocytogenes*. However, it was found to be effective against Gram negative bacteria in the presence of 20mM sodium citrate. The skim milk based medium comprising 10% reconstituted skim milk, 2% glucose, 1% yeast extract and 0.1% Tween-80 was found to be an excellent medium for the growth as well bacteriocin production by the bacteriocinogenic strain. The bacteriocin, pediocin 34, was optimally produced in this medium in a 7-litre capacity fermenter at 30 C for 24 h and agitation at 100 rpm. Down stream processing of the fermentate yielded 160,000 AU/g of the bacteriocin activity in the spray dried powder. Biopreservative formulation containing 5,000 AU/ml pediocin, 0.1% potassium sorbate and 20 mM sodium citrate was used for extending the shelf life of paneer. The paneer block/cube samples were dipped in the biopreservative solution for 2h before packaging individually in the polyethylene (HDPE) bags and stored at refrigeration temperature (5-7°C). The control and treated samples were analyzed for various sensory, microbiological and chemical parameters at regular intervals for a period up to 75 days. The shelf-life of the biopreservative treated paneer samples extended up to more than 60 days at refrigeration temperature suggesting strong potential of its application in extending the shelf-life of several other perishable foods. The pediocin 34 powder showed a storage stability of more than six months at refrigeration temperature without losing any appreciable activity.

## The impact of high pressure on the antioxidant activity of yellow mombin pulp

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Tropical fruit products acceptance have highly increased in European and North American markets. Such an interest may be related to the consumer's nutritional awareness and search for a healthier lifestyle, as well as for the fruits' exotic flavors. Among the tropical fruits, the yellow mombin (*Spondias mombin*) has an increasing importance in the economy of north and northeast regions of Brazil, where it is produced. The fruit is an ellipsoid drupe of 3 to 4 cm of length, has a thin and smooth yellow-orange skin, and presents a sweet-acidic pleasant flavor. It is commercialized as frozen pulp in other areas of Brazil and it is also exported, for further manufacturing of other products such as juices, nectars and ice creams. It contains high amounts of carotenoids and phenolic acids, the main contributors to its high antioxidant activity. Dietary antioxidants are considered effective functional compounds in the prevention of oxidative stress-related diseases such as inflammation, cardiovascular disease, cancer, and aging-related disorders. High-pressure processing (HPP) has been proved to generally retain food quality and natural freshness and extend product shelf life. The aim of this study was to evaluate the impact of high pressure processing on the antioxidant activity of yellow mombin pulp. The applied pressure ranged from 117 to 441 MPa, while the pressurization time ranged from 3 to 17 minutes, according to a central composite design for a total of 11 different treatments. The temperature was kept at 25°C. The antioxidant activity was evaluated using the ABTS radical assay and the extracts were obtained using acetone and methanol. The antioxidant activity of the fresh yellow mombin pulp was 22.9 µmol TEAC (Trolox equivalence antioxidant activity). There was no difference ( $p < 0.05$ ) in the antioxidant activity between the pressurized and the non-pressurized pulp or among the pressurized samples. The applied pressures and pressurization times were able to preserve the antioxidant activity of the yellow mombin pulp suggesting that high pressure could be an effective technology for preserving the product.

## Combination of high pressure and temperature as an alternative sterilization process

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High pressure thermal sterilization is an emerging technology. In particular, isostatic high pressure can reduce the thermal load of a food product helping to retain its quality. The mechanism of inactivation of bacterial spores by heat and pressure is still a matter of discussion. But the complete understanding of this mechanism is essential to introduce this technology successfully in the food industry. Pressures in the range of 100-200 MPa could cause spore germination by an activation of the germinant receptors. However, a part of the whole spore population is still in the dormant state, which could cause foodborne diseases. Consequently, higher pressures and temperature are needed for the sterilization of foods. Applying very high pressure and temperature to spore suspension in buffer systems, phenomena like the dissociation equilibrium shift in the buffer solution, a possible spore agglomeration and the adiabatic heat of compression as to be taken into account. Using an innovative micro high pressure unit (Stansted Mini-Food-lab; 300 µl sample volume, 250 MPa s<sup>-1</sup> pressure build-up,  $p_{\max}$  1400 MPa) with temperature control for an adiabatic pressure build-up and isothermal dwell times, inactivation kinetics for the commercial sterilization indicator *Geobacillus stearothermophilus* were investigated in a pressure- temperature range of 600-1200 MPa and 90-120°C in ACES- buffer solution (pH 7). Highest inactivation rates were found within 700-800 MPa, as well as pressure stabilization at 1100 MPa. This could be explained by a pressure induced opening of the Ca<sup>2+</sup>-DPA-channels, which triggers the cortex lytic enzymes and cause inactivation of the same enzymes. The reduction levels ( $N/N_0$ ) were studied by fitting an  $n$ th- order decay reaction and two different pressure- temperature planes, one for isothermal and isobaric conditions and one for the whole process, with isokinetic lines were generated. By using the F-value concept ( $T_{\text{ref}}=121.1^\circ\text{C}$ ,  $z_{600\text{MPa}}=35.36^\circ\text{C}$ ,  $D_{121.1^\circ\text{C}}=13.52$  s at 600 MPa and  $z_{700\text{MPa}}=37.45^\circ\text{C}$ ,  $D_{121.1^\circ\text{C}}=11.51$  s at 700 MPa) for pressure holding times  $T(t)_p$ , it was possible to incorporate these data into high pressure process charts of the few existing pilot systems. A complete sterilization (>12D) after 3 min dwell time could be achieved for a insulated 10 L vessel (600 MPa, 90°C, Flow Pressure Systems QUINTU S, Avure Technologies, Kent, WA, USA) and a non-insulated 55 L system (700 MPa, 95°C, Uhde High Pressure Technologies GmbH, Hagen, Germany). An improved understanding of spore inactivation mechanisms and the possibility to calculate the desired inactivation levels will help to introduce the high pressure thermal sterilization in pilot and industrial scale.

## Impregnation techniques for aroma enrichment of apples: A preliminary study

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Food industry often needs flavour enriched food products to be employed as ingredients of more complex preparations. At the best of our knowledge there are not applications concerning with the production of minimally processed food items enriched with aromas. This research aims to enrich apples with an artificial green apple aroma, applying different techniques; vacuum impregnation (VI), ultrasound technology (USI) and the combination of these two techniques (VUSI) were tested and compared with atmospheric pressure impregnation (AI). An isotonic solution of fructose, containing ascorbic acid and green apple artificial aroma was used for the impregnation of regular and uniform sticks of apple. Different durations (2.5, 5 and 7.5 minutes) of impregnation were tested and the impregnation kinetics of the artificial aroma main components were recorded. Significant differences between treatments were detected: VI and VUSI gave the highest aroma enrichment at 5 minutes of treatment. Different impregnation kinetics were recorded for alcohols and esters: the first tended to increase even after 7.5 minutes of treatments, the others components instead grown until 5 minutes and then decreased, mainly when ultrasounds were applied (US and VUSI). Some possible causes of such results were hypothesized, but the need of further studies is, also suggested in order to clarify the mechanisms involved.

## Processing to control plant dispersion particle morphologies and their rheological properties

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Processed fruits and vegetables are food materials that provide dietary fibre and micro-nutrients for health benefit, with functional attributes for food texture. There is a substantial potential to refine conventional processes and develop new novel techniques for food manufacturing and preservation to develop new food using plant cell dispersions with a healthier composition and with no added stabilisers or thickeners. The rheological properties of plant particle dispersions (40-250  $\mu\text{m}$ ) are determined by the resulting particle shape, size and distribution, particle concentration and deformability, and hydrodynamic forces arising from the relative motion of particles to the surrounding fluid. In addition, the solubilisation of cell wall polymeric material and softening of cell wall fragments may also affect the viscosity and flow behaviour of the dispersion. The challenge is to establish a structure-function model relating the plant cell wall microstructure at the molecular and macro scale to the flow properties of the dispersion.

In our study, a range of thermal and mechanical processes were applied to create dispersions with designative particle morphologies, i.e. systems that contain primarily plant cell wall clusters, single cells or cell fragments. The rheological properties of these dispersions (visco-elastic properties, shear viscosity, flow properties and yield stress) were determined. The particle size distribution and morphology was determined using static light scattering, confocal laser scanning microscopy and imaging analysis. Plant particle dispersions displayed abrupt yielding at the critical stress with a 3-4 order decrease of the viscosity. High yield stress at low solid contents (phase volumes) suggests formation of a colloidal network. In this paper, the relationship and rheological models between the physical behaviour of particle suspensions as a function of solid content and their microstructure will be discussed.



## Online-monitoring of physiological fitness of *Lb. plantarum* during fermentation and identification of optimal harvest points

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Due to unfavorable conditions in food matrices most functional microorganisms (e.g. deep frozen or freeze-dried starter cultures) are separately grown and preserved for subsequent addition into the final product. Although these processes eventually lead to cell stabilisation, they represent a tremendous burden to the organisms by subjecting them to numerous stresses as dehydration, osmotic pressure, oxidative stress, heat or the formation of ice crystals. The survival rate depends on strain properties, process parameters, as well as presence or absence of protective or inhibitory substances. Moreover, intrinsic factors which can be summarised by the term “physiological fitness of microorganisms” determine the resistance against stress. The energetic status of membranes and metabolic activity are two of these factors. The physiological fitness and thus the potential stress resistance is a subject to change during fermentation, depending on the age of the culture, environmental and physical parameters. The measurement of optical density, pH, temperature and release or uptake of certain metabolites or nutritive substances is either time-consuming or not alone sufficient to describe these intrinsic changes. However, an online monitoring system containing flowcytometry and EloTrace®, an electrooptical measurement device, will be shown to capture and visualize aspects of the physiological fitness with a very short time lag. Thus, the exact and timely identification of optimal points for harvesting and preservation is feasible and leads to enhanced survival rates.

## Sensor technology for the identification of mycotoxine producing fungi in the processing of wheat grain

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Mycotoxins are toxic fungal metabolites that may contaminate primary food products such as cereals, nuts and fruits. Among others, the most predominant mycotoxins in Europe are the Aflatoxins, Ochratoxins and Patulin produced by storage fungi, such as *Aspergillus* and *Penicillium* species, and toxins from field-borne *Fusarium* species, for example Zearalenone, Deoxynivalenol and Fumonisin. These toxins are cytotoxic, carcinogenic, mutagenic and immunosuppressive. Because of the potential health hazards to humans the monitoring of food and feed for the presence of these toxins is highly important with respect to food safety aspects. A reliable and sensitive in-situ detection of contaminations with fungi as well as with mycotoxins in the raw materials at the beginning of the food production chain (e.g. in storage facilities, during loading or before processing) is indispensable in order to increase food and feed safety. Within the joint research project „ProSenso.net2“ absorption and fluorescence spectroscopy, diffuse reflection (DR) spectroscopy, ion mobility (IM) spectrometry as well as fluorescence lifetime imaging (FLIM) and Raman spectroscopy are applied for the detection of mycotoxin contaminations on grains. In order to evaluate the capabilities of each method, basic spectroscopic parameters are determined first (for model systems and in a subsequent step for real-world samples). Based on the experimental data it can be shown that fluorescence measurements in combination with absorption and DR spectroscopy yield qualitative and quantitative information on the contamination with fungi and, moreover, the presence of mycotoxins in the model systems. The investigation of grains is especially demanding, because of the large variance in size, shape, colour, density, composition (water, starch, protein) and texture. Hence, additional chemometric tools are essential in order to eliminate these disturbing factors and to extract the desired chemical information with respect to contamination with fungi and/or mycotoxins. Selectivity, sensitivity, and cross sensitivity are characterized for the different spectroscopic methods, and subsequently, advanced algorithms for data evaluation are developed.

## Monitoring of food freezing process by using ultrasonic method

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The final goal of this study is to control food freezing process via supercooling by using ultrasonic technique. If the foodstuff could be rapidly cooled immediately after release of supercooling, the sizes of inside ice crystal would be smaller. In this presentation, the potential use of ultrasonic phase velocity for detection of state changes during food freezing is discussed. Agar-sucrose sol was put into the acrylic cell (15\*15\*15 mm) and held until gelation occurred at room temperature. Two ultrasonic probes were attached on the cell facing each other. One probe was excited by a pulser, and the other probe detected the ultrasonic wave transmitted through the agar gel. This acrylic cell was placed in a freezer having a temperature of 233 K. Phase velocity of ultrasonic wave was continuously measured until the gel was frozen. Usually phase velocity of ice is much higher than that of liquid state of water. However, when the gel was supercooled below a freezing point of water, the phase velocity continued to decrease, because the state of gel is liquid. The supercooling state is not stable and eventually released. At the release point the heat of solidification increases the sample temperature. The phase velocity was also increased at this point. This is because the ice crystals formed in the sample increase the hardness of the whole sample. The temperature and phase velocity rapidly increased at the same time for any condition of sucrose. The supercooling release point during food freezing, therefore, could be detected by measuring the phase velocity. It might be effective in controlling freezing process via supercooling. The phase velocity continues to increase after the supercooling release. This is because the growths of ice crystals make the agar gel harder. The phase velocity is correlated to the percentage of ice crystal in the food material. It might be effective in evaluating the frozen state of food.

## Microwave sensor response in relation to durian fruit maturity

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This research studied the microwave (MW) response in relation to maturity process of durian fruit (*Durio zibethinus* Murry cv. Monthong) using a microwave sensor at frequency of 2.45 GHz. The MW sensor was designed by two patch antennas for coupling microwave signal from durian. The experiment was conducted on 30 intact durian fruits at 91-118 days after full-bloom. One fruit was attached with the MW sensor at the outer peel on the tree. The MW sensor response was recorded everyday. Meanwhile, three durian fruits with the same size and age were picked from the tree for every third day to determine their maturity indices e.g., reducing sugar, starch, moisture content and dry matter of durian pulp. The result showed that the MW sensor response linearly decreased during the first period day 91-103, then linearly increased during day 104-118. As the wave from MW sensor penetrated through the peel, it may interact to one of the maturity indices in the pulp, possibly reducing sugar since it exhibited the similar trend to the MW response. The transition of MW response was approximately at day 103, implying that durian maturity was about 80%, corresponding to an onset of reducing sugar. The MW responses may be beneficial for durian farmers because of its non-destructive characteristic for durian maturity prediction and the suitable harvesting period in commercial practice.

## Characterizing the product quality attributes of extrudates of selected crops from a locally developed extruder

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Product characteristics from starchy ingredients depend on physicochemical changes occurring during extrusion which can vary considerably depending on the extruder type, screw configuration, feed moisture, temperature profile in the barrel, screw speed, feed rate and die profile. These changes can be measured by product quality attributes. Hence, they are important parameters as well as indicators of extrusion processes. In this study, the effect of the effect of extrusion variables: feed moisture (25, 30, 40%), extruder temperature (40, 70, 100°C) built up by varying the duration of sampling and screw speed (100, 150, 200 rpm) on product quality attributes including product moisture content, expansion ratio, compressive strength, functional properties e.g water absorption index (WAI) and water solubility index (WSI) and pasting properties e.g hot paste viscosity (HPV) and cold paste viscosity (CPV) of extrudates of cassava and maize (flour and starch respectively) was investigated. Also, Response surface methodology, stepwise regression, correlation and Analysis of Variance were employed to a factorial experiment in completely randomized design to study the effect of extrusion variables on the product quality attributes. The study revealed that the rate of change of product moisture with duration of operation increased negatively as the duration increased and up to a moisture loss of 55% w.b. was obtained. Minimum product moisture content of 10.6% was attained at 150 rpm and 25% moisture content by cassava flour. A maximum expansion ratio of 11.57% per 30 minute was attained through viscous dissipation at 150 rpm and 30% moisture content by cassava starch. Expansion is negatively correlated to compressive strength. Compressive strength varies inversely with duration of operation for cassava products. Cold paste viscosity decreased when moisture decreased and temperature increased. An increase in moisture content of maize starch decreased the transverse expansion and the WSI, but increased the WAI and hot paste viscosity. Also, an increase in moisture content decreased the gelatinization of cassava and maize than that of wheat flour. The equations relating the various dependent and independent variables were established to predict the performance of the machine. Generally, the response surface study revealed the range of the extrusion variables for optimum performance. Quadratic coefficients (0.61- 0.86) fits the extrusion data very well, better than linear models.

## Extrusion characteristics of cassava and defatted soyflour blended extrudates

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Cassava flour and defatted soyflour were mixed (90:10) and conditioned to 16% moisture content and extruded. The extrusion experiments were carried out in a single-screw laboratory extruder with a screw diameter of 19 mm, a length / diameter ratio of 25:1, a nominal compression ratio of 2:1 and a die opening of 2 mm (Model ; KE 19, Stand alone Extruder, M/S Brabender measuring and control systems, Germany). The temperature gradient along the three barrel zones was 15°C. A screw operated hopper fed the extruder at 20 rpm. The independent variables were extrusion temperature, screw velocity and the ratio of cassava flour and defatted soyflour. The hardness and energy required for compression were measured using texture analyzer (stable micro systems, UK). The volumetric flow rate ranged from 61.16-to 130.77 cm<sup>3</sup> min<sup>-1</sup> and mass flow rate varied from 44.93 to 80.03 g min<sup>-1</sup>. The maximum flow rate was obtained at 180°C die temperature and 80 rpm of extruder screw speed. The physical characteristics of cassava flour and defatted soy bean flour (90:10) extrudates such as expansion ratio, bulk density, true density and porosity were estimated. The expansion ratio of the extrudates ranged from 3.3006 to 4.2314, bulk density from 476 to 814 kg m<sup>-3</sup>, and porosity from 37.22 to 64.423%. The high expansion was achieved at 140°C die temperature and 120 rpm of extruder screw speed. The study showed that cassava and defatted soyflour may be a suitable blend for the production of good quality extrudates.

## Approaches to modelling packaging ventilation performance in fresh food handling: a comparative review

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Packaging plays crucial a role in the maintenance and management of fresh food cool chain. In postharvest handling of fruit and vegetables, packaging affects product quality and energy costs through its impacts on airflow and other thermodynamic process inside around and within the produce. The delivery and distribution of cold air inside the package and discharge of warmer air out of the package is usually accomplished through vents located at desired positions on the sides of the package. Obviously, the physical characteristics of the vent such as size and shape affect both airflow pattern and product cooling rates. Therefore, it is important for scientific research to underpin the design and performance evaluation of ventilated packaging. Modelling offers a viable economical proposition as an aid in thermal design and performance assessment of packaging, including the modelling and prediction of airflow and heat and mass transfer. This paper presents an overview of the approaches and tools used to model packaging ventilation performance, including empirical, heuristic, analytical and computational fluid dynamics (CFD) models. The review showed that during the past decade CFD modelling was the most widely adopted approach to modelling packaging ventilation performance while the analytical and empirical models have made minimal contributions to the research literature. Future prospects for CFD modelling of packaging performance are proposed, including modified atmosphere packaging and spread of microbial organisms which contribute to losses due to decay and rots.

## Modelling post-harvest colour development in limes and tomatoes

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Colour is an important post-harvest attribute of fruit and vegetables: the consumer often uses colour as an ad hoc guide to quality and ripeness, and in many products the post-harvest physiologist can also use colour as an indicator of maturity and of other quality measures such as texture. In this project a system that captures and analyses an image of the entire fruit surface was used to monitor the colour development of (120) limes and (100) tomatoes stored in different temperature regimes (10°C, 15°C, 20°C, 25°C, and 30°C), at 97-98% humidity, for up to 70 days. Conventional spectrophotometry was also used to analyse the stored fruit. Both sets of colour measurements were fitted to a logistic equation for each temperature regime and this data was used to estimate the temperature dependence of the rate constant for the ripening fruit. Both the tomatoes and the limes had an optimum (fastest) rate of colour change at a storage temperature of about 20°C. It was found that a Zwietering style equation for the rate constant fitted better than an Arrhenius style equation. This allowed the "maturity" of individual fruit to be estimated by how far they deviated from the average ripening curve at their storage temperature.



## Strange attractor in the chlorophyll difference model of Longjing tea

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The paper first investigates the strange attractor in the chlorophyll difference model between 2 pieces of Longjing tea leaves nearest leaf buds during its growing process. Chlorophyll meter SPAD-502 is used to measure the chlorophyll contents of 2 pieces of Longjing tea leaves nearest leaf buds during its growing process and estimate their difference values. Grassberger-Procaccia (G-P) phase space reconstruction algorithm is used to compute fractal dimension of chlorophyll difference series of 2 pieces of Longjing tea leaves. It shows that the fractal dimension is 9.066 and chlorophyll difference model of Longjing tea leaves is restricted in chaos environment during its growing process. Chlorophyll differences of 2 pieces of Longjing tea leaves are governed by strange attractors. Finally, put forward the supposal of the quality of Longjing tea correlating with the fractal dimension to some extent.

## Numerical simulations of pulsed electric field processing for chamber design and optimisation

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Traditional food processing technologies are heavily dependent on temperature alone for the inactivation of enzymes, pathogenic and spoilage microorganisms in order to meet product shelf-life, safety and quality requirements. These thermal processes often have adverse effects on the physiological, nutritional, sensory and other functional properties of food products. Pulsed electric field (PEF) is known to induce permeabilisation of biological cells, thereby it can to inactivate microorganisms at low temperatures, which makes it a promising method for pasteurisation of liquids containing important heat labile bioactive or volatile components. PEF can be also used to facilitate and increase the extraction efficacy of bioactive components and juices from plant or microbial sources. One key component for efficient application of this technology is the treatment chamber, in which the product is exposed to a pulsed electric field. For high efficiency of the method and to achieve the best product quality a detailed knowledge and optimisation of the electric field strength and the induced temperature distribution in the chamber is necessary. Experimentally it is not feasible to determine such distributions. The numerical simulation of the fluid dynamics coupled with the electric and thermal fields inside the treatment chamber can provide this information with high spatial and temporal resolution. Numerical simulations are not only beneficial for the characterisation of existing systems, where typically the design has been predominantly based on trial-and-error, but they also provide inexpensive opportunities to effectively design new treatment chambers with optimised geometry. Such models can provide the information to improve the uniformity of the electric and thermal fields between the electrodes and thus avoid localised over- or under-processing of foods. A specific CFD model describing flow, electric field and temperature distribution locally and time specified inside a coaxial treatment chamber of a pilot-scale unit at Food Science Australia will be presented. The simulations are validated by means of integral temperature studies using temperature markers. The model improves the fundamental understanding of the physical phenomena occurring in PEF processing. Process conditions for maximal field strengths and homogenous temperature distribution and some opportunities the redesign current chambers will be presented and discussed.

## **Combined mathematical and finite element modeling to simulate firmness of linearly solid potatoes**

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The food firmness has been verified to have high correlation to quality and maturity. As a texture characteristic, firmness describes that a product which, during mastication, displays moderate resistance to breaking. Also, the firmness may be interpreted in terms of the elasticity modulus or shear modulus. This characteristic can be determined by the quasistatic compression and penetration tests, or by the dynamic tests. In this paper, nondestructive firmness of linearly solid potatoes is simulated using the combination of both mathematical approach and modal finite element modeling. A general but effective technique is used to model the potato firmness. Solid potatoes are assumed as ellipsoids with one long principal axis and two equal short principal axes. The firmness of potatoes is dependent on the mass, density, and two natural frequencies of the lowest modes causing along the long and short axes, respectively. The developed firmness for potatoes can be extended to derive the firmness for fruits or vegetables from a spherical to an ellipsoidal shape. In the present work, the modal firmness of potato specimens is given which it gives rise to model the firmness.

## Computational methods and experimental measurements

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Mathematical simulations, as a tool to control and predict results, are widely used in food area for simulating whole industrial process as well as small laboratory experiment. They are used as a general approximation and also as a way to understand the process in detail. The major advantage of this tool is that it can provide a prediction of results without having to perform experiment, which means, saving of time, avoiding expensive costs to develop experiments, or when the measuring equipment itself disturbs the process. The resolution of complex mathematical problems requires computational techniques. There are numerous software to carry out this process, for example; FLUENT (Fluent, Inc.), COMSOL (COMSOL, Inc.), ANSYS (ANSYS, Inc), ALGOR (ALGOR, Inc.), etc. These programs use finite volume method or finite element method to resolve a set of partial differential equations. The partial differential equations describe the change of a phenomenon or an entity as an independent variable is changed, e.g. a space coordinate or time. The first step is to draw the geometry, which is possible using CAD (Computer Aided Design) tools, some software provide it, such as; GAMBIT (Fluent, Inc.), AutoCAD (Autodesk, Inc.), Rhinoceros (Robert McNeel & Associates) or some FEM/VEM software with CAD tools. The geometry is a digital model of a physical system, which would be interesting to study, and it can be real (drawing of existent models; food, pipes, treatment chamber, etc), but it does not necessarily exist (for developing new designs). The prediction of results using mathematical simulations should be validated with experimental results. The present work provide a review of mathematical simulations in food processes, and examples of numerical simulations and experimental validations, which are divided into four sections: 1) Simulations performed using regular 2-D geometries. 2) Simulations performed using regular 3-D geometries. 3) Simulations performed using irregular 3-D geometries. 4) Optimization of simulations using commercial software and coupled algorithms. The areas in which the simulations were carried out, are the following: Heat transfer (using as source of heat: water and electricity) and fluid dynamics (study of velocity profile and generation of turbulence using mixing devices). Experimental techniques used to validate simulations are divided into two sections: 1) Direct measurements, like temperature sensors based on fiber optic or infrared. 2) Indirect measurements, like enzyme and microbial inactivation, and residence time distributions applied to measure the mixing and turbulence level.

## Steam deacidification of model fatty systems: experimental and simulation

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Steam deacidification or deodorization is the most important step in the physical refining of vegetable oils and is performed under extreme operational conditions (high temperatures and very low pressures) in order to vaporize undesirable compounds, such as free fatty acids and odoriferous components, without causing significant damages to product quality. This kind of process has been studied in the literature in batch lab-scale deodorizers. Although it is rarely used in industrial scale, the batch process gathers the main features of the continuous equipment and is suitable for research purposes. In order to answer the growing demand for better product quality it is important to improve the operational conditions of this step of edible oil refining. Computational algorithms for process modelling can also contribute, as a complementary tool, for improving process performance and product quality. However, mathematical modelling of complex chemical systems, such as vegetable oils, demands knowledge of several physical properties and requires predictive methods, whose accuracy can be questioned. Moreover, previous experimental works do not provide enough information for a precise modelling of the entire deodorization system in order to be possible to simulate it consistently. The present study aimed to investigate experimentally the batch steam deacidification of known composition fatty model systems (triacylglycerols + fatty acids), controlling the main process variables (temperature, pressure and mass percentage of injected steam) and following a 2<sup>2</sup> factorial design with three central points. It also aimed to validate the simulation tool by comparison between experimental results and computational ones. We used commercial triacylglycerols (triolein SIGMA, 77%), a pure triacylglycerol (tricaprylin SIGMA, 99%) and a commercial fatty acid (oleic acid, MERCK, 72%) for formulating the model fatty systems. The effects of process variables upon the selected responses, final oil acidity and neutral oil loss, were evaluated and the experimental results compared with the simulated ones, showing a mean absolute deviation of 0.22 for acidity and 0.14 for neutral oil loss. These results showed that the simulation tool can correctly predict the experimental results.

## Mathematical modeling of lipid peroxidation reaction of vegetable oil with phytochemical antioxidant treatment during frying

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Antioxidants are important inhibitory materials against the oxidative deterioration of food. The present study focused on the effect of various phytochemical antioxidant systems [oleoresin rosemary (OR), oleoresin sage (OS) and citric acid (CA)] on the changes in physico-chemical characteristics of refined-bleached-deodorized (RBD) palm olein. The oxidative behavior of various mixtures of these antioxidants in RBD palm olein was also conducted during repeated deep-fat frying. Response surface methodology was used to optimize the use of the mixtures. An RSM-based computer program, namely the Echip software (Echip Inc., Hockessin, Delaware, USA) was used in this study to provide initial experimental designs, calculate multi-regression equations and provide statistical evaluations. For frying experiment, fresh potatoes were peeled by hand and sliced to a thickness of 1.5 mm before frying. Fried oil samples were analyzed for different physical and chemical properties. Quality parameters of oil were analysed using IUPAC methods. For the optimization purposes based on results from both analyses, mathematical models or equations developed in this study were as follows:  $\text{Response} = b_0 + b_1(\text{OR}) + b_2(\text{OS}) + b_3(\text{CA}) + b_{12}(\text{OR})(\text{OC}) + b_{13}(\text{OR})(\text{CA}) + b_{23}(\text{OS})(\text{CA}) + b_1^2(\text{OR})^2 + b_2^2(\text{OS})^2 + b_3^2(\text{CA})^2$ . Results showed that OR and SE were two effective phytochemical antioxidants for the protection of RBD palm olein against oxidative deterioration during frying. Based on fatty acid composition results obtained after 1 and 5 d of frying, a C18:2/C16:0 ratio was used to predict the optimal amounts of OR, OS and CA for controlling RBD palm olein during frying. In this study, the natural antioxidants yielded high  $R^2$  values (0.972 and 0.832, respectively) after both 1 and 5 d of frying. During five days of frying, parameters anisidine value (AnV), peroxide value (PV), free fatty acids (FFA), polymer content, colour units, viscosity, adsorbances at 232 and 268 nm, all gradually increased, whereas iodine value (IV) and ratio of C18:2/C16:0 decreased. Statistical analyses, including coefficients of determinations ( $R^2$ ) and probability (P) of F values, indicated that mathematical models for each dependent variable could be developed confidently in this study. Thus, models or equations developed could be used for prediction and optimization of antioxidant mixtures. All parameters examined had  $R^2$  values greater than 0.90, with the FFA content having the highest value (0.994). This was followed by  $E_{1\%1\text{cm}}$  at 268 nm (0.990),  $E_{1\%1\text{cm}}$  at 232 nm (0.975) and a C18:2/C16:0 ratio (0.972).  $R^2$  values for AnV, PV, IV, polymer content and viscosity were 0.945, 0.904, 0.961, 0.960 and 0.961, respectively, whereas red and yellow colours had  $R^2$  values of 0.932 and 0.903, respectively.

## Modeling techniques for the control of thermal exchanges in mixed continuous-discontinuous flow food plants

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Chemical, microbiological, organoleptic properties of food products are modified during their processing in a plant. These characteristics are typically governed by kinetics which are driven, among others, by the time-temperature (t-T) profile assumed by the product during the process. This profile can be profitably used by control systems to optimize the effect of the process and to enhance the final quality of the product. This can be implemented, for example, using actual t-T profile to adjust and calibrate target temperatures and/or holding times in pasteurizers, to the aim of minimizing damages on the sensory and nutritional quality, as well as of reprocessing or discarding product that has been subject to an insufficient treatment. The time-temperature profile can be easily determined in continuous-flow processes using the information arising from temperature measurements collected in some selected points along the path followed by the product. A different situation can be found in plants where a mixed continuous-discontinuous flow condition occurs. This is the case, for example, of plants where cut off valves can temporarily inhibit or modify the flow of the product and/or where buffer holding tanks temporarily accumulate the product. These conditions are usual in cooking, filling and packaging devices as well as in continuous-flow processes when some anomaly or external event stop the flow. In the case of mixed continuous-discontinuous flow conditions, standard food engineering tools cannot be used, while finite elements or CFD simulations are too much complicate for real-time applications. Aim of this paper is to present a new modelling framework that allows the derivation, via real-time simulation, of the t-T profile of any small portion of the food product while it is processed in a plant that presents flow discontinuities. The estimated t-T profile gives information that are complementary to those supplied by the residence time distribution analysis, method that has been proposed for continuous-flow plants in the case of significant velocity profiles. The model structure proposed in the paper uses a joint time-mass discretization and quantization to describe the thermal interactions that can occur between the product and service fluids, as hot/cold water, steam etc., as well as inside the product itself. Results are discussed presenting a real application of the proposed methodology to a jam production plant, based on a cooker, a concentrator, a heated holding tank and a filling machine.

## Wireless magnetoelastic biosensors for the simultaneous detection of *Salmonella typhimurium* and *Bacillus anthracis*

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This presentation describes an investigation to develop multiple magnetoelastic biosensors for in-situ detection of *Salmonella typhimurium* bacteria and *Bacillus anthracis* spores measured simultaneously in a flowing solution. The biosensor is composed of a magnetoelastic (ME) resonator platform that is coated with different bio-recognition elements, in this case phage, to detect the presence of multiple pathogens. An applied magnetic field is used to resonate the ME biosensor to determine its resonance frequency. Upon contact with a target pathogen, the phage binds the pathogen to the biosensor changing the mass of the sensor. This mass change is measured as a change in the resonance frequency. Two different phages, one genetically engineered to bind with *Salmonella typhimurium* bacteria and one genetically engineered to bind with *Bacillus anthracis* spores were immobilized onto the surfaces of two ME resonator platforms to form biosensors. These biosensors were placed in a tube and held in place using a magnetic field while analyte containing the target pathogens was passed through the tube. A blocked ME resonator platform without the bio-molecular recognition agent was used as a reference sensor for the system. Experiments were conducted where an analyte containing only *Salmonella typhimurium* was passed through the system. Only the biosensor coated with phage for *Salmonella typhimurium* responded. Similarly when an analyte containing only *Bacillus anthracis* spores was passed through the system, only the biosensor coated with phage for *Bacillus anthracis* responded. Scanning electron microscopy (SEM) was used to verify the specific interaction of bacteria and spores with the phage. The measured number of bound cells corresponds closely to the theoretical calculation value obtained from frequency shift measurements. Wireless biosensors as small as 5 x 40 x 200  $\mu\text{m}$  have been fabricated. Detection limits of approximately 98 CFU/ml of liquid with a sensitivity of 13.1 kHz/decade of target species concentration have been measured for these devices. Detection limits of approximately 800 CFU/ml of liquid have been measured for simultaneous detection of *Salmonella typhimurium* bacteria and *Bacillus anthracis* spores. The effects of 10 masking agents (nonpathogenic bacteria and spores commonly found in the environment) are described. Cost of fabrication of a single sensor is less than 1/100000 of a US dollar and the wireless nature of this biosensor allows remote readings. Results of testing in milk and apple juice are discussed.



## Online, rapid and portable microcantilever biosensors for food safety monitoring

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Recent improvements in food quality connected to the great improvement of micro and nano-technologies open very interesting perspectives in the agro-industrial field. The evident limits of nowadays technologies (expensiveness, difficult automation, low sensitivity, accuracy and precision for quantitative methods) are hampering the development of applications. Therefore, the development of highly integrated devices able to rapidly and automatically perform thousands of complex biochemical analysis is strongly needed. Application of micro- and nano-cantilevers to molecular recognition is a recent breakthrough in life science and biochemistry and has rose great expectations in the scientific community for its fundamental and technological perspectives. Depending on the final applications, proper functional moieties can be introduced on cantilever surface either to create reactive sites able to covalently anchor target-molecules and to improve the compatibility of materials by preventing nonspecific adsorption. Specific antibodies and/or nucleic acid sequences can then be immobilized on the functionalized surfaces in order to capture the targeted molecules. The interaction between the binding sites of receptors and targets is quantified by monitoring the resonance frequency change (due to mass changing). Cantilever-based sensors have been successfully applied to the detection of small biomolecules such as nucleic acids and disease proteins and recently very interesting results have been achieved for detection of pathogenic microorganism, where detection limits of 10 cells/ml (in PBS buffer) and 50–100 cells/ml (in ground beef) have been demonstrated. The micro- and nano-technologies coupled with a deep knowledge of organic/inorganic interfaces guarantee an exceptional sensitivity and selectivity of the sensor, while the lab-on-a-chip platform reduces assay times and limits sampling and/or sample preparation, providing compact and portable objects. Therefore, the analysis can be performed directly (on-line) on raw materials, semi-products and final products. Finally, cantilever arrays with different functionalizations can be used simultaneously to gain information about chemical nature and concentration of different targets

## The acoustic impedance – an indicator for concentrations in alcoholic fermentation and cleaning progress of fouled tube heat exchangers

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For processing foodstuff, it is crucial to determine necessary values fast, easily, inexpensive, and (often) online because several hygienic and quality standards have to be maintained. Not maintaining these standards can result in loss of product and a rise in costs concerning the production. Not only during processing foodstuff but also during cleaning the process equipment used it is necessary to determine certain values. E.g. cleaning cycles in dairy industry are often too long and hard to adapt to a fouled heat exchanger. A powerful method to gain this information is measuring with ultrasound, high frequency sound. Ultrasound is widely used in non destructive testing to get information about hidden details. It can be used non-invasively and without time-consuming sample preparation. The obtained ultrasonic signals have to be analysed to state the status of the sample and/or the processing equipment. Often, the speed of sound in the medium is analysed. Another important parameter is the acoustic impedance. It is specific for every material and dependent on the material density. If the density changes the acoustic impedance is changing, too. Density changes can be caused by concentration or state changes of the foodstuff. Our self-developed innovative impedance method uses multiple reflections between a stainless steel wall and the foodstuff behind it. The usage of multiple reflections enhances the sensitivity highly. The intensity of the reflected wave is then used for the analysis and the impedance is determined by calculating the reflection coefficient. It is self-calibrating and therefore independent of the transducer settings. With this method it is possible to gain information about the state of the foodstuff and adapt manufacturing and cleaning processes. Experiments have been made to determine the concentration of sugar and ethanol, respectively. The results are promising and show the correct trend for the impedance and therefore the concentration: for increasing sugar concentration the impedance increases, for increasing ethanol concentration it decreases. These results are comparable to the calculated value existing of measured speed of sound and measured density. Also, it is possible to determine the presence of milk fouling on a heated surface clearly.

## The impact of bioprocessing on rice nutritional quality

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Rice is the second largest produced cereal in the world and boiling is the usual way of preparing it. Comparing to instantiation, extrusion or expanding, thermal procedures able to confer to rice a very good digestibility, boiling give a lower one because starch is gelatinized at a lower extent. Having in view this fact, the possibility to biotechnologically improve the boiled rice digestibility was investigated in a laboratory study. In this respect, boiled rice was solid state fermented using a strain of *Saccharomycopsis fibuligera*, an amylase producing yeast originating from raggi, the inoculum used in Indonesia to prepare tapé: a fermented product based on rice. The fermented rice was then analyzed from the point of view of its content in reducing sugar, protein, amino-acids, phosphorus and vitamins from B group. The chromatographic studies revealed that the fermented rice has a 10 times higher content of reducing sugars than boiled rice, due to starch hydrolysis. Biochemical analyses also proved that the fermented rice contains maltodextrins and isomaltodextrins that are prebiotic compounds. The protein content is 2 times higher than in boiled rice because the final product contains the yeast biomass, which protein content is rich in lysine (amino acid that lacks in rice), methionine and tryptophan. The fermented rice is enriched in vitamins from B group (B1, B2, and B6) that are synthesized by the yeast. The phosphorus bioavailability is increased as result of fermentation. The product induces a rapid glycemic response and generates low extent fermentation at colon level, effects that are indicated for children nutrition. The sensorial profile of boiled rice is also improved by fermentation. The boiled rice fermented with the *Saccharomycopsis fibuligera* strain could be consumed as so or used as ingredient in creams and sauces, after transforming it into flour.

## Detection of deoxynivalenol using excitation-emission matrix

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Deoxynivalenol is a mycotoxin produced in wheat, corn and other cereal grains when exposed to fungi such as those in the *Fusarium* genus. It is especially notable in wheat when affected by *Fusarium* head blight. Not only does it reduce yield and quality but causes symptoms such as vomiting, diarrhea and headaches upon human and animal ingestion. Contamination by DON is reported around the world and is a major problem since the cereal grains are also used as feed for livestock. The Health, Labor and Welfare Ministry of Japan announced May 2005 the temporary reference concentration of DON to be 1.1 ppm. DON is a colorless, low fluorescent-reactive substance and is therefore difficult to detect. In the past, the gas chromatography-electron capture detector (GC-ECD) or the enzyme linked immunosorbent assay (ELISA) method has been used to detect DON, but these methods are time consuming, difficult and require expensive equipment and reagents. A new method to detect DON quickly, easily and accurately has been at demand. This study focused on the excitation-emission matrix (EEM) of DON, measured using a fluorescence spectrometer. EEM is a graph composed of an excitation wavelength axis, an emission wavelength axis and a fluorescence intensity axis. It is acquired by measuring the fluorescence intensity of a sample at consecutive excitation and emission wavelengths. Each pair of excitation and emission wavelength adds a new dimension to the EEM, resulting in a data with several hundred dimensions. Consequently, the EEM is expected to contain information which would otherwise be lost in a normal measurement of a few wavelengths. The pattern of the EEM is unique for each constituent, making it possible to identify a particular substance in a mixture or detect foreign substances in foods. Therefore, a simple detection of DON through the measurement and analyzing of EEM was presumed to be possible. The objective of this study was to obtain fundamental knowledge which would contribute to the development of non-destructive methods of detecting mycotoxins, by measuring and analyzing the EEM of DON.

## Monitoring of CO<sub>2</sub> during fermentation process by means of impedance spectrometry sensor

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This paper presents a new on-line, low-cost sensor for monitoring CO<sub>2</sub> production, based on electrical impedance measurement during alcoholic fermentation. This complex biological process is common in wine, beer, and cider industry. CO<sub>2</sub> production is an extremely important parameter for controlling the processes. One of most important steps in production of wine, beer, cider and other similar liquids is the alcoholic fermentation that determines final organoleptic characters. Alcohol production during fermentation process is depending on process and it can be determined indirectly by measurement of total CO<sub>2</sub> release. Fermentation kinetics could be controlled by measurement of total CO<sub>2</sub>, providing action criteria to modify fermentation conditions and improving the complete process, producing stable characteristics of final liquid. On-line measurement of CO<sub>2</sub> in liquid can be carried out by means of resistance, due to effect of CO<sub>2</sub> bubbles (carbon dioxide bubbles increase the value of total resistance); however, the measurement process has some disturbances such as temperature and cell concentration. Present cells are *Saccharomyces* yeast, used to initiate and produce the alcoholic fermentation, but the huge volume of yeast cells in several phases of fermentation, introduce an impedance distortion in measurement, which can be reduced by selecting an appropriate excitation frequency. This paper shows a sensor system based on impedance measurement and several experimental results obtained from complete fermentation process of grape juice. The sensor was built by means of two stainless-steel plate electrodes and impedance is measurement by means of AC bridge, working at high frequency to allows us the reduction of the yeast effect. A linear temperature compensation was not necessary if liquid temperature was stable as usual in industrial fermentation process, but it is included to prevent interferences. The temperature compensated sensor was tested in a real industrial fermentation process, comparing its results with CO<sub>2</sub> readout of a commercial system. Differences found are due to the huge number of cells in several phases of fermentation. So, this system has a potential to use in industrial control fermentation.

## Monitoring wine alcoholic fermentation using a resistivity sensor

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The traditional monitoring of wine fermentation kinetics is based on density measurements, usually carried on by isolated measures, by this way it is impossible to make a predictive control. Advanced systems must be incorporated to wine making processes in order to get an on-line supervision and control, must be understood as a mean of conduction of wine elaboration considering an exhaustive knowledge of the whole process variables in real time, and different control parameters can be integrated in a system of optimized managing. The objective of this work is the modeling and characterization of a resistance sensor for on line monitoring of wine fermentation kinetics. The design of the sensor was developed based in an immersed sensor which measures changes on wine resistivity and they are related to fermentation kinetics. Interference caused by capacitance created by yeast growth is limited testing and using a 40 kHz frequency in the measurement sensor. The system has been tested both in laboratory scale and in cellars using must made from red varieties of grapes Bobal and Tempranillo. Results have been adjusted to kinetic models which make the predictive control of wine fermentation possible.

## Analysis of mixing degree of granular products using micro-tracers

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Mixing of loose, granular materials is a very complex process, where the mixed compounds are distributed by random, chaotic motion of the particles. Mixing process is realized in various mixers, different in the type, shape of agitator, technological parameters etc. Mixing process is strongly affected by the physical properties (such as the density, moisture content, average particle size, the angle of repose, slip angle and shape of the particles) of the components. Moreover, the kinetics of mixing process depends on its realization conditions as well as on the construction of mixing assembly. Usually the mixtures used in feed processing industry are multicomponent, where each component represents different physical properties; thus, achieving their satisfactory blend may be often very difficult. Determination of basic mixing parameters, such as mixing duration for given type of the mixer, is an important element deciding on the quality of final product. Paper presented the results of investigations on the mixing process of six mineral blends of similar physical properties. Mixing process was realized in the mixers of various construction and capacity. Different mixing duration and filling degree of the mixers were used. The uniformity of mixtures was determined indirectly, by means of microtracers introduced into mixture: the uniformity of their distribution in mixed material was determined after each mixing cycle. The investigations concerning determination of homogeneity for 6 mixtures from mixtures from various mixers by means of the microtracers showed that this method is useful to analysis of mixing process in production plants. The method enables fast reaction during technological process running, thus it eliminates the risk of producing mixtures of non-standard parameters.

## Researches regarding bioethanol yield increasing

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The paper presents researches concerning the increasing of bioethanol yield by using corn and wheat as raw material. In both cases the bioethanol has been obtained using a technology different from the classic one through the way the starch is hydrolysed in a noncooking process helped by a special enzymatic packet. The results show that the most elevated bioethanol yield is obtained using corn as raw material at 45 degree hydrolyse temperature. Also the influence of added calcium salt on lowering hydrolyse temperature has been studied, results showing that the hydrolyse process can be done at 36 degree without having unwanted additional fermentations. Using this technology an increased yield of bioethanol is obtained and important quantities of cooling water and energy are spared in comparison with the classical cooking procedure.



## Process development of premium quality canned Thai red curry paste

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Red curry paste, an essential ingredient in many Thai dishes, contains several herbs and spices well known for their health benefits. For preserving, it was thermally processed in hermitically sealed container. This study aims to find the optimum thermal processing conditions for producing premium quality canned red curry paste. An antioxidant activity, 1,1-diphenyl-2-picrylhydrazyl (DPPH), was used as a key quality attribute. The D and Z values of DPPH were investigated and incorporated with the finite difference heat transfer model for cylindrical can to predict the DPPH residual after processing. The experimental validation was performed by processing the paste in 13 different time and temperature conditions. The predicted value agrees well with the experimental data which lead to optimize the heat processing conditions for maintaining antioxidant activity, producing safety and high quality product.

## Characteristics in cell wall structure of green bean during control freezing point storage

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Green bean (*Phaseolus vulgaris* L.) has been planted extensively in the northeast region of china. Green bean is harvested seasonally. The control freezing (CF) point storage means that the storage temperature is in a non-freezing temperature zone between the freezing point of water and food. It has been demonstrated that CF storage can prolong the storage-life of fresh food. Degradation of cell wall polysaccharide has greatly affected on the texture properties of green bean cell walls. During CF storage, activities of cellulose, pectin methyl esterase and polygalacturonase were inhibited effectively. It resulted in a slower degradation of cellulose and pectin, and less expansion of cell wall and less dissolution of pectin layers. As a result, the web structure of cell wall was kept. At CF temperature, the hardness of green beans was decreased slightly. The hardness significantly correlated with the chemical properties as revealed by principal component analysis. It was found that homogalacturonan of chelate pectin was degraded into galacturonic acid, and the side chains of the soluble alkali pectin were degraded into pectinose and galactose. At the later stage of CF storage, the web structure of cell wall polysaccharides was destroyed, and the hardness of green bean decreased. However, the pectin degradation in green bean was inhibited significantly during CF storage.

## Effect of freezing and cooking processes on the texture of Atlantic salmon (*Salmo salar*) fillets

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Texture is an important quality parameter of the fish flesh. It is an important characteristic for consumer and also an important attribute for the mechanical processing of filets by the fish food Industries. This study aims at comparing the effect of freezing and cooking processes on the texture of Atlantic salmon filets. Atlantic salmon (*Salmo salar*) samples were frozen by pressure-shift freezing (PSF, 200 MPa, -18°C) and cooked by Water Bath (+80°C). The texture was determined with a compression test in a Kramer cell. The toughness of the cooked samples was higher than that of the PSF samples. The denaturation of protein in the cooked sample is probably the major reason leading to the increased of toughness. The cooking process was generally much more influent on quality parameters than the freezing process. High pressure process exerted a partial denaturation of protein, which can be compared to a partial cooking. These results show the potential of high pressure for cooked dish in food Industry.

## The thermal stability of onion (*Allium cepa* L.) flavonols – Influence of crop production and food processing

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Plant phenolic compounds are an important constituent of the human diet. In recent years they have gained much attraction due to their antioxidative, antibacterial, and anticarcinogenic properties, leading to an enormous increase in research on cancer prevention and reduction of cardiovascular diseases. In this context, onion is an interesting vegetable plant species due to its natural high content of phenolic compounds and its widespread popularity all over the world. In comparison to other vegetables, onions can contain high levels of flavonol glycosides (mainly glucosylated quercetin derivatives). With regard to chemical changes of these compounds during harvesting, storage and food processing knowledge is still insufficient. Especially thermal processes such as boiling, frying, and deep-frying influence the flavonoid content of different vegetables. From the viewpoint of human nutrition it is desirable to define crop production systems that increase the amount of potential health promoting ingredients and lead to a flavonoid profile, which remains stable during different (thermal) processing techniques. The aim of the present study was to test whether variations in the root environment (nitrogen form in the substrate) affect the flavonol profile of onions and its stability towards roasting. For this purpose, onions (Centurio, *Allium cepa* L.) were grown on Perlite in a greenhouse. They were provided with different ratios of nitrate and ammonium (95:5 and 25:75) as a nitrogen source. After reaching maturity, plants were harvested, cut, freeze-dried and ground. Beside common crop quality parameters (fresh and dry matter weight, bulb size, Brix value, sugars), the flavonol profile was analyzed using HPLC-DAD. For the thermal treatment samples were roasted at 180°C for 5 and 10 minutes. Quercetindi- and monoglucosides increased with nitrate as the dominant nitrogen source. Colonization with mycorrhizal fungi additionally increased the production of polyphenolic compounds. Thermal treatments showed that the quercetin glycosides are degraded depending on roasting time and temperature, but especially depending on the flavonol profile. It can be concluded that both high nitrate supply and the use of mycorrhiza as a biofertilizer may support increased formation of quercetin glycosides in onion. As the flavonol glycosides are degraded during thermal food processing, a flavonol profile consisting of a high amount of diglycosides seems to be advantageous during roasting: The monoglycosidic intermediates formed have a high bioavailability and a less cytotoxic potential compared to their respective aglycones.

## Influence of shaking on heat penetration during retort processing

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The effects of five shaking frequencies (0, 160, 230, 310 and 380 cycle/min) and five viscosities of the bentonite solution (0, 3, 5, 7 and 9 percent w/v) on heat penetration (fh) were investigated during one-direction shaking in the water spray retort. The samples were filled into the 305x409 can size with 1 cm of headspace. The cans were horizontally rearranged and shook in the retort. The center cans temperatures were record until the processing time for obtaining commercial sterility (F0 value = 10 minute). The results showed that the processing time reduced by 16.6-75.40 percent when the shaking were applied. The fh values decreased between 1.10 and 90.5 percent compared with still retort. Furthermore, the processing time and the F0 value prediction models were empirically formulated as a function of viscosity and shaking frequency.

## Mechanical and thermal treatments of crushed tomatoes or carrot purées: Effects on In vitro accessibility of antioxidants and on structure/consistency

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Tomato and carrot based products attain much attention for their expected health promoting effects, mainly ascribed to antioxidants such as lycopene (tomato),  $\beta$ -carotene (carrot) and ascorbic acid. The microstructure of plant foods influences both textural properties and accessibility of micronutrients. The aim of the present study was to evaluate the effects of mechanical and thermal treatments on structure, consistency and lycopene accessibility of crushed tomatoes and  $\beta$ -carotene accessibility of carrot purées. For tomato, processing parameters of interest were mixing time, high temperature short time (HTST), low temperature long time (LTLT) blanching and the mixing/blanching order as well as the addition of  $\text{CaCl}_2$  to LTLT samples. Textural properties were determined using a Bostwick consistometer. Polygalacturonase and pectinmethylesterase activity, as well as the pectin degree of methoxylation were evaluated. Microstructure was studied by light microscopy and transmission electron microscopy. The mechanical and thermal treatments did not affect the lycopene content to large extent; however, the in vitro accessibility seemed to be favored by extensive crushing followed by heating. Crushing or homogenization in itself was not enough to increase lycopene accessibility. Crushing and subsequent heating affected the pectin degree of methoxylation and the consistency of crushed tomatoes. A tendency of enhanced lycopene accessibility with decreasing consistency was observed. The results indicate that heating of the samples is crucial to lycopene accessibility, that LTST is favorable to HTST and that addition of  $\text{CaCl}_2$  to LTLT treated samples significantly reduces the accessibility. Investigated processing parameters when treating carrot purées were; heating time, addition of oil, and pH. Total  $\beta$ -carotene content of treated carrots was determined using a HPLC method and  $\beta$ -carotene accessibility was estimated using a static in vitro model. The highest accessibility of  $\beta$ -carotene was obtained in the sample where oil was added to carrot purée made from carrot pieces heated 40 min. A higher in vitro accessibility of  $\beta$ -carotene was obtained in heated carrot purée (10-40 min, 90°C) compared to raw purée but the  $\beta$ -carotene accessibility decreased after longer thermal treatment (>60 min). Higher in vitro accessibility of  $\beta$ -carotene was also gained in the samples where carrot pieces were first heated and then blended compared to the carrot purée that was first blended and then heated.

## **Influence of fat and protein contents on the thermo-physical properties of milk-application to the standardisation of milk-**

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As a raw material, the control of the composition of milk is carried out at various levels of the dairy field and the nature of the criteria used can vary according to the objectives. Except the raw material, the totality of the dairy products are generally subjected to multiple controls of composition either to check their conformity with the standards or to control the manufacturing processes. The milk, material complex and heterogeneous, has a great variability in its composition; all milks do not have the same aptitude for the cheese-making transformation due to their physicochemical and thermal characteristics different. The objective of this work is the control and optimisation of standardisation of fat and protein contents. In the long term, the aim is to consider a reduction of nonconformities related to the cheese-making production thanks to the application of a more powerful control system of the standardisation of milk. In this study, the influences of the temperature, fat and protein contents on the density and specific heat of different milks were investigated with pycnometric and calorimetric methods. The authors highlight different relations between the composition of milk and their thermo-physical characteristics. The monitoring of density according the temperature highlights a nearly perfect correlation between an empirical relation and the experimental points. Thus, for a fat content, the density of a milk can be given thanks to a simple linear relationship to the temperature. In addition, this work reveals that the density decrease with the increase of fat content and increase with increase of protein content. This result is interesting in the sense where, when in the line production of the cheese dairy, it will exist a variation with the standardisation, analysis in situ will be able to detect it through the evolution of the value of the density of milk. Finally, the fat and protein contents and temperature are many influential on the specific heat of milk. These measures should thus make it possible to go back to the composition of the milk and of thus to optimize standardisation.

## Identification of an optimal set of parameters for the process of pasteurization of beverages by using dense gases

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Continuous pasteurization of liquid and liquid-like beverages by supercritical fluids was investigated in order to find an optimal set of process parameters. In particular, temperature, pressure, dense gas to feed ratio, length of contact zone, and physical and critical properties of carbon dioxide (CO<sub>2</sub>) and nitrous oxide (N<sub>2</sub>O) were considered. The effect of each of the above mentioned parameters on nutritive value, color, taste, and shelf life of the treated material was first investigated in order to find the corresponding range of feasible values. Then, the combined effect of the whole set of parameters was considered by accounting for the capability of a supercritical fluid to penetrate cell walls without mechanical rupture which becomes significant at hydrostatic pressure higher than 200 MPa, an order of magnitude higher than the typical operating pressure which is used when applying the technology under consideration. The experimental validation of the results obtained by considering the supercritical fluids as solvent along with its thermodynamic and transport properties, was done at laboratory scale by using a 250 cm<sup>3</sup> apparatus equipped with a thermostatic system, a mass flow meter, and a pressure control and measurement system. A procedure for scaling up these results at industrial scale is also given. It was found that, under proper operating conditions, this mild technology does not damage the product while significantly improving its shelf life.



## Investigation of macro-structure of gluten-free rice cakes baked in infrared-microwave combination oven

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The aim of this study was the investigation of the macro-structure and pore size distribution of gluten-free rice cakes baked in both conventional and infrared-microwave (IR-MW) combination oven by using image analysis. Moreover, the effect of the addition of different types of gums on pore size distributions was investigated. The formulation of the rice cakes was composed of 100% rice flour, 100% sugar, 9% egg white powder, 3% salt, 5% baking powder, 25% shortening, 1% hydrocolloids and 90% water (flour weight basis). The hydrocolloids used for structure development in gluten-free rice cakes were xanthan, guar and xanthan-guar gum blend. As control, cake containing no gum was used. For conventional baking, two cake samples (100 g each) were baked in conventional oven at 175°C for 30 min. In IR-MW combination oven, cake samples of 100 g were baked at 70% upper and lower IR power and 40% microwave power for 7.5 min. For image analysis, baked cakes were cut into two halves by a razor blade vertically and scanned by a scanner having a resolution of 300 dpi. These scanned images were used for image analysis by using the software; Image J. Addition of gum types to the formulation increased the area fractions, which represented the porosity of cakes. Porous structure of the rice cakes were improved by the addition of gum types. The highest area fraction and uniform distributions of pores in the crumb were obtained for cakes containing xanthan gum for both conventional and IR-MW baking. Baking mode also affected the porous structure of rice cakes that IR-MW baked cakes had higher area fractions. Moreover, pores were evenly distributed in rice cakes baked in IR-MW combination oven when compared to conventional oven.

## Impact of micronization on rapidly digestible, slowly digestible and resistant starch contents in different barley varieties

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Three different barley varieties were heated at different temperatures by infrared heating (micronization) at different initial moisture contents. Samples are also dried by across-flow thin-layer dryer. Rapidly digestible, slowly digestible and resistant starch contents as well as thermal transitions were compared under different micronization conditions and dryer system. The effect of chemical composition of varieties (e.g. apparent amylose content) on formation of resistant starch was investigated. The impact of micronization on appearance and physico-chemical properties of processed samples was determined.

## Increasing of biodegradability and digestibility of dairy sludge by microwave treatment

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In consequence of the large amount of sewage sludge the cost of the wastewater treatment process has continuously raised and represents significant technical and economical challenges. Waste sludge thickening, drying, temporary and final disposal represent a large capital and operational cost. The anaerobic fermentation has many advantages in biological decomposition and provides an efficient process from energetic aspects. The main structure of municipal and food industrial sewage sludge consists of extracellular polymeric substance, multivalent cations, and other organic and inorganic matter. This agglomerated complex flock structure is resistant to direct anaerobic degradation. The thermal treatments can alter the structure of sludge, reduce the resistant and transform part of suspended organic solids into soluble compounds. Microwave heating is a popular alternative to conventional heating mainly due to considerable reaction time reducing and non-thermal microwave effects. Due to high water content the sewage sludge can absorb microwave energy efficiently and microwave treatment causes a higher flock and cell destruction compared to conventional heating. Our work focused on the effect of the microwave energy at the aerobic biodegradability and anaerobic digestibility of sewage sludge. In our experiments thickened dairy sewage sludge was used which was originated from a physico-chemical wastewater management technology. The microwave treatment was carried out in a lab-scale monomode cavity resonator at 2,45 GHz frequency at 1 to 10 W/g specific microwave power level. Biodegradability was characterized by the ratio of biochemical oxygen demand and chemical oxygen demand (COD), the solubility was given by the ratio of water soluble and total organic matter content (sCOD/COD). Biogas production tests were performed in batch mode, under mesophilic conditions, at 40°C for 30 days, in temperature controlled anaerobic digester. Results showed that the microwave irradiation could be a promising and rapid process in sewage sludge management. The microwave pre-treatment enhanced efficiently the biodegradability (from 8 to 41%) and the solubility of organic matter content of sludge (from 9 to 52%), thus the biogas yield increased considerably. The microwave treatment decreased the lag-phase period of anaerobic digestion process, therefore besides the cumulative biogas product the average rate of digestion process was increased.

## Application of novel soybean varieties to Tofu (soybean curd) and utilization of the Tofu byproduct for functional food development

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It has been stated for a long period by the FAO that protein intake is not sufficient in most developing countries. For this reason, a nutritious soybean product, Tofu (soybean curd) having high quality and digestible proteins has gained large attraction, but it has not become popular in developing countries yet with the exception of the Far East Region. It is said that the reason comes from its particular smell, it is so called “beanny flavor”. Although Japan has effectively used Tofu byproduct (Okara) and imported Indica rice for many years, they are still major targets to be solved in the agriculture and food industries. The authors group has investigated a sort of fermented pancake based on the Indian Dosa that is made from the rice, beans and Tofu byproduct. In this study, therefore, reduction of the particular flavors in Tofu, establishment of the pancake process and quality evaluations of the two products were conducted to solve those issues. Three normal varieties and 2 novel lipoxigenase free varieties (non GM) were used for Tofu production. Two types of milled rice, Indica and Japonica, black gram and Tofu-byproduct were used as raw materials of fermented pancake. The flavor components in Tofu were measured with HPLC. The texture profile and palatability test were conducted for evaluation of Tofu quality. As for the pancake production, mixing ratio of the 3 raw materials and fermentation condition were optimized by the quality evaluations which were volume expansion, pH, organic acid, and microorganism in the batter. Obtained results were as follows; 1) production of less flavor Tofu having good texture is possible by the optimized processing conditions as well as by using the novel varieties, 2) although addition of Tofu byproduct provided a dosa like texture and taste to the pancake, the mixing ratio should be limited. Otherwise, a hard texture will be obtained due to the constraint of volume expansion, and 3) important functionalities in the final pancake baked were fortified by soybean based components.

## Functional components in traditionally consumed foods from Botswana

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Functional components in foods could be any of a variety of entities, including proteins, peptides and amino acids, essential fatty acids, dietary fibre, vitamins, minerals, prebiotics and probiotics, phytonutrients, etc., that provide health benefits beyond basic nutrition. Owing to a sharp rise in the incidence of lifestyle diseases such as cardiovascular disease and diabetes in Botswana, consumers are increasingly being advised to revisit their traditional eating habits, and actively adjust their current menus to focus mainly on traditionally consumed-, minimally refined foods, which seem to promote longevity. It has been observed that despite the average elderly Botswana consuming a typically less than ideal diet in terms of mainstream nutrient intake, there clearly are indications that certain components in such diet are responsible for the observed fairly high life expectancies; identification of these components, and subsequent product development based on them, will go a long way in combating the effects of increasingly observed conditions such as cancer, HIV/AIDS, obesity, etc., with which Botswana is grappling. This paper discusses the findings of a study that was done to investigate the potential of traditionally consumed Botswana foods, in terms of functional properties, and how their raw materials can be used in developing functional or nutraceutical food products that would help ease the pressure that is currently experienced by the country's health system. The effect of processing on the levels of functional compounds was also investigated; the primary focus was on raw materials that are typically collected from the wild, including mmilo fruit (*Vangueria infausta*), morula fruit (*Sclerocarya birrea* subsp. *caffra*), baobab fruit (*Adansonia digitata*), phane or mophane worm (*Imbrasia belina*), as well as wholegrains and pulses that are traditionally grown under Botswana's dryland farming systems e.g. sorghum, beans, cowpeas.

## Controlling the nutrient profile of fruits and vegetables during prolonged storage prior to processing

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The seasonal nature of fruit and vegetable crops requires either that supply is maintained over a wide geographical distribution range or that produce can be stored relatively long term. We have shown that relatively long term storage of fruit and vegetables can be undertaken with little deterioration in texture and without compromising microbiological safety. Associated experiments, to test produce from different geographical locations and using different agronomy conditions, have also been undertaken. The effect of transport + storage on nutrient profile was studied in carrots, broccoli and tomatoes. Phytochemicals assayed include carotene, lycopene, folate, and ascorbic acid. The plant cell wall composition, free sugars and fibre content have also been determined. In carrot (mg/g dry weight),  $\beta$ -carotene was ~0.7 mg; ascorbic acid ~0.3 mg, sugars ~500 mg, and dietary fibre ~300 mg. In broccoli, corresponding nutrients were: ascorbic acid up to 8.6 mg, folate ~0.005 mg, sugars ~250 mg, and dietary fibre ~400 mg. In tomato, the data vary in different varieties but on average, corresponding nutrients were lycopene ~0.8 mg, ascorbic acid ~2.5 mg, sugars ~480 mg, and dietary fibre ~400 mg. The storage conditions chosen were temperatures of 2-4°C and relative humidity between 70 and 99%, depending on the raw materials. During storage, little change was found in sample compositions post harvest. Fully ripe tomatoes had lost some lycopene but vitamin C in broccoli increased during storage, independent of the variety. Although total dietary fibre content did not change during storage there was a noted modification to constituent pectic polysaccharides; shown as a loss of pectic arabinan and galactan in carrot. The results show that carefully controlled storage conditions were appropriate for the purpose of maintenance or enhancement of nutritional and textural properties. However, shelf life of produce may be compromised by transport conditions. It is therefore recommended to keep transport time short and to ensure that optimum storage conditions can be maintained during transport. Preliminary results indicate that transport rather than storage conditions are the major problem in maintaining product nutrient profile and microbiological quality prior to processing.

## Identification and quantification of betalains, carotenoids and chlorophylls in prickly pear fruit

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Qualitative and quantitative analysis of betalains pigments in ten cultivars/lines of prickly pear (*Opuntia* spp.) fruit of diverse pulp colors were conducted with reverse phase high-performance liquid chromatography-diode array detection (HPLC-DAD) coupled with electrospray mass spectrometry (ESI-MS). Betacyanins and betaxanthins were identified by comparison with the UV/Vis and mass spectrometric characteristics as well as the retention times of semi-synthesized reference betaxanthins. Carotenoids and chlorophylls were also identified and quantified based on their molecular mass determined by applying HPLC-DAD coupled with positive atmospheric pressure chemical ionization mass spectrometry (APCI-MS). A total of 24 known/unknown betalains were present in the studied prickly pear fruit, including 18 betaxanthins and 6 betacyanins. The ratio and concentration of betalains pigments are responsible for the color in the different cultivars/lines, showing the highest betalains content in fruit of purple color, comparable to that found in red beet (*Beta vulgaris* L. cv. Pablo). All cultivars/lines had a similar carotenoids profile, in which lutein was the most abundant compound in 'Carmuesa', while neoxanthin was the most abundant compound in '21441'. Chlorophyll A was the most abundant in all cultivars/lines with the highest quantity in '21441'. Our results indicate that prickly pear fruit can be considered as a potential rich source of some important pigments, especially some yellow and red natural colorants.

## Evaluation of 11 pesticide residues in dried figs from Estahban region in Iran

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Organic foods are grown without synthetic pesticides, growth hormones, antibiotics, modern genetic engineering techniques, chemical fertilizers, or sewage sludge. Objective: The present study was carried out to investigate the Iranian dried fig in order to determine organic and inorganic produces. Seven samples (three hundred and eighty nine figs) from Estahban region (Iran) were analyzed for Lindane, Heptachlor, Aldrin, Chlordane, Endosulfan I, Endosulfan II, Dieldrin, Endrin, DDT, Methoxychlor and Permethrin by gas chromatography. The performance of the method was evaluated according to the guidelines of the EU. The monitoring data were combined with fig farming data to evaluate organic farming in Estahban region. The 11 pesticides were selected because some of them are recommended for fig and almond orchards belonging to different classes. Pesticides residue were not detected in any sample (not detected  $\leq$  1 ppb). Results verified production data that showed farmers do not use any pesticides. Nowadays, biological control are providing by Iranian authorities in order to control pest in fig farming.



## Interactions of a novel monoglyceride-stabilized oil in water emulsion with wheat flour, starch, and gluten

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Monoglyceride-oil-water emulsion (MAG gel) is a recently developed alternative shortening that is trans fat-free and is typically composed of monoacylglycerol, stearic acid, water and canola oil. This material is a cellular-solid structure with water-swollen MAG multilamellae surrounding 1-2 micrometer oil globules. While there is potential to use MAG gel in a variety of baked products, its application is limited due to a lack of understanding about its interactions with flour, flour components and following different hydrothermal treatments. This study investigated the potential interactions between MAG gel (6-24% fwb) and flour by using a Farinograph, with gluten at room temperature using a Gluten Peak Tester (GPT) and with starch following heating and cooling in a RVA. These data were then compared to oil, shortening or a mixture comprising the components that make up the MAG gel. Data from the Farinograph showed delayed development of dough with increasing levels of lipids; and the observations were similar for all the lipid types, except for shortening, which exhibited rapid development and breakdown. Similar trends were observed with both hard and soft wheat flours. The MAG gel dough exhibited a similar stickiness trend to dough with shortening, but had extensibility properties similar to that of the mixture. Depending on the type of lipid used, the maximum torque and onset of torque development was different for the different treatments in the GPT; and trends were different between different types of lipid and whether they were used with hard or soft wheat flours. Evaluations of the interaction of gluten with the different lipids showed that the onset of torque development was earlier and the torque maximum was also higher compared to gluten alone when tested with the GPT. Differences were observed in the pattern of torque development between different lipid types. These observations strongly suggest that there is an interaction between lipids and gluten; however, MAG gel did not exhibit a different property compared to the other lipids. Following heating and cooling in the RVA, starch interaction with the monoglyceride component of MAG gel appeared to be the dominating factor resulting in an increased pasting temperature and a higher rate of viscosity development upon cooling. Overall, the results suggest that MAG gel is not significantly different from other lipids when evaluated in dough systems at room temperature. It appears that significant differences will be elicited upon heating which is the focus of our future research.

## Properties of MPC and WPC-stabilized O/W emulsions as influenced by oil droplet surface composition

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Milk protein and whey protein concentrate aqueous dispersions (3w%) were heated to/at 60, 70, 80, 90 or 95°C for 5 min before combining with rapeseed oil (7:3). The emulsions were obtained at the temperature of 60°C and pressure 10 MPa on the first and 2 MPa on the second stage of homogenization. Membrane-bound proteins were determined by SDS-PAGE of a denatured protein sample obtained from oil droplets. Intensity of individual protein bands was quantitated through an image-analysis system based on the TotalLab software. Incorporation of casein in unheated-phase MPC-stabilized emulsions was higher than in heated one. An increase in the heating temperature showed a higher amount of incorporated whey proteins, in particular b-lactoglobulin. Oil-water interface of WPC-stabilized emulsions consisted mainly of b-lactoglobulin and a-lactoalbumin; their percent composition increased with protein heating. The experimental observations are discussed in terms of viscosity, conductivity and improved emulsion stability.

## Effect of atmospheric pressure plasma treatment on the stability of flavonoids

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Flavonoids are an important constituent of the human diet. In recent years, they have gained much attention in research on cancer prevention and reduction of cardiovascular diseases due to their naturally high antioxidative and anticarcinogenic properties. Thermal processes such as boiling, frying, and microwave cooking are able to reduce the flavonoid content of vegetables and a decrease in the antioxidant activity after heat treatment in aqueous solution has been observed. These limitations have fostered the development of gentle food process techniques that do not affect the bioactivity of the flavonoids. In this context, non-thermal atmospheric pressure plasma is an innovative and emerging technology that seems to be a promising alternative to thermal treatments, since an efficient inactivation of microorganisms comes along with a moderate heating of the treated surface. Yet, energetic electrons from the plasma can interact directly with the tissue surface, causing a.o. fragmentation. As well the respective roles of UV photons and reactive oxygen species and radicals and their influence on dietary bioactive compounds are not well understood. The aim of this study was to investigate the stability of selected model quercetin glycosides using a cold discharge (plasma jet) with varying gas mixtures. Plasma treatment was performed using a non-thermal plasma jet operated in argon at atmospheric pressure and driven by radio frequency of 27.12 MHz. The reaction of the Ar plasma with quercetin glycosides has been studied at various radio-frequencies driven voltage, gas flow rate and at different positions from the jet nozzle outlet. The degradation of quercetin and its derivatives was followed by high performance liquid chromatography/diode-array detection and UV/VIS spectroscopy. First results show that the quercetin glycosides are degraded by interaction with the plasma depending on increasing plasma voltage and exposure time. Depending on the working conditions, different plasma intermediate species have been observed by optical emission spectra. From the results on the type of intermediate species, different processes for the plasma-induced decomposition are proposed. The experiments provide useful insights about the plasma-induced physical and chemical reactions in view of future industrial adaptations in food processing technology.

## Studies on physico-chemical characteristics and preservation of cultivated mushrooms

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Commercially cultivated Button (*Agaricus bisporus*, *A. bitorquis*) and Oyster (*Pleurotus ostreatus*) mushrooms were collected from commercial farms and evaluated for their physico-chemical characteristics and preservation in brine solution. The study period was 90 days. During this period the preserved mushrooms were steeped in brine solution containing various combinations of fixed (citric acid, acetic acid, table salt, ascorbic acid and potassium sorbate) and variable chemical preservatives (potassium metabisulfite and sodium benzoate). The doses of chemical preservatives were optimized to control browning in mushrooms and identify minimum dose of variable chemical preservatives just sufficient for preservation. Because, combined use of chemical preservatives allow us to reduce their levels and boost its preservative effect. Effect of chemical preservatives on mushroom flavor was also studied to assess the suitability of chemical method of preservation. It was observed that most abundantly found flavor 1-octene 3-ol was totally lost and results of biological studies also showed that chemical preservatives even in small amount affect the bio-availability of mushrooms. It was concluded that a high temperature tolerant mushroom *Agaricus bitorquis* was found to be the best when evaluated through sensory evaluation methods. Statistical analyses were carried out using response surface methodology.

## Physicochemical change and protein oxidation in porcine longissimus muscle as influenced by different freeze-thaw cycles

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Frozen storage is an important preservation method for meat and meat products. Temperature fluctuation or abuse generally occurs during transportation and storage, and repeated freeze-thaw is also common at retail and in the home or restaurant. Although there are publications on the effects of the freeze-thaw process on seafood quality, few studies have addressed the possible influence of freeze-thaw handling on pork protein oxidative stability and meat quality. The objective of this study was to investigate physicochemical changes and protein oxidation in porcine longissimus muscle subjected to multiple freeze-thaw cycles. Drip loss, cooking loss and colorimetric b\* value increased ( $P < 0.05$ ) and a\* value decreased ( $P < 0.05$ ) with increasing number of freeze-thaw cycles. Muscle shear force increased after one freeze-thaw cycle (from 2.89 kg to 4.12 kg) ( $P < 0.05$ ), but decreased with further increases of freeze-thaw cycles. The decreases in Ca<sup>2+</sup>- and K<sup>+</sup>-ATPase activity and sulfhydryl content ( $P < 0.05$ ) with concomitant production of protein carbonyls and TBARS indicated that multiple freeze-thaw handling promoted protein and fat oxidation. Gel electrophoresis patterns showed that multiple freeze-thaw cycles could cause cross-linking of protein in myofibrils. Overall, the freeze-thaw process had a detrimental effect on the quality of pork. The findings suggested that reduced quality of freeze-thaw treated pork was related to the oxidative deterioration of muscle proteins. Therefore, it is important to minimize temperature fluctuations during transportation and storage of frozen pork for a maximum protection of meat quality.

## Evaluation of *Escherichia coli* inactivation and quality attributes in apple juice subjected to pulsed electric fields in combination with high intensity light pulses

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The combination of novel, non thermal technologies for preservation purposes is a recent trend in food processing research. Pulsed electric fields (PEF) and high intensity light pulses (HILP) represent emerging technologies for the preservation of beverages and when combined under mild processing conditions they could serve to ensure microbial stability and safety with little or no loss of product quality characteristics. In the present study treatments involving monopolar square wave PEF in combination with HILP were applied to reconstituted apple juice in a continuous system using a 2 x 2 factorial design. Two PEF field strengths (24 kV/cm or 34 kV/cm) were selected with a treatment time of 92  $\mu$ s in each case to provide a high and a low energy input treatment. The juice was subsequently cooled, then pumped through a HILP system (pulse length 360  $\mu$ s, frequency 3 Hz) at different flow rates in order to receive a high and a low energy dosage of 5.5 J/cm<sup>2</sup> and 4.0 J/cm<sup>2</sup>, respectively. Microbiological analysis was performed by inoculating the juice with *Escherichia coli* DH5- $\alpha$  and counting microbial numbers pre- and post-processing. Selected product quality attributes (pH, °Brix, colour, non enzymatic browning index (NEBI), total phenols content and total antioxidant activity) were also measured to compare juice processed by the combination of non thermal technologies with unprocessed juice. The *E. coli* population was reduced by approximately 6 log cfu/ml without a significant effect of either the PEF electric field strength or the HILP energy level. All the combinations achieved the minimum reduction of 5.0 log units of microorganisms as required by the FDA. In terms of product quality, the juice pH (3.60) and °Brix (12) were not affected by any processing combination compared to the untreated control. No significant differences to the latter were found either in colour attributes (Hunter Lab values L, a, and b), in total phenols content (354 mg GAE/L) or in total antioxidant activity. An increase (p<0.05) in the NEBI was observed in all the treated juices compared to the unprocessed sample (0.141) but no difference was detected between the four treatments (0.158). The results indicate that all the combinations of PEF and HILP could successfully reduce levels of *E. coli* in apple juice while maintaining the quality parameters of the treated juice.

## **Spatial distribution, attachment and growth of bacteria on fruit and vegetable tissues**

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We have identified the colonisation of fruit and vegetable tissues as a three-stage process: initial attachment; a consolidation stage, sometimes involving production of extracellular polymer by the attached bacteria; growth. We have investigated the spatial distribution of bacteria on broccoli, carrot and tomatoes, and found a differential distribution depending on the plant part. The initial attachment of bacteria has been measured and occurs rapidly. We have defined an attachment and detachment coefficient, and these can be used to model the attachment phase of colonisation. Furthermore, the rate of attachment to specific parts of the tissues varies with the differential distribution. We have also measured the change in numbers of bacteria within and on tissues during storage. This equates to the consolidation and growth phase of colonisation, and provides information about the potential for decontamination of tissues for subsequent use. The work described here has received funding from the European Community's Sixth Framework Programme under grant agreement FOOD-023115.

## Changes of aldehydes in essential oil during postharvest treatment of red pepper (*Capsicum annuum* L.) for paprika production

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During production of spice paprika one of the obligatory steps is postharvest ripening of pepper fruit. This step usually last for 15 days. During ripening of paprika fruits most obvious is change of color which is due to biosynthesis of carotenoid pigments, predominantly capsantin and capsorubin. Presence of carotenoids in paprika powder is main reason for use as a spice in food, but beside color, paprika is known for its hot flavor and characteristic aroma. Aim of this paper is to determine changes in essential oil composition as consequence of postharvest treatment of spice pepper fruits in two different stages of maturity. One third of paprika sample after harvesting was immediately dried and ground and other two parts were postharvest treated for 15 days with and without light. After treatments fruits were dried and grounded. Essential oils were obtained by distillation and separated by GC-MC. Differences in essential oil composition of fruits as a consequence of postharvest treatment and maturity stage was established. Determined aldehydes were divided in three groups: ones that did not change its content during treatment (e.g. decanal, trans-2-nonenal), that increased its content (e.g. safranal), and group with decreased content (9,17-octadecadienal). Most abundant aldehyde in paprika essential oil was trans,trans-2,4-decadienal witch proportion reached 2.02% in essential oil of red untreated fruit. Content of this aldehyde decreased with ripening stage and with treatment.



## Fermentation of spherical bacterial cellulose product by shaking culture

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As an important functional food ingredient, bacterial cellulose is widely used in food industry in the form of small cube such as Nata de Coco. Spherical bacterial cellulose products have many potential applications as a unique food ingredient. The fermentation conditions of the spherical bacterial cellulose product were investigated in this paper. The optimum fermentation medium contained following constituents: sucrose 15 g/L,  $(\text{NH}_4)_2\text{SO}_4$  3 g/L,  $\text{KH}_2\text{PO}_4$  3 g/L,  $\text{MgSO}_4$  0.2 g/L, yeast extract 1 g/L, coconut water 400 g/L, and pH 5.0. 200 mL of the fermentation medium was loaded in a 500 mL shaking-flask (3 cm depth) and fermented at 180 rpm, 30 for 10 days. Under these conditions, the spherical bacteria cellulose product was obtained with cellulose yield of 2.02 g/L.

## **Chemical, nutritional and microbiological quality of fluid milk available in chittagong metropolitan area of Bangladesh**

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The study was conducted to find out the nutritional (percentage of butter fat, solids-not fat and protein), chemical (pasteurization, added preservatives, and adulteration status) and microbiological (standard plate count and coliform count) parameter to evaluate the quality of milk collected from vendors, departmental stores, suppliers and dairy farms in Chittagong Metropolitan area of Bangladesh during the period from 1<sup>st</sup> August 2007 to 15<sup>th</sup> February, 2008. A total 100 samples were analyzed such as 19 (vendor supplied collected from rural area), 24 (vendor supplied collected from farm), 12 (farm milk) and 45 (brand market milk). Study reveals that available market milk irrespective of brand milk maintaining the Bangladesh Standard Testing Institute (BSTI) standards as far as butter fat, solids-not fat and protein and microbiological quality is concerned. Moreover, all brands' milk is properly pasteurized. The nutritional quality of farm produced milk was good except high coliform count. The nutritional quality of farm produced milk and rural milk deteriorated by the middlemen due to adulteration with water. Water adulteration was detected in 69% and 56% of milk samples in case of vendor supplied rural and vendor supplied rural milk respectively. Most alarming fact is 10% milk samples contained formalin in case of vendor supplied rural milk.

## Modeling of microparticulation process of whey proteins: development and validation of a novel model based on the phenomena of their thermal denaturation

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Whey proteins are high functional food ingredient due to their excellent technological and nutritional properties. Functionality of these proteins can be additionally improved by heat treatment resulting in thermal denaturation and formation of particles with different size distribution and shape (microparticulation). The properties of the particles as well as their behavior as additives in food matrix are strongly dependent on the heating conditions, compositional, and process factors. For achieving high functionality the whey proteins must be transferred into a form of particles with average diameter between 0.5 and 20  $\mu\text{m}$  dependent on the area of application. The process parameters need too be optimized regarding composition of the whey protein concentrate used. However, the searching for optimal conditions is a time- and costs-consuming procedure that can take years before the developed microparticulation process is stable and ready to scale up. The optimization procedure can be carried out much faster if a part of the physical experiment is replaced by mathematical modeling. In this case the optimal parameters can be preselected by a virtual experiment and validated by the pilot plant experiment. This approach results in a reduction of the experimental effort and, consequently, leads to significant time and cost savings. There are a number of mathematical models adapted from aggregation of colloidal particles applied for the whey proteins aggregation process. However, most of the proposed models can not be used for the optimization purposes since they are not able to describe all of the known phenomena of proteins denaturation. The main reason for it is the inability of the models to take correctly into consideration the unfolding process. Based on denaturation phenomena of whey proteins (such as sharp bend on the Arrhenius plot, DSC-measurements, accumulation of dimers during heat treatment) we developed a novel kinetic model describing quantitatively unfolding and aggregation of the unfolded proteins. The validation of the mathematical model was performed by its ability to describe phenomena mentioned above. A serial of experiments were carried out using analytical techniques such as HPLC, DSC and PAGE and the results were compared with mathematical simulation of the process. By the comparison of the experimental and theoretical results we could show that the developed model can be used for the process optimization.

## Multi-objective optimization of pervaporation process for food products

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This paper describes a multi-objective optimization model applied to the food technology. The process analysed consists of the flavours recovery from spieces, adopting pervaporation technology. Aim of this work is to carry out a model that determines all the possible configurations of the system, optimizing objectives and finding the optimal one between these. The whole process is characterized by three phases: drying, sterilization and Volatile Organic Compound recovery through PDMS membrane. An Excel sheet was created, modelling the physical relations between the process variables. At this point was used modeFRONTIER™ software, a multi-objective optimization and process integration tool based on the Pareto-optimal frontier of the objectives space. It was decided to set, as input variables, the total flow exiting from the dryer, the percentage of aroma in weight, pressure ratio, membrane selectivity, total permeate pressure, membrane permeability and thickness. Output variables are permeate concentration and feed pressure. We considered a couple of constraints for each output of the model. Initial population was generated through SOBOL space filler and the optimization was carried out using NSGA-II (Non-dominated Sorting Genetic Algorithm) multi-objective algorithm. After 500 generations, a Pareto-optimal frontier characterized by 2359 Pareto-optimal solution was obtained. The percentage of flavours in weight is between 60,75% and 78,37% and the feed pressure between 1500000Pa and 2500000Pa. Final step was performed whit the aim to determine the optimal solution between all the Pareto-optimal ones. This phase was carried out using Multi Criteria Decision Making (MCDM) tool included in modeFRONTIER™ software. The purpose of this application is to determine the solution that minimize membrane thickness and feed pressure and maximize membrane selectivity, membrane permeability and permeate concentration. Search activity was carried out using a MCDM based on a genetic algorithm (GA MCDM), finding a solution that better satisfies all the requirements defined during MCDM implementation. The final setting for the system is the follow: membrane selectivity: 15.032; membrane permeability: 6003 Barrer, membrane thickness: 0.00014 m; permeate concentration: 70,49%; feed pressure: 1974400Pa.

## Computational fluid dynamics modelling and simulation of maltodextrin solutions spray drying to control stickiness

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A numerical computational fluid dynamics (CFD) simulation of the spray drying of model maltodextrin DE12 and DE21 aqueous solutions in a pilot spray dryer was performed at steady state. The objectives were to calculate the evolution of air and drops properties inside the spray dryer. The temperature and water content of drying drops as a function of their position (time) could be used to identify conditions leading to sticky drops/particles in the chamber. Knowing these conditions and the positions of the sticky regions could allow either to prevent powder sticking on walls to avoid product losses or to take benefit of this behaviour to favour controlled agglomeration in the spray drying chamber. Several hypotheses were made on the geometry of the chamber (axial symmetry simplified inlet air disperser and rotary atomizer) and on air and product properties. To simulate the lower drying rate of solutions compared to pure water, the drop water vapour pressure was decreased using a fitting parameter identified from experiments. Measurements of air temperature and humidity at different positions inside the chamber were used to identify model parameters and for model validation. Simulation allowed obtaining further information not acquired by direct measurements, especially on air flow pattern and drying particles properties evolution. Air re-circulations were put in evidence, mainly in the rotary atomizer zone. Particle water content evolution could be followed inside the chamber, and from these results the evolution of particle glass transition and sticky temperatures could be calculated. The time gap and the positions for which each particle had a temperature between glass transition and sticky temperature were determined, leading to the identification of possible sticky zones inside the spray dryer. It appeared that MD12 was quickly dried below glass transition in the upper part of the chamber, while MD21 could exhibit a sticky behaviour in a wider part of the chamber depending on the liquid flow rate. Modelling results are coherent with the different drying behaviour and sticky properties of the two maltodextrins. The modelling scheme may be applied to spray drying of more complex solutions.

## Effect of temperature on water activity of Dutch type semi-hard cheese: computation and prediction on the basis of heat of sorption

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Water activity ( $A_w$ ) is an important thermodynamic parameter of biological materials. It is used especially in food technologies.  $A_w$  describes the energy state of water in the food, and hence it has potential to act as a solvent and can participate in biochemical reactions and growth of microorganisms. It is an important property of  $A_w$  that is used to predict the stability and safety of food with respect to microbial growth. The critical value of  $A_w$  for most biological products ranges between 0.6 and 0.7. Values of  $A_w$  are function of temperature and heat of sorption ( $Q_s$ ) shows this dependence. Knowledge of  $Q_s$  can be used for  $A_w$  prediction. If the  $A_w$  of a food is known at one temperature but the food is stored or handled at any other temperature, the responsible value of  $A_w$  can be computed using the  $Q_s$ . The Clausius-Clapeyron equation from thermodynamics is used to compute the  $Q_s$ : where  $A_{w1}$  is the water activity at temperature  $T_1$  [K],  $A_{w2}$  is the water activity at temperature  $T_2$  [K],  $R$  is the gas constant, and  $Q_s$  is the heat of sorption. Ripening Dutch type semi-hard cheese produced from pasteurized milk was used in the experiment. Measurements of  $A_w$  were made on samples with fat content 45% at temperatures 5, 15 and 25°C after 5 days storage. Tests were carried out on randomly selected slices with the edge and corn part, and with the average weight 7 g. Moisture content ranged between 20 and 42% (w.b.), and  $A_w$  ranged between 0.82 and 0.96. Measurements started at the lowest temperature and proceeded to the highest one. Some samples were measured with both increasing and decreasing temperature to assure that a systematic error was not introduced. Values of  $A_w$  of the semi-hard cheese were computed for the temperature range of 5 and 25°C, and compared with the values measured. As expected,  $Q_s$  of cheeses increased with decreasing the moisture content. Chemical potential of water was calculated, too, and consequently the change in  $A_w$  per Centigrade was determined. As  $A_w$  approached the highest values, the changes with temperature went to zero. The study was supported by the CR MSM Project No. 6215712402.

## Quantification of nitrogen status in rice by least-squares support vector machines and reflectance spectroscopy

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The estimation of nitrogen status non-destructively in rice was performed using canopy spectral reflectance with visible and near infrared reflectance (Vis/NIR) spectroscopy. The canopy spectral reflectance of rice grown with different levels of N inputs was determined at several important growth stages. This study was conducted at the experiment farm of Zhejiang University, Hangzhou, China. The SPAD value was used as a reference data that reflects nitrogen status in rice. A total of 64 rice samples were used for Vis/NIR spectroscopy at 325-1075 nm using a field spectroradiometer, and chemometrics of partial least squares (PLS) was used for regression. The correlation coefficient ( $r$ ), root mean square error of prediction (RMSEP), and bias in prediction set by PLS were 0.8545, 0.7628, and 0.0521 for SPAD value prediction in tillering stage, 0.9034, 0.5603 and 0.0921 in booting stage, 0.8632, 0.7469 and 0.0324 in heading stage, respectively. LS-SVM model was compared with PLS and back propagation neural network methods, and the results showed that LS-SVM was superior to the conventional linear and non-linear methods in predicting SPAD values of rice. Independent component analysis was executed to select several SWs based on loading weights, and the optimal LS-SVM model was achieved with SWs of 560 nm, 575-580 nm, 700 nm, 730 nm, and 740 nm for SPAD value prediction in booting stage. It is concluded that Vis/NIRs combined LS-SVM regression method is a promising technique to monitor N status in rice.

## A predictive model to compare the factors influencing oat and barley $\beta$ -glucan levels in harvested grain

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Cereal  $\beta$ -glucans have gained much attention for their functional and nutritional importance as bioactive ingredients, and hence are desirable for human consumption. Among cereals, oats and barley are the major sources of  $\beta$ -glucan. The objective of this study was to develop a farm-level baseline model (including scenario analysis) to compare and assess the impact of pre- and post-harvest stages (including genotypic factors, environmental conditions, agronomic factors and storage) on  $\beta$ -glucan levels in the harvested oat and barley grains. The model used Monte Carlo simulation techniques to model various stages influencing the level of  $\beta$ -glucan content in both hulled (HO, HB) and naked (NO, NB) oats and barley genotypes during cultivation of the crops. A baseline model is proposed for both oats and barley and a number of scenarios are subsequently created separately, to look at the impact of different model assumptions and input parameters. The simulated  $\beta$ -glucan level in harvested oats grain was 35.6 and 43.1 g kg<sup>-1</sup> for HO and NO, whereas levels were 40.99 and 56.77 g kg<sup>-1</sup> for HB and NB genotypes, respectively. A sensitivity analysis highlighted that genotypic selection was the most important parameter in both oats and barley for determining the final  $\beta$ -glucan level (correlation coefficients of 0.62 and 0.79 for HO and NO, with 0.66 and 0.78 for HB and NB genotypes, respectively), when compared to other environmental and agronomical factors. This shows that naked genotypes of both oats and barley are nutritionally superior to the hulled varieties in terms of  $\beta$ -glucan levels, this result in a greater potential in industrial applications. The analysis also indicated that oat genotypes sown in the latter part of the sowing season may have higher  $\beta$ -glucan content with a potential 30% increase in the final  $\beta$ -glucan levels compared to the baseline model. In contrast, harvesting delay may influence barley genotypes negatively with a potential 30% decrease in the final  $\beta$ -glucan levels. Germination time, storage days and temperature showed a negative impact on the final  $\beta$ -glucan levels in both oats and barley genotypes. By eliminating any storage of oats and barley after harvesting (scenario 3), the  $\beta$ -glucan content increased by 11% and 20%, respectively. This study illustrates a methodology which can evaluate and compare the critical factors influencing  $\beta$ -glucan content in harvested oat and barley grains.



## Fast quantitative analysis of soluble solids content in cherry based on statistical analysis of PLS-LSSVM and genetic algorithm

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Cherry belongs to the family Rosaceae and contains anthocyanins - the red pigment in berry. Anthocyanins are potent antioxidants under active research for a variety of potential health benefits and the soluble solids content is an important factor in nutrition and mouthfeel, in this study visible and short-wave near-infrared spectroscopy (VIS/SWNIR) technique was applied. For sake of investigating the feasibility of using VIS/SWNIR spectroscopy to measure the soluble solids content in cherry, and validating the performance of selected sensitive bands, for the calibration set was formed by 225 Cherry samples, while the remaining 75 cherry samples for the prediction set. The combination of partial least squares and least squares support vector machines (PLS-LSSVM) was used to calculate the prediction model based on raw spectrum data. Based on PLS-BP, the determination coefficient for prediction ( $R_p$ ) was closed to 0.95 and root mean square error for prediction (RMSEP) was 1.4. It is concluded that infrared spectroscopy technique can quantitative the soluble solids content in cherry, and the process is simple and easy to operate. So more, further steps were put forward to get the sensitive bands, which were selected by genetic algorithm (GA) and the peak in spectrum, the determination coefficient for prediction was applied to be the objective function, considering the feature of spectrum, each four continuous data were used to be a input of GA. Finally, four bands were found, which can apparently reflect the main characteristics of soluble solids content in cherry. The prediction results indicated that the way to make quantitative analysis of soluble solids content in Cherry based on SWNIR spectroscopy and LS-SVM model is a better way in today.

## Prediction of viscosity changes in rainbow trout skin gelatin, produced at different pre-treatment time using artificial neural network model

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Artificial neural network (ANN) technique was used to model viscosity changes of rainbow trout (*O. mykiss*) skin gelatine at six temperature levels (20-60°C), different gelatine concentration (0.5-4%) and pre-treatment time of 1-3 hours. Experimental data had been divided into three parts, train (70%), cross-validation (10%) and testing data (20%) then MLP network was built according to independent variables of time, temperature, and concentration. The optimal configuration of neural network model was obtained by varying the different parameters of ANN: transfer function; learning rule, number of neurons, hidden layers and learning runs. Maximum coefficient of determination ( $R^2$ ) and minimum level of MSE were index of selecting the best network. In predicting of viscosity, 3 layer MLP by structure model of 7-4-4 and  $R^2$  (0.9819) and MSE (0.0007) was the optimum result. The result of this study will be used in pumps and transference lines designing.

## ***In-situ* observation of high pressure induced changes of food materials using neutron radiography**

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With the use of conventional thermal processes the properties of the complex system “food” and/or single food components could be influenced with respect to the process target. Different aggregate states are used for drying, steaming, crystallizing, melting and extracting. The phase or state changes are not only influenced by temperature but also directly effected by the acting pressure. With the application of high hydrostatic pressure there arises a new opportunity to specifically control phase changes during treatment of foods. To better understand the entire processes in-situ observation of the related changes is challenging. Cold neutron radiography (CNR), a novel approach was used to visualize high pressure induced changes of food materials. D<sub>2</sub>O was applied as pressure transmitting medium, which has a smaller mass absorption coefficient for neutrons than H<sub>2</sub>O. Different model foods (water, olive oil, potato) were used as samples. CNR was conducted at V7, HZB, Berlin. Before compression the samples were inserted into a special sample holder for liquid food samples, separated from the pressure transmitting medium by a floating piston made of Teflon. Pressure was built up in different steps (0.1, 10, 50, 100, 150, 200, 300, 400 MPa) and at each level CNR images were taken every 15 seconds with an exposure time of 10 seconds. Teflon and D<sub>2</sub>O created positive contrast when compared to the treated sample. Visualization of the gaseous-liquid phase changes was realized and volume changes of the samples were clearly observed from the movement of the floating piston. Results and potential of the CNR technique will be discussed.

## Use of lacunarity for characterization of pork ham slice surfaces from digital binary images

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An important goal for characterization of texture appearance is the quantification of spatial patterns. The objective was to investigate the potential usefulness of the fractal metric lacunarity as a descriptor of visual texture in ham slice images. Ham slices in general have complex and inhomogeneous colour surfaces and these inhomogeneities can be attributed mainly to formulation, presence of pores/defects and fat-connective tissue, and colour variations. Suitable descriptors could provide objective information, and a second-order metric such as lacunarity is, in theory at least, able to characterize better these surfaces, providing data about the spatial distribution of the intensity pixels. Images were acquired from three qualities of pork ham slices typically consumed in Ireland (200 slices/quality). The segmented images of pores/defects and fat-connective tissue were separately evaluated to compute lacunarity curves. Lacunarity computation using the gliding box algorithm has the advantage of large sample size that usually leads to more consistent statistical results. Lacunarity is smaller when the binary image is nearly translationally invariant, being made of “diffuse” clumps separated by smaller empty lacunas, like in the case of the medium quality slices. Lacunarity is higher when the image (premium quality slices) consists of structures in the form of “tight” clumps separated by larger empty gaps. Linear and log-log curves appear more representative for the characterization of texture appearance, due to the changes of lacunarity over different gliding box sizes. Additionally, normalized lacunarity plots emphasize more, all the typical features which are already found in lacunarity curves. The behaviour of lacunarity curves (linear axes) resembles the one of an exponential decay and the fitting of these curves was carried out using a three-parameter ( $m$ ,  $n$ , and  $q$ ) single exponential decay function. These parameters can better represent the variation of mass density of pixels. Results suggest that lacunarity has a discriminating effect among the three ham qualities which is more apparent in the pores/defects binary images, where the curves differentiate the ham qualities better than in the fat-connective tissue images. Specifically, the three ham qualities statistically differ from each other with respect to parameter  $m$  and  $q$  for the pores/defects binary images. Lacunarity as a descriptor of texture appearance indicated the characteristics of space filling capacity and heterogeneity in the images. This investigation confirmed the usefulness of this fractal metric as a quantitative descriptor of texture appearance in sliced ham images.

## **Thermoluminescence detection of irradiated crustaceans: comparison between two methods for extracting minerals**

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Among the industrial applications of ionizing radiation, the treatment of food for preservation purposes is a worldwide recognized tool, provided that proper and validated identification methods are available and used. The thermoluminescence (TL) is one of the physical methods recommended by the European Committee for Standardization in the EN1788 from 2001 for the identification of irradiated food, from which silicate minerals can be extracted. The efficacy of the method strongly depends on the quantity and purity of the extracted minerals, and therefore on the extraction procedure. In this work we applied the TL for the identification of irradiated crustacean *Nephrops Norvegicus*, for which the European Committee has not yet validated any identification method, and we compared two different procedures for extracting minerals: a) by means of a density gradient of sodium polytungstate solution; b) with acid hydrolysis. These procedures were applied to samples not irradiated and to samples irradiated at 0.5 - 1.5 - 3.0 kGy. The identification of the irradiation treatment was always achieved with both procedures, without any false positive. According to our results, a little preference should be given to the acid hydrolysis extraction since, with respect to the sodium polytungstate procedure, it requires less quantity of food sample and reagents, as well as less time to be carried out.

## Prediction of consumer panel assessment of beef palatability from digital image features

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Cooked beef palatability has been successfully investigated with computer vision systems on previous occasions using colour, marbling and wavelet surface texture features extracted from digital images of raw beef steaks post carcass excision. These investigations used a trained expert sensory panel to give the assessment of palatability. However the truest measurement of palatability is a consumer panel test where a large number of untrained members of the public give the assessment of palatability. Thus to enhance the usefulness of the previous computer vision methods, those methods were reapplied to predict the consumer panel determinations of palatability. As before beef muscle colour was characterized by pixel value distributions in the red, green and blue (RGB) colourspace and muscle marbling was characterized by marbling fleck size distribution and density within the muscle. High magnification imaging with a camera telescope produced images showing fine details of muscle fibre arrangements with muscle texture revealed from these images via the Cb (difference from a blue standard) grey-scale derived from the digital video colour space YCbCr. In an effort to simplify the texture analysis, texture was characterized with the symmetric modified Daubechie wavelet transform applied only at 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> orders. To eliminate redundant and duplicate predictor variables a genetic algorithm searched for the best subset of image features to predict each palatability measurement. Partial least squares regression (PLSR) predictive models for each palatability measurement were developed from their respective best subset. Three criteria of model stability were satisfied leading to good predictions of overall likeability ( $r^2=0.82$ ), tenderness ( $r^2=0.78$ ), juiciness ( $r^2=0.79$ ) and flavour ( $r^2=0.76$ ). The predictive models were developed with linear and non-linear terms. In conclusion a basis for accurate modeling of beef palatability has been developed. Addition of further data such as hyperspectral may yield more accuracy.

## Early prediction of rice leaf blast based on multi-spectral image

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Rice blast is one of main diseases in rice production which distributes widely all over the world. This disease causes serious damage to the rice production. Hence, it is important to predict the rice blast in the early stage. In this paper, a method was proposed to predict rice leaf blast and classify the rice blast base on the multi-spectral images of rice leaves. Firstly, four varieties of potted plant rice were chose in south of China. And artificial spray inoculation was done by gradient concentration of bacterial liquid at seedling stage. Multi-spectral images of rice leaves were collected after several days. Secondly, the backgrounds of multi-spectral images were removed by threshold segmentation and artificial neural network (ANN). Then an algorithm which united the water-shed algorithm and wavelet transform was used to extract the infectious region from the image, the water-shed algorithm was used to rough recognize the infectious region from the image. And the couple orthogonal wavelet base was used to detect the image edge. Thirdly, calculate the area of the infectious region which was extracted by the algorithm above. Then calculate the area ratio of the infectious region to the whole leaf. Finally, classify the leaf blast by the area ratio, according to the international grade standard of the rice leaf blast. Compared to the artificial grade results made by the experts, the accuracy of grade results based on the multi-spectral images approached to 90%. The method developed in this paper established a foundation for achieving automation of rice leaf blast prediction and classification.

## Fish size estimation and sorting using laser light sectioning

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This paper proposes the method to estimate volume from three-dimensional characteristics of fish by computer vision system using laser light sectioning. The vision system measures a number of features of fish as seen by a camera perpendicular to a conveyor belt. The features used here are the widths and heights at various locations along the fish. The image data was extracted from the structured laser light projecting on the fish surface. After image pre-processing, the laser profile is calculated the center of gravity in order to extract the image coordinate. The homography transformation is used to transform the extracted coordinate to the real world distance (in metric system). Furthermore, we apply a measure of dispersion expressed as the ratio of the maximum to the minimum radius from the maximum area cross section which can be sorted the different shape of fish species. A metric vision based on light sectioning for discrimination between samples of three fish species had been developed and tested.



## Packaging properties of cassava starch nanocomposite films

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The litter problem with regard to the environment pollution has created an urgent need to develop new biodegradable materials that have comparable properties with today's polymeric materials at an equivalent cost. Biodegradable polymers based on natural polysaccharides, particularly starch, can be produced at low cost and at large scale. Cassava is an abundant and cheap agricultural source of starch and is cultivated throughout the Brazilian territory. Starch is not a real thermoplastic, but, in the presence of a plasticizer, high temperatures (90-180°C) and shearing, it melts and fluidizes, enabling its use in injection, extrusion and blowing equipment, such as those for synthetic plastics. Plasticizing agents can improve mechanical properties of the films, resulting in materials with better flexibility and extensibility. Others additives can be used in the film formulation in order to overcome the high permeability caused by the plasticizer and also to improve mechanical properties of the films. Thermoplastic starch reinforced by clay has been investigated because it is notorious the potential of clays to improve mechanical and barrier properties of the films. In order to produce cassava starch nanocomposite films, two concentrations of glycerol (7.5 and 12.5 g<sub>glycerol</sub> / 950 g<sub>water</sub>) as plasticizer and two concentrations of nanoclay particles (0.5 and 1.0 g<sub>nanoclay</sub> / 950 g<sub>water</sub>) were used to prepare films using a casting process. Films without nanoclay particles were used as control. Mechanical and barrier properties of films were evaluated by statistical analysis (ANOVA two-way) to verify if both glycerol and nanoclay particles content influenced the results, at 95% confidence interval. ANOVA applied on results showed that the incorporation of glycerol and nanoclay particles influenced significantly ( $p > 0.05$ ) water vapor permeability of the films. As expected, glycerol caused significant differences in both tensile strength and elongation at break. The plasticizer molecules interfered with starch packing, decreasing intermolecular attraction and increasing polymer mobility. This involved an increase in elongation and a decrease in tensile strength as glycerol content rose in film formulations. Regarding nanoclay particles, tensile strength decreased with increase of their content. Concerning barrier properties, it can be observed that an increase in glycerol content lead to an elevation of water vapor permeability. This fact was expected because the decrease in the intermolecular attraction caused by glycerol incorporation and the hydrophilic character of the plasticizer facilitate the migration of water vapor molecules, and as a consequence, permeability values are always significantly higher for plasticized films. On the other hand, the presence of nanoclay particles causes a significant decrease in water vapor permeability values, which was important to demonstrate the potential use of nanoclay particles in biodegradable film formulations. These results infer that films based on cassava starch can be considered as an interesting biodegradable alternative packaging, but so much investigation is necessary to improve their mechanical and barrier properties.

## Monitoring of the vibration damage for packaging mangos in a corrugated fiberboard box during transportation

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The objective of this study is to reduce the damage of mangos during transportation. In Taiwan, the mango is one of the most popular and widely grown fruit crops. The mangos are transported by trucks from Tainan county to Taipei city in a distance of about 330 km. Improper package and transportation will cause the physical damage of mangos due to bruising and abrasion during transportation. The damage caused by physical injury will result in an accelerated deterioration in fruit quality. Therefore, our research will focus on the mango's packaging method and transportation quality. In this study a new monitoring system that uses a three-axial vibration recorder and an accelerometer to measure the whole vibration situation on a truck was developed. The accelerometer was installed in a corrugated fiberboard box which is filled with mangos. Different cushion materials were used in the corrugated fiberboard box among mangos. The selected cushion materials were shredded newspapers, net wraps, foam rubber pads, small styrofoams and styrofoam trays. The acceleration values from different test sets during transportation were acquired. The damage level of mangos could then be evaluated according to these acceleration values. The results showed that the overall mean acceleration value obtained by a combination of net wraps, small styrofoams and styrofoam tray as a cushion method in a corrugated fiberboard box among mangos was  $6.41 \text{ m/s}^2$  which was the lowest value in the whole test sets. Compared with the traditional packaging method this kind of packaging can reduce the damage of mangos during transportation significantly.

## Development of web-based software for packaging design

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PACK-in-MAP is a web-based ([www.packinmap.com](http://www.packinmap.com)) software tool that helps in designing modified atmosphere packages (MAP) for fresh and fresh-cut fruits and vegetables. The user-friendly online software determines the needs for packaging of fruits and vegetables in order to maintain the high quality and extend the shelf-life. The software contains a database on information on product respiration rate, optimum temperature, and optimum range of O<sub>2</sub> and CO<sub>2</sub> concentrations as well as permeability of different packaging materials, including micro-perforated films. The database can be accessed online and even user can configure it to their product/package requirements. In the PACK-in-MAP software, the user defines the type of product and the software selects the optimum temperature, O<sub>2</sub> and CO<sub>2</sub> and calculates the respiration rate for that product. The system then selects the best possible packaging material and/or amount of product required to achieve the desired gas exchange and simulates the O<sub>2</sub> and CO<sub>2</sub> atmosphere inside the package. It helps to design and simulate the package atmosphere without knowledge of mathematical models, and modified atmosphere packaging itself. It has capability of simulating the package at varying temperature set according to the real-life distribution chain and also evaluates the impact of product and package variability on internal package atmosphere. The software has been successfully used to designing MAP of mushrooms, carrots, cheese, mango and onions and the results have been validated with the experimental data. A case study will be presented to illustrate the use of the software to design a MAP for 1 kg of whole mango var. Nam dok mai packed in a box type package with total volume  $1.55 \times 10^{-3} \text{ m}^3$ . Ethyl cellulose was found to be the best film with an area of  $0.0221 \text{ m}^2$  yielding 6.5% O<sub>2</sub> and 7.35% CO<sub>2</sub> at steady state level. This gas composition was found to be within the optimal range for whole mango. The software was further used to simulate the package O<sub>2</sub> and CO<sub>2</sub> during storage, to know other alternative films and also to evaluate the impact of product and package variability on MAP.

## Analysis of microwave distribution for ready-to-cook fresh-cut Asparagus packaging

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This contribution presents an analysis of 2.45 GHz microwave distribution for ready-to-cook fresh-cut asparagus in polyethylene (PE) packaging. Pre-packed asparagus was simulated for cooking process inside a domestic microwave oven with size of 30x30x20 cm (w x l x h). Simulation applied finite integral method and Maxwell equations to solve an E-field inside microwave cavity. The E-field was further converted into temperature mapping based on heat transfer equations. Validation was performed by comparing the simulated and actual temperatures of microwaved asparagus captured on thermal imaging camera. Then heat distribution for asparagus in modified microwavable packaging was studied. The result indicates that the simulated temperature mapping of asparagus on a regular PE packaging agreed with the thermal images. The temperature distribution of asparagus was not uniform within a range between 76.8 and 28.2°C. From simulation, the modified microwavable package with dielectric loss,  $E''$ , of 16 (similar to  $E''$  of asparagus) improved heating uniformity and reduced temperature difference at hot-spot by 27°C compared to regular PE packaging with  $E''$  of 0.41. This work provided guidelines to modify the microwave cooking conditions and the microwavable packaging with minimal experimental cost for ready-to-cook foods.

## Water vapour permeability, mechanical and thermal properties of carboxymethyl cellulose-based edible films containing potassium sorbate

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Water vapour permeability (WVP), tensile strength, % elongation and thermal properties (differential scanning calorimetry, DSC) were investigated in carboxymethyl cellulose films containing potassium sorbate as a preservative and plasticized by polyethylene glycol (PEG 400) and glycerol. The WVP of films was determined to be  $1.18 \times 10^{-6}$  ( $\text{g day}^{-1}\text{m}^{-2}\text{pa}^{-1}$ ) for films plasticized with glycerol, without sorbate while WVP values for the films containing 1 and 2% sorbate increased to  $3.77 \times 10^{-6}$  and  $15.5 \times 10^{-6}$  ( $\text{g day}^{-1}\text{m}^{-2}\text{pa}^{-1}$ ) respectively. Incorporation of 3 and 4 percentage of sorbate decreased water vapour permeability significantly. Films plasticized with polyethylene glycol without sorbate had good water transition compared with glycerol as a plasticizer. Tensile strength of films with potassium sorbate decreased in comparison to control and incorporation of sorbate increased the flexibility to 28.81% for 3% sorbate while higher concentration of sorbate decreased the strain percentage. Films plasticized with polyethylene (400) was brittle because of high tensile strength and poor elongation. The observed depression for these polymer blends was proportional to the plasticizer content (water, polyethylene, glycerol) especially for water. Results of DSC showed a sharp pick for films which contain potassium sorbate probably due to melting point of potassium sorbate in 151-156 °C.

## The effect of calcium alginate coating on the storability of strawberry at the refrigerator

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Edible coating made from alginate was investigated to preserve the quality of strawberry at cold storage (5°C). The fruit was immersed in sodium alginate solution and subsequently dipped in calcium chloride solution to form calcium alginate coating on the surface of strawberry. The quality of coated and non-coated strawberries were evaluated by weight loss, visible decay, titratable acidity, total soluble solids and reducing sugar content over 14 day storage period. Obtained results showed that calcium alginate coating had no significant effects on weight loss, while physicochemical parameters compared to control fruit resulted in a better preservation of the fruit by protecting strawberry against fungal infection.

## Effects of modified atmosphere packaging on the quality of barberry

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In a laboratory scale investigation the effects of modified atmosphere packaging (MAP) on quality and microbial property of dried fruit were studied. At first all samples were dipped in 85°C water for 30 second (blanch), and dried in a cabinet drier at 40°C temperature, then product were packed in polyamid bags with tree condition containing: air, nitrogen and vacuum. Then samples of all treatments were stored in ambient temperature for 12 months. Above mentioned methods were compared every two month by measure the pH, anthocyanin content and quality (panel test). It was concluded that mold and yeast contamination were reduced by blanch treatment lower than standard. During storage pH increased, anthocyanin content and the quality of barberry decreased. Also discoloration in MAP with nitrogen treatment was slower than others.

## Effect of pretreatment by ethyl oleate and packaging on qualitative characteristics of stored dried mulberry

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Aim of pretreatment drying of mulberry was to reduce the moisture content to a level that allows safe storage over an extended period. In this research after different combination of ethyl oleate pretreatments, mulberry was dried industrially (cabin dryer). Dried mulberries packed in polyethylene and polystyrene and preserved for 5 months in 20°C. NEB was tested at 440 nm by spectroscopic method. Organoleptic tests were done by trained panel. Hardness, adhesiveness, springiness and chewiness of dried mulberries were measured by a texture analyzer. Statistical method was 2 factors factorial in frame of completely randomized design with three replicates. Factor A was different pretreatments and factor B was packaging type. The results showed that Least intensity of brown color was in dried white mulberry pretreated by ethyl oleate 2% +ascorbic acid 1% and then in ethyl oleate 2% +potassium meta bisulfate 0.5% treatments. The lowest total count was in white mulberry in ethyl oleate 2% +potassium meta bisulfate 0.5%. The results of Panel tests showed highest score for texture, color, odor, taste and overall acceptance in pretreatment of fruits with ethyl oleate 2% +potassium meta bisulfate 0.5%. The results of rheological tests showed that the highest score for chew ness was in white mulberry pretreated with ethyl oleate 2% +potassium met bisulfate 0.5%. White mulberry pretreated and packaged in poly styrene had the lowest scores for brown color and total count after 5 months storage. Totally it is concluded that dried white mulberry pretreated with combination of ethyl oleate 2% and potassium meta bisulfate 0.5% and packed in poly styrene preserved its qualitative, sensory and rheological characteristics after 150 days in 20°C.



## An innovative process for extraction of fruit juice using microwave heating

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Traditionally, the manufacturing of fruit juice uses enzymes as pressing aids, which demands long incubations (typically 2-3 h, at 40-60°C) and causes oxidation, and thus browning of juice. We propose an alternative technique where the juices are extracted by microwave-driven hydrodiffusion. This allows inactivation of endogenous oxidase and thus alleviates risks of browning. Further, the extraction requires no processing aid. Our objective is to measure the diffusion of juice, to relate the availability of the micronutrients to the fruit composition, and to study the impact of microwave energy on the plant structure, particularly the cell walls. Fruits (500 g i.e. 7 plums) were placed in the extraction vessel for each treatment. During experiments, time, temperature, pressure, and power can be controlled with the "easy-WAVE" software package. Temperature was measured by a fiber optic temperature sensor inserted directly into the sample container. Temperature was controlled by a feedback to the microwave power regulator. In a typical procedure performed at atmospheric pressure, fruits were heated using a fixed power without added any water. A mixture of hot "crude juice" and steam (in situ water) move thus naturally by earth gravity outside the microwave by an aperture. Juices and fruits were analysed for sugars and acids using colorimetric enzymatic methods, for phenolics by HPLC after thioacidolysis, and for polysaccharides, collected as ethanol-insoluble solids, by colorimetry (uronic acids) and GC after derivation to alditol acetates for sugars and head-space for methanol content. The extraction kinetics were followed as a function of microwave energy density; all proceeded through the same 4 stages. Stage 1 corresponds to the time necessary for heating the matrix, it is the time necessary for the first fruit juice droplets to pour outside the microwave cavity. Stage 2 corresponds to an intensive extraction of fruit juice at increasing flow rate. It is also the phase of extraction of easily exchangeable water in fruits. Stage 3 corresponds to a decrease of the flow rate of extraction. Stage 4 is the end of extraction process, the fruit is almost dry. At the end of extraction, we collected from 300 to 610 ml of juice per kg of plum, depending on power density. The juices were a clear bright red, quite viscous and perceived as tart and slightly astringent. The final juices actually had very low soluble solids contents. High concentrations of pectins were recovered in all the juice (e.g. 7.6 g/L, for 1 W/g energy density).

## Pulsed electric field assisted extraction of plant raw materials

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The development of new methods and technologies for a sustainable processing of raw materials aims to reduce process intensities and retain or enhance the nutritional quality of the product. The reduction of energy and water consumption, as well as the most complete use of the raw material including all by products are considered as the driving force for the optimisation or replacement of conventional technologies. When exposed to high electric field pulses cell membranes develop pores which may be permanent or temporary, depending on the intensity and treatment conditions. Low treatment intensity allows a reversible disturbance of the phospholipid bilayer and recent investigations showed the potential of this low intensity treatment to induce stress reactions in plant cells resulting in the promotion of a defense mechanism by increased production of secondary metabolites as a post-harvest biosynthesis. An irreversible perforation of the cell membrane reduces its barrier effect permanently. Applied to fruit and vegetable cells mass transfer processes like pressing or extraction are enhanced. The presented results will show the application of low intensity PEF treatment of blueberries for the stress induced biosynthesis of polyphenols. Process effect was evaluated by the determination of total polyphenol content in the extracts recovered after PEF treatment and subsequent the storage of intact fruits. To enhance extraction yield of polyphenols from blueberry mash PEF was applied for cell disintegration leading to an increased release of bioactive components. The same finding could be made after PEF treatment of blueberry pomace used for further extraction after juice recovery. Impedance measurement was used as a capable tool to determine the degree of cell disintegration after PEF treatment. An outlook on industrial feasibility of the PEF technology and an evaluation of time and energy requirements in comparison with traditional technologies for cell disintegration will complete the presented topic.

## Ultrasound accelerated maceration for direct aromatisation of olive oil with basil

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The use of ultrasound and its applications to the food industry has been widely studied and it is still one of the most studied research area. It was preliminarily used as a control system in the food industry by using high frequency ultrasound (also called diagnostic ultrasounds) but more and more interest has been given to high power (or low frequency) ultrasounds as a food processing alternative. In fact low frequency ultrasounds have been found to give greater yields in extraction processes, or same yields at lower temperature or even decreasing the processing time. The effect of ultrasound on extraction yields is attributed to the microstreaming and enhanced mass transfer produced by cavitation bubbles collapse resulting in cell destruction and greater solvent penetration into the plant material. Essential oils of aromatic plants are well known for showing high antioxidant activities which constitute an interesting product on a nutritional point of view. In fact the protective effect of the Mediterranean diet against risk of cancer and cardiovascular diseases has been attributed to high intake of antioxidants. Essential oil glands are usually located on the external part of the plant so are directly exposed to the cavitating bubbles which explains why ultrasonic power is a very interesting alternative system for essential oil extraction. Olive oil aromatisation is a new trend in the Mediterranean area, both for sensory and for nutritional improvement. The aim of this work was to develop a green enrichment of an olive oil with basil. Basil leaves are directly put in the olive oil and ultrasounds are applied to the mixture in order to accelerate diffusion of the basil aromas in the olive oil. The processing time is reduced from days to few minutes when comparing traditional maceration and ultrasound assisted aromatisation. Sensory profiles are similar between macerated and ultrasounds assisted oils and the news aromatised oil is well accepted by potential consumers.

## Precipitation of ethyl cellulose by solution enhanced dispersion by supercritical fluids

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Among the many variants of cellulose, ethyl cellulose (EC) has attracted considerable attention since it can be used as a binder, taste mask, dispersing agent, stabilizer, water conserving agent, and a sustained-releasing agent in medicinal and functional-food applications. Over the past two decades, microparticle formation by supercritical fluid (SCF) has gradually become a promising technique, in which CO<sub>2</sub> is the most popular fluid of the SCFs. The objective of this work was to investigate the application of the solution enhanced dispersion by supercritical fluids (SEDS) process for the precipitation of EC microparticles. First, the solubility of EC in the supercritical CO<sub>2</sub> was calculated by a semi-empirical formula, which confirmed the possibility of using SEDS process to form EC microparticles. Ethanol, acetone and dichloromethane (DCM) were chosen as the solvent respectively. The influence of different process parameters, such as the operating pressure and temperature, was studied experimentally. The microparticle size of EC and their distributions were compared among the three organic solutions. Additionally, it was observed that the presence of EC in the ternary mixtures had very little influence on the fluid phase behavior of the systems, and the data of vapor-liquid equilibrium of the binary systems CO<sub>2</sub>-ethanol, CO<sub>2</sub>-acetone and CO<sub>2</sub>-DCM could thus be used to analyze the microparticle formation. Therefore, the results presented in the current study could contribute to furthering SCF technology research on the functional microparticle or microcapsule formation in the food industry.

## Pressurized low polarity water extraction kinetics of *trans*-resveratrol and *trans*- $\epsilon$ -viniferin in grape canes

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Recent reports on the health-beneficial properties of phenolic and other phytochemicals have led to increased interest in the search for new sources of these and related compounds. Grape canes (*Vitis vinifera*), a byproduct of the wine industry, appear to have potential as a source of bioactive compounds, especially *trans*-resveratrol and *trans*- $\epsilon$ -viniferin. Also, in recent years, there has been an increase in the quest to develop novel processes that may overcome some of the major drawbacks encountered in conventional organic solvent extraction methods. Pressurized low polarity water (PLPW) extraction, also known as subcritical water extraction, has shown potential as an environmentally benign extraction method for phytochemicals. A slight increase in the yield of *trans*-resveratrol was seen with increase in the narrow temperature range of 85°C to 95°C; further rise up to the highest temperature level of 160°C investigated resulted in a severe decrease in *trans*-resveratrol content of extract. An increase in *trans*- $\epsilon$ -viniferin content of the extract (up to 120°C) followed by sharp reduction with increasing temperature in the studied range. The effect of ethanol in the range of 0 to 15% (v/v) on the extraction efficiency of *trans*-resveratrol, and *trans*- $\epsilon$ -viniferin was positive. The three parameters modified Gompertz equation was used to describe the extraction kinetics of bioactive compounds from grape cane samples by PLPW extraction system. Results indicated that the modified Gompertz equation with high determination coefficient ( $R^2$ ) and low mean square error (MSE) values was a good option for stilbene compounds, *trans*-resveratrol and *trans*- $\epsilon$ -viniferin. Temperature and ethanol concentration dependencies of the model parameters (maximum extraction yield, maximum extraction rate and time period required to reach the beginning of the maximum extraction rate) were represented by ad-hoc secondary models. The maximum extraction rate of both phenolics showed a tendency to increase with increasing temperature and ethanol concentration. The curve effect of temperature was observed on the maximum extraction yields and time parameters of the fitted equation for both phenolic compounds. Increasing ethanol concentration caused increase in the maximum extraction yields of studied phenolics whereas, the time parameters displayed different trends.

## Effects of whole fat rapeseed expanding on the pre-pressing cake oil residue

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In this paper the new technology of whole fat rapeseed expanding and pre-pressing and extracting was put forward according to the disadvantages of the traditional processing craft of the rapeseed. The effect of die diameter, expanding temperature, feed rate, mass moisture content on the pre-pressing cake oil residue of rapeseed and the optimal conditions for lower cake oil residue were studied by response surface methodology. The result showed that pre-pressing cake oil residue was extremely significant affected by the feed rate and mass moisture content, the pre-pressing cake oil residue was significant affected by the die diameter; the pre-pressing cake oil residue was non-significant affected by expanding temperature. the optimal technical conditions for lower cake oil residue were determined by quadratic polynomial regression analysis and frequency analytical method as follows: the optimal amount of die diameter was 9.3~10mm, the optimal amount of expanding temperature was 95.3~98°C, the optimal amount of feed rate was 33.6~35.1t/hr, the optimal amount of mass moisture content was 8.8~9.5%. By verification, the values of pre-pressing cake oil residue obtained under the optimal conditions were accommodated with the value of predication.

## Antioxidant properties of various solvent extracts of some food processing by-products

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The growing interest in the substitution of synthetic food antioxidants by natural ones has fostered research on vegetable sources and the screening of raw materials for identifying new antioxidants. The food and agriculture products processing industries generate substantial quantities of phenolics-rich by-products, which could be valuable natural sources of antioxidants. Some of these by-products have been the subject of investigation and have proven to be effective sources of phenolic antioxidants. Practical aspects of extraction and production of sufficient amounts of natural antioxidants from most of these sources remain to be elucidated. The aim of this work is to focus on the effects of different extracting solvents on the total phenolic content and antioxidant activities of potato peels, sugar beet pulp, and sesame cake extracts. Antioxidant activities of the extracts were evaluated by 2,2-azinobis (3-ethylbenzthiazoline sulphonate) (ABTS) radical scavenging activity, 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging capacity, and  $\beta$ -carotene/linoleic acid test system for total antioxidant activity, and compared with that of butylated hydroxy anisole (BHA), butylated hydroxy toluene (BHT) and tert-butyl hydroquinone (TBHQ). Methanol exhibited the highest extraction ability for such phenolic compound followed by ethanol and acetone, where the total phenols were 2.91, 2.74, 2.38 (potato peels), 1.79, 1.52, 0.83 (sugar beet pulp), and 0.81, 0.55, 0.24 respectively (sesam cake) (mg gallic equivalent/g powder). The results showed that solvents with different polarities had significant on antioxidant activity. All three methods proved that potato peels extract had a higher antioxidant activity due to its high content of polyphenol. A few of these extracts are as strong as some common synthetic antioxidants. On the basis of the results obtained, potato peels, sugar beet pulp, and sesame cake were found to serve as natural antioxidants due to their marked antioxidant activity.

## Effects of supercritical CO<sub>2</sub> fluid parameters on chemical composition and yield of carotenoids extracted from pumpkin

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Pumpkin is a traditional food that is grown extensively worldwide and is believed to be beneficial to human health due to its high contents of carotenoids. The carotenoids in pumpkin were extracted by organic solvent and by supercritical carbon dioxide (SC-CO<sub>2</sub>), and then they were identified, quantified, and compared.  $\beta$ -carotene (31-41%) was the predominate carotenoid in pumpkin. Lutein and lycopene contents were much higher in SC-CO<sub>2</sub> extracts than those in organic solvent extract. Cis- $\beta$ -carotene increased by more than two times in the SC-CO<sub>2</sub> extracts, even at a relatively low temperature of 40°C, over those in the solvent extracts, indicating both enhanced solubility and isomerization from trans- to cis- $\beta$ -carotene. The influences of modifier (10%), temperature (40-70°C), and pressure (25-35MPa) of SC-CO<sub>2</sub> extraction on the change of carotenoid yields were also investigated. The highest yield (109.6  $\mu$ g/g) was obtained at 70°C and 35 MPa, with a 73.7% recovery. Selective extraction could be achieved by adjusting the temperature and pressure. Higher proportions of all-trans- $\beta$ -carotene extracts were achieved at 40°C under both 25 MPa and 35 MPa conditions. In order to extract more cis-isomers, a higher temperature of 70°C was preferred.



## A study of the effect of micro and nano-bubbles in the dynamic properties of water

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The acceleration in the physiological activity was observed in some plants and shellfishes when water containing micro and nano-bubbles (MNB) was used. In order to understand the mechanism of this phenomenon, the dynamic properties of water containing MNB have been investigated. Preliminary studies showed the decrease in NMR  $^1\text{H}$  relaxation times, spin-lattice relaxation time  $T_1$  and spin-spin relaxation time  $T_2$ , however this was mainly caused by the dissolved oxygen (DO) concentration of the sample water because of the paramagnetic effect of the oxygen which causes an efficient relaxation. For this reason, the dynamic state of the water containing micro and nano-bubbles (MNB) could not be detected through NMR measurements. To solve this problem, manganese ion ( $\text{Mn}^{2+}$ , introduced as  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ ), which is also paramagnetic, was added to the water before the production of MNB in order to provide an excess of paramagnetic substances. With that, it was expected that the paramagnetic effect originated from oxygen would be masked, and the change in the dynamic properties of the MNB water could be detected through  $T_1$  measurement. Different manganese ion concentrations, in the range between 5 mM and 40 mM, were tested. Then, the effect of the micro and nano-bubbles on  $T_1$  was examined among three samples: (1)  $\text{Mn}^{2+}$  solution itself as a control, (2)  $\text{Mn}^{2+}$  solution containing oxygen MNB, and (3)  $\text{Mn}^{2+}$  solution in which oxygen was introduced by simply diffusing the oxygen to form only macro bubbles but not MNB. Both samples of (2) and (3) presented similar DO concentrations ( $38 \text{ mg L}^{-1}$  at  $20^\circ\text{C}$ ). As a result, at 10 mM of  $\text{Mn}^{2+}$ , the water with MNB showed a  $T_1$  of  $12.8 \pm 0.1 \text{ s}$  ( $n=5$ ) against  $11.5 \pm 0.2 \text{ s}$  ( $n=5$ ) of the control sample, that is, approximately 10% greater. The water with macro bubbles showed the same value as the control sample with  $11.6 \pm 0.3$  and  $11.6 \pm 0.2$ , respectively ( $n=5$ ). These results indicate that the paramagnetic effect of oxygen was completely masked at this  $\text{Mn}^{2+}$  concentration, and the change in dynamic state of the MNB water was detected. With the introduction of MNB, the water molecules network was probably disturbed, resulting in a decrease of the number of hydrogen-bonded water molecules. These data can support the acceleration of cytoplasmic streaming rate observed in barley coleoptile cells, since the less bounded the water structure, the easier is the granules flowing in the cytoplasm in cell.

## Ultrasonic assisted microencapsulation of cardamom essential oil

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Essential oils, despite of having many advantages over ground spices, have limited applications in the food industry for being sensitive to light, heat and oxygen. One approach to overcome this is microencapsulation. The present work reports on ultrasonic emulsification of cardamom oil followed by its microencapsulation by freeze-drying using different types of modified starch including Hi-cap 100, capsule and oxidized starch as wall materials. The microcapsules were evaluated for their content of entrapped 1,8 cineole and its stability during storage for four weeks. Hi-cap offered greater protection towards cardamom oil than other starch varieties.

## Effects of the salting step conditions on Tunisian Kaddid meats: kinetics and quality

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Salting and drying are among the oldest techniques of food preservation, aiming to increase shelf life of the product. However, the current demand of cured meats is essentially driven by the flavor of the product. The sensorial characteristics of these products depend on local customs and habits. Kaddid meats are Tunisian salted, spiced and sun dried beef or lamb traditional products. Local industrials are now interested on a mechanized and controlled process allowing them to produce Kaddid. Two different methods for producing Kaddid are traditionally used: during the first processing step salting may be realized in brine or by dry salting. Salting, which is an osmotic treatment, includes complex phenomena, due to counter current salt and water transfer along with actin-myosin-NaCl interactions. The aim of this work is to study the Kaddid's salting step: kinetics and quality, in order to establish the most appropriate procedure toward controlling the first and most critical step for Kaddid production. The beef meat used had  $76.02 \pm 0.50\%$  water content,  $23.53 \pm 0.40\%$  proteins,  $1.2 \pm 0.26$  ash,  $1.53 \pm 0.53\%$  NaCl on a fresh basis and a pH of 5.4. Salt uptake and water loss were analyzed during brine salting at three different concentrations (15%, 21% and 26.5% w/w) as well as during dry salting. Experimental kinetics were obtained. Different mathematical equations modeling water and salt transfers during osmotic treatment were tested. Experimental and theoretical data allowed accessing the effects of salting conditions on water loss and salt gain for all osmotic treatments. Microbiological analyses were run before and after the salting period. Test included mesophilic aerobic microorganisms, moulds and yeasts, total coliforms, fecal coliforms, aerobic sulfite-reducer bacteria, staphylococcus aureus, lactic bacteria and salmonella. All tests showed lower counts than recommended standards. Even though lactic bacteria, which are considered as starter in fermented meats, responsible of its rapid fermentation, showed a more important count in dry salted meat. Proteins denaturation due to salting was confirmed first by a change in the extractability of sarcoplasmic and myofibrillar proteins and second by electrophoretic studies which had shown that both type of proteins undergo changes during osmotic treatment.

## Concentration and formulation of elder berry anthocyanins using membrane process and PGSS(TM) technology

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Elder berry and juice pressed using cold technology is rich in anthocyanin, flavonols and other valuable components. As anthocyanin is a valuable material for human organism it is important that the as more as possible be saved during processing of elder berry. In this study two novel technologies were applied to concentrate and maintain anthocyanin in the product prepared using modern separation processes. At first mild concentration of elder berry juice by membrane-filtration was the aim of my experiments. Removing of suspended solid ceramic tube ultrafiltration-membrane was applied (0.3 m<sup>2</sup> filtration-surface) like prefiltration. The recirculation flow rate (~180 L/h) and transmembrane pressure difference (8 bar) were adjusted during the measurements. The prefiltered elder berry juice was concentrated by nanofiltration using flat sheet membrane (0.046 m<sup>2</sup> filtration-surfaces, 75% salt rejection) next to 500 L/h flow rate and 20 bar transmembrane pressure difference. The other method of concentration was reverse osmosis (RO) by 400 L/h flow rate and 40 bar transmembrane pressure difference. The RO retentate was further concentrated by osmotic distillation. Temperature of filtrations was 30°C in every case. In the course of filtration and concentration total soluble solid content was measured with manual refractometer and total anthocyanin content of samples were determined with analytical method. For the second part of experiments the original juice and concentrates of filtrations were further formulated using supercritical fluid technology, namely Particles from Gas Saturated Solution (PGSS(TM)). The PGSS(TM) formulation was carried out using supercritical carbon dioxide, which results in an organic solvent-free product. In process, the compressible medium is solubilized in the substance which has to be micronized. The investigated carrier material was palm fat. In this method high pressure was applied. The different concentrated juice were compared. After the PGSS(TM) powderous anthocyanin-palm fat products obtained which showed good colour stability, which gives good bases for potential applications in the future. The products are homogenously coloured fine powders from light pink to violet, depending on anthocyanin contents. Median particle size of powder is 15-23 µm. The authors would like to acknowledge the support of the Hungarian OTKA foundation (T049850) and the Hungarian – Slovenian Cooperation project (TÉT SI – 11/2007).

## Obtention of gels from *Brama australis* and biaxial extensional viscosity characterization

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Gelatine from marine sources (fish skin, bone and fins) has been looked upon as a possible alternative to bovine and porcine gelatine, especially since the outbreak of the BSE (mad cow disease) in the 80s. The commercial interest in fish gelatine has this far, however, been relatively low. This is due to different physical properties compared to mammalian gelatine. Common problems connected with fish gelatine from cold water species, such as those from Chilean coast, are low gelling and melting temperature and low gel modulus. Lubricated squeezing flow is an useful technique to quantify gel behavior changes and, at the same time, it offers practical solution to slippage conditions and unperceived damage caused to the sample when subject to measurement. Lubricated squeezing flow method has not been applied to gelatine gel obtained from *Brama australis*. Therefore, the objective of this work was to study effects of pH and concentration on the extensional viscosity of *Brama Australis* fish gelatine gels using lubricated squeezing flow method. *Brama Australis* fish was bought and skin gelatine was extracted. Cylinders were formed with the gel (120 samples of diameter 2.1 cm with 1.8 cm height) which were tested using an Universal Texture Analysis equipment under 30% deformation. Based on force and distance (time) values, biaxial tension variables were obtained, along with deformation gradient, extensional viscosity and textural parameters given by Peleg expression. From the results it was found that at a constant pH force values increased as concentration increased. Conversely, in the case of pH variation, a pH of 8.5 is reached for maximum force. At a constant shear rate, when concentration increases the biaxial stress increases; also, although the compression rate is kept constant, the shear rate values vary due to concentration effects. This behavior can be explained because if a gel has higher concentration, it has less water content and therefore is more rigid due to a higher number of inter and intra molecular bonds, which leads to a more stable tridimensional network. Biaxial stress is a textural parameter influenced by concentration; when *Brama australis* fish gelatine concentration increases biaxial stress values increases. Extensional viscosity increases with increasing fish gelatine concentration.

## Exploring metabolic responses of potato tissue induced by electric pulses

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The induction of sublethal stress by the application of pulsed electric fields (PEF) is a novel technique for metabolic stimulation, being unique as a stress regarding its primary effect on cell membranes and by causing a homogeneous effect over the whole treated tissue. Therefore, research is needed to find appropriate conditions (e.g. pulse shape and polarity, number, width, interpulse time) for PEF-induced metabolic stimulation. These conditions should be chosen upon an understanding of physiological responses. In this investigation, we have explored metabolic responses of potato tissue induced by the application of PEF at different pulse widths and strengths. Potato tissue was subjected to field strengths ranging from 30 to 500 V/cm, with a single rectangular pulse of 10  $\mu$ s, 100  $\mu$ s or 1 ms. Metabolic responses were monitored using isothermal calorimetry, changes on electrical resistance during the delivery of the pulse as well as impedance measurements. Our results show that the metabolic response involves oxygen consuming pathways as well as other unidentified events that are shown to be insensitive to metabolic inhibitors such as KCN and sodium azide. The metabolic response is strongly dependent on pulsing conditions and is independent of the total degree of permeabilization. Evidence is provided showing that calorimetry is a simple and powerful method for exploring conditions for metabolic stimulation, providing information on metabolic responses that can not be obtained from electrical measurements.

## Implementation of water jet cut in cutting and peeling processes of agricultural products

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For the production of high-quality, hygienically flawless products, procedures which minimize the direct contact between product and personnel must be applied. This paper shows the development of a tool that combines robotics, water-jets and image processing to a process of peeling and cutting tropical fruits that minimize losses in the process and increase levels of hygiene required by EBLIS (European authority for food security). This authority demands assistance of producing companies, e.g., also in the third world countries which want to export agricultural products to the EU, by partner companies and/or by partners in the intermediate trade from the EU.

## Optimal shape design of holding tubes configuration in aseptic processing

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The concept of aseptic processing originated to solve problems associated with conventional 'in-container' sterilization of foods such as low rate of heat penetration to the slowest heating point in the container, the long processing times required to deliver the required lethality, destruction of the nutritional and sensory characteristics of the food, low productivity, and high energy costs. Aseptic processing technique has been successfully applied to liquid foods and acid foods containing discrete particulates. However, the extension of aseptic processing to heterogeneous low-acid liquid foods containing discrete particulates has been difficult due to lack of data on critical factors such as interfacial heat transfer coefficient between the liquid and the particle as well as the residence time distribution (RTD) of particles in the holding tube of the aseptic system. Geometry of holding tube represents a primary parameter in determining the residence time distribution of particulate inside an aseptic processing system. Several configurations had been investigated in the past, including curved geometries in order to minimize spreading of RTD. Optimal Shape Design (OSD) is a numerical technique allowing an automatic design of an optimal functional shape. In such approach, the solution is obtained by coupling together a discrete model of the process parameters, in this case obtained by solving the Navier-Stokes equations for a non-newtonian fluid, including the geometrical shape as a part of the degrees of freedom of the problem, and a constrained multivariate minimization algorithm is used in order to minimize an objective mathematical function describing the efficiency of the process. The essential element respect to classical numerical simulations in fixed geometrical configurations, is to introduce a certain amount of geometrical degrees of freedom as a part of the unknowns, which means that the geometry is not completely defined, but part of it is allowed to move dynamically in order to minimize the objective function. In this work, the OSD approach is applied in order to optimize the holding tubes shape and configurations in aseptic processing.



## Design and performance evaluation of a multi-crop slicing machine

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A multi-crop slicing machine was designed, fabricated and evaluated for performance. The major components of the machine include the hopper, mainframe, conveying disc, slicing unit, slicing shaft, idler shaft, pulley, bearing, electric motor base and outlet. The machine is powered by a three-phase, 1400 rpm, and 2 kW electric motor. The performance of the machine was evaluated in slicing four selected crops (carrot, potato, onion and yam), grouped into three sizes (small, medium and large) at five machine speeds of 39 rpm, 41 rpm, 43 rpm, 46 rpm and 48 rpm respectively. The parameters that were investigated were slicing efficiency and throughput capacity. A speed of 46 rpm was found to favour the slicing of large size crops only, while a throughput capacity of 48.9 kg/h and efficiency of 95.4% were obtained for carrot. Medium and large size samples gave good result for potato at a speed of 41 rpm with capacities and efficiencies of 72.8 kg/h, 88.9 kg/h, 97.9% and 94.8% respectively. Best result for small and medium size grade of onion we achieved at speed of 41 rpm with capacities and efficiencies of 44.6 kg/h, 71.6 kg/h, 91.7% and 96.4% respectively. A throughput capacity of 135.7 kg/h at a speed of 41 rpm and efficiency of 96% was obtained for yam. The machine is therefore observed to perform best at the optimum operating speed of 41 rpm for all the crops selected except carrot. The result of the study shows that the machine can slice root and tuber crops satisfactorily with slices ranging from 8 mm to 9 mm thickness were obtained.

## Cold neutron radiography for non-destructive analysis of food water status

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Water is a most important constituent of fresh horticultural produce and minimally processed food. Hence, comprehensive knowledge of water status is an important prerequisite for the evaluation of quality and quality changes during processing in many aspects. However, truly non-destructive methods for the in-situ study of water content, water diffusion or water transport are rare. An effective imaging method is cold neutron radiography (CNR). This method utilizes the strong interactions of cold neutrons, in particular, with hydrogen to establish a high contrast “water images” even for very small amounts of water. Since the early 1990<sup>th</sup> CNR imaging has been successfully used to observe water distribution of biological material. A variation in tissue structure and/or density of biological materials e.g. due to dehydration changes the contrast in the transmission images. However, steady state water flows or water diffusion can not be detected by radiographic technique. Therefore, contrast agents, such as Iodine for x-ray radiography are needed to indicate this water movement. In our most recent tested approach we use D<sub>2</sub>O as a tracer to observe steady water flow. D<sub>2</sub>O, showing much less interactions with cold neutrons than normal water, proved to be a suitable low-contrast tracer. Hence, the combination of CNR with the low-contrast tracer allows the direct visualization of water flow and the calculation of water flow with a high resolution at the tissue level. Here, we give a general introduction into this method, describe their latest developments, report about studies applying neutron radiography in plant science and provide most recent results of our experiments in this field.

## Variation in carrot texture under different storage conditions

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The objective of the work reported here was to determine the changes in carrot texture during short term storage. The purpose was to determine different firmness characteristics, such as the specific cutting force, the work performed during cutting and the impact stiffness coefficient. The carrots were stored under non-ideal conditions to get texture changes during the storage. The carrots were of 200-270 mm length, 25-40 mm diameter and 0.14-0.28 kg mass. The tested samples were divided into two groups. The first group was stored under  $7.5\pm 0.5^{\circ}\text{C}$  temperature and  $92\pm 5\%$  relative air humidity and the second one under  $15.0\pm 0.5^{\circ}\text{C}$ , and  $96\pm 4\%$  humidity. Each time during the experiments the cutting force and the work performed for cutting were measured on carrot disks of 5 mm width. The impact stiffness was measured on the carrots by a special purpose small hammer fitted with an acceleration sensor. This hammer was used to hit the carrot surface at 25-30% from the crown of the carrot length. The specific cutting force was calculated from the ratio of the maximum cutting force measured with Stable Micro System TA-TX2 texture analyzer by special sharp blade of 3 mm thickness. The specific cutting force was calculated from the ratio of the maximum cutting force to the cutting diameter of the measured carrot disk. The work performed for cutting the carrot disks was analyzed for two ranges: in the 1st range where the work increased (between zero and maximum force) and in the 2nd range where it decreased (between the maximum and zero force). The mass, the moisture content, the color attributes and NIR absorbance were measured, as well. The NIR absorbance was measured in the 1000 to 2500 nm range. The changes in the carrot taste attributes were measured by the electronic tongue since juice was made of the tested carrots by pressing. The mass of the tested carrots decreased during storage and the crispiness of the carrots decreased while the gumminess increased. The changes in carrot texture were therefore characterized by the specific cutting force, the ratio of the work performed in the 2nd range relative to the work in the 1st range and the impact stiffness. Consequently, the specific cutting force, the ratio of the work performed for cutting and the impact stiffness are suitable for characterizing the changes in carrot texture that can be expressed in the crispy and gummy character of the carrot during storage.

## Pork and turkey hams classification from colour and textural features using computer vision

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The aim of the present work is to classify the pork and turkey hams with the identification of the best colour and textural features by implementing the computer vision system. Image processing techniques were developed to predict the classification and characterization of three types (high, medium and premium quality) of pork and turkey hams from their image features. Images from cooked pork and turkey hams were extracted and evaluated to classify them on the basis of the best colour and textural features. Different colour and textural features (a total of 26 colour features and 40 textural features) were extracted and the best features which might have significant effect to classify the three types of hams from each other were obtained from Mahalanobis distances observed between groups and inter-correlations among the features. In such a way, two best colour features (mean of S, std. deviation of  $b^*$ ; from HSV and  $L^*a^*b^*$  colour space, respectively) and three textural features (entropy of  $b^*$ , contrast of H, entropy of R; from  $L^*a^*b^*$ , HSV and RGB colour space, respectively) for pork, and three colour features (mean of R, mean of H, std. deviation of  $a^*$ ; from RGB,  $L^*a^*b^*$ , and HSV colour space, respectively) and two textural features (contrast of B, contrast of L; from RGB and  $L^*a^*b^*$  colour space, respectively) for turkey hams were selected as features with the highest discriminant power. The Linear Discriminant Analysis (LDA) was used to predict the classification accuracy. High classification performances were reached for both types of hams (>99.5% for pork and >90.5% for turkey) using the best selected features or combinations of them.

## Near-infrared spectral imaging for the evaluation of food additive effects on prawn properties

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The cross-sectional structure of prawns was directly observed by near-infrared (NIR) spectral imaging. Non-boiled and boiled prawns immersed for 24 hours in aqueous solutions of sodium chloride or trisodium phosphate as samples for the observation. The concentrations of the solutions were 0%, 0.5%, 1%, and 4%. An indium gallium arsenide (InGaAs) NIR camera with a band-pass filter of 1500 nm wavelength, where the absorption band of ice exists, was utilized to take images of cross-sections of frozen samples. Intensity of each pixel in acquired images was converted into absorbance, which was proportional to the original water content of the samples before freezing. It was found that the structure of the muscular fiber border was almost same for the samples treated by 0%, 0.5%, and 1% Na<sub>3</sub>PO<sub>4</sub> aqueous solutions, while the muscular fiber border changed from being parallelogram to being circular when the concentration was 4%. Statistical analyses of absorbance data indicated that 1% Na<sub>3</sub>PO<sub>4</sub> aqueous solution was the best additive for keeping the water contents of the boiled prawns, while those of NaCl treated prawns drastically decreased after boiling. As a result, the effect of different food additives on the muscular tissue structure and water content of the prawns could be simultaneously observed.

## Evaluation of white shrimp freshness during Iced storage using texture analyzer and machine vision

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The objective of this work was to evaluate shrimp freshness during iced storage by using Texture Analyzer (SMS-TA XT plus) and machine vision system. The effect of crosshead speeds (0.1, 0.5 and 1.0 mm/s), measured position on sample was considered in term of textural properties. Texture profile analysis, compression, cutting, penetration and relaxation tests were determined. It was found that the best condition explaining the behavior of shrimp tissues during storage was testing at the second muscular of shrimp with crosshead speed at 0.1 mm/s. Firmness and shear work obtained from cutting test and penetration test with spherical probe clearly distinguish texture characteristics of white shrimp at various storage time. The color properties of white shrimp were performed by machine vision system. Increase of storage time increased firmness and shear work of fresh shrimp and RGB values of shrimp head decreased during iced storage.

## Digital image analysis for the optimal control of bread and rolls baking

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In many bakeries the rolls are baked in place by the salesclerk. However, the baking goods can not be monitored all the time, because the selling consumes most of the time of the salesclerk. The current state of the art is a purely timely based process control, which does not consider the actual quality of the raw material as well as the process parameter like the humidity. The baking process is absolutely irreversible. If an error occurs, it will show up in the final product. Without a process monitoring just suboptimal results can be obtained. Therefore, an automated supervisory system is necessary. It must be able to identify the current state of the baking goods and to decide which action has to be carried out. Based on parameters like the baking time, the temperature as well as the pastry color the state of the baking process can be identified and necessary actions can be performed. In a joined project we are developing an intelligent baking-oven to optimize industrial baking using digital process imaging and experience-based Fuzzy control. The main goals of the project are the development of an optical system, which is able to give digital images in a continuous form and high quality of the baking goods. The development of algorithms for the characterization of colour and shape of the images retrieved from inside the oven, in such a way that it is possible to evaluate the current status of the process. An optical on-line volume measuring instrument will be developed and its estimation concerning accuracy, reliability and product independence. The optical measured values will be correlated with the pastry condition by the use of classical dough and bread analyzing methods. A fuzzy based expert system and a control system will be developed, which will fully automated control the baking process. In our contribution the structure of the intelligent baking-oven will be presented. Using examples of images of baking goods the results of the analysis system will be discussed.

## Microscopic analysis of particle caking of corn distillers dried grains with solubles

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Particle caking of bulk products such as food powders and granular feed is an undesirable phenomena caused by liquid bridging of particles that are exposed to high humidity environments. The effects of caking are poor flowability that could cause down time in production processes and changes in physical or chemical properties that reduce product quality. While the mechanisms of caking have been described in the literature, not many studies have used detailed microscopic analysis to monitor and quantify the evolution of particle caking. Microscopic studies yield some fundamental understanding of the mechanisms of particle caking in powders and granular products and most especially reveal the role and interaction of the particle with moisture in humidify and dehumidifying environments. This study focuses on single particle microscopic analysis of caking evolution in corn distillers dried grains with solubles (DDGS). DDGS is a coproduct of corn ethanol production from dry-grind processing and has high feed value due to its nutritive contents. Like most granular solids of biological origin, DDGS is hygroscopic, thus it absorbs or loses moisture when exposed to the environment during storage and transportation. This can lead to liquid bridging, thus causing the product to cake and flow poorly from hoppers, which is currently a major hurdle in marketing DDGS. Single particle microscopic images of DDGS under humidifying and dehumidifying environments were analyzed to determine caking evolution mechanisms. Atomic force microscopy was used to determine the forces of adhesion and their evolution during humidifying and dehumidifying environments. These studies promise to provide fundamental insight into the caking of powders and bulk food products.



## Image processing applied to classification of avocado variety hass (*Persea ymericana* Mill) during their ripening process

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Noninvasive methods for quality evaluation of food products have been increasing in recent years. Nowadays, image processing methods has been developed rapidly and that has allowed measuring of size, shape, color and texture features of food materials. Therefore, the work was undertaken with objective of evaluating the ripening process of avocados variety Hass (*Persea Americana* Mill) during their storage by image processing. A set of avocados (70) variety Hass (exportation quality) with similar color, weight, shape and age was selected. This set was divided in two groups; a set (10) was used to evaluate the maturity stages by means of a computer vision system. Ripening evolution of avocados was followed everyday during 12 days. The rest of avocados were used to determinate ripening parameters (In pulp: oil content, dry matter content, firmness, and mass loss; on the peel:  $L^* a^* b^*$  parameters) by standard methods. Principal Component Analysis (PCA) was used to classification of ripening stages. During ripening process the firmness values of avocados were decreasing from 7.69 until 0.268 Kgf and showed a sigmoid behavior. Oil content and skin color values were constants during 8 days. After of this time was observed a falling in oil content values (30.5 to 20.8%) as well as peel color values (9.8 to 2.3 to  $a^*$ ), it is possible that this behavior could be due to a period of enzymatic induction. Five image features were extracted from digital images. During ripening the image features such as color parameters ( $L^* a^* b^*$ ), entropy (4.23 to 3.96), angular second moment (ASM 0.297 to 0.364) and fractal dimension (2.58 to 2.44) had a similar behavior to ripening parameters ASM was textural feature most sensitive to changes in the peel. Relationships between image features and ripening parameters were obtained. The parameter  $a^*$  (from green to red) was digital feature most helpful to establish three stages of maturity with an acceptable percentage of classification (85%). Results obtained by means of image processing and PCA could be useful to evaluate the ripening process of the avocados. Additionally, the results found in this work may be used in design of artificial neural networks to an automatic classification of avocados.

## Reuse of sucrose solutions in the production of osmotically dried peach

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The combined osmotic pre-drying (OPD)/ conventional drying (CD) process generally results in high quality dried products. However the sustainability and economic viability of the process depends on reutilizing the dehydrating solution. The objective of this study was to determine the possibility of reusing the sucrose solution in producing dried peach by OPD/CD. The study consisted of 15 OPD cycles (50°C, 65°Brix, 4:1 syrup/fruit ratio, 4h process time), the osmotic solution leaving one cycle being reconditioned and employed in the next cycle. Reconditioning consisted of: sieving (1 mm mesh), vacuum concentration and addition of sugar and water. The fruit and solution masses were weighed before and after each cycle. The moisture contents were determined and the following drying parameters calculated: Water loss (WL) and solids incorporation (SI). The complementary drying process consisted of applying forced air at 65°C to a 20% moisture content. The following analyses were carried out on the osmotic solution at the start of each cycle: soluble solids content, pH, titratable acidity (TA), reducing sugar content (RS), color (L\*, a\*, b\*), turbidity, electrical conductivity and yeast and mold count. A sensory analysis was carried out comparing differences from standard method for dried peach from 1, 5, 10 and 15 cycles, the product from the 1<sup>st</sup> cycle being considered as the standard. The following attributes were evaluated: flavor, texture, color and appearance. No tendency for the drying parameters to vary between cycles was observed: mean WL=52.9±1.5%, mean SI=5.0±1.5%. Increases in TA (0 to 0.21 g citric acid/100 g), RS (0 to 4 g/100 g) and turbidity (from 1.3ntu to 4.26ntu) were observed up to the seventh cycle. In the first cycle the pH lowered from 7.47±0.04 to 4.27±0.04, and then stabilized. The electrical conductivity increased continually up to 150%. Up to the tenth cycle the a\* (red), b\* (from blue to yellow) and the hue angle (from blue to red) increased possibly due to non-enzymatic browning and pigment extraction. The yeast and mold count of the syrup remained low (<102 cfu/g). Resulting, the attributes flavor and texture showed no significant difference (p<0.05), while color and appearance improved with reuse. Concluding, the alterations found did not compromise the sensory quality of the dried fruit, and the reutilization of the osmotic solution for at least 15 cycles in the OPD of peach by the method studied was possible.

## Drying characteristics of ginger rhizome (*Zingiber officinalis*)

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This paper presents the drying characteristics of ginger rhizome (*Zingiber officinalis*) under blanched and non-blanched conditions using hybrid solar dryer and mechanical tray dryer at 50°C, 60°C and 70°C temperatures. The drying rate increases with the increase in drying air temperature and blanching also increases the drying rate. The drying rate also depends on shape and size of the ginger rhizome. The highest drying rate of the ginger rhizome was found for sliced samples followed by splitted and whole samples. The moisture content of the whole ginger rhizome remains almost constant during the whole drying period of 32 h and this is true for either blanched samples or non-blanched samples. Lightness of ginger rhizomes decreased with an increase in drying temperature for all samples except sliced and blanched samples. Five thin layer drying models have been fitted to the experimental data of sliced with blanched ginger rhizome. The agreement between the predicted and experimental results was excellent. For drying of ginger rhizomes to make powder, it must sliced and blanched and can be dried in a mechanical tray dryer or solar assisted dryer for better quality dried product.

## Optimization of drying parameters of saskatoon berries (*Amelanchier alnifolia*) using a combined microwave and vacuum method

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Saskatoon berries (*Amelanchier alnifolia*) possess food as well as medicinal value and have a strong commercial worth. The berries are highly perishable and need to introduce a sustainable preservation system which ensures their extending shelf life and maintains the quality of the berries. Combined microwave - vacuum drying is getting popular as an alternative drying method in the food industry because it is rapid, more uniform and energy efficient compared to conventional drying. The objective of the research work is to optimize the microwave-vacuum drying process variables of microwave power, drying time and initial feeding fruit weight to minimize the moisture content and water activity at a safe level for longer shelf life of the berries during storage. The berries were dehydrated for different microwave vacuum drying conditions of microwave power (5.07 - 6.93 kW) drying time (46.5 - 63.5 min) and initial feeding fruit weight (9.6 - 10.4 kg). Overall observations of the experimental results show that the moisture content and water activity decrease linearly with microwave power and drying time and inversely related to initial feeding fruit weight. In order to get the best drying efficiency, the process requires optimization of the independent variables of microwave power, drying time and initial feeding fruit weight. A statistical experimental design based on central composite rotate design and a response surface methodology are used to characterize the influence of process variables and arrive at optimal processing drying conditions. The statistical moisture content yield (50.58%) at the optimum point was at 5.56 kW, 47.45 min and 10.40 kg and water activity yield (0.87) at the optimum point was at 5.6 kW, 50.35 min and 10.04 kg. The statistical analysis also shows that the optimal condition for moisture content and water activity is not a unique optimum. Therefore, it is concluded that the yield of moisture content and water activity can be reduced to 20% and 0.53, respectively, in the range of microwave power (5.69 - 6 kW), drying time (51.3 - 55 min.) and fruit weight (10 - 9.75 kg). The study is expected to be significantly useful for the design of microwave-vacuum drying of Saskatoon berries in the industrial scale.

## Colour degradation of lemon balm (*Melissa officinalis* L.) as affected by the drying process

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Lemon balm (*Melissa officinalis* L.) is implemented for several purposes in the food, pharmaceutical and cosmetic industries due to its flavoring, medicinal and therapeutic properties. The most common technique for processing and marketing of medicinal plants is by hot air drying in order to reduce the moisture content to safe level for storage. However, improper application of the method affects quality characteristics such as color. Usually, when the herb is used for tea the colour of the leaves is of prime importance to the consumer as product quality criterion and consumer prefers leaves with natural green colour. The effect of the conditions of the drying air on the colour of lemon balm leaves was investigated in this research. Fresh leaves of *Melissa officinalis* L. cultivar citronella with 80% w.b. initial moisture content dried to moisture content of 10%. The drying experiments were conducted in a high precision through flow laboratory dryer at air temperatures ranging from 30 to 70°C, ambient relative humidity (10 g/kg absolute humidity) and constant air velocity of 0.2 m/s. In addition, trials were carried out at 15, 20, 25 and 30 g/kg absolute humidity maintaining a temperature of 40°C and an air velocity of 0.2 m/s to investigate the effect of relative humidity. The colour of the dried leaves was measured by a CR-400 Minolta reflectance colorimeter. The individual colour parameters were expressed as  $L^*$   $a^*$   $b^*$  and converted into  $L^*$   $C^*$   $h^\circ$  colour space. One-way analysis of variance (ANOVA) was conducted using SAS statistical package to compare the mean values and to verify whether any significant difference exists among the drying conditions with reference to colour parameters. Hue, expressed as  $h^\circ$  value proved to be the appraisal criterion for the colour quality of lemon balm since it depicts the visual impression of browning effectively. Drying air temperature showed significant effect on the colour of the leaves. Samples dried at 30 and 40°C appeared greener in colour showing the highest  $h^\circ$  values, 110° and 104° respectively. Considerable colour degradation was observed at temperatures above 50°C. In particular, at air temperatures of 60 and 70°C the  $h^\circ$  values decreased to 89° and 84° correspondingly and the leaves turned yellow indicating drastic browning reactions. The effect of relative humidity on the colour was insignificant below 40%, however, a decrease of the  $h^\circ$  value from 103° to 98° was observed for an increase in relative humidity from 40 to 50%.

## Determine maximum permissible temperature for during rapeseed and sunflower seed

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Experiments were evaluated the influence of the drying temperature of free fatty acids (FFA), as well as seed germination of sunflower (*Helianthus annuus* L) and 00-rapeseed (*Brassica napus* L.). Thin-layer drying experiments were first conducted at 35, 40, 45, 50, 55, 60 and 65°C air temperatures, with each product dried down to 8% wb, then drying of samples was repeated at 40, 50, 60, 70, 80, 90 and 100°C air temperatures for two hours. Drying temperatures up to 60°C showed no influence on FFA-content in sunflower. However, above this temperature, the concentration of FFA increased significantly. The results showed that the FFA of rapeseed decreased at higher temperatures significantly. Thus, increasing drying temperature causes decreasing the FFA-content due to lipolyse enzyme neutralisation. The germination of sunflower and rapeseed decreased significantly with increase in the air temperature. For effective seed germination, the allowable drying temperature range for sunflower and rapeseed was up to 40°C.

## Polyphenol degradation mechanisms during soaking and drying of apples

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Apples (*Malus domestica*) are well-known to be healthy. Their regular consumption as fresh or processed products contributes to welfare by preventing cancer and cardiovascular diseases, particularly thanks to the antioxidant components, especially polyphenols, naturally present in fresh apples. Nevertheless, precise experimental data on polyphenol retention during processing are scarcely available. In this study, two processes, dehydration impregnation by soaking (DIS) and convective drying, have been studied both separately and combined. Cider apples were chosen for their high polyphenolic content (about five times higher than in dessert apples). Two cultivars were selected: Guillevic and Marie Ménard, harvested at maturity in the experimental orchard of the CTPC (Sees, France) and stored at 4°C until transformation. The first one has a special polyphenolic profile with high polymerised procyanidins and no monomeric catechins, so a low sensibility to enzymatic browning, whereas the second one has a classical polyphenolic profile with a high content in hydroxycinnamic acids and catechins, which are widely involved in oxidation reactions and browning catalysed by the polyphenoloxidase (PPO). The impact of each process has been followed through polyphenol degradation kinetics. Polyphenols were measured by HPLC after thiolysis by adapting the method for high sugar content extracts. Effect of cultivar, temperature and impregnated sucrose level on the polyphenolic content was studied as a function of processing time. Results confirmed the negative impact of the temperature on polyphenol preservation and showed different behaviours depending on the polyphenolic classes of compounds. During DIS, dihydrochalcones were better preserved than hydroxycinnamic acids, which are preferentially oxidized by the PPO, and can diffuse more easily to the soaking solution. For Guillevic cultivar, an increase in the degree of polymerisation of the procyanidins has been observed with the soaking time, even higher when temperature increases. It can be due to the diffusion of the smallest flavan-3-ols into the solution. Polyphenol retention also depends on the process, and it has been noticed that if DIS is applied as a pre-treatment, the sucrose impregnation acts as a protection for the polyphenolic retention during the convective drying. This study is part of the Isafruit European project (IP-FP6).

## Mathematical modelling of solar assisted hybrid dryer for banana

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A solar assisted hybrid solar dryer was developed for drying of fruits. It consisted of flat-plate concentrating collector, a heat storage cum auxiliary heating unit and a drying unit. A mathematical model was developed for this solar assisted hybrid dryer. The model was a physically based taking into account the heat transfer in the collector and heat and mass transfer in the dryer. One set of equations was developed to predict cover, receiver and air temperatures in the collector. Another set of partial differential equations was developed to predict the air and product temperatures, air humidity and moisture content for drying of banana in the dryer. First set of equations were solved iteratively and the second set of equations were solved numerically based on an exponential solution over the finite difference grid element using the outlet air conditions of the collector as inlet air conditions of the drying unit. The model was validated with the experimental results conducted at Potsdam, Germany. The simulated cover, air and receiver temperatures in the collector agreed well with the measured temperatures. Good agreements were also found between experimental and simulated air and product temperatures, air relative humidity and product moisture content in the dryer. This model can be used for providing design data of a hybrid dryer for drying of banana as well as other fruits and vegetables.



## Development and evaluation of a solar assisted hybrid dryer for spices

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A prototype of a solar assisted hybrid dryer was developed for drying of fruits, vegetables and spices. It consisted of a flat-plate concentrating collector, an auxiliary electric heater and a drying unit. Temperature in the dryer was higher than the ambient temperature and it could be maintained as desired using temperature controller. The dryer was tested for drying of chilli and ginger during March to August 2008. Moisture reduction was higher in solar dryer than that of open sun drying. It took about 25 and 32 hours to reduce the moisture contents of chilli from 75 to 10% (wb) in the solar dryer and sun drying method, respectively. The highest drying rate of the ginger rhizome was found for sliced samples followed by splitted and whole samples. The capacity of the dryer was to dry about 20 kg of fresh samples per batch. The use of a hybrid dryer and blanching of sample led to a considerable reduction in drying time and dried products of better quality in terms of colour in comparison to products dried under the sun. The experimental data were fitted to several thin layer drying models and the Page model was found to be the best fitted model for thin layer drying of chilli and ginger. The solar assisted hybrid dryer is recommended for drying of spices as well as fruits and vegetables in developing countries.

## Definition of a new post-harvesting treatment of paddy rice; characterization of final product

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A post-harvesting process including an instant controlled pressure drop (DIC) treatment and a normal hot-air drying of paddy rice has been developed and compared with the normal drying process. The optimal steam pressure and temperature-residence time combination have been worked out. This new process significantly reduces the drying time reaching about two hours without any tempering time whereas the usual classic method needs more than 8 even 24 hours with one or two tempering times. The quality of integral rice in terms of convenience, sensory and cooking time is highly improved. The milled rice whiteness of DIC system is significantly superior to that of normal steamed samples. The milling breakage is practically nil. There is a difference of 70% in cooking time with 7 to 9 minutes instead of 20 minutes of usual product. The shelf life of final product is much higher.

## On the usage of ultrasound for online dough evaluation techniques

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The baking industry automation requires a non contact measurement for physical characteristics of the food during processing for higher throughput, greater reliability and often for cost- effectiveness as well for product hygiene as the end user is human. The usage of the ultrasonic approach to evaluate the physical properties of the dough during processing has been demonstrated, while the traditional approaches are slow and off line the ultrasound provides a non destructive, non invasive, rapid, online and low cost approach. In this study the ultrasonic working principles and the theoretical background of the new method to measure the physical properties of the wheat flour water system using a low frequency ultrasound are presented. The speed of sound, attenuation, bulk modulus of elasticity density and pressure variations are investigated with different water contents and flour types. The measurements were validated and correlated proving the success of this approach.

## Non-destructive electromagnetic pecan analysis

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The application of non-destructive pecan quality assessment is important to both pecan growers and pecan buyers and would allow quick, easy, and reliable quality checks of pecan batches before transactions occur. This research analyzes pecan samples using electromagnetic waves in the radio/microwave range, from 100 MHz to 2.5 GHz with an open air transmission-type measurement device. Fifteen to 20 new-crop samples each of the Merrimac, Kansas, Pawnee, and Giles cultivars ranging from 20 to 28 nuts per sample depending on the size of the cultivar are analyzed for the signal attenuation and phase shift caused by the sample of pecans using a network analyzer. Samples of each cultivar vary in both overall quality and moisture content. Physical quality parameters of each sample are also reported, such as in-shell density, edible kernel mass, non-edible kernel mass, volume percent fill, packing material mass, shell mass, kernel oil and water contents, and shell water content. Each measure of quality is correlated with the attenuation and phase shift of the sample at each of the 101 measured frequencies, with the closest matches reported. Results suggest there is a correlation between kernel mass and both signal attenuation and phase measurements in the 500 MHz and 1 GHz ranges, while there is very little correlation between shell mass and attenuation and phase at any frequency. Results can be applied to design a non-destructive and automatic pecan grading machine to further the market technologically.

## Measuring and steering vacuum in the milk tube to avoid vacuum maxima at the teat end

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Conventional milking systems have no mechanism to inhibit temporary vacuum maxima, but vacuum maxima can abet udder inflammation. The aim of this study was to assess, if pressure transmitters are appropriate to get integrated in a milking system, for steering the vacuum. If it is possible by means of transmitters to control the vacuum exact, then the number of udder inflammations can be decreased and the service life of dairy cows can be increased. Possibly this could bring a positive effect to the image of dairy farming, so in last consequence, it could lead to a higher income of many farmers. Vacuum measuring occurs with the “wet test-method” according to DIN ISO 6690 for milking systems. At this, one tank, four water flow meters and the DIN ISO artificial teats are used for simulating the udder of a cow. Water was used instead of milk. Resulting, liquid flow rate can be adjusted on a permanent level during the entire milking process. Artificial teats have a measuring point for teat end vacuum, so it is possible to measure the vacuum at nearly each point in the milk tube. For evaluation, the error rate between a reference and the used transmitters will be accounted. Furthermore, by comparison, the best place to insert the transmitters can be determined. It is one aim of this study to find out, where the transmitters can be inserted, without causing high costs and without error in measurement. Furthermore the transmitters have to be resistant against chemicals, which are used for cleaning. Many vacuum measurements have been done already. First results show, if the transmitters are inserted next to teat end, the measuring result will be more precise than inserting them far away from teat end. First Evaluation leads to the result, that the error rate between reference and used transmitters is about 1.2%, if both are inserted at the same point. The value gets higher, if they are inserted at different points. One concept is to insert each transmitter in a carrier, which is special constructed for this case and integrated between milk tube and teat cup. Another concept is to construct a new teat cup, with transmitter integrated. At the end of this study, an improved milking system, with possibility for vacuum steering will become available.

## Geographical origin, cultivar, harvesting year verification of European and non-European olive oils using proton transfer reaction mass spectrometry with multivariate data analysis

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Volatile profiles of 308 virgin olive oils were used for oil authentication with respect to geographical origin, the olive oil cultivar, and the year of harvesting. The latter two were expected to provide some insight about the underlying factors of geographical origin classification. The compositions of the volatile compounds of virgin olive oils originating from European and non-European countries were analysed by proton transfer reaction mass spectrometry (PTR-MS). Samples originated from Europe (France, Greece, Italy, Spain), Africa (South Africa), Australia (Australia, New Zealand), and South America (Argentina, Chile). They were obtained courtesy of the EC-JRC Ispra, Centro di Ricerca per l'Olivicoltura e l'industria Olearia Rende, and ITERG Pessac. Samples were equilibrated at 30°C and the headspace of the samples was delivered directly to the inlet of the PTR-MS system. Measurements were carried out in the mass scan mode, whereby a mass spectrum in the range of 20-150 amu was gathered at a rate of 0.2 s mass<sup>-1</sup>. Analyses were carried out in triplicate, data were transmission and background corrected. The concentrations of the ions analysed varied with the continents, countries, cultivars, and years of harvesting. The fingerprint mass spectra were subjected to partial least square discriminant analysis using the full data set in order to classify the samples into their classes of European and non-European origin. Models were also fitted to the subsets of European and non-European olive oils for classification into larger and smaller-sized regions, as well as into year of harvesting and olive oil cultivars. Results show, the larger the area/region was, the more successful the classification. 89% of the European oils were classified correctly and 91% of the non-European oils. 80% of the samples were classified correctly to continent of origin. Individual European countries varied between 63 and 82%. Additional models showed that cultivar determined to some extent origin classification, whereas years of harvesting had a minor influence. In all, the present study shows PTR-MS to be a promising technique for geographical origin determination of food samples.

## The implementation and verification of advanced traceability system in the Polish fish processing plant

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The implementation of traceability systems has been required since the 1<sup>st</sup> of January 2005 by the Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. The most of the Polish fish processing plants use the simplest paper traceability systems which are often not sufficient for big factories, especially in the case of the particular product batch withdrawal. In order to increase the product safety the main aim of the project was the implementation and verification of advanced, based on the GS1 standard, traceability system in the Polish fish processing plant. The implemented system utilizes the advanced equipment like: database server, wireless terminals, access points, barcode printers, panel computers and uses both the wire and wireless communication methods. The system comprises all the stages of the production process for example: reception of the raw materials, primary processing (e.g. heading, gutting, filleting), freezing, packaging, storage and distribution. During the whole production process (from the reception to the final distribution) the pallets with raw materials, semi products and final products obtain the labels with GS1-128 barcodes what enables to identify the particular product using: the name of the product, item number - GTIN, batch number and pallet number - SSCC. All the used data structures are compatible with the GS1 standard what facilitates the data transfer between the operators in the international trade. The reports generated by the system present all data about the processing, storage and distribution operations and facilitate the whole production process management. The verification of traceability systems is necessary to ensure the system efficiency. Then in the case of recall procedure execution the food operators can be sure that the particular product batch can be quickly and efficiently withdraw from the supply chain. The verification of the implemented traceability system in the above mentioned processing plant confirms that almost all of the raw material and final product batches were traced efficiently and also all the information about the particular product batch was obtained in less then three minutes.

## Sensory quality assurance for process optimization of cheese production

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In Arla Foods different initiatives have been taken for optimizing the cheese production. One initiative is to use the system of PAT (process analytical technology) and the Process Analytical tools to understand and control the dairy processes. Focus is to optimize yield and quality in cheese production and hereby consistently ensure a predefined quality at the end of the manufacturing process. Gains in quality and efficiency are likely to come from preventing rejects and re-processing, facilitating continuous processing to improve efficiency, manage variability, increasing capacity and reducing production times by using on-, in-, and/or at-line measurements and controls. In optimizing cheese production the goal is to optimize and reduce the variability in chemical parameters of cheese like moisture and fat content, which can easily be measured at the laboratory or on-line. But another goal is also to optimize and model the cheese production against the quality parameters like taste, smell, consistency and look of the final cheese. To be able to optimize against the quality parameters it is necessary that the sensory assessment of the cheese quality result in numbers on a linear scale, which afterwards can be used in multivariate data analysis. Almost every dairy foundation has its own rules for how sensory assessments are done. The traditional scale in Denmark is an 8 points scale. The challenge with this scale is that the assessment is a mixture of different issues, which makes the results very nonlinear and therefore hard to use for process optimization in context of PAT. The challenge in optimizing cheese production from quality parameters in context of PAT has resulted in a new way of sensory assessing the cheese quality, which is being tested in Arla Foods. The new sensory assessment separates the rejection or approval of the cheese from the assessment of the different quality parameters, and the assessment is made linear. By thoroughly training of the assessors and having a clear definition of faults the assessment is as objective as possible. The new way of sensory assessing the cheese quality will be presented in more detail. The last step in optimizing cheese production is then to correlate the results with the different process variables and on-line measurements in the cheese production – the context of PAT.



## Effect of spice oleoresin and powder on the quality and microbial shelf life of white bread

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Most of the previous studies on the efficacy of spices as potential source of antimicrobial ingredient in food formulation have been conducted in-vitro. This study compares the physical, sensory and preservative effects of adding powder and oleoresin from two spicy vegetables - ginger (*Zingiber officinale*) and clove (*Eugenia caryophyllus*) - during dough making on the loaf quality and mould-free shelf life (MFSL) of composite cassava-wheat bread. The effects of oleoresin (500-1000 ppm) and powder (1-2%) were determined on the moisture content, oven rise, specific volume, MFSL and organoleptic characteristics (crust and crumb colour, taste, flavor and overall preference) of white bread. Inclusion of spice powders generally gave higher loaf moisture (32.5-37.5%) compared to control bread sample (31.5%). The specific loaf volume of bread samples, which ranged between 5.03 and 6.80 cm<sup>3</sup>/g, was generally higher with the addition of ginger than with clove powder or oleoresin. Addition of spice delayed the appearance of mould on bread sample from about 4.0 days for control bread sample till about 4.5-7.0 days and 6.0-9.0 days for bread containing powder and oleoresin, respectively. The shelf life increased with increased addition of both spice powder and oleoresin. In spite of the pungency and characteristics color of the vegetable materials added, neither the effect of vegetable type nor the concentration of the powder and oleoresin significantly affected the crumb color, flavor and overall preference of bread samples. However, crust color and taste were significantly influenced by the concentration of spice powder and oleoresin ( $P < 0.05$ ). Bread samples containing ginger powder and oleoresin were more acceptable and comparable to control bread in most of the sensory attribute.

## Food quality and monitoring and bioprocessing in Georgia

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Georgia as a former Post-Soviet country has passed the significant stages of its development from political, social and economic and mental point of view. Today Georgia being a sovereign state has the fair pride, desire and orientation to help out the country and the whole of population of current economic and social difficulties, the prevention of which means the strategic development of the country. Therefore, creation of the firm basis for the development is considered to be one of the basic tasks both for governmental and non-governmental sectors. In spite of a certain success achieved in this sphere, there still remain serious problems, especially painfully encountered by small and middle farmers and farmers' economies. After the change to the market economy it was discovered that there are missing many structural units of the market. These are commodity exchanges, auctions, agribusiness infrastructure, and markets of retail and wholesale trade, also market information systems and expert services. Today's Georgian consumers want to know more about the products they eat and drink. They are becoming more interested in and concerned about such issues as food labeling, food science, health claims, the safety of ingredients and food additives, as well as the effectiveness of inspection processes. New varieties of foods, beverages, and food ingredients, as well as new scientific reports on health benefits and food safety, are issues of ongoing interest and concern to consumers and journalists, and all have increasingly global ramifications. New developments in food science increasingly impact agriculture, food production, food ingredients, food processing, and nutrition—regionally and globally. News of positive developments can excite interest and stimulate further and more rapid advances in nutrition, health, and food safety. Yet at the same time, lack of information and conflicting interests and opinions can create misunderstanding and heightened levels of consumer concern. Informed consumers worldwide share a common interest in seeking accurate information about food safety, expanded food choices, and a balanced diet that can maximize their potential for sustained good health. They are increasingly looking to health officials, health professionals, and the news media as they search for dietary guidance. As new or enhanced food varieties become available, consumers want to know how to incorporate them as part of their own diet. In addition to the availability of safe and nutritious food, consumers are increasingly emphasizing fair pricing and convenience to meet the needs of their changing lifestyles. The production of environmental friendly, climatically sustainable basic chemicals based on renewable raw materials can help to save limited fossil resources and to increase the economic potential of rural areas. The cultivation and utilization of renewable resources for the non-food application become an alternative source of revenue in agriculture and forestry. Even though the manifold potential is used only for a small part today the production and processing of renewable resources will be a growing economic factor in future. The long-term availability of renewable resources and the manufacture of biobased products (bioconversion processes) become very attractive according to their material and energetic impact respectively as well as their environmental importance. The research program "Bioconversion of starchy agricultural raw materials" coordinates related topics which belong to the production of value added goods by biological and chemical conversion processes respectively. The utilization of regional resources like rye for the non-food sector is in the focus of interest. The main products of these bioconversion are lactic acid and ethanol to produce the solvent ethyllactate via esterification. In this way there are different products for a wide range of application in industry (biodegradable plastics, basic chemicals for further synthesis, biofuels) and agriculture (acidification, cleaning and preservation agents, disinfectants). Nutrition and food safety are two vitally important issues that affect all of the world's people. Many countries throughout the world are increasingly interdependent on the availability of their food supply and on its safety. As a result, communications about these issues are becoming truly global. One of the most thorough and effective food safety and defense systems performs the following chief functions: Establishment of Safety Standards Monitoring and Inspection Enforcement Tracking Food Safety Problems Protecting the Food Supply providing HACCAP standards and quality control.

## Quality characteristics of aonla pulp as affected by ohmic heating pretreatment

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Present study was planned to investigate the behaviour of aonla pulp in terms of quality parameters during ohmic treatment at different voltage gradients and fixed temperature. The relevant heating characteristics like electrical conductivity, bulk density and specific heat were evaluated for aonla pulp. Process parameters (voltage gradient, time and temperature) were standardised for ohmic heating treatment of aonla pulp. The independent variables selected for the study were treatments (ohmically treated, conventionally prepared and controlled pulp), voltage gradient (11, 13, 15 and 17 V/cm) and KMS treatment (with and without addition for each treatment). The time and temperature were the process variables which were kept fixed on the basis of preliminary experiments. The product characteristics were evaluated for vitamin C, tannin content, titrable acidity and colour. Results indicate that point electrical conductivity of aonla pulp was higher than the bulk electrical conductivity. The time dependant effect on the electrical conductivity of aonla pulp was found to be non-significant. Temperature had a more significant effect than voltage gradient on point and bulk electrical conductivity. The influence of temperature and voltage gradient on total heating time and total electrical energy consumption of aonla pulp was analysed and was found to be significant. All the quality parameters (i.e. vitamin C, tannin content, titrable acidity and colour) were influenced by treatment and KMS addition significantly. In terms of quality parameters, effect of KMS addition was more pronounced for the treated samples of aonla pulp, ohmically treated at 11 v/cm followed by 13, 15 and 17 v/cm voltage gradient and was found least in conventionally prepared pulp. Percent loss in vitamin C, tannin content, titrable acidity and colour darkening was found to be least in aonla pulp samples, ohmically treated at 17V/cm voltage gradient followed by 15, 13 and 11 V/cm and it was found maximum in conventionally prepared aonla pulp. Percent losses in aonla pulp samples, ohmically treated at 17 V/cm voltage gradient was found in the range of 7.14-8.20%, 21.18-22.35%, 17.75-19.20% and 15.11-22.09% respectively while maximum losses was found in conventionally prepared pulp which was in the range of 33.18-35.20%, 29.42-31.76%, 28.62-30.07% and 36.13-44.13% respectively. Results revealed that ohmically treated aonla pulp was far superior than conventionally prepared aonla pulp in terms of quality parameters.

## Poster Session

## Machine vision for automatic sorting and cultivar identification of rice grains

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A machine vision system was used to automatically identify the size, shape, and cultivar of samples of 52 popular rice varieties in the Philippines. Thirteen morphological features were extracted from each set of digital images consisting of 110 grain samples that is randomly taken from three datasets. The data were then used as inputs to statistical and multilayer neural network pattern classifiers to identify size, shape, and cultivar class of the grain samples. Results showed that an overall mean classification accuracies of 96 and 98.64 per cent for grain size; 96.6, 96.7 per cent for grain shape, were obtained respectively by statistical discriminant analysis and artificial neural network. The cultivar of each grain sample can be correctly identified at an overall accuracy of 69 and 69.43 per cent respectively by statistical discriminant analysis and neural networks. More than 50 percent of the grain samples can be accurately identified as to to their cultivars using each classification method. The result of the study showed that machine vision with adequately trained classifiers can be used as a tool for rapid objective classification and inspection of rice grains samples during rice marketing in the Philippines.

## Prediction of potato damage under impact loading with nonlinear model

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Losses of agricultural products and the related financial losses are considerable in Iran. Potato is one of the most important crops in Iran and has the most nutritious energy per area. The losses of potato are considerable as statistical reports. The mechanical damage is one of the factors in potato losses that occur during harvesting and handling of potato tubers. When reduction in mechanical damage of tubers is of concern, attentions are automatically drawn towards the design and adjustment of the potato harvester. Of course the design and adjustment of the potato harvester is one of the coin, the other side is the potato tuber themselves. For some potato varieties that are highly susceptible to mechanical damages, even a well designed and adjusted harvester can still cause extensive damage. For this reason a prior knowledge about damaging impact energy threshold of potato tubers are as important as the knowledge about the harvester. Tubers with more than 1.5 cm damage on their surface are out of use in market. In this research a constructed pendulum was used to measure the damaging impact energy threshold for Agrida, Aula, Marfona varieties. After measuring volume of damage, the logistic model was used to study effect of impact angle, varieties and tuber size. Output of the model calculated probability of damage and show it with 0 or 1. Results show that, varieties, impact angle and tuber size has significant effect on the volume of damage and aula variety is more susceptible to damage than other varieties. Also, volume of damage in large tubers are increased.

## Evaluation of adulterated caramel colour in commercial apple juices

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Fruit juice adulteration in world is estimated to be minim at least a billion dollar per year (1995). Adulterated forms of apple juice (Coppola, 1984) have all been detected on the world market. The evaluation and quantification of voluntary added caramel colour in finished apple juice is not a simple analytical work, because is gradual produced by heating of carbohydrates and comprises a complex mixture from low molecular weight compounds to colloidal aggregates. Additional typical natural color of fruit (apple) juice fresh processed, but later coloured by enzymatic or nonenzymatic browning process develop on brown – red. Any batches of apple juice concentrate were suspected of being fictive adulterated with caramel colour from a specific caramel colour raw material. Analyses of both the caramel colour raw material and the finished apple juice products were conducted. The evaluation of the caramel reference compound 5 – hydroxymethyl furfural (5 – HMF) (CAS 611 – 13 - 2) and 4 – methylimidazole (4 – Mel) (CAS 822 – 36 – 6) and 2 – acetyl – 4 – (1, 2, 3, 4 – tetrahydroxybutyl) imidazole (THI) (CAS 94944-70-4) in the raw material was consistent with its classification as a class IV caramel colour. A specific four – peak sequence in the HPLC – UV rang of the raw material was accessed to match the caramel colour to its future commercial products. The same peak sequence was accessed to detect and quantify added voluntary caramel colour in the finished apple juice products. This was the first step of a fictive (monitorised) adulterated apple juice product and the wok in which voluntary added caramel colour has been matched to its commercial products. The complex nature and limited knowledge of the chemical composition of caramel colour makes its determination in apple juices a specific challenge for researchers. Analysis for the caramel marker (reference) compounds (THI, 5 – HMF and 4 – Mel) is useful for the characterization of caramel colour raw materials but is much less practical for batches of apple juices in which these structures are frequent too dilute. HPLC – UV method was successfully accessed for the evaluation of monitorised added caramel compounds in adulterated apple juices. Quantitative evaluation was based on peak areas using a usually caramel standard in the range of 0.02 – 0.2%.

## Changes of chlorophylls, $\beta$ -carotene and lutein during storage of lettuce of control plants and $\text{CaCl}_2$ pre-harvest treatment

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Lettuce is one of the important salad vegetable as the source of carotenoids, vitamins and phenolic compounds. Carotenoids such as  $\beta$ -carotene and lutein can act as antioxidants in lipid phases by trapping free radicals or physically quenching singlet oxygen and inhibit lipid peroxidation. They have been also associated with lowered risk of developing degenerative diseases such as cancer, cardiovascular diseases, cataract and macular degeneration. Chlorophylls are the most ubiquitous of all natural pigments and are responsible for the color of all green plants. It plays the primary role in photosynthesis. Different postharvest techniques for preserving the quality of fresh-cut vegetables involve the maintaining external color, preventing tissue browning and inhibiting pathogen development during postharvest life. Many studies focus on postharvest influence of different factors on the food quality. The aim of this work was to study the effect of pre-harvest different concentration of calcium chloride on the changes of chlorophyll pigments and selected carotenoids during the storage of lettuce heads. Research material involved Omega variety of lettuce. The experiment was carried in greenhouse. Plants of lettuce two and one week before harvest were sprayed by  $\text{CaCl}_2$  in the dose of  $2,5 \cdot 10^{-4}$ ;  $5 \cdot 10^{-4}$ ;  $1 \cdot 10^{-3}$  mol per plant. After harvest plants were divided into three groups. One of them was analyzed directly after harvest, the second after 7 and the third after 14 days of the storage at the temperature  $4^\circ\text{C}$ . The content of carotenoids and chlorophyll was determined by HPLC method using gradient elution: solvent A was 80% acetonitril containing 0,05% triethylamine and solvent B was ethyl acetate containing 0,05% triethylamine. Samples were analyzed on C-18 column with detection at 450nm. Obtained research results showed beneficial effects of pre-harvest of  $\text{CaCl}_2$  treatment of plants on the lettuce quality after storage. It was found the inhibition of chlorophyll a and  $\beta$ -carotene degradation during 14th days of storage time. Higher content of lutein was noted also in plants after  $\text{CaCl}_2$  treatment at the highest concentration and stored for 14 days in comparison to control plants stored at the same conditions. There was not noticed the unequivocal influence of  $\text{CaCl}_2$  on the level of the assayed compounds in fresh plants. In conclusion, results suggest that the pre-harvest of  $\text{CaCl}_2$  treatment of plants can be used in the case for safe keeping of lettuce.



## Reduction of gray mould on strawberries by acetic acid vapour and quality analysis of produce

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Strawberries are very perishable fruits and susceptible to fungal spoilage. Gray mould due to *Botrytis cinerea* infection is the main cause for decay in postharvest. Application of specific fungicides to reduce gray mould resulted in resistances of some *B. cinerea* strains. Therefore, the development of effective, hazard free alternative methods is requested. Several reports have shown that acetic acid (AA) treatment of fresh fruit (apple, pear, apricot, plum) effectively suppresses fungal decay. Therefore, this study aimed to examine the effect of AA vapour on *B. cinerea* and the quality of fruits. For evaluation of gray mould inhibition fruits were inoculated with *B. cinerea* ( $3 \cdot 10^5$  spores·ml<sup>-1</sup>) by spraying. The fruits were then fumigated with AA vapour in a closed ventilated 22.4 l perspex box (variant I: c(AA) = 0, 2, 4 and 6 mg l<sup>-1</sup>, t = 30 min; variant II: c(AA) = 0, 1x2, 2x2 and 3x2 mg l<sup>-1</sup>, 30 min per treatment). Afterwards, strawberries were stored at 22 °C in nearly water vapour-saturated air for 4 days and inspected at the end of storage. For the evaluation of nutritional, physicochemical and sensory quality the fruits were prepared in the same way but without inoculation. Odour and taste of produce were evaluated by 4 female and 4 male panellists (mean age 40.3 ± 13.8) 2 and 26 hours after treatment. Until tests fruits were stored in open boxes or in boxes wrapped with perforated plastic film (500 g). Fruits were mainly tested for the presence or absence of acetic acid flavour and odour. To analyse possible effects on quality fruit water content, stiffness, TSS and total osmotic content, soluble sugar and vitamin C content were measured. AA vapour inhibited *B. cinerea*. This effect increased with concentration. Best results were obtained after triple treatment with 2 mg l<sup>-1</sup> AA where *B. cinerea* was reduced to 44%. AA treatment up to 6 mg l<sup>-1</sup> did not affect the quality and taste of fruits. However, the odour of fruits stored in film covered boxes was permanently affected at an AA concentration of 4 mg l<sup>-1</sup>.

## Enzymatic hydrolyze of soy oil using lipase by *Geotrichum candidum*

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In recent years, lipase production by microorganisms has been extensively studied and different applications have been proposed for this enzyme. The aim of this work was to use the lipase generated by *Geotrichum candidum* to perform the soy oil hydrolysis as a first step of the enzymatic biodiesel production. Lipase was obtained using optimized medium containing 8% of corn steep liquor and 0.6% of soy oil agitated at 250 rpm, with initial pH of 7.0 and temperature of 30°C. The lipase activity was 15.0 U/mL. Enzymatic purification was done through ethanol addition (2 parts of ethanol: 1 part fermentation medium) at 2°C, centrifuging of the resulting solution, dissolution of the precipitated in phosphate buffer (0.1 mol/L pH 7.0) and lyophilization for 2 days. Enzymatic solid obtained presented 692 U/mg of lipase activity and 13.7% of water. This enzyme was used to carry out the enzymatic hydrolysis of soy oil using a 50 mL thermostatic reactor provided with magnetic agitation. The hydrolysis was performed under different conditions of temperature (from 34 to 40°C), water concentration (from 5 to 15% m/m) and enzyme concentration (from 3 to 5% m/m, that means a range from 21 to 35 U/g oil), according to a central composite design 23. All experiments were carried out with 2.0 g of Brazilian soy oil. The hydrolysis progress was verified by a free fatty acids titration method for which a solution of NaOH (0.05 mol/L) was used. The percentage of hydrolysis was calculated considering the saponification index equivalent to 100% of hydrolysis. For this experimental design, the best hydrolysis result (34%) was obtained at 40°C, with 15% (m/m) of water and 3% of enzymatic solid (21 U/g oil), after 24 hours of reaction. This reaction was found to be very dependent on the lipase activity in enzymatic solid, which means that the best results were related to the highest enzyme concentrations. In another experimental design, an enzymatic solid with 925 U/g was used to carry out this hydrolysis reaction and the best results obtained were 40%, 53% and 29% of hydrolysis after 12, 24 and 48 hours of reaction, respectively, with 15% (m/m) of water and 5% (m/m) of enzyme (46 U/g oil), at 37°C. These results demonstrate this lipase's good capability for the soy oil hydrolysis, and its related production of free fatty acids, indicating that it could represent an appropriate option for the biodiesel production.

## Feasibility of a simplified handheld optical system for blueberries ripeness field evaluation

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During last years, small fruits farming and marketing have increased widely in Italy in response to consumer's interest in bioactive and health protecting compounds fruits rich. Small fruits cultivation in Italy has been established as small-scale farms giving extra income to family businesses. At present, the ripening stage and harvest time is normally estimated by a visual analysis based on grower's experience. Farm growers could be supported in their decisions by simple and portable devices, used to directly assess the berries ripeness in the field and accordingly to plan the best harvest time. The aim of this work was to study the feasibility of a simplified handheld and inexpensive optical device, based on measurements and processing of diffuse reflectance at a few wavelengths appropriately selected. This study is focused on selecting the most significant wavelengths able to identify in the field the blueberries ready to be harvested. To this aim Vis/NIR spectra in the range 445-970 nm were acquired for *Vaccinium corymbosum* ('Brigitta' cultivar) during two different growing seasons (2005 and 2006), harvested in Valtellina area (Lombardy, Italy). Spectra measurements were taken in the field on individual berries along their equator region. Fruits samplings were performed weekly, and picked fruits were divided in four ripeness classes according to external colour: green (class I), less than 50% blue-pigmented (class II), 50% to completely blue-pigmented except stem's end (class III), and fully ripe berries (class IV). Principal Components Analysis (PCA, The Unscrambler® 9.6) was applied to acquired spectra to find possible clustering of the berries spectra belonging to the four different classes. The PCA of 634 fruits spectra highlighted two principal spectral bands (around 650 nm and 740 nm) in which differences among fully (class IV) and not completely ripe (classes I-III) samples spectra are maximized. Reflectance values at these wavelengths were used to obtain spectral ratios normalised to 850 nm reflectance. Based on these relations, a simple fruits classification algorithm was proposed. Berries ripeness grading based on the proposed index showed a high ability in discriminating fully ripe fruits from partially ripe fruits and unripe fruits. More than the 93% of samples were correctly classified in validation phase. The results of this study demonstrate the feasibility of a simplified and low-cost handheld device, based on the use of only three wavelengths, able to quickly estimate blueberry ripeness in the field, with special reference to the last and most sensitive stages of ripening process.

## Marketing of pomegranate in Iran: Difficulties and recommendations

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Iran is one of the main producers and exporters of pomegranate in the world. Khorasan is one of the biggest producing provinces of the pomegranate fruit in our country. Pomegranate production of Khorasan province is 86,492 ton with mean yield of 12,996 kg/hectare. Figures of Jihad Agricultural Organization revealed that pomegranate cultivated in 7,121 hectare in some cities and their suburbs in Khorasan province. Financial importance of pomegranate is due to the price of its production in one hectare that is very reasonable for the producers. So the income of pomegranate production can be an important percent of national income of Iran. This research was carried on in Khorasan agricultural and natural resources research center in 2006 in order to recognize the barriers for exporting of pomegranate, suggesting some solutions and therefore enhancing the producers' income. In this research ,production stages( pomegranate variety, diseases, pests, size, nutritional value and production), handling, packaging (type and characteristics of packaging), storage (cold storage, traditional storage), main export centers (governmental, private), fruit quality and accordance with international standards and wholesomeness of importing countries (consumption market) were investigated. Then in each stage between production and consumption by Iranian or foreign consumers, the critical hazard points in decreasing of pomegranate wholesomeness were studied and scientific and practical suggestions for enhancing of fruit export via improving fruit quality, packaging and exporting trends and international market were performed. The results showed that regarding the pre harvest factors such as suitable agronomic operations, selection of appropriate orchard and variety and post harvest factors such as suitable harvest time, harvesting technology, sorting, packaging, shipping and accordance with standards, increasing fruit quality and storage life and suitable marketing is necessary for export of high quality pomegranate to international markets.

## Acoustic analysis for non-destructive detection of quality defects in fruits and vegetables

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The market of fresh produce is determined by producers and consumers quality requirements and regulations according to EU standards. Several exterior quality parameters like color, form or the absence of external damages can be detected in sorting plants. The determination of internal parameters like the content of sugar and acidity based on optical spectroscopy methods is possible, too. Despite the non-destructive detection of caverns in plant tissues, which are undesired by consumers and not permitted by EU regulation, is still an unsolved task. Especially after a long and cold winter period the occurrence of caverns in asparagus spears is a major problem for asparagus producers and consumers. In years with above mentioned conditions the amount of hollow asparagus spears can reach 50% of total crop yield at the beginning of harvest time. At present the sorting of hollow spears is very labor intensive and can be done solely manually, therefore, by a consortium of two SME's and one scientific institute it is tried to develop a new efficient, non-destructive and fast sorting method. In two-year experiments we examined the application of the acoustic impulse response method for non-destructive classification of hollow asparagus. The examined samples had been harvested in Brandenburg (Germany). The method bases on a gently mechanical excitation of the sample followed by its characteristic response detectable as sound. Under laboratory conditions the extraction of resonance eigen frequencies and the implementation of mathematical models as classification base offered the distinction between hollow and not-hollow asparagus samples with a high correlation coefficient. However, the effects of natural variations and especially of the environmental conditions are not negligible disturbing factors.

## Effect of calcium applications and storage condition in apples on calcium and polyphenol content related with physiological disorder of bitter pit in apples

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Bitter pit is a physiological disorder that affects apples and that has been attributed to a deficiency of calcium in the fruit; however this relationship is not clear and therefore subjected to controversy. Attempts to know the effect of the fruit calcium content and other constituents on this physiological disorder have been done, however the observed differences have not been clear and successful for explaining the changes in the fruits, probably due to that at the same time occurred many physiological changes attributed to cellular disorganization during the pit development. The objective of this study was to evaluate the effect of edafic and foliar calcium applications at different concentrations during 'Golden Delicious' apple growth, as well as the effect of storage, on the "bitter pit" physiological disorder and their relation with some polyphenols, calcium content of the fruit. Calcium nitrate ( $\text{Ca}(\text{NO}_3)_2$ ) was used as the source of calcium ion. Calcium ions at different concentrations were applied at five different stages of fruit growth through a "fertirrigation" system. In addition, these treatments were subject to six foliar applications with and without calcium ( $\text{Ca}(\text{NO}_3)_2$ ) from complete flowering to the harvest. The apples were harvested, stored in both conventional and controlled atmosphere, and evaluated in each stage for calcium content, some fruit physical properties, "bitter pit", total polyphenols as well as for the identification and quantification of the polyphenols (+) catechin, (-) epicatechin, phloridzin, rutin, caffeic acid, chlorogenic acid, and p-coumaric acid. Polyphenols, either individual or total, did not show any significant changes in response to the different calcium treatments. The application of calcium treatments in edafic way significantly affected the "bitter pit" physiological disorder: at  $160 \text{ kg}^{-1} \cdot \text{Ha}$  the apples did not show this physiological disorder, while the control without calcium application showed incidence of the disorder up to 83%. This same tendency on the physiological disorder was observed for conventional storage. The storage significantly affected the bitter pit development. Low incidence was presented for the apples stored in controlled atmosphere. The bitter pit physiological disorder was not significantly correlated with polyphenols content, and calcium concentration.

## Improvement of fruit storage in the supply chain with modified atmosphere packaging

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The management of freshness in the storage is fundamental to maintain high profits in the agro-food sector to improve the distribution and to respond to retailers and consumers requirements. MA added to low temperatures influence fruit metabolism and reduce ethylene production, weight losses, hardness of pulp, preserving vitamins and organic acids. The objective is to improve storage conditions of fresh fruits with limited shelf life (strawberries, raspberries, blueberries, plums) long every step of supply chain through the use of modified atmosphere. Considered units are commercial pallets, with large batches of product and individual basket units. Fruit quality and ripening monitoring during storage is performed through the use of traditional analysis (destructive) and UV-Vis spectroscopies (non destructive).

## Increased level of flavonoids in fermentation solution of dyers woad leaf

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Health risks resulted from cardiovascular diseases, hypertension and diabetes had been concerned increasingly. It had been known that Dyers Woad Leaf (*Isatis indigotica*) had the effects of anti-hypertensive activity, anti-lipid activity, anti-oxidant activity and anti-tumor activity, reducing serum cholesterol and thus preventing cardiovascular suffers. However, some functional compounds are encapsulated with cellulose in cell wall. The higher cellulose in cell wall, the more difficult the functional compounds is fully absorbed by human body. To release more functional compounds from cell, it is necessary to remove cellulose from cell wall with cellulose, an enzyme available to hydrolyze cellulose extra-cellular excreted by fungi. Flavonoids is one of the important functional compounds naturally existed in most of plants. Ultraviolet spectrophotometry was used to detect and assay the flavonoids level in dyers woad leaf. In order to produce more flavonoids, juice of dyers woad leaf fermented with the strain *Trichoderma viride* AS3.4004 which could produce hydrolyzed-enzymes. The factors affecting juice fermentation, including carbon source, nitrogen source, initial pH of medium, stirred speed, temperature and inoculation size, etc, were investigated. The optimal fermentation parameters for the production of flavonoids from dyers woad leaf were 10 g/L of glucose as carbon source, 0.300 g/L of urea as nitrogen source, an initial pH at 5.5 in medium, 200 r/min of shaker, temperature at 28°C and 5% of inoculation size, respectively.



## Anthocyanin producing from grape pomace (*Vitis* sp) and barberry

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Anthocyanin pigment content of barberry fruit and six grape varieties Betch, Torkman, Rokh Siah, Siah Ghochan, Sine Kaftaree and Shahani were investigated using optical spectroscopy (The pH- differential method), including quantitation of monomeric anthocyanin pigment (red color indice), and polymeric color, color density and percent polymeric color as indices for degradation. Result showed significantly difference between sample in monomeric anthocyanins, polymeric color, color density and percent polymeric color. Monomeric anthocyanins were 2990, 2333, 2170, 1632, 1177, 1050, 202 mg/L for shahni, Rokh Siah, Siah Ghochan, Torkman, Sine Kaftaree, Barberry fruit and Betch respectively. Polymeric color were 41, 36, 27, 20, 13, 11 for Rokh Siah, Betch, Torkman, Sine Kaftaree, Barberry fruit and shahni binary and Siah Ghochan respectively. Color density were 129, 97, 79, 47, 44, 42 for shahni, Siah Ghochan and Sine Kaftaree binary, Rokh Siah, Barberry fruit, Betch and Torkman respectively. percent polymeric color were 80%, 62%, 41%, 28%, 21%, 11%, 10% for Betch, Torkman, Rokh Siah, Barberry fruit, Sine Kaftaree, Siah Ghochan and shahani respectively. Attention to the result concluded that shahani, Siah Ghochan and Sine Kaftaree has a proper potential for producing anthocyanin pigment.

## Development of quality small – scale agricultural processing enterprises in Uganda

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Small-scale agricultural processing enterprises have played a very important role in the Ugandan economy, particularly in terms of employment generation, better income distribution and as a training ground for entrepreneurs before they invest in larger enterprises. But the growth has been slowed due to quality management.

## Design and test of solar dryer for leafy vegetable

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The fossil fuels, used as main source of energy in industries, soon will be finished. Therefore, the use of sustainable energies, such as solar energy, is increasing. Because of high moisture content and delicate tissues, vegetables, specially leafy ones are very sensitive to drying process. Drying of leafy vegetables with high temperature by conventional dryers causes contamination and waste of crops. Hence, solar energy dryers are very suitable for vegetable drying. The designed solar dryer in this study was a forced convection distributed type and its drying capacity was 10 kg of fresh leafy vegetables in a Kermanshah summer day. The solar radiation and meteorological data of Kermanshah (latitude 35°42') was used. Required air mass and its characteristics were calculated by psychometric chart. Drying air temperature was raised up by a flat plate-fined type solar energy collector with aperture area of 1.83 m<sup>2</sup>. Forced convection of drying air was produced by a small fan with city network electricity. Drying chamber had two sliding trays with total area of 1 m<sup>2</sup>. Complete drying of crop in a single day was one of the advantage of the designed dryer. Mint was used for dryer evaluation. Dryer tests were conducted in September. The rate of mint drying in the dryer was about 4 times faster than that of open-to-sun drying.

## Production of virusless potato seed for Georgian potato farmers

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Potato is one of the leading crops in Georgian agriculture and is one of the main food substances for a people together with the grain-crops. In Georgia, potato mainly is cultivated in highlands, such as Kvemo Kartli (Dmanisi, Tsalka), Samtskhe-Javakheti (Akhaltzikhe, Adigeni, Aspindza, Akhalkalaki, Ninotsminda) and Adjara (Keda, Khulo). According to the information published by the company AFRD, potato producing during 2005-2006 in Georgia fluctuates between 120000-150000 t. per year. It should be mentioned that in Georgia there is no significant amount of high yield elite seed production. According to Statistical Department of the Ministry of Agriculture in 2005-2006 years (data for 2007 is not available) land under potatoes has been considerably decreased. For example if in 2005 potatoes were planted on 40,000 ha, in 2006 it has been only 22,800, accordingly potato harvest has decreased. In Samtskhe-Javakheti in 2005 potatoes were planted on 15,500 ha, where in 2006 planted area decreased to 8,100 ha. In Kvemo Kartli in 2005 potatoes were planted on 9,500 ha, in 2006 planted area decreased to 9,200 ha. Both regions are main potato areas and given figures are not encouraging. Accordingly the average per ha yields also decreased, in Samtskhe-Javakheti from 12.9 t/ha in 2005 to 6.7 t/ha in 2006, same picture was also observed in Kvemo Kartli where per ha yields decreased from 13.0 t/ha in 2005 to 7.6 t/ha in 2006. Main reason for potato low yields in Georgia (average 7.0-8.0 t/ha) is the poor quality of planting material and unavailability of high quality potato seed. It must be mentioned, that in profitable year the demand on potato is satisfied and in less profitable year, as was 2006, the demand was not satisfied and 56000 t. of potato was brought in from Turkey. The low figure of producing potato in Georgia (average 10-12 t per hectare) is due to the bad seed materials. Earlier existed seed system mainly was based on bringing in the best potato from Russia and its former cultivation in the special seed industry system. It must be mentioned, that even this system did not work properly, there was high rate, of brought in potato diseases, for which the loss of harvest was about 50-60%. Today in Georgia we do not have the centre of seed industry, where the high quality seeds could be cultivated and the seeds will be free from diseases. It is known that the virus diseases reduce twice the potato producing. Since 1996 many international humanitarian organizations tried to start seed producing in Georgia, for this purpose they bring in the high quality (mainly A and C class) potato seeds, but it does not have large effect on producing high quality seeds in the country.

## **Influence of temperature on quality of red pepper (*Capsicum annuum*, L. var. Hungarian) during dehydration: colour, texture and antioxidants properties**

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Red pepper is an excellent source of antioxidants, very rich in ascorbic acid and other components such as carotenoids which confer protection against aging process. This pepper is highly appreciated for its flavour and colour, being the latter the main quality attribute that determines its overall quality and consequently its final market price. Drying conditions, particularly temperature, leads to pepper modifications that can cause quality degradation. For this reason, operative conditions must be controlled to produce high quality final dry peppers. In this work, the effects of process temperature between 50 and 90°C on rehydration properties, colour, firmness, vitamin C, antioxidant capacity and total phenolics during the drying of pepper were analysed. The rehydration ratio decreased with temperature ( $p > 0.05$ ) and the maximum water holding capacity of  $47.4 \pm 2.8$  (g retained water/ 100 g water) was achieved at 50°C ( $p < 0.05$ ) indicating minimum deterioration of pepper tissue at that temperature. Both, vitamin C content ( $p < 0.05$ ) and the total phenolic content ( $p < 0.05$ ) decreased as air-drying temperature decreased. The radical scavenging activity showed higher antioxidant activity at high temperatures (i.e. 80 and 90°C) rather than at low temperatures (i.e. 50, 60 and 70°C). Colour changes associated to non-enzymatic browning compounds ( $p < 0.05$ ) and ASTA colour ( $p < 0.05$ ) were also affected by drying temperature. Furthermore, firmness which is one of the most desirable attributes in fresh as well as dehydrated peppers shows a reduction of 50% compared to fresh sample at 70°C ( $p < 0.05$ ). The obtained results represent an important contribution in the knowledge of optimal pepper operative conditions during dehydration. In particular, the effect of temperature was studied, which is the most relevant variable in this operation on the main quality pepper characteristics. Processors of dry pepper need this information to enhance not only efficiency of process but also quality of final product, which is an increasing consumer's demand.

## Changes of rheological behaviour of wheat flour by archaic wheat varieties addition

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The use of spelta and dicoccum wheat flour for bread making purposes is rare in the Czech Republic. The study investigated properties of dough and bread from composite flour made by mixing spelta or dicoccum flour to white wheat flour (strong and weak quality) at rates of 0 and 10% (w/w). Rheological properties of flours were tested by means of farinograph, extensigraph and amylograph (Brabender, Germany) and alveograph (Chopin, France). The dough prepared with sugar, salt, fat and yeast was described according to fermentograph SJA (Sweden), maturograph and oven spring (Brabender, Germany) tests. Baking quality parameters as specific volume of bread, loaf shape, sensory evaluation and crumb penetration were also conducted. Incorporation of non-traditional wheat flour in the two different wheat flours had not influence on water absorption but dough stability decreased in regard to basic flour parameters. Viscoelastic dough characteristics according to ratios  $v/d$  and  $P/L$  slightly decreased as same as the alveograph and extensigraph energy. Maximum at amylogram curve dropped approximately on 20% by spelta flour and changes was not provable by dicoccum addition. Fermentograph dough volume, optimal proofing time and dough stability during fermentation periods increased in relation to the wheat addition and quality of basic flour. Specific bread volume increased with spelta fortification and negative effect coursed dicoccum wheat. Incorporation of non-traditional wheat in the dough had not an effect on the crumb colour. Flavour, aroma and overall acceptability of bread were not influenced by different wheat flour replacement.

## Lupin addition effect on wheat flour, dough, and bread properties

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The use of lupin-wheat flour for bread making purposes and consumption are new in the Czech Republic. The study investigated properties of dough and bread from composite flour made by mixing lupin flour to white wheat flour at rates of 0, 10 and 20% (w/w). Rheological properties of flours were tested by means of farinograph and amylograph (Brabender, Germany) and alveograph (Chopin). The dough prepared with salt, sugar, fat and yeast behavior was described according to fermentograph SJA (Sweden), maturograph and oven spring (Brabender, Germany) tests. Baking quality parameters as specific volume of bread, loaf shape, sensory evaluation and crumb penetration were conducted. Incorporation of lupin flour in the wheat one increased water absorption and dough development time. Alveograph ratio P/L decreased more than twice, but W value lowered nearly about 20%. Maximum at amylogram curve dropped approximately on half value - from 840 AU to 400 AU. Also fermentograph dough volume, optimal proofing time and dough stability during fermentation periods decreased in regard to the lupin amounts addition. Specific bread volume significantly increased with lupin fortification but sticky dough during baking test was found at higher rates. Incorporation of lupin in the dough had a positive effect on the crumb colour. Flavour, aroma and overall acceptability of bread were not influence by lupin flour replacement.

## Simulated in-transit vibration damage to watermelons

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Vibration generated during road transport by vehicles has an important effect on agricultural products damage process, particularly on vegetable and fruits. Modulus of elasticity is one of the most important mechanical properties of fruits and its variation can be described as one of the damage criteria during transportation. This research was conducted to evaluate the effects of vibration parameters (frequency, acceleration and duration) and fruit position in the bin, on the watermelon damage. At first, vibration frequency and acceleration were measured on the different points of truck-bed in order to obtaining the range of vibration frequency and acceleration distribution during transportation. Second, a laboratory vibrator was used to obtain some factors influencing the damage during watermelons transportation. The damage was described as a difference of modulus of elasticity of the watermelon (flesh and hull) before and after the test. According to the results measured on the truck-bed, vibration frequency mean values were 7.50 Hz and 13.0 Hz for 5 - 10 Hz and 10 - 15 Hz frequency intervals, respectively. Furthermore, vibration acceleration mean values were 0.30 g and 0.70 g for 0.25 - 0.50 g and 0.50 - 0.75 g intervals, respectively. Vibration frequency and acceleration mean values were used for vibration simulation. Vibration durations were 30 and 60 min and damage was measured for watermelons at top, middle and bottom positions in the bin. Laboratory studies indicated that, vibration frequency, vibration acceleration, vibration duration, and fruit position, which were taken into consideration as controlled variable parameters, significantly affected the damage ( $p < 0.01$ ). Damage to the watermelon flesh was higher than watermelon hull. Vibration with a frequency of 7.5 Hz, acceleration of 0.70 g, and duration of 60 min caused higher damage levels. Fruits located at top position in the bin had more damage than middle and bottom positions ( $p < 0.05$ ).

## Extraction and identification of the hepatoprotective bio-active components of the root of *A. deliciosa*

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The objective of the present work was to find out the hepatoprotective bio-active components from the root of *A. deliciosa* comprehensively and accurately, and promote the exploitation and utilization of the whole resource of *A. deliciosa*. The root of *A. deliciosa* were fractionated into various extract fractions with differential polarity solvent, the hepatoprotective activities of various solvent extracts were assessed by examining the effect on carbon tetrachloride (CCl<sub>4</sub>)-induced hepatotoxicity in rats. The highest hepatoprotective activities fraction was further isolated with column chromatography. The structures of the activities monomers were identified with modern spectrum technology such as IR, UV, EI-MS, <sup>1</sup>H-NMR, <sup>13</sup>C-NMR and DEPT-NMR. Of various extract fractions, the ethyl acetate extract (EAE) were found to have significantly higher hepatoprotective activities than that of other extracts and silymarin ( $p < 0.05$ ). When EAE at a dose of 200 mg/kg pre- and post-treatment in the CCl<sub>4</sub>-induced rats, the activities of alanine transaminase decreased 90.10% and 88.60%, aspartate transaminase decreased 80.69% and 79.92% in rat serum; the lipid peroxidation decreased 42.11% and 45.53%, glutathione increased 114.12% and 147.62% in the rats liver homogenate, respectively, as compared with that of the CCl<sub>4</sub> control rats. When the EAE was separated into five fractions by silica gel chromatography, fraction III showed high yield and high hepatoprotective activities, the fraction III was further separated into five fractions using silica gel chromatography. Which were investigated for the main chemical constituents by column chromatography techniques, physico-chemical constants and spectroscopic analysis. Its mainly chemical constituents were three triterpenoids named 3  $\beta$ -hydroxy-urs-12-en-28-oic acid (ursolic acid); 2  $\alpha$ , 3  $\alpha$ , 23-trihydroxy-urs-12-en-28-oic acid; 2  $\alpha$ , 3  $\beta$ , 19, 23- tetrahydroxy-urs-12-en-28-oic acid. Conclusion: The findings indicated that the highest hepatoprotective activities fraction of the root is enriched with triterpenoid. The three triterpenoids were isolated from the *A. deliciosa* root for the first time.



## Hygiene and waste and wastewater management of fresh-cut vegetables

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The aim of this study is to develop small-scale production of fresh-cut vegetables, mainly carrots and lettuce. The main focuses are on the quality of raw material, processing, disinfection techniques, process water, wastes and wastewaters. Harmful microbes can find their way from fields or irrigation water to processes and products. Methods to improve the hygiene of fresh-cut vegetables in the whole production chain will be examined. Testing and adopting of new and existing decontamination techniques for products, process hygiene and process water (e.g. UV-C, ozone, hot water, electrolysed water) will be included. An important topic is the development of machines and equipment to ensure both the safety of operation and the ease of throughout cleaning leading to good hygienic quality of the product, to minimise the amount of wastes generated and to improve water reuse. Practical methods for screening the quality of the raw material and processing level will be tested. As a result of this work, the industry will benefit from improved hygienic quality, longer but safer shelf-life of fresh-cut vegetables and reduction of harmful environmental impacts.

## **Influence of osmotic pre-treatment and microwave power on the volatile profile of dried cherry tomatoes**

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Vegetable flavour is an important quality factor that influences consumer acceptability. Dried Tomato is a highly valued product due to its sensorial, nutritional and functional characteristics. Its final quality is strongly dependant on the drying method. Sun drying and air drying are the traditional processes used for drying tomatoes; however, the optimal combination of different drying techniques such as osmotic dehydration or microwave assisted air drying could lead to high quality self-stable products. Osmotic pre-treatment involves immersion of the product in concentrated sugar/NaCl solutions, where both partial dehydration of tissue and solid uptake take place. Mass transfer during this pretreatment depends on factors such as temperature, type and concentration of osmotic medium, size and geometry of the samples, etc. In this paper, the influence of some of these variables on the volatile profile of dried Cherry tomatoes was analyzed. Cherry tomatoes cut in halves, were dried until they reached a final moisture content of 60%. The experiments were carried out under different osmotic pre-treatment conditions (two different osmotic solutions were employed, a binary sucrose solution of 55 %Brix, and a ternary solution containing 27.5% sucrose and 5% NaCl), air temperature (40 and 55°C), and microwave power (0 and 1 W/g). Volatile compounds of fresh, osmotic pre-treated and dried tomatoes were extracted by the purge and trap thermal desorption method and analyzed by GC-MS. In the volatile fraction of all samples 24 major compounds were identified. Principal component analysis was performed on the means of the volatile compounds identified in the different samples analyzed. In general treatments provoke changes in the volatile profile depending on processing conditions. Osmotic pre-treatment and microwave power have a significant influence on the volatile profile of the final product, while it does not seem to be affected by the air temperature used for drying.

## Effect of proteins on lactose-induced stickiness in dairy powders

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Powder stickiness, vapour sorption dynamics and surface composition were investigated for a range of non-fat, milk powders. Powders differing in protein: lactose ratio were spray dried following ultrafiltration of skim milk to increase the protein level or dilution of skim milk with permeate to decrease the protein level. Stickiness was measured using a miniaturised fluidised bed apparatus for each powder over a range of temperature and RH. Dynamic vapour sorption was used to determine the rate of sorption and desorption of powders as a function of RH. X-ray photoelectron spectroscopy was used to determine the relative proportions of protein, lactose and fat on particle surfaces and showed that surface composition of powders was significantly different from bulk composition. The proportion of protein and fat on powder surfaces was much greater than the equivalent bulk concentrations. Increasing the proportion of milk protein increased the RH at which sticking occurred, i.e. decreasing susceptibility to sticking. This is consistent with previously reported protein-induced delays to crystallisation of lactose. The rate and extent of sorption and desorption were proportional to the protein: lactose ratio. As such, the presence of proteins in dairy powders produces a stabilising effect against stickiness. Over-representation of protein at the particle surface enhances this effect, as the phenomenon of stickiness involves surface contact between particles.

## Soy milk residue (“okara”) dried in flash dryer - uses as food ingredient

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The objective of the current research project was to evaluate the physical-chemical characteristics and the technology functional properties of the dried residue and suggest some uses in food formulations. The residue from soymilk, called “okara”, which was provided by two industries A and B, localized in two different cities in Brazil. The drying process of the okara in flash dryer was technically viable, since the initial moisture content (83% w.w.b) of the okara was adjusted to at most 67% (w.w.b) by mixing with okara previously dried in a tray dryer (65°C/8h). The dried okaras of A and B industries, obtained using a central compound rotational design (CCRD), showed approximately the same values for protein (35 to 41% d.w.b.) and lipids (16 to 18% d.w.b.). However, okara A presented values of fiber (20 to 22% d.w.b.), ash (4 to 4.28% d.w.b.) and carbohydrate (34 to 41% d.w.b.) a little higher than okara B, probably due to the presence of the hulks in the okara A. These values are close of those obtained in the okara dried in the tray dryer, called here as original okara. The response surface methodology (RSM) showed that the drying parameters: re-circulation of dried residue rates (RR or  $x^1$ ) and the drying air temperature (T or  $x^2$ ) didn't affect the residue's physical-chemical composition and technology functional properties, as compared within the eleven samples from the CCRD. In the dried okara A the emulsification capacity (EC), stability of the emulsion (SE) and solubility of protein (SP) were significant ( $p \leq 0.05$ ) higher than the dried okara B. The water holding capacity (WHC) varied from 19 to 32 g water.g<sup>-1</sup> protein in both okaras. The original okara showed lower values of EC and SE when it was compared on the flash dryer. These results indicate that the process of drying on the flash dryer have positive effects especially in the technology functional property. The dried okara A obtained from trial 5 of the CCRD showed better results in EC (414 ml oil g<sup>-1</sup> protein) and SE (89%) and could be used in the formulation of sausage, where the emulsifying property is most important. The dried okara A from trial 7 of the CCRD showed good WHC (28 g water g<sup>-1</sup> protein at pH 3) with high SP (41% at pH 7) and EC (339 ml oil g<sup>-1</sup> protein) and emulsion with excellent stability (92%). This material is indicated in products like confectionery products where the water holding capacity is more important.

## Quality and development of organic juice of assai and passion fruit enriched with unripe banana pulp

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The beverage market has presented significant growth, especially for natural fruit beverages such as ready-to-drink fruit juices. Combined with the fact that consumers prefer foods that are healthier and free from harmful chemical substances such as pesticides, especially organic food products, there is an increase in the production of fruit beverages with such characteristics and a demand for research and innovation in this field. Therefore, considering the need for innovation in the beverage field and at the same time seeking to meet the need for healthier food products, the following project's goal was to develop an organic juice containing assai and passion fruit and enriched with green banana pulp as a source of resistant starch. The beverage was packed in glass bottles, submitted to pasteurization by immersion in boiling water at 98°C for 12, 15 and 20 minutes and stored under refrigeration. The results of the physical-chemical analyses (pH, titratable acidity, soluble solids, total solids, reducing sugar, total sugar, instrumental color and ascorbic acid) and the affective sensory tests were evaluated through variance analysis (ANOVA) and Tukey test using the SAS® software. The results indicated that the thermal treatments used didn't influence the beverage's sensory acceptance. The beverage's sensory analysis presented good acceptability, with an average score between 6.5 and 7.0 for the treatments used.

## Antioxidant activity and polyphenols of the whole pulp cagaita (*Eugenia dysenterica*, D.C.)

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Fruit and fruit juices made of tropical fruit native to Brazil have conquered the consumer market. However, most fruit and their by-products have been little explored both in their nutritional composition and potential benefit to health. Cagaita (*Eugenia dysenterica*, DC) is one of the fruit commonly consumed in the Brazilian cerrado, both in natura and as pulp, sweets, jelly, and ice cream. Thus, it is necessary to investigate this species' macro and micronutrient composition as to its antioxidant activity and polyphenols. This work aimed to determine the antioxidant capacity and total polyphenols in the whole cagaita pulp. The pulp was process and subdivided into 4 samples. The experiment design was in triplicate. The antioxidant activity dosage was carried out by the in vitro photolorimetric method of the stable free radical DPPH (2,2-dyphenyl-1-picrilhydrazil). The samples were prepared from cagaita extract solutions, lyophilized and diluted in ethanol at concentrations of 2.5 to 500  $\mu\text{g mL}^{-1}$ . The same procedure was carried out for the ascorbic acid standard. The capacity to sequester free radicals was calculated based on the decrease in the absorbance observed and expressed as radical oxidation inhibition percent. Total polyphenol quantification was determined through the spectrophotometric method of Folin-Ciocalteu with some modifications. The samples were prepared from caigata extract solutions lyophilized and diluted in distilled water at concentrations of 50  $\mu\text{g mL}^{-1}$  at 5  $\text{mg mL}^{-1}$ . The calibration curve was constructed using gallic acid as standard and the results were expressed in mg of gallic acid (AE) per g of sample. The antioxidant capacity results varied between 6.60% ( $\pm 0.36$ ) and 96.82% ( $\pm 1.47$ ) and the cagaita pulp was found to reach its maximum value at the concentration of 500  $\mu\text{g mL}^{-1}$ . In the determination of total polyphenols from the calibration curve obtained with the gallic acid standard solution ( $y = 0.0916x - 0.0388$ ), the values found varied between 0.43  $\text{mg AG g}^{-1}$  ( $\pm 0.01$ ) and 10.08  $\text{mg AG g}^{-1}$  ( $\pm 0.01$ ). It could be concluded that the caigata pulp has high antioxidant capacity, compared with that of other fruit, this activity being likely related to the relevant amount of polyphenols present, since such functions are directly related.

## Comparative study on nutritional and morphological aspects of lychees (*Litchi chinensis* Sonn.) after osmotic pre-treatment and conventional dehydration

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Lychee is a tropical and subtropical fruit of high commercial value, with high sugar content, vitamins and minerals such as potassium, calcium, magnesium and phosphorus in appreciable quantities and is consumed fresh, canned, dried or processed as juice, wine, pickles, jams, yoghurt and ice cream. The conventional dehydration is a simple application process that, in addition to prolonging the shelf-life, reduces the weight of the product for the transport and the space needed for storage. Osmotic dehydration generally does not provide a product with low moisture enough to be considered in shelf stable, and therefore has been used as pre-treatment by the drying process, aiming to reduce post-harvest losses, improve the quality of the final product, inhibit the enzymatic browning and retain volatile substances responsible for flavor and aroma. The objective of the current research was to evaluate the changes of litchi fruit, osmotically pre-treated and conventionally dehydrated, when compared to fresh fruit, through their nutritional composition (proximate and mineral composition) and cellular integrity. The evaluation of the proximate composition was performed in fresh fruit, osmotically pre-treated and dehydrated on the following parameters: moisture, protein, lipids and ashes, according to methodology recommended by the AOAC. The difference of carbohydrate contents was expressed on dried base (BS). The quantification of the minerals was carried out by ICP spectrometry, after decontamination and digestion of the samples according to 990.08 and 999.11 methods by AOAC, respectively. The cell integrity was performed by histological sections with the aid of layers of stainless steel and Styrofoam® media. The slides were mounted with aqueous solution of a 50% glycerol and observed using a microscope. The dried fruit had lipids, proteins and ashes contents higher than those of dehydrated samples. The osmotically pre-treated fruit presented higher carbohydrate content than the conventionally dried sample, and these results are consistent with the osmotic dehydration process. The minerals contents, in general, were higher in the conventionally dried fruit, showing the lychee to be very rich, especially in K, P and Mg. The fresh fruit presented higher cell integrity than the osmotically dehydrated sample, which in turn had less plasmolysis than conventionally dried fruit.

## Determination of the antioxidant capacity and polyphenols in acid lime (*Citrus latifolia* Tanaka cv. Tahiti) clarified by microfiltration: a preliminary study

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Acid lime is one of the most important citric fruits in Brazil, its second major producer and major exporter. Microfiltration (MF) is a separation process with membranes that restrict the transportation of one or various chemical species utilized by the food industry in liquid clarification, concentration and cold sterilization. The aim of this study was to evaluate the antioxidant capacity and total polyphenols present in MF-clarified acid lime juices at different trans-membrane pressures. A total of 58.4 kg of acid lime and the juice extracted in multiprocessor and sieved were used. The juice was clarified with a polyethersulphone tubular membrane of 0.3  $\mu\text{m}$ , at pressures of 0.5 and 1.0 Bar. The antioxidant activity of the whole and clarified juices was determined by the in vitro photocolometric method of the stable free radical DPPH (2,2-diphenyl-1-picrylhydrazyl) and the samples were prepared with extract solutions of the whole acid lime and clarified at 0.5 and 1.0 Bar, lyophilized, and diluted in ethanol at concentrations of 50  $\mu\text{g mL}^{-1}$  at 5  $\text{mg mL}^{-1}$ . The same procedure was carried out for the ascorbic acid standard. Quantification of the total polyphenols was carried out according to the spectrophotometric method of Folin-Ciocalteu, with adaptations. The samples were prepared with solutions of the clarified acid lime extracts at 0.5 and 1.0 Bar and diluted in distilled water at concentrations of 5  $\text{mg mL}^{-1}$  at 50  $\mu\text{g mL}^{-1}$ . The calibration curve was performed through gallic acid standard and the results expressed in  $\text{mg (AE)/g}$  of sample. The results as to the antioxidant capacity varied from 16.96% ( $\pm 5.95$ ) and 98.83% ( $\pm 0.25$ ) for the depulped whole acid lime sample and 3.36% ( $\pm 1.67$ ) and 98.64% ( $\pm 10.48$ ) and 12.05% ( $\pm 0.61$ ) and 97.09% ( $\pm 0.83$ ) for the samples clarified at 0.5 and 1.0 Bar, respectively. It was observed that the maximum value was attained at the concentrations of 3.0  $\text{mg mL}^{-1}$  for the clarified juice at 1.0 Bar and at 5.0  $\text{mg mL}^{-1}$  for that at 0.5 Bar. The polyphenol values varied between 0.52  $\text{mg AG g}^{-1}$  ( $\pm 0.03$ ) and 3.02  $\text{mg AG g}^{-1}$  ( $\pm 0.08$ ) for the juice clarified at 1.0 Bar, and 0.53  $\text{mg AG g}^{-1}$  ( $\pm 0.01$ ) and 2.61  $\text{mg AG g}^{-1}$  ( $\pm 0.02$ ) for that at 0.5 Bar. The clarified acid lime juices presented low antioxidant activity when compared to the whole juice made of acid lime. Significant losses are believed to have occurred after the clarification process due to fouling, what can be minimized with enzymatic hydrolysis prior to the MF process.



## State diagram of deglet nour dates by differential scanning calorimetry

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The state diagram of Deglet Nour dates was developed using freezing curve, glass transition line, and maximal-freeze-concentration condition. Freezing points and glass transition temperature of Deglet Nour were measured by differential scanning calorimetry (DSC). The freezing curve and glass transition line were modeled using the Clausius-Clapeyron equation, adjusted with unfreezable water, and the Gordon-Taylor model, respectively. Maximum-freeze-concentrated conditions was found as  $X_w'$  (characteristic water content) = 0.22 [ $X_s'$  (characteristic solid content) = 0.78] with the characteristic temperature of glass transition being  $T_g'$  (characteristic glass transition) =  $-55.3^\circ\text{C}$  and  $T_m'$  (characteristic end point of freezing) =  $-38.2^\circ\text{C}$ . The developed state diagram can be used in determining the stability of Deglet nour dates during storage as a function of temperature and moisture content. In addition optimum drying and freezing conditions could be identified from the state diagram.

## Optimization of combined microwave-hot air roasting for malt based on energy consumption and neo-formed contaminants (NFCs) content

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In brewery industry, speciality malts; coffee, chocolate, and black malts, are used to give particular colors, and flavors to beers. To produce speciality malt, malts were roasted by combined microwave-hot air at various specific microwave powers (SP = 2.5 - 3.0 W/g), microwave heating times (tmw = 3.3 – 3.5 min), oven temperatures (Toven = 180 – 200°C), and oven heating times (toven = 60 – 150 min). The response variables; color, energy consumption by microwave (Emw) and oven (Eoven), total energy consumption (Etot), quantity of Hydroxy methyl furfural (HMF), furfural, furan, and acrylamide were determined. HMF, furfural, furan and acrylamide are neo-formed contaminants (NFCs) which are the products of Maillard reaction in thermally processed foods. Response surface methodology (RSM) was performed to analyze and predict the optimum conditions for the speciality malt production using combined microwave-hot air roasting process based on minimum energy consumption and NFCs content. At 95% confident level, SP, Toven and toven were the most influencing effects with regard to Etot, whereas tmw did not affect Etot. Toven and toven significantly affected malt color. Only Toven significantly influenced the NFCs content. The optimum parameters were: SP = 2.68 W/g for 3.44 min, Toven = 206°C for 136 min for coffee malt, SP = 2.5 W/g for 3.48 min, Toven = 214°C for 136 min for chocolate malt, and SP = 2.5 W/g for 3.48 min, Toven = 211°C for 150 min for black malt. Comparing with conventional process, combined microwave-hot air reduced Etot by approximately 40%, 26%, and 26% for coffee, chocolate and black malts, respectively and reduced HMF, furfural, furan and acrylamide contents by 40%, 18%, 23% and 95%, respectively.

## **Combined effect of glycerol and oleic acid on the physical and thermal properties of carboxymethyl cellulose based edible films**

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Glycerol and oleic acid (OA) were incorporated into carboxymethyl cellulose (CMC) films through emulsification. The films with different amounts of glycerol and OA were examined for mechanical properties, water vapor permeability (WVP), moisture uptake, optical and thermal properties. Increasing the concentration of glycerol significantly decreased mechanical strength and increased WVP and moisture uptake ( $P < 0.05$ ). Addition of the OA to CMC films significantly improved the WVP, but adverse effect of OA on the mechanical properties was lower than glycerol. By increasing of OA content, the cloudiness intensified and b values of the films increased but glycerol was able to reduce this negative effect of OA. Both glycerol and OA were able to decrease Tg of CMC films. But the effect of the glycerol on the thermal properties of films was higher than OA. Generally, properties of the films containing 0.6 g/g CMC in OA and 0.3 ml glycerol were better than others.

## Effect of gellan gum as the fluid gel forming agent, on particle size distribution, turbidity and rheological properties of orange juice

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Orange juice is a wide spread beverage all around the world due to its favorable taste, flavor and nutritional values. Citrus and similar flavored beverages are recognized as cloudy products and the lack of this property may be diagnosed as a quality shortage; Pulps and fibrous materials precipitate in a pulpy orange juice. In this research fluid gel technology was used to suspend pulp particles and obtain the required stability in orange juice. Gellan gum was used as the fluid gel forming agent. Final orange beverages containing different concentration of gellan (0, 0.015, 0.03% w/w) with total solid contents (10.5% w/w) and at presence of different percentages of solids originated from concentrated pure juice (0, 20, 40% w/w) were produced. Flow behavior index and consistency coefficient of sample 20% juice and 0.03% gellan was 0.41 and 1.08, respectively. Maximum yield stress was 2.01 in the same sample. Flow behavior was influenced interestingly and high apparent viscosities observed at low shear rates by addition of gellan. Gellan increased the size of colloidal particles. Gellan gum at a concentration of 0.015% reduced the serum separation by 82% compared to the serum separation in samples without stabilizer. Dynamic yield stress of samples were calculated and stability of particles predicted by estimation of different forces acting on the particles. Dynamic yield stress was observed for samples containing gellan and calculated by using extrapolation of flow curves and particle stability predicted by force balance. Validity examination performed with the experimental stability measurements.

## Effect of superchilled storage on the freshness and quality of pork

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Effect of superchilling on freshness and quality of pork, and effectiveness of temperature fluctuation during the superchilling storage were studied. Physicochemical parameters such as aerobic bacterial count, total volatile base nitrogen, liquid loss, pH value and sensory evaluation were carried out to evaluate the freshness and quality of pork under steady temperature of  $-1^{\circ}\text{C}$  (superchilling I), fluctuant temperature around  $-1^{\circ}\text{C}$  (superchilling II),  $4^{\circ}\text{C}$  and  $-18^{\circ}\text{C}$ . It was showed that superchilling I could keep pork fresh for 19 days, while superchilling II was just 12 days and  $4^{\circ}\text{C}$  was only 4 days. Pork with superchilling I had less liquid loss and more acceptable sensory evaluation compared with that under the frozen storage at  $-18^{\circ}\text{C}$ . Superchilling was an effective method for keeping pork fresh, and the stabilization of temperature was significant for the effectiveness of superchilling.

## The effects of different hydrocolloids on staling of gluten free cakes baked in different ovens

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Products containing gluten can not be consumed by people suffering from gluten intolerance. Hydrocolloids are required to be used in gluten free product formulations to overcome quality defects. It is important to study not only baking but also staling of gluten free cakes since staling has considerable economic importance for the baking industry. The main objective of this study is to investigate the effects of different hydrocolloids on staling of gluten free cakes baked in different ovens. The cakes were formulated using rice flour. As hydrocolloids, xanthan and guar gum and their blend at concentration of 1.0% were used. Xanthan and guar gums were mixed at equal concentrations to obtain the xanthan-guar blend. Control cake formulation contained no gum. Baking was performed in MW-IR combination and in conventional oven. After baking, cakes were stored at 20°C for 120 h. As staling criteria, hardness and retrogradation enthalpies of cakes were determined during storage. For both types of ovens and different cake formulations, the hardness and retrogradation enthalpy values increased with time during storage. For both types of oven, gum blend or xanthan gum resulted in softer cakes after 120 h of storage. Cakes baked in conventional oven were softer than the ones baked in MW-IR combination oven. The addition of xanthan-guar gum blend to the formulation reduced retrogradation enthalpy meaning that staling was delayed. The retrogradation enthalpies of cakes baked in MW-IR combination oven were found to be lower than the ones baked in conventional oven.

## Effect of storage and processing on reducing and non-reducing sugar content in potatoes

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Fried potato meals have become very popular over the last decades. During frying Maillard reaction takes place contributing to colour and taste development in potato products. As one of the main factors influencing the colour formation is the amount of reducing sugars available for Maillard reaction while non-reducing sugar – sucrose is responsible for the taste. Storage of potatoes at temperature below 9°C induces an increase in the sugar content, resulting in the development of a darker colour of the product after frying. The aim of this research was to study the effect of potato storage and various cooking methods on the amount of reducing sugars and non-reducing sugar. In cooperation with the State Priekuli Plant Breeding Institute (Latvia) five table potato varieties were selected: 'Lenora', 'Brasla', 'Imanta', 'Zile' and 'Madara'. Selected potato varieties were analyzed shortly after harvesting (in 2 weeks necessary for sizing) and after 6.5 month storage (before new harvest) at  $5\pm 1^\circ\text{C}$  temperature and relative air humidity (RH)  $80\pm 5\%$ . Potato samples were prepared using common cooking methods: deep fat frying ( $180\pm 5^\circ\text{C}$ ), shallow frying ( $150\pm 5^\circ\text{C}$ ) and baking in oven ( $210\pm 5^\circ\text{C}$ ). Afterwards analyses were done on the amount of total reducing sugar amount, fructose, glucose, sucrose and dry matter content as well. Comparing the content of total reducing sugars in fresh potatoes prior to storage the highest content was established in potato variety 'Brasla' (i.e.  $0.690\text{ g } 100\text{ g}^{-1}$ ) while after the storage period – in 'Lenora' (i.e.  $0.912\text{ g } 100\text{ g}^{-1}$ ). In the potato variety 'Brasla' glucose content before storage was the highest as well (i.e.  $0.516\text{ g } 100\text{ g}^{-1}$ ), while after the storage period – in 'Zile' (i.e.  $0.808\text{ g } 100\text{ g}^{-1}$ ). In regard to the amount of fructose – the highest content both: before and after storage was found in potato variety 'Lenora'. Content of sucrose after the storage shows slight decrease in all potato varieties. Potato storage and heat treatment processes strongly influence both reducing and non-reducing sugar content. Comparing all the obtained results after applying selected processing methods shows that potato variety 'Lenora' had one of the highest reducing and non-reducing sugar contents.

## Influence of blanching and drying treatment on total polyphenols and antioxidant activity in apple pomace

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Apple pomace contains polyphenols, which show potential anticarcinogenic and other beneficial properties. The effect of both blanching in apples and drying treatment over stability of polyphenols, physical properties and antioxidant activity of apple pomace was evaluated. Batches of both blanched and unblanched apples were extracted and the apple pomace were dried in a cabinet dryer with through flow at a speed of 3 m·s<sup>-1</sup> at 50, 60, 70 and 80°C until 0.05 Kg H<sub>2</sub>O·Kg dw<sup>-1</sup>. Water absorption and solubility indexes, color, total phenolics, flavonoids, anthocyanins and total antioxidant activity were analyzed. Total phenolics were quantified by Folin-Ciocalteu and HPLC. Individual characterization and determination of phenolics were made by HPLC. Blanching process retained a clear color on the dried apple pomace as compared with unblanched. The highest total phenolics and flavonoids contents were obtained for fresh blanched apple pomace. Drying process of fresh and blanched pomace has a marked effect causing a reduction of about 60% of the initial total antioxidant activity. Drying temperatures does not show a significant effect on the total antioxidant activity of either fresh or blanched apple pomace. Despite the reduction on the antioxidant activity by the drying process, dried pomace still retains an important antioxidant capacity. Therefore, apple dried pomace powder can be considered as an alternate source of antioxidants as well as an ingredient for use in functional foods.



## Lycopene solubility and its extraction from tomatoes and their by-products

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In recent years, there has been a growing interest in functional foods. Functional foods are obtained from traditional foods with an ingredient able to provide or promote a beneficial action for human health. These ingredients are extracts of plants, antioxidants, polyunsaturated fatty acids and others. Among the different compounds with functional properties, antioxidants are the most widely studied. Particularly, lycopene is the most efficient natural antioxidant. The unique chemical properties make lycopene hydrophobic and soluble in organic solvents (hexane, chloroform, benzene, triglycerides). In this work, was attempted to prepare lycopene solution and to find an excellent and cheap source of lycopene are presented. It is clarified that accomplished the exhaustive analyze of literature, lycopene is assimilated better from the product of tomatoes, using it with oil. Therefore, it can be maintained, that the most suitable solvent for lycopene extraction is oil, which is innocuous to our organism. Typically, carotenoids and lycopene are extracted from foods by solid-liquid extraction, which consumes large volume of organic solvents. The lycopene extraction with oil is replacement of toxic organic solvents (hexane, chloroform, benzene), a more environmentally friendly and faster extraction procedure. The scientific literature offers no information about the solubility of lycopene. The most important source of lycopene is tomato and its processed food products. Lycopene concentration of tomatoes is 37 mg/kg. The tomato waste from the tomato production has been proved to be an excellent and cheap source of carotenoids. During the processing of tomatoes into pastes or sauces, a large proportion of lycopene is removed by discarding peels. Peels are particularly rich in carotenoids. The best possibilities to refine lycopene present tomatoes skins left after production of juices. It was established that there is by 7-15 times more lycopene in tomato skins than in tomato flesh (it is being found up to 65.150 mg/100 g of lycopene in skin). Data from this study suggest that lycopene solubility in oil at 20°C ranged between 0.07–0.08 mg/g and that the oils of vegetable origin are the most suitable lycopene source for the creation of functional food with natural lycopene.

## Quality of raspberry fruits after frozen storage

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Raspberry is a fruit of low mechanical resistance and short shelf-life. Freezing has the potential to prevent the deterioration of fresh fruits, that's why in the World market frozen raspberries are more valuable. Significant quality differences exist between cultivars of the same culture. Therefore the objective of this study was to determine quality changes of raspberries after frozen storage, and differences between cultivars. Fresh and defrosted fruits of nine raspberry cultivars (*Rubus idaeus*), red-fruited 'Dalniaja', 'Molling Seedling', 'Nagrada', 'Novokitaevskaja', 'Obilnaja', 'Peresvet', 'Volnica', 'Williamette' and yellow-fruited 'Helkal', were analyzed for content and stability of ascorbic acid, anthocyanins, phenolics and soluble solids content (°Brix). Drip loss of raspberries during thawing was also evaluated. Fresh fruits of 'Obilnaja' and 'Nagrada' had the highest amount of ascorbic acid (respectively 30.8 and 30.4 mg 100 g<sup>-1</sup>). In defrosted fruits the average of ascorbic acid content was lower by 29.8%. Anthocyanins content in fresh berries ranged from 2.3 in yellow raspberry cv. 'Helkal' up to 68.77 mg 100 g<sup>-1</sup> in red raspberry cv. 'Molling Seedling'. The average of anthocyanins loss after frozen storage was 25%. Fresh and defrosted fruits of cv. 'Helkal' had the highest total phenolics content (respectively 589.0 and 600.5 mg 100 g<sup>-1</sup>). In defrosted fruits the average of total phenolics content was higher by 23.2%. Frozen storage did not change non-descantly soluble solids content. The average of soluble solids in fresh fruits was 11.12%, and after frozen storage – 11.01%. Significant differences were established among cultivars in drip loss. According to this criterion the most suitable for freezing are fruits of 'Molling Seedling' and 'Peresvet'. CIE L\*a\*b\* color values of fresh raspberries were also determined. In the present study, weak positive correlation ( $r = 0.43$ ) was found between redness value a\* and total anthocyanins content, and medium negative correlation ( $r = -0.67$ ) was found between lightness value L\* and anthocyanins content of raspberries.

## Fast determination of titanium dioxide content in juice powder based on Vis/NIR spectroscopy technique

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Titanium dioxide often is used as a colorant in most of food, the amount of titanium dioxide is limited according to the GB2760-2007 (National Institute of Standards) for it is bad to human health. Because of the shortage of methods for determining the content of titanium dioxide, some food processing enterprises abuse it in many foodstuffs illegally, and this non-destructive will be a food safety risk. In order to quickly and accurately detect the titanium dioxide, the sample spectra within visible (Vis) and near infrared (NIR) region was studied in this paper. The Kraft juice powder which contains titanium dioxide was obtained from the market. First, the content of titanium dioxide in the juice powder was got by spectrophotometry, and then different portions of titanium dioxide were adulterated into the juice powder. A total of 320 samples were prepared and the diffuse reflection spectra were collected. Different preprocessing methods were carried out on the spectra, such as standard normal variate (SNV), multivariate scatter correction (MSC) and smoothing of moving average, etc. After comparison, MSC was found to be the most appropriate spectral preprocessing methods. One mixed algorithm was presented to discriminate the content of the samples with principal component and artificial neural network (ANN). Processing the original spectral data using partial least squares (PLS), 7 best principal factors were selected based on the contribution ratio, the scores of these 7 principal factors would be taken as the input of three-layer back-propagation artificial neural network (BP-ANN). Trained the BP-ANN with samples in calibration collection and predicted the samples in prediction collection. The results using PLS ( $R^2=0.9008$ , RMSEP=0.05) were better than those obtained by PLS-ANN ( $R^2=0.863$ , RMSEP=0.04). The result not only proved the linear correlation characteristic of Vis/NIR spectra and the content of titanium dioxide but also indicated the content of titanium dioxide in the juice powder detected by non-destructive determination method was very feasible and laid a solid foundation for setting up the titanium dioxide content forecasting model of juice powder.

## Screening of *Aspergillus niger* strains for the biotransformation of the solid residues of manioc processing for obtain glucose syrup

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Brazil is the second biggest producer of *Manihot sculent* of the world, behind barely of the Nigeria. During the cassava processing a large amount of waste is generated, between them, the solid residue composed by manly starch, fiber and water, with 75%, 15% and 86%, respectively. This material represents a environmental problem and it cannot be used like animal feed broadly, due to antinutritional factors that it presents. The present work had as purpose to select a mutant strain of *Aspergillus niger* with a big capacity of hydrolyzing the residual starch of this waste. Seven strains were selected randomly (4D40, 9D40, 9D80, 11T25A5, 11T53A9, 11T53A14 and 11T53B12) and evaluated in the same conditions. The criteria for the strains selection were the enzymatic index and the pectinases and amylases expression by solid fermentation (SF). The first one consisted of measure the ratio between the diameter of the mycelium and the halo of the enzymes produced when the fungus was inoculated into solid cultures media with starch as sole carbon source. The enzymes activities were established following DNS protocol for the pectinases activities and commercial enzymatic protocol for the amyloglucosidases activities. The results for the enzymatic index and pectinases activities did not present statistically significative differences, being the 11T53A14 and 4D40 strains that were detached. However, the amiloglucosidases activities from the 11T53A14 strains was approximately 43% to more than others strains, being so selected for acting as agent of biotransformation of cassava residue. After the screening, an experimental design with 4 factors (ammonium sulphate and zinc sulphate concentration, humidity and headspace) was carried out for established the best condition for conduce the SF. This study showed 82% of conversion from starch to glucose when the fungus is inoculated into flask containing the residue with a minimum headspace, 45% of humidity, 0.91% of ammonium sulphate and 0.5 mg/kg zinc sulphate.

## **The instant controlled pressure drop (DIC) technology as a manufacturing process of high quality snacks and expanded granule powders of onion and super-fruits**

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Swell drying of various foodstuffs, that is, hot air drying of such products at low initial temperature between room temperature and 40 – 60°C followed by DIC steaming for 20 – 30 seconds, instantaneously dropping the pressure towards vacuum 5000 Pa and final drying and grinding, gives snacks (before grinding) and powder with quality attributes higher than normal dried or spray dried powders. The expansion rate is very high, as well as the porosity and the specific surface area. Total drying time is reduced by at least 50%. The process saves about 40% energy and can be easily adopted by primary processors in developing countries. The final snacks as well as the expanded granule powders have been sensory, functionally and structurally evaluated and found “perfect”. The product is completely decontaminated and its nutritional value is somewhat partially preserved or even improved.

## Combination use of gravity separator and optical sorter for decontamination deoxynivalenol of wheat

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Reducing effect of deoxynivalenol (DON) concentration with some grading machines was investigated by using Japanese spring wheat HARUYUTAKA or HARUYOKOI each of which were partially affected to the red mold germ. Thickness grading machine was able to decrease DON concentration from 3.6 ppm to 1.8 ppm for example. Because the thickness of the red mold affected grain is smaller than that of not-affected. But Japanese provisional standard value (1.1 ppm) of DON couldn't be satisfied only with this method. Bulk specific gravity varies in a position of the deck exit with a gravity separator. In the raw lot of wheat, as much as the damage of the red mold disease is severe, bulk specific gravity of grains becomes low. For this reason, gravity separator can get rid of the high DON concentration grain as a trash (low specific gravity). DON concentration was decreased from 2.9 ppm to 0.7 ppm with process yield rate of 92%. The near infrared wavelength rays (NIR) permeation rate of the grain affected in the red mold sickness is different from that of not affected. It was able to reject highly DON concentration grains effectively by optical sorter (Au2000) which uses the permeation light of near infrared rays. Au2000 can selectively reject the grain of high DON concentration. But it can't increase the value of bulk specific gravity as high as gravity separator with the same material. The purpose of the preparation is not only decrease of DON concentration but also Improvement in bulk specific gravity. After process of gravity separator, the NIR optical sorter can act efficiently with high process yield rate and high bulk specific gravity.

## Determination of protein content of *Auricularia auricula* using near infrared spectroscopy and least square-support vector machine

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Near infrared spectroscopy was investigated to determine the protein content of *Auricularia auricula*. The protein content is one of the most important quality parameters of *Auricularia auricula*. The traditional methods for the detection of protein were the Kjeldahl nitrogen determination method, ultrasonic extraction method and so on. These methods were time consuming, laborious, and not convenient for fast and non-destructive determination. Along with the rising attention caused by food safety and authenticity, a fast and accurate method was very necessary for the determination of protein. Recently, near infrared spectroscopy was widely applied for food quality determination with characteristics of high speed, accuracy, simplicity and low cost. Herein, near infrared spectroscopy was applied to determine the protein content of four varieties of commercially used *Auricularia auricula* from different geographical origins were collected including Qishan (Anhui, China), Heihe (Heilongjiang, China), Huangshan (Anhui, China) and Qingyuan (Zhejiang, China). Sixty samples for each origin and a total of 240 samples were prepared for further analysis. The samples were randomly separated into three data sets, the calibration set ( $30 \times 4 = 120$ ), validation set ( $15 \times 4 = 60$ ) and prediction set ( $15 \times 4 = 60$ ). The spectra were obtained by a spectrometer (Foss NIRSystems 5000, Silver Spring, MD) with the wavelength region 1100-2500 nm. Before the calibration, the performance of different pretreatments was compared. The determination coefficients ( $R^2$ ) and root mean square error (RMSE) were used as model evaluation indices. Partial least squares (PLS) analysis and least square-support vector machine (LS-SVM) were used as the calibration methods. Simultaneously, a variable selection method of successive projections algorithm (SPA) was used for the selection of effective wavelengths (EWs). In the development of LS-SVM model, three problems should be pre-settled. Firstly, the inputs of LS-SVM was determined by the latent variables from PLS model and EWs from SPA selection. Secondly, the kernel function was settled using radial basis function. Thirdly, the model parameters of  $\gamma$  and parameter  $\sigma^2$  were determined by a two-step grid search technique. Three models were developed including PLS, LV-LS-SVM and SPA-LS-SVM. The expected final results were  $R^2 > 0.9$ . The results indicated that near infrared spectroscopy might successfully be applied for the determination of protein content in *Auricularia auricula*.

## Fast measurement of soluble solids content in mango based on visible and infrared spectroscopy technique

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Mango is a kind of popular tropical fruit, and the soluble solids content is an important quality factor. In this study visible and short-wave near-infrared spectroscopy (VIS/SWNIR) technique was applied. For sake of investigating the feasibility of using VIS/SWNIR spectroscopy to measure the soluble solids content in mango, and validating the performance of selected sensitive bands, the calibration set was formed by 135 mango samples, while the remaining 45 mango samples formed the prediction set. The combination of partial least squares and backpropagation artificial neural networks (PLS-BP) was used to calculate the prediction model based on raw spectrum data. Based on PLS-BP, the determination coefficient for prediction ( $R_p$ ) was 0.757 and root mean square error for prediction (RMSEP) was 0.865. It is concluded that infrared spectroscopy technique can quantify the soluble solids content in mango, and the process is simple and easy to operate. Compared with the partial least squares (PLS) result, the performance of PLS-BP is better. According to the result of PLS - especially the result of regression coefficients and the loading weights, which present the contribution of each spectrum datum - the sensitive bands were obtained for validating the performance of selected sensitive bands. The mathematical analysis of support vector machine regression (SVR) was put forward to build the model and optimize the results. The  $R_p$  was higher than 0.6 and the RMSEP was closed to 0.9. The result shows that the VIS/SWNIR is an advanced way to get the information of soluble solids content of mango.



## New preservation procedure for liquid egg

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The food industry today uses pre-processed egg products as raw materials rather than shell eggs. These are released as liquid egg products or in dehydrated form as egg powder after breaking out the shell eggs and followed by the pasteurisation step. Pasteurisation of egg products means a heat treatment of several minutes at about 60°C. Two important issues shall be kept in mind: to destroy as much contaminating micro-organisms as possible and at the same time not to damage the valuable egg proteins. Experience shows that the number of micro-organisms in pasteurised liquid eggs is between 10<sup>2</sup>-10<sup>3</sup> cfu/ml and from time to time *Salmonella* bacterium can be found among the survivors. In the research we conducted microbiological examinations to develop an alternative pasteurisation method, which can be used in the manufacture of egg products. We studied the effect of 24-hour incubation at 55°C in the given cases. The samples were artificially infected with Enterobacteriaceae. The samples were raw liquid whole egg, liquid egg white and liquid egg yolk coming from an egg products manufacturing plant. In the detailed investigations on heat destruction we studied 3 bacteria species from the most frequently occurring contaminants in egg products. They were *Serratia marcescens*, a common contaminant, *E. coli*, which is significant from hygienic point of view and *Salmonella* bacteria, which are the most risky for egg products. Having determined the reduction in viable cell counts against time, the data obtained were in good agreement with literary ones, as the destruction of bacteria is faster in liquid egg white than in products containing egg yolk. In the case of all three Enterobacteria experience shows that during the incubation for 12 hours the initial cell count decreased by 4-5 log cycles. Our results showed that in 24 hours of incubation at 55°C we can obtain germ-free products with high probability. We compared the incubation treatment with the widely used pasteurisation procedure for these products. We found marked differences, i.e., while pasteurisation only slightly decreased cell counts, we measured 0 cfu/ml in the investigated egg products after 24 hours of incubation at 55°C.

## The effect of composition on the physical properties of compressed candy

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Compressed candies are popular confectionery products, with potential for the vast array of diverse products, and relatively simple manufacturing process. Most widely used process in compressed candy manufacturing is die compaction, during which forces involved in compression reduce amount of air in the powder bed. This induces decrease of porosity, increase in toughness as well as changes in other physical properties of compressed candies. Also, quality of the compressed candies is affected by the size distribution of the constituent particles, and their structure, as well as toughness is often related to the composition of powdered mixtures. All primary particle properties affect secondary properties such as porosity of powder, and subsequently the toughness of compressed powders. The main objective of this study was to define a role of candy porosity on the toughness. Also, prediction of the physical properties of obtained candies was attempted. Pore size and particle size distribution were analyzed, together with their influence on the porosity and toughness of the compressed candies. In this study, six different carbohydrate mixtures (glucose, sucrose, maltodextrine) were prepared. Prepared mixtures were compressed using an instrumented single punch press with flat faced punch. Mass of obtained compressed candies was measured on a digital balance. Thickness of the candies was also measured, using a mechanical caliper. Particle volume was determined by mercury intrusion porosimetry. Image analysis was performed on the Olympus DX microscope, connected to the personal computer equipped with the AnalySIS software. Software determined ratio between number of pixels and real diameter of particles. Mechanical force necessary to fracture compressed candies (fracture toughness) was determined using the texture analyzer TA-HDPlus. All 6 mixtures had similar particle size distribution, despite their different composition. Also, all tested mixtures had a peak in the size distribution corresponding to particle diameters of 10 – 15  $\mu\text{m}$  range. Decrease in particle size increased the fracture toughness of compressed powders. Area distribution of the particle sizes shows that the largest area is occupied by particles with diameter larger than 200  $\mu\text{m}$ . Data obtained for toughness is in direct correlation with porosity, and with increase in porosity, toughness of compressed candies decreased rapidly.

## Morphological characterization of powder milk and their relationship with rehydration properties

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Microstructure and morphology of powder milk has an important influence on rehydration or instant properties such as wettability, dispersability and solubility; due to water diffusion capability depends on surface area and particles porosity. These properties have been used in characterization and quality evaluation of these products in powder. Recent advances in microscopy, image processing and fractal analysis have been useful for quantitative evaluation of structural elements within food materials, parameters such as particle size, tortuosity, shape factor, compactness, Feret diameter, among others. The aim of this work was to study morphological characterization of five different powders milk and their relationship with rehydration properties; these samples are consumed in México. Light stereomicroscopy and electronic microscopy were used to obtain the images of powder milk agglomerates; image processing and fractal descriptors were performed to evaluate the morphological parameters of agglomerates. As a rehydration capability measure of powder milk their wettability, dispersability and solubility were evaluated by traditional methods used in powder materials. Image processing provided different morphological and microstructural parameters of powder milk. Major length, shape factor, compactness, fractal dimension of contour (FDc), fractal texture (FT) and entropy (En). Solubility (0.66 mL to 2.16 mL) and wettability (8.95 s to 8019 s) increased as the particle size (116.368 to 433.334  $\mu\text{m}$ ). Shape factor values (0.427 to 0.641) increased when compactness (24.392 to 42.336), FDc (1.1289 to 1.1410) and dispersability (97.577% to 99.540%) values decreased. Agglomerates size increased with the FDc, FT (2.59 to 2.67) and En (4.86 to 5.59) values, which according to literature could be associated with high tortuosity and major rugosity on the surface and boundary of powder milk agglomerates, and these were associated with better rehydration capability. These results provide an adequate tool for assessing the quality and morphological characterization of powder food, as well as the parameters obtained by image processing allowed the association of microstructure and morphology agglomerates of powder milk with rehydration capability.

## Studies of cryogenic freezing of multilayer confectionery products

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Importance of convenience foods is increasing and the quality of these products is one of the most important factors in the market. Nowadays, more and more frozen confectionery products appear on the frozen food market. Quality parameters of these products can be well retained using cryogenic freezing methods. Cryogenic freezing typically means freezing in liquid nitrogen. Using the very low temperature liquid for freezing, as the result of high temperature difference between the product and the liquid nitrogen, and the very high heat exchange, super fast temperature decrease occurs nearby the surface with over-freezing. So the correct estimation of the endpoint of this freezing process is one of the most important economical factors. The aim of our studies is to optimize the cryogenic freezing technique for multilayer confectionery products, namely layer cakes with coating. In this experiment, our objective was to optimize the freezing process and stop freezing when enough heat was removed from the product to reach the required core temperature without using more liquid nitrogen than necessary. During the experiment, after different freezing periods, equalization temperatures and times were determined, and the amount of liquid nitrogen, sufficient to reach the required temperature, was measured. Differential scanning calorimeter was used to determine the melting points of the water present in the sponge cake and the margarine cream, in order to determine the appropriate storage temperature. In addition, the bound water content of samples was determined based on the difference between enthalpy calculated by integration, and the moisture content of samples. Rheological properties of cakes after thawing were measured by SMS texture analyzer. Differences were found between freeze-thawed sponge cake samples and fresh ones. Texture profile analysis measurements revealed the differences between freeze-thawed sponge cakes and fresh-baked ones. The latter ones were springier, higher force was needed for their compression, and they had higher chewiness, too. These differences didn't deteriorate significantly the quality of the frozen product.

## **How to assure the safety and high quality of canned food products processed in water-cascade and water-spray retorts**

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Contemporary water and energy saving water-cascade and water-spray retorts may cause hazards for safety of canned products sterilized in such retorts, if retorts are improperly constructed, built, equipped and operated. The results of many investigations of thermal sterilization processes carried out by ourselves on water-cascade and water-spray retorts in commercial conditions showed that the main and hazardous disadvantage of performance of that types of retorts are, in many cases, a very large differences in heating rate of particular containers throughout the very some load into the retort. Manufacturers and operators of retorts usually are not conscious about that. This may lead to understerilization of part of load of processed products and to oversterilization the other part of the load during the very same sterilization process. The main reason for not uniform heating and cooling rate of every container throughout the retort is insufficient water flow in water circulation system of the retort. To assure the performance the safe and optimized thermal sterilization processes in the water-cascade and water-spray retorts that retorts shall be obligatory equipped with the water flow-meter. The common, international minimum technical standards for water-cascade and water-spray retorts should be agreed and established.

## Development and performance evaluation of a machine for removing essential oil from orange rind

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Peeling of orange before juice extraction is difficult and time consuming. Yet there are no commercially available mechanical peelers for the fast growing fruit juice processing industries in Nigeria. One feasible method of eliminating peeling during the processing is to get rid of the essential oil contained in the orange peels that will contaminate the juice if not removed. Therefore, orange essential oil removal machine was designed and fabricated. Its major component parts are the water tank, rasping cage, water pump and electric motor. Power transmission is achieved with belt-pulley arrangement and power rating of 3.4 kW. The performance evaluation of the machine was carried out. The aim was to investigate the effects of time of operation, size of orange and the throughput capacity on the performance of the machine. The results of the performance evaluation showed that time accounted for a greater portion of variability in efficiency than throughput capacity. A unit increase in time resulted in an increase of about 22% in extraction efficiency whereas a corresponding unit increase in throughput capacity only increased the efficiency by 3%. The machine showed higher throughput capacity of 60 kg/h with maximum extraction efficiency of 88.9% and favourable economic advantage over bigger ones being imported into the country. The machine was found to perform very well and posed no problem with its operation. The results obtained show that the machine could be very useful where considerable quantities of oranges have to be handled in limited time thereby preventing spoilage of harvested orange fruits since orange fruit deteriorate in quality soon after harvest.

## Studies on the system parameters of a locally developed extruder at different extrusion conditions

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Extrusion system variables (torque, specific mechanical energy, die pressure, and product temperature) are important parameters as well as indicators of extrusion processes. They are the controlled variables in an extruder. In this study, a single screw starch extruder developed locally was used to investigate the process for screw extrusion of the flour and starch of maize and cassava which are grown in Nigeria in large quantity. These were compared with wheat flour which is commonly used for the production of alimentary pastes. Response surface methodology, stepwise regression, correlation and analysis of variance were employed to a factorial experiment in completely randomized design to study the effect of extrusion variables: feed moisture (25, 30, 40%), extruder temperature (40, 70, 100°C) built up by varying the duration of sampling and screw speed (100, 150, 200 rpm) on system parameters including product temperature, mean residence time, torque, specific mechanical energy input (SME) and Extrusion pressure. A maximum temperature of 150°C per 30 minutes was attained through viscous dissipation and up to a moisture loss of 55% w.b. SME decreased with increasing moisture content and a lower product temperature. Also, screw speed has better effect on shear than residence time. The equations relating the various dependent and independent variables were established to predict the performance of the machine. Generally, the response surface study revealed the range of the extrusion variables for optimum performance. Coefficients of determination (0.61- 0.86) fits the extrusion data better than linear models.

## Biosensors and their applications in biology

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One of the factors for nanotechnology development in bioscience is nanoparticle production and application. The nanoparticle applications in sensors, specially, biosensors can open a new window for using them in different sciences such as medicine, pharmacology, agriculture, food and environmental science. Biosensors are devices combining three components including biological part, physicochemical detector, and transducer. They can be classified based on biological component into protein and non protein groups and based on transducing signal into electrochemical, optical, thermometric, piezoelectric and magnetic classes. The main requirements for designing a biosensor in terms of research and commercial applications are to identify a target molecule, to access a suitable biological recognition element, and the potential for disposable detection system. Key attributes of biosensors are their specificity and sensitivity. In near future, biosensors are used not only in laboratory but also in the real world and most of the biological fields will be under the governess of biosensors either in vivo and/or in vitro scientific activities. This review shows the importance of biosensors, by explaining of biosensor`s variety and application in biological science.



## Iran strategy for using nanotechnology in packaging industry

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Nanotechnology research has emerged as one of the most revolutionary scientific topics in decades. Nanotechnology focuses on the physical/biological structures smaller than 100 nm which result in unique properties because of their nanosize. Today, food packaging and monitoring are a major focus of food industry-related nanotech R&D. Packaging that incorporates nanomaterials can be “smart,” which means that it can respond to environmental conditions or repair itself or alert a consumer to contamination and/or the presence of pathogens. The objective of this paper is to bring this new wave of thinking to the attention of the food science and technology community and to show the strategy of Iran for using nanotechnology in packaging industry in purpose of decreasing agricultural losses. The ten-year planning period has been divided into three horizons of two year (short-term), five year (middle-term) and ten year (long-term). In light of growth pattern of nanotechnology, in each of these three horizons, there are actions that should be taken. In this plan, the quantitative goals in inputs and outputs’ section have been determined for the two year horizon. This period will be the period of making the preparations and providing the pre-requisites of future development, although it is expected it will have achievements for the country which in its own place will be treated.

## Physical properties of ultrasound treated whey protein suspensions with and without hydrocolloids addition

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Ultrasound is a method of transferring energy of sound and vibrations into liquid medium. The frequencies usually used in food processing are in a range from 20 kHz to 2 MHz. The aim of this research was to investigate the effect of ultrasound treatment on the physical properties of several model systems prepared by mixing adequate amount of whey protein isolates (9.5% w/w) with guar gum or methyl cellulose (0.5% w/w), as well as with sucrose (10% w/w) or milk powder (5% w/w). Ultrasound treatments were performed with 30 kHz frequency probe set for 5 and 10 minutes. Before and after treatments foaming, emulsifying and rheological properties as well as freezing and thawing temperatures were determined. The results obtained have shown that ultrasound treatment of WPI suspensions as well as suspensions with guar gum or MC addition had no positive effect on the foaming properties. In the contrary, addition of sucrose or milk powder in WPI suspensions significantly increased foam volume and improved foam stability. Ultrasound treatment induced a decrease of emulsion activity and emulsion stability indices of all investigated model systems. The results of rheological properties determination have shown that all investigated model systems exhibit dilatant non-Newtonian properties. Viscosity of suspensions depended on their chemical composition (hydrocolloids, sucrose, proteins) and duration of ultrasound treatment. The results have shown a significant increase of viscosity after 5 minutes of treatment, but after 10 minutes the lowering of viscosity has happened. Ultrasound treatments, both, after 5 and 10 minutes, caused the lowering of initial freezing as well as thawing temperatures of all samples. The degree of this decrease was proportional to the time of US duration and chemical composition of suspensions.

## A new, low-cost, on-line RGB colorimeter for wine industry based on optical fibers

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Color contributes to the organoleptic attributes of a wine and depends on some parameters (grape composition, winemaking techniques and storage) and this color changes continuously during winemaking and storage, with associated changes in sensory characteristics. There are some standard methods to determine the chromatic parameters in all wines types (CIE, OIV), that use transmittance and absorption measurements at several wavelengths in blue, green and red spectrum areas, obtaining three colorimetric values to situate each wine in one point of each specific color space. These methods have similar characteristics, including high cost, because they use very expensive spectrometers and special illuminants. In addition, final color read-out involves a complex procedure, avoiding on-line operation and limiting the use of these colorimeters in winemaking process. On-line and low-cost requirements force to explore new methods of color measurement, in order to include them in the control loop of winemaking processes. This paper presents a new design that uses RGB color space, a specific probe-type sensor and takes advantage of optical fiber as transmitter: high noise immunity, measurement to long distance and great reliability as much electrically as mechanically. Optical fibers avoid external interferences, disturbances and uncontrolled attenuation along the air light-path as it usually happens in standard colorimeters. A reflective surface is used in addition to bifurcated optical fibers. Thus, light from illuminant reaches the wine by optical fiber, is transmitted through the wine, reflected in the surface, and returns to fiber through the wine. With a good reflectance surface, total effect is equivalent to transmit the light along the double of distance between the end of fibers and reflective surface. A commercial-grade halogen lamp has been used as low-cost illuminant with a full-stabilized power supply that allows us a constant value of applied voltage and, consequently, a constant filament temperature, causing a constant emission spectrum. The observer, which receives the collected light, is a multiple photodiode-type with specific sensible areas for each color with a conditioning circuit to transform the colorimetric information to voltage signals becomes necessary. The designed equipment has been verified with red, rosé and white wines, and compared with commercial equipment based on spectrometry techniques. Finally, an excellent correlation between the results of both systems can be observed. Experimental results demonstrated that RGB colorimeter for wine can be used to obtain color differences between same type of wines: blue and green channels provide enough sensitivity to differentiate each rosé or white wine, and red channel can easily differentiate each individual red wine. As final conclusion, the use of RGB colorimeter with bifurcated optical fibers and reflective sensor can simplify measurement procedures, and is able to work on-line. Consequently, it introduces two types of economic benefits: a decreasing of equipment and procedures costs and, an improvement in final product (wine) because color can be controlled along winemaking process.

## Application of optical fibers to true on-line turbidimeter for wine and other food industries

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Turbidity is a parameter which quantifies the number of particles in suspension in a liquid and is of great interest in food industry. In the wine industry in particular, turbidity is a basic control parameter during wine-making and it is related to the fermentation kinetics and presents similar conduct to CO<sub>2</sub> release velocity, which indicates the fermentation activity in the unfermented grape juice because it is linked to the growth of the yeast number and the increased production of fermentation gasses. Turbidity is usually very low for a finished wine, in most cases below 1 NTU but, during the wine-making processes, the values that can be reached may reach 4000 NTUs, a very wide measuring range. Most nephelometric turbidimeters have some drawbacks: they cannot work in the large range requested, and need manual or automated sampling process. Thus, on-line operation is unreachable for that equipment. This paper presents a new type of nephelometric turbidimeter capable of really functioning on-line, avoiding any type of sampling of the liquid to be measured and, as a result, not requiring valves, pumps or any other type of electromechanical device, which results in it lasting longer and reducing maintenance. In addition, it takes advantage of the possibility of light conduction via optical fibres to avoid the electrical parts coming into contact with or close proximity to the liquid. This work discusses several possibilities for measuring turbidity that could be used, analyzing their advantages and disadvantages. Proposed solution uses direct light feedback and ratiometric measurement to guarantee monotonic quasi-linear static transfer function. The proposed system is a three-beam nephelometric turbidimeter working in IR spectrum area, similar to nephelometric turbidimeters, but the direct light feedback guarantees a constant excitation, regardless of liquid turbidity, ageing of the emission source, warming-up processes, general temperature disturbances, and disturbance caused by coloured liquids, above all when working with sensitive wavelengths. Extensive tests were carried out using turbidity standard solutions, founding an excellent ratio between the pattern value and the read-out from the system, with a maximum error below 1% over the whole measuring range. This system is also tested during wine fermentation process under laboratory conditions and in the wine industry. In all cases, we found excellent correlation between obtained results and reference results.

## High hydrostatic pressure enhancement of isoamyl acetate biosynthesis in ionic liquid-alcohol biphasic system

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Lipases are used in flavor biosynthesis of isoamyl acetate which has a banana flavor and can be considered “natural”. However, lipases are often unstable above 40°C. This study examines the application of high hydrostatic pressure (HHP) on the apparent kinetics of immobilized lipase (*Candida antarctica* lipase B) in a biphasic ionic liquid-alcohol system for the synthesis of isoamyl acetate from isoamyl alcohol and acetic acid. While most current applications of HHP are for inactivating deleterious enzymes, there is evidence that HHP can stabilize and increase lipase activity. Although enzymatic biosynthesis has traditionally been conducted in aqueous media, and more recently in organic solvents, ionic liquids have become an attractive alternative media because they have been shown to enhance stability, selectivity, enantioselectivity, product yield, and reaction rate. The benefits of both HHP and the use of ionic liquids have previously been documented separately, but this study is the first to explore their combined effects. Although the mechanism of HHP or ionic liquid enhancement of lipase remains to be fully elucidated, there is evidence that the combination of these enhancement techniques could be useful in improving or modifying activity and stability of lipase.

## Can the wine store container be part of the winemaking process?

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Nowadays, micro-oxygenation (MOX) is a very important technique since it is used in several periods of winemaking in order to improve its characteristics. The techniques of accelerated wine aging imply the use of small doses of oxygen and the addition of alternative oak products (AOP) to the wine. In this work the viability of proposed non-recyclable and auto micro-oxygenated containers has been studied as an alternative to the classical ageing tank technique (stain steel tank + AOP + MOX). This work presents the first results of the ageing of red wine in alternative systems, the ageing tank and auto micro-oxygenated container. A wine had been treated in stainless steel vessels with wood pieces (chips) and low micro-oxygenation levels and repeated simultaneously with the studied wine container with chips. All the trials have had the same wood surface per wine volume index and the same oxygen addition rate. Oak used had different toast levels: light, medium and high tested in quadruplicate way in each system (3x4x2=24 vessels). All AOP were supplied by the same manufacturer. The wines used were elaborated with the variety "Tinto del País" from Ribera del Duero Appellation of Origin, young wine elaborated in September 2007 aged in different aging systems along 4 months. All the samples analyzed presented similar characteristics in both ageing systems. So this new use for the storing containers might be considered as a way to improve wine quality using during the last part of the winemaking process being already stored. A specific design of these containers must be done.

## Recovery of aroma compounds from model solution using pervaporation membrane

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The pervaporational membrane separation is available to eliminate the organic compounds solved in water. The aroma compounds of foods can be damaged in big rate or lost during the process in connection with the applied pressure and temperature. The application of high temperature can be avoid during this process, so the separation of heat-sensitive and volatile compounds can be separated as well. During the process and concentration of foods a big part of volatile organic compounds are lost caused by evaporation. The concentration of fruit juices and drinks is carried out by evaporation widespread. The deposition, heat degradation, the evaporation loss of volatile compounds and the slagging to the kettle can cause problem during the concentration by evaporation. We have to take in account the remarkable loss of the aroma compounds near the vaporization of water. The evaporated aroma compounds are recovered in the industry by rectification carried out on high temperature and washing the gas. The high rate of the aroma compounds can be found in the steam come out the evaporation, and it can be recovered by vapour permeation (in case the vapour is lead directly to the membrane) or pervaporation in case condense is lead to the membrane surface. Earlier experiences show that a part of the aroma compounds get to permeate during multi level membrane concentration, so the recovery of these can be reasonable as well. During my experiments the separation of model solutions were studied. My primary goal was to determine the factors used to the characterisation of separation efficiency such as permeate flux, activation energy and separation factor. The studied compounds were the water, ethyl-acetate, and i-butanol. Mathematical modelling of the process was carried out by the experimental results. The results allow us to conjecture that both temperature and feed concentration increase had favourable effects on the separation efficiency. It can be said after the modelling that the velocity of the separation is determined mainly by the diffusivity of the different compounds in the membrane. I seek the opportunity how can this process be applied in the industry and become widespread by analyzing and utilizing the preferential properties of pervaporation.

## The original technology processing vegetative mass of buckwheat

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The use of physiologically active substances in the pharmaceutical, food and other areas of the national economy is limited today not only over lack of understanding of their biological activity and limited number of sources of raw materials, but also over the complexity of methods for isolation of the compounds in pure quality. Therefore, for Ukrainian people the necessary P-vitamin preparations are met largely through import of rutin, which is produced of *Sophora japonica* bud. The search of new efficient and economically profitable sources of flavonoids and drug development with P-vitamin activity is one of the major problems of the pharmaceutical industry. Results of the present research provide the biochemical composition of 4 species of buckwheat (*F. esculentum* Moench. In diploid and tetraploid forms, *F. tataricum* L. , *F. cymosum* Trev. Meissn., and *F. giganteum* Krotov.) showed that the content of rutin in leaves and inflorescence reached an average of 5% of the dry weight. These data have been serving as the basis of waste technology for processing vegetative mass of buckwheat for biological products with P-vitamin activity. The originality of the proposed technology of getting rutin consists in formulation specific additives (precipitating agents), procedure of extraction, separation of extract, crystallization of rutin, irrigation and drying. The technology delivers high product content of rutin (more than 85% of the content in raw materials) with high degree of purity (not less than 95%). The absence in technological process of organic solvents and expenditure of energy in processes of evaporation ensures the environmentally sound technology with low energy costs.



## Shelf-life investigation of whey protein concentrate-rice bran oil coated kiwifruit (*Actinidia deliciosa*)

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Edible coating can effectively provide protection for fresh fruits. In this paper we use an edible coating based on whey protein concentrate (WPC) and four different levels of rice bran oil (0, 0.2, 0.4 and 0.6 ml/100 ml) to maintain the quality of kiwifruit (*A. deliciosa*). Post harvest storage quality conditions tested included weight loss, color parameters ( $L^*$ ,  $a^*$ ,  $b^*$ ) texture changes, titratable acidity, soluble solid content, pH and sensory attributes coated groups and a control group in four subsequent weeks. Coating application reduced weight loss in coated kiwi fruits compared to uncoated (control) fruits. Results also showed no significant difference in soluble solids content and titratable acidity between control and coated apples after 4 weeks at 4°C in coated and uncoated kiwi fruits. Results show that kiwi fruits coated with whey protein concentrate-based coatings had higher  $L^*$ , and lower  $b^*$ ,  $a^*$ , and  $ab^*$  than uncoated kiwi fruits. The panelists differentiated samples coated with whey protein-rice bran oil coatings from uncoated kiwi fruits with higher scores. Differences due to rice bran oil contents in coated were significantly ( $P < 0.05$ ) different in taste and firmness attributes at the end of the storage time. Result indicated that WPC-rice bran oil-coated fruits were rated highest for taste, glossiness, color and overall acceptability and lowest for weight loss in this study.

## Shelf-life of whey protein concentrate-gellan coated apricots (*Prunus armeniaca* L.)

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Edible coating made from whey protein concentrate (WPC) and gellan gum (G) were investigated for their capacity to preserve the quality and prolong shelflife of fresh apricots. WPC (10 g) and gellan gum (0, 0.02, 0.4 and 0.6 g) coatings at different concentrations, plasticized with 4 g glycerol (Gly) were tested. Post harvest storage quality conditions tested included weight loss, color parameters ( $L^*$ ,  $a^*$ ,  $b^*$ ) and texture changes, titratable acidity and soluble solids content, pH, and sensory attributes. Coating application reduced weight loss in coated apricots compared to uncoated (control) fruits. Results also showed no significant difference in soluble solids content and titratable acidity between control and coated apricots after 4 weeks at 4°C. Results show that apricots coated with whey protein concentrate-based coatings had higher  $L^*$ -, and lower  $b^*$ -,  $a^*$ -, and  $ab^*$  than uncoated apricots. The panelists differentiated samples coated with whey protein-gellan coatings from uncoated apricots with higher scores. However, differences due to gellan contents in coated were not significantly ( $P > 0.05$ ) different at the end of the storage time. Result indicated that WPC-gellan-coated fruits were rated highest for taste, glossiness, colour and overall acceptability and lowest for weight loss in this study.

## Pulsed electric fields to control microbial growth in raw milk

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Pulsed electric field (PEF) treatment can be an alternative to traditional thermal pasteurisation since it combines gentle food preservation with short treatment times, continuous operation and easy implementation into existing product flow and the process is capable of destroying micro-organisms while maintaining fresh-like physical and chemical characteristics of food products. Pulsed electric field processing for non-thermal pasteurization applications consists of treatment with very short electric pulses (1 – 100  $\mu$ s) at an electric field intensity in the range of 20–50 kV/cm and an input of electrical energy of around 100 kJ per kg treated product at moderate temperatures to affect the integrity of microbial cell membranes by electroporation. Investigations, conducted at Berlin University of Technology, showed a microbial reduction of 4.5 log cycles in milk whereas the inactivation of bioactive components in milk by PEF revealed only a slight decrease of 5-10% in enzyme activity. A combination of thermal preservation assisted by PEF proved to be a possibility to reduce protein fouling and to improve the selective inactivation of thermophilic bacteria. Protein denaturation and aggregation was assessed using PAG-electrophoresis. The degree of  $\beta$ -lactoglobulin denaturation due to thermal and/ or PEF-effects was investigated using RP-HPLC and ELISA. Bioactivity of lactoperoxidase, alkaline phosphatase, lactoferrin, lysozyme and immunoglobulinG was under investigation to determine possible detrimental effects caused by PEF. As the PEF effect on enzymes and other milk proteins remained small its application could be used to reduce the microbial count in raw milk for production of raw-milk-type cheese varieties. A shelf life assessment of PEF treated milk was carried out by monitoring microbial growth, showing that the antimicrobial effect of an activated lactoperoxidase-system is retained after a PEF treatment and the synergetic effect of PEF inactivation and the antimicrobial activity of retained native milk constituents effectively prevent microbial growth. The results of the physico-chemical and microbial analysis of raw milk after PEF treatment will be presented. Different concepts for the implementation of the PEF technology as a first step of preserving raw milk quality at the farm but also as a later step within the production chain will be pointed out.

## Three-dimensional measuring technique of bubble size distributions in ice cream

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A novel technique to recognize bubbles in ice cream and analyze their size distribution was developed by using a cryogenic micro-slicer spectral imaging system (CMSIS). The CMSIS has functions to capture cross-sections exposed by multi-slicing of a frozen sample with the minimum thickness of 1  $\mu\text{m}$  and to determine the size and distribution of bubbles from 2-D quantitative information, such as the periphery and area of the bubbles. A sample was taken from soft ice cream on the market, and it was frozen in liquid nitrogen before slicing tests. Bubbles in the ice cream sample were identified as defocusing spots in 2-D images of CMSIS due to the difference in focal distance created by vacant spaces. From the ice cream sample, 50 cross-sectional images (slicing thickness: 2  $\mu\text{m}$ ) were taken from a 500×396×100  $\mu\text{m}$  portion. Equivalent diameters of the bubbles ranged from 3 to 56  $\mu\text{m}$  with an average of 8  $\mu\text{m}$ . A total of 283 bubbles were recognized by reconstructing the circles in the 2-D images into 3-D spheres; and the volume, length of major and minor axes, nucleus, and aspect ratio of each bubble were measured from the 3-D images. In this research a measuring method for the equivalent diameters of the spheres corresponding to the bubbles was established, and it turned out to be that the equivalent diameters of the spheres in the 3-D images were larger than those of circles in the 2-D image. The proposed technique can provide a novel tool to investigate the effect of freezing treatment on size, morphology and distribution of bubbles in ice creams.

## Infrared assisted microwave tempering of frozen foods

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Infrared heating is important in many common food processing operations such as baking, roasting, blanching, and surface pasteurization, due to its intense heating (high heat flux) capability. The main purpose of using infrared heating in the same cavity as in microwave heating is to assist microwave heating in terms of reaching a more homogeneous temperature distribution in the target food. The objectives of this study are to investigate the effect of infrared heating on microwave tempering and to model the temperature distribution inside the frozen potato puree during infrared assisted microwave tempering. A halogen lamp–microwave combination oven was used for infrared assisted microwave tempering of frozen potato puree. A commercial potato puree powder having a moisture content of 6% was used as the sample. The samples were shaped as a disc with 25 cm diameter and 2.5 cm height. Three different halogen lamp power levels (10%, 20%, and 30%) were used in combination with 30% microwave power level. Temperature was measured with fiber optic temperature probes at three different points (0.5 cm, 1.5 cm, and 2.5 cm far from the surface). The temperature distribution inside the frozen samples was modeled by using finite difference model. The dielectric properties and heat capacity of the frozen potato puree were also measured for modeling. Results indicated that infrared heating provided an additional flux and shortened tempering time significantly as compared to conventional tempering. An increase in halogen lamp power also decreased the tempering time. The predicted temperatures by the developed finite difference model showed good agreement with the experimental results.

## Temperature mapping of deep fried chicken strips using magnetic resonance imaging

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Deep frying is a simultaneous heat and mass transfer process. It is important to collect temperature data within food material to obtain heating profiles. Temperature data can be recorded only at limited number of points using thermocouples. Magnetic resonance imaging can be used to map the spatial distribution of temperature within food material. The main objective of this study was to analyze the heating patterns of battered chicken strips fried for different times. Frying was conducted at 180°C for two different times, 2 and 5 minutes. Three axial slice images were taken through the sample one minute after frying by using proton resonance frequency method. Presence of cracks with varying size and position was visualized through the sample in two dimensional temperature maps. All samples had nearly uniform temperature distribution after 13 minutes of holding time. Increasing frying time resulted in more heterogeneous temperature distribution and rapid rate of cooling during holding. Longer frying time also resulted in structural heterogeneity throughout the sample.

## Highbush blueberry (*Vaccinium Corymbosum* L, cv. C97-390) peroxidase: characterization and kinetics of thermal and high pressure inactivation

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Blueberries are one of the richest sources of antioxidant phytonutrients. Losses of anthocyanins and other polyphenols occur during postharvest handling and processing due to the activities of the oxidative enzymes polyphenol oxidase and peroxidase. The objective of this work was to study the thermal and high pressure inactivation kinetics of blueberry peroxidase (POD). The enzyme was partially purified and some biochemical characteristics were determined. Blueberry POD was found to be quite thermolabile. 95% inactivation of the enzyme was observed after 1 min thermal treatment of the enzyme in citrate-phosphate buffer (pH=3.6, the natural pH of blueberry puree) at 80°C. In the temperature range between 40 and 65°C, the inactivation kinetics of the enzyme was described by fractional conversion model with almost instant inactivation of the thermolabile fraction. However, the proportion of the thermoresistant fraction decreased with increasing temperature. In the temperature range between 40 and 50°C, the thermoresistant fraction was about 80% while that decreased to 56% in the temperature range between 50 and 65°C. At temperatures higher than 65°C, the thermal inactivation kinetics was best described by first order biphasic model with 65% labile and 35% stable fractions in the temperature range up to 75°C. The activation energies of inactivation of the labile and the stable fraction were estimated to be 307.2 and 481.6 kJ/mol, respectively. At 78 and 80°C, the proportion of the thermolabile fraction increased to 87 and 95%, respectively. The result suggests that blueberry POD consists of at least four isoenzymes with different thermal stability. The effect of high pressure treatment at 100, 400, and 690 MPa was also investigated in the temperature range between 30 and 90°C. At 100 and 690 MPa, increasing the temperature resulted in increased inactivation. For instance about 23% inactivation was observed after 10 min treatment at 690 MPa and 30°C while complete inactivation was observed after treatment of the same duration at 90°C. A clear antagonistic effect of pressure and temperature was observed at 400 MPa and temperature higher than 50°C. In the temperature range between 50 and 90°C, the inactivation at 400 MPa was much less than what was observed at atmospheric pressure and 100 and 690 MPa. Particularly noteworthy was the 40% increase in the activity of the enzyme after 10 min treatment at 70°C and 400 MPa.

## Comparison of two impact detecting devices to measure mechanical load on potatoes

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Mechanized production techniques cause numerous mechanical loads on perishable fruit and vegetables and, therefore, frequently mechanical damage and economical losses. Laboratory tests were conducted to measure and to compare two impact detecting devices, the artificial fruit PMS-60 measuring pressure and a data transmitting sensor for implantation into perishable fruit measuring acceleration. Both devices can be used to detect mechanical load in potato processing lines. A specific test device with two conveyor belts running in circuit at four velocities of 0.2, 0.4, 0.55 and 0.65 m/s and with several free fall steps was used for the experiments. The data transmitter was implanted in a real potato. This potato was run together with PMS-60 and other potatoes through the conveyor belt circuit. Results show significant differences between mechanical loads recorded with PMS-60 and the implanted sensor. Data transmitting sensor recorded higher average load values (51.2, 53.3, 54.9 and 54 N,s at belt velocities of 0.2, 0.4, 0.55 and 0.65 m/s respectively) than PMS-60 (41.8, 43., 43.3 and 42.4 N,s). The results will be discussed.



## Applicability of chemiluminescence spectroscopy on the quality change of brown rice

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When molecules which consist organic matter transform their shape in the course of chemical change, energy difference between two stages of chemical bonding sometimes cause light emission. This light emitting phenomenon is called as chemiluminescence. These phenomena has been utilized for the determination of oil/fat degradation, however their intensity are so low as only to be able to be observed as accumulated photon counts. A chemiluminescence spectrometer MS-8310, recently developed by Japan Applied Technology Inc., which employed very sophisticated optical system, enabled the observation as spectrum in a VIS/NIR region of 350-900 nm. We carried out the investigation on the relationship between the chemiluminescence spectra and brown rice quality, in particular on the origin of the chemiluminescence and on how it relates to brown rice quality. As results, we obtained 1) immature kernel's intensity was six times stronger than sound kernel's one, 2) the correlation coefficient at 632 nm with freshness of brown rice was  $r=-0.72$ . We will continue to investigate further in particular on the origin of the chemiluminescence spectra of both immature and sound brown rice.

## Estimation and on-line measurement of cow milk parameters to improve nutritional facts and quality of milk from farm side

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This paper presents a new concept in milk industry: the inclusion of farm into the production chain by means of a full control of main milk parameters such as total protein, fat content, SCC, and lactose content. Traditional process of cow milk in present food industry begins when the milk is taken from bulk tanks in farms and is transported to processing plants. Then, several steps take place including mechanical processing, addition and/or suppression of nutrients, thermal treatment, etc. in order to achieve specific final values of milk nutrition facts. But, these treatments cause two effects: first, a lost in initial quality of milk, and second, they reduce the perception of consumer about the cow milk as a natural product and introduce that consumer has doubts concerning the benefits of milk consumption on the human health. The final effect is a progressive reduction of milk consumption in developed countries that is partially compensated by an increase in consumption of milk products such as cheese, yogurt and others. Recent developments of on-line sensors for milk parameters and several new studies about the parameter evolution in function of cow age and days-in-milk (DIM) allows us to predict and –potentially– obtain desired values of some milk figures. This goal could be achieved by means of a segregation process during milking and would result in two or more types of milk in the farm. The farm could produce high quality custom milk, able to reduce most of above mentioned treatments, and to keep the natural concept in that product. But, that farm also produces other types of milk with lower quality, which will be processed in plant. In this paper, we present the use of a cow milk segregation processor that uses the information provided by both, on-line sensors and off-line sensors (observers) in order to achieve the desired values of milk quality figures. On-line sensors (fat content and SCC of raw milk) provide information during milking and off-line sensors (total protein content and lactose) provide information for each cow and for each day. The segregation system processor will decide the destination of milk. Several experimental results and discussion are included in this paper to demonstrate the feasibility of this proposal and the benefits for farms and milk industry. The experimental results are obtained from a real farm equipped with fat and SCC sensors in the parlor. The processor used additional lab analysis to complete the estimation of milk quality parameters.

## Detection of oxidation processes in bovine raw milk using fluorescence spectroscopy

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Milk has a high value for human nutrition, and belongs to the very perishable products like all foods of animal origin. Besides the spoilage through microorganisms, oxidation processes through light and oxygen influence play an important role. The fast detection of these quality deteriorations would be of advantage not only for consumers but also for producers and retailers. Fluorescence spectroscopy needs only a short time period for one measurement, is highly sensitive as well as selective and therefore best suitable for these challenges. Bovine raw milk was stored in polyethylene boxes for 10 days at 5 and 8°C in darkness to avoid light induced oxidation. Additionally, 20 ml raw milk was stored in dark, sealed compound foil bags with different amounts of fresh air for 16 days at 5°C. Fluorescence spectra have been measured using a fluorescence spectrometer (LS55, Perkin Elmer, Germany) in 'front-face' mode with an excitation wavelength of 390 nm in an emission range of 420 to 700 nm. When exposing raw milk with light at 390 nm, among other components mainly riboflavin (vitamin B2) fluorescence is excited, which emits with maximum intensity at around 525 nm. Riboflavin is known to be very unstable under light exposition. The milk samples were stored in the dark; therefore the vitamin B2 fluorescence emission intensity did not change significantly over time. However, oxidation products were excited, which were formed in raw milk during storage. Their maximal fluorescence intensity at around 455 nm increased markedly from the 7<sup>th</sup> day on at a storage temperature of 5°C. When increasing storage temperature to 8°C, the rise of the fluorescence peak started already at the 5<sup>th</sup> day. Under reduction of oxygen or air, respectively, formation of this fluorescence signal according to oxidation products was consequently minimised.

## Mastitis detection and prevention during milking process

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Mastitis is an important udder disease of dairy cows which leads to reduced milk quality and high economic losses. Increasing somatic cell count of milk is an indicator for udder infections and is used for monitoring milk quality commonly by Fossomatic method at the dairy processor. In recent years conventional milking systems are more and more replaced by automatic milking systems. That implies the requirement of fast and reliable methods for online measurement of relevant infections to ensure the demanded hygienic status and quality of the milk. Furthermore, fast and effective methods are needed for the disinfection of milking cluster to prevent passing on mastitis related pathogens from cow to cow. In the present study an early mastitis detection method using Coulter Counter was investigated. Measurements were performed on single foremilk quarter samples both from healthy cows and from cows with inflamed udder. Coulter Counter measurements based of IDF Standard 148 were compared with somatic cell count determined by the Fossomatic method. Furthermore, peracetic acid (PAA) was used for the disinfection of teat clusters between milkings in automatic systems to inactivate mastitis pathogens. Therefore, inactivation effects of peracetic acid were investigated exemplarily on *E. coli* after different treatment times and acid concentrations by conventional plate count methods and additionally with flow cytometric technique. When using the Fossomatic method only somatic cells were detected. In contrast all particles in milk are measured with Coulter Counter. Foremilk samples from infected cows showed an increase in cell counts at particle sizes between 7 and 20  $\mu\text{m}$ . The disinfection of teat clusters between milkings has to be a short-term process of less than one minute and no toxic residues are allowed to mix with the milk. PAA is a sanitizer with a high bactericidal, virucidal, fungicidal, and sporicidal effectiveness that inactivates bacteria within a short time. Moreover, no toxic residues occur because PAA decomposes to oxygen and acetic acid. In addition, PAA is effective at low concentrations and treatment times.

## Calibration models for online monitoring of syneresis in a cheese vat using broad-spectrum NIR reflectance over a range of milk fat level and gel firmness at cutting

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An on-line NIR sensor was used to monitor the course of syneresis during cheese-making with the purpose of developing a calibration model involving broad-spectrum NIR reflectance for predicting syneresis indices using PLS with cross-validation and jack-knifing methods. Curd moisture, yield of whey and fat and solids in whey were measured over a range of milk fat level and gel firmness at cutting. A factorial experimental design was undertaken with three milk fat levels and three gel firmness levels. Trials were carried out using recombined whole milk in an 11 L cheese vat. Models successfully predicted curd moisture and yield of whey ( $R_2 = 0.83$ ,  $N = 216$ ) and fat in whey ( $R_2 = 0.79$ ,  $N = 72$ ), using either of the above-mentioned techniques. This illustrates the potential of online NIR sensors for process control in cheese-making.

## Application of weibull model for describing osmotic dehydration of mamey strips

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It is necessary finding simplified methods to describing the changes in mass during osmotic dehydration of foods that compensate numerical effort of analytical methods. Weibull model is of a empirical nature and presents the main advantage of remaining very simple and being sufficiently robust to describe both monotonic downward and upward concave curves. Application of Weibull model was investigated for describing the changes in in moisture content and weight during osmotic dehydration of mamey strips using osmotic solutions at different concentrations (0.45, 0.50 and 0.55 g sucrose/g) and temperatures (45, 50 and 55°C). Mamey fruits (*Mammea americana*) were acquired from same crop grown in La Asuncion, Margarita Island, Venezuela. Mamey fruits were cut into strips with a length of  $30.2 \pm 0.3$  mm, width of  $20.3 \pm 0.2$  mm and thickness of  $6.1 \pm 0.4$  mm. Initial moisture content and weight of each strip were determined. Seven groups with 4 strips in each were introduced simultaneously into an osmotic solution of a given concentration and temperature. One group was removed at intervals of 20 min during first hour, of 30 min during second hour and of 60 min during 2 hour more. Moisture content and weight of each dehydrated strip were determined. Obtained data was fitted to Weibull model using non lineal regression. The high regression coefficients ( $R^2 > 0.97$ ) and low mean relative errors ( $< 3.5\%$ ) indicated the acceptability of Weibull model for predicting both moisture and weight loss. Values of scale parameter ( $\alpha$ ) of the Weibull model ranged from 30.98 to 76.23 min and from 67.43 to 140.00 min for changes in moisture content and weight, respectively. Values of shape parameter ( $\beta$ ) of the Weibull model ranged from 0.40 to 0.98 and from 0.55 to 0.93 for changes in moisture content and weight, respectively. Analysis of variance showed significant differences ( $p < 0.05$ ) in  $\alpha$  and  $\beta$  caused by concentration and temperature of the osmotic solution.

## An incremental adaptive procedure to modeling of viscoelastic contact problems in solid spherical fruits

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In biosystems engineering, majority of the spherical fruits and vegetables exhibit as viscoelastic solids. Contact pressure distribution throughout the contact interface has a critical role on the bruising of the contact systems in fruits. Generally, contact of deformable bodies is a nonlinear problem. Viscoelastic materials have a time-dependent response, since both viscous and elastic characteristics depend on time. Such types of materials have the capability of storing and dissipating energy. When at least one of the contacting bodies is made of a viscoelastic material, contact problems become more difficult, and a nonlinear time-dependent contact problem is obtained. The objective of this paper is to develop an incremental adaptive computational model capable of handling quasi-static viscoelastic frictionless contact problems in solid spherical fruits. Based on the principle of virtual work, a general but effective finite element technique associated with an incremental relaxation procedure is established for the analysis of viscoelastic contact problems with friction. A generalized Maxwell model is used to model the viscoelastic constitutive equations, in which the relaxation function is represented by the sum of a series of decaying exponential functions of time. The incremental augmented Lagrange programming method is adopted and improved to model the contact problem of viscoelastic bodies. By the incremental relaxation procedure developed, the stress of each element of the generalized Maxwell model at instant  $t^{(N+1)}$  includes two parts: 1] the part decaying from the stress at instant  $t^{(N)}$  during the time interval  $[t^{(N)}, t^{(N+1)}]$ , and 2] the incremental stress induced from the incremental strain applied at instant  $t^{(N)}$ . The total stress at instant  $t^{(N+1)}$  can thus be computed by the sum of the stress of the elements of the generalized Maxwell model and is only dependent on the previous stress level and the incremental strain applied at instant  $t^{(N)}$ . The influence of friction on the contact traction distributed on the contact surface at various time instants is presented. At this work, as an example, contact of apple fruits are investigated and validated by experiments.

## Mathematical modeling of the time-dependent poisson's ratio in linear viscoelastic solid fruits

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In biosystems engineering, majority of the fruits and vegetables exhibit as viscoelastic solids. The Poisson's ratio phenomenon is a critical aspect of fruit rheological properties. In general, Poisson's ratio in viscoelastic solids is a time dependent (in the time domain) or a complex frequency dependent quantity (in the frequency domain). As in the case of elastic solids, the Poisson's ratio in linear viscoelasticity is used in the calculation of stress and strain distributions when these are expressed in terms of a modulus and a Poisson's ratio. The three-dimensional stress fields such as those associated with stress concentration depend on Poisson's ratio. In particular, characterizing pressure and bruising in solid fruits strongly depend on it. In a viscoelastic material, a time-dependent Poisson's ratio will be associated with time-dependent stress and deformation, so stress concentration factors and interface stresses can depend on time and frequency. In viscoelastic solids, Poisson's ratio may be defined in several ways. As for experiment, one can determine Poisson's ratio directly from measured axial and transverse strains, or, in isotropic solids, derive it from time-dependent Young's and shear moduli. A general but effective technique is used to model time-dependent Poisson's ratio. We show that the viscoelastic Poisson's ratio has different time dependence depending on the test manner chosen. A generalized Maxwell model is used to model the viscoelastic constitutive rheological equations of solid fruits, in which the relaxation function is represented by the sum of a series of decaying exponential functions of time. Interrelations are developed between Poisson's ratios in relaxation. Correspondence principles are developed for relaxation type Poisson's ratio in the time domain, and complex Poisson's ratio in the frequency domain. The viscoelastic Poisson's ratio need not increase with time, and it need not be monotonic with time as is shown for selected material systems. In the present work, as an example, Poisson's ratio for apple fruit specimens are given which give rise to modeled time dependent Poisson's ratios.



## Mathematical model for microwave-assisted extraction used for the isolation of Platycodin from Platycodon radix

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In this paper, a method of microwave-assisted extraction (MAE) was for the first time used to extract total platycodins from *Platycodon radix*, which have been reported to have several medicinal properties and uses. The extracts were directly determined by colorimetric method without any further treatment. A mathematical model on yield of platycodin was set. Compared with supercritical fluid carbon dioxide extraction (SFE) and normal ultrasound -assisted extraction (UAE), MAE only need 22 min to give the highest yield of platycodin at 7.1%, while the other extraction methods need several hours and give lower yield. Several factors affecting the MAE extraction rate were also discussed, such as extraction time, firepower, ratio of solvent to material and concentration of ethanol. Optimal conditions of MAE can be concluded as follows: 21~22 min at 0.4 or 0.6 firepower, the ratio of solvent to material is between 33.6 and 35.9, by using pH 5.2~5.8, ethanol concentration of 50.3%~56.1% as the solvent.

## Mathematical modeling of vacuum drying of Kabkab date paste

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Date paste has a wide range of application than dates and can be used as an enriching ingredient in many food products. In the present work, a sample of date paste was dried in a laboratory scale vacuum oven. Drying characteristics of the date paste were investigated under various conditions of date paste thickness (1, 1.5, and 2 cm) and vacuum chamber plate temperature (60, 70 and 80°C) at 60 cm Hg absolute pressure. Different drying models were used to simulate the observed drying data. The Tow-Term and Approximation of diffusion models showed better fit to the experimental drying data as compared to other models. Effective moisture diffusivity computed on the basis of Fick's law varied between  $6.08544 \times 10^{-8}$  and  $4.86835 \times 10^{-7} \text{ m}^2 \text{ s}^{-1}$ . Effective diffusivity increased with the increasing of temperature and sample thickness. The temperature dependence of effective moisture diffusivity was expressed by an Arrhenius type equation.

## Non-destructive on-tree monitoring of *Prunus domestica*

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The demand of *Prunus domestica* fruits on the Northern European market stagnates due to their minor sensory quality and their restricted shelf-life. The plum quality with respect to the consumer's requirements was neglected in research projects so far. However, plums account for a health promoting diet, since they contain an interesting profile of phenolic compounds, vitamins and mineral salts. The monitoring of the fruit quality with respect to their sensory parameters and their nutritional compounds would be a valuable tool in the production and post-harvest processing. In the present study, fruit spectra in optical geometry for recording remission (Pigment Analyzer, C.P., Germany) and fluorescence (LF 401 Lambda, I.O.M., Germany) were measured non-destructively on different varieties of plums to detect differences in fruit compound contents. Additionally, mechanical fruit properties of the fruits were evaluated during ripening and postharvest processing using the non-invasive acoustic impulse-response technique and elasticity analysis. With the help of simultaneously accomplished chemical analyses (determination of soluble solids content, sugar to acid ratio, phenolic compounds) and sensory evaluation of the fruit material, chemometric models were built to characterise the fruit development pre- and postharvest aiming an approach to predict the optimum harvest date. The application of remission and fluorescence spectroscopy was aimed at a non-destructive, rapid and objective screening method to measure the changes in fruit pigments (anthocyanins, carotenoids, chlorophylls) on-tree and post-harvest. Furthermore, the potential of the optical methods was investigated to build up models for the prediction of the optimum harvest date regarding a consumer's adequate ratio of fruit sugar and acid content. With the help of the acoustic impulse response technique the stiffness of plum cultivars was measured and correlated with the elastic modulus and the sensory determination of the fruit shelf life.

## Application of different PLS methods for variable selection on Vis-NIR spectroscopy to determine pH and soluble solid content of syrup of plum

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Visible and near infrared (Vis-NIR) spectroscopy was investigated to determine the pH and soluble solids content (SSC) of syrup of plum. Five concentration levels (100%, 80%, 60%, 40% and 20%) of syrup of plum were studied. Different spectral pretreatment, including Savitzky-golay smooth with different span and degree values, standard normal variate (SNV) and multiplicative scattering correction (MSC), were combined and compared. Sgolay smooth with span of seven and degree of two combined with SNV shows the best result based on least square-support vector machine (LS-SVM) with full-spectra. However, with hundreds wavelengths of full-spectra as input variables, the training procedure is time-consuming and not convenient to fulfill the high speed features of spectroscopic techniques. Some wavelengths or wavelength bands in full spectral regions may contain useless or irrelevant information, which can worsen the predictive ability of the whole model. Effective wavelength bands were selected based on different partial least squares (PLS) methods, including interval PLS (iPLS), backward interval PLS (biPLS), synergy interval PLS (siPLS), and uninformaton variable elimination PLS (UVE-PLS), respectively, and used to establish calibration models using LS-SVM. Prediction results of these models were compared, and UVE-PLS shows its best performance on both pH and SSC prediction (with coefficient of determination,  $r^2 = 0.95$  and residual predictive deviation, RPD = 6.7 for pH and  $r^2 = 0.94$  and RPD = 6.3 for SSC) than other PLS method and also the PLS model with full-spectra. High RPD values of 6.7 and 6.3 show the ability of the models to predict pH and SSC are good. Meanwhile, 213 and 198 wavelength variables were selected by UVE-SPA compared with 1025 variables from full-spectra. The good performance showed a potential application using UVE-PLS to select effective wavelength band. UVE-PLS can both speed up the calculation and improve the predicted results. The results indicated that it was feasible to fast determine pH and SSC of syrup of plum using Vis-NIR spectroscopy.

## Decision support system for osmotic dehydration process of tomatoes

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The use of solutions containing sugar, salt and acids in pre-osmotic treatment of fruit and vegetables is an alternative to the conventional drying process. This treatment shows advantages such as energy saving, increase in the content of solids and improvements in color and flavor of the final product. In addition, the osmotic pre-treatment can be used with other processes has been effective in reducing structural collapse of delicate fruits, even when aggressive procedures such as freezing or heat treatment are applied, resulting in products with acceptable sensory characteristics. These arguments have led to a PhD degree which shows the result of the analysis of the effect of composition of osmotic solution in the loss of weight of tomatoes subjected to this type of drying, detained according to the methodology of response surface of the software Statistica 6.0 ®. The considerations for the subjective variables involved, as presented by the expert in the area of drying, reveal them as also able to the analysis interpretation according to the theory of fuzzy sets, which justifies this research, aiming to analyze the effect of the concentration of salt and citric acid in osmotic drying of tomatoes. The implementation of thermal processing in agricultural products after harvesting as a process to ensure their conservation is a topic of interest that requires important decisions. Results from the research that examines the composition of various factors in the process of osmotic drying of tomatoes, sets of experimental data were classified as fit to re-examination according to the theory of fuzzy. For this, first a set of linguistic rules between selected variables, which is conducted according to the specialist knowledge to then justify the other options of fuzzy toolbox of scientific computing environment MatLab, for analyzing the composition of same as the theory of fuzzy sets according to that given in the manual. The results had been obtained and in comparison to those ones from the analysis previously performed, showed agreement, which demonstrates the use of the theory of fuzzy sets as another decision supporting tool in processing of agricultural products.

## Simulation of malt roasting during microwave heating

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Using microwave for roasting malt in brewery industry is attributed to improve quality of final product and reduce heating time. Disadvantage of microwave roasting is heterogeneity in the distribution of heat inside malt bed. It is essential to control and optimize the conditions of microwave energy supplying in order to control roasting process of malts during microwave heating. In this study, microwave heating of malts in beaker by using COMSOL 3.3, three-dimensional commercial finite element software, has been simulated. Since the food surface losses its temperature to the surrounding by convection over the food surface is unavoidable and exerts a great influence on the temperature profile. Therefore, convection heat transfer term has to be included in the boundary condition. The simulation results showed that absorbed microwave energy concentrated near the center of malt bed. The model was experimentally validated by using pilot scale microwave oven, operated at 2450 MHz. Temperature profiles from experimentally measured were compared with the numerical predictions. The temperature predictions and the experimental measurements were close to each other.

## Chemical analysis of soybean methyl ester as biodiesel

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In order to study the probability of using fuel based on vegetable oils, soybean was selected. Oil seed was extracted in a compound of mechanical and chemical method. The amount of extracted oil showed that it was concluded 20% by weight. The best results in oil extraction process were gain in 80-90°C and 270 rpm. Soybean methyl ester (SME) as biodiesel was made by transesterification of raw soybean with pure methyl alcohol. Sodium metoxide was selected as catalyst at 70-80°C. All the oil seed extraction and SME preparation were done at laboratory complex of Tehran Azad University, Science and Research Campus. Gas chromatography and mass spectrometry showed that 96.4% of oil was converted during the reaction. Also analysis indicated that octadecadienoic acid methyl ester (C<sub>18</sub>H<sub>34</sub>O<sub>2</sub>) and hexadecanoic acid methyl ester (C<sub>16</sub>H<sub>32</sub>O) were the main compound in SME. The amounts of them were 49.17% and 29.72%, respectively.

## Comparison of physical and chemical properties of Soybean methyl ester as biodiesel and diesel fuel

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In order to study of physical and chemical properties of biodiesel in comparison with diesel fuel, different blends of soybean methyl ester (SME) were tested. It made by transesterification of soybean oil with methyl alcohol in presence of KOH at 75°C. Tested fuels were conventional diesel fuel as control and blends with 25, 50, 75 and 100% SME in volume basis which named by B00, B25, B50, B75 and B100 respectively. Fuel tests indicated that cetane number, viscosity, flash point and specific gravity of B100 were 60.8%, 31.5%, 56.8% and 4% more than B00. Also heating value, sulfur content, ash and pour point of B100 were 11.6%, 0.1, 100% and 9°C less than B00 respectively. Results indicated that properties of B25 were very similar to B00. They showed that heating value, viscosity and specific weight of B25 were 1%, 3.66% and 0.7% less than B00 and its acid number was 1.3 time of B00.



## Structural and rheological properties of Barijeh (*Ferula galbaniflua*) gum

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*Ferula galbaniflua* (Barijeh) is one of the natural plants of Iran that its exudates, Barijeh gum, can be used in food industry. For this purpose, Barijeh gum was extracted from crude exudates by alcoholic extraction with 90% ethanol. The yield of Extraction was 5% and there were 4.3% protein impurities. The molecular weight of the Barijeh gum, as determined by gel permeation chromatography, was approximately  $1.364 \times 10^5$  Dalton. Barijeh gum had smaller molecular weight and lower intrinsic viscosity than Arabic gum. HPLC analysis of hydrolyzed polysaccharide showed that gum composed of galactose (65.2%), arabinose (10.4%), and uronic acid (24.3%). The intrinsic viscosity was determined by extrapolating Huggins' and Kraemer's equations to zero concentration. The obtained intrinsic viscosity was 0.213 dl/g. The viscosity of the Barijeh gum solution was very close to that of arabic gum. Newtonian plateau was seen in low shear rates while a weak shear thinning behavior was observed in higher shear rates and Barijeh gum solutions showed Newtonian behavior. The frequency sweep test showed that in 3% gum solutions the loss modulus ( $G''$ ) was greater than the storage modulus ( $G'$ ) at low frequencies and then it became lower than  $G'$  with increasing of frequency. However, critical point was located at very high frequencies.

## Decision making about banana storage conditions based on the effect of temperature on quality

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In order to offer consumers the best quality, retail companies selling bananas have to make decisions about storage conditions according to commercial requirements and sale expectations. The effect that retail temperatures have on the quality of Cavendish bananas was studied. Four scenarios were considered: three at constant temperatures (10, 13 and 22°C) and one, which represents the usual commercial conditions [from central market distribution (1 day at 10°C) to the supermarket shelf (7 days at 22°C)]. In all cases, the variations in colour, peel spotting, cutting force, weight loss (WL) and consumer acceptance were evaluated before storage as well as at 1, 2, 4, 6 and 8 days. The results obtained on the last day for 10°C, 13°C and 22°C were respectively:  $a^*$ (5.63; 7.5; 12.13),  $b^*$ (34.77; 32.47; 25.76),  $L^*$ (57.94; 57.42; 45.83), Spotting score (2, 3, 4), cutting force (0.59; 0.4; 0.26 N) and WL (2.6; 5.95; 8.58%). Constant temperatures of 10°C slow down the evolution of the physicochemical parameters studied. This storage temperature enables the quality of the banana to be extended over its commercial life time. As regards consumer acceptance, storage at a constant temperature of 13°C (typical for tropical fruit) shows good performance at short storage times not exceeding four days. Storage at a constant temperature of 22°C brings about the fastest evolution of all the parameters studied. In these conditions the consumer rated it very highly, as long as a storage time of two days is not exceeded. The fourth scenario (usual commercial conditions), produces intermediate behaviour between 13°C and 22°C in all the parameters studied with a maximum acceptance by the consumer when eating at a storage time that does not exceed 4thdays. It has been shown that all the studied physicochemical parameters are within consumer acceptability limits if the product is stored at a suitable combination of time and temperature. Therefore, it is not possible to say that one temperature is more appropriate than another, since its suitability is conditioned to the policy of the company. The results highlight the fact that decision making about storage conditions depends on factors such as the availability of space, special offers from suppliers and sales expectations.

## Study of volatile compounds in cagaita

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Brazil has an extensive diversity of fruit exotic in flavor, characterizing a great economic potential in aroma research, among other physical, chemical and nutritional parameters. Cagaita (*Eugenia dysenterica* DC) (Myrtaceae) native to Cerrado is one of such fruits and is used by the local population for food and medicinal use. The methods used for the extraction of volatile substances are time-consuming and require large amounts of sample. Solid-phase micro extraction (SPME) is a fast, inexpensive and easy to use technique that allows the extraction of these substances to be analyzed by gas chromatography coupled to mass spectrophotometry (CG/EM), and a substitute of traditional extraction methods, avoiding the formation of artifacts without the need of solvents, thus minimizing artifact formation. This work aimed to identify the volatile substances present in the cagaita pulp by SPME/CG/EM. The fruit was peeled and the pulp processed in a blender. Extraction by MEFS with headspace was carried out with polydimethylsiloxane/divinylbenzene (PDMS/DVB) microfiber. The volatile substances extracted were desorbed during 3 minutes in Agilent 6890N chromatograph at 250°C and operated in the mode without flow division (splitless). The separation of the substances was carried out in capillary column HP5 (5% phenyl-95% methylsilicone) of 30 m X 0.32 mm X 0.25 µm, using hydrogen as carrier gas (1.5 mL/min) and temperatures at 40°C (3 min), 40 at 240°C (3°C/min). For quantification, the % area values of a flame ionization detector were used, operated at 280°C. Five repetitions were performed per sample. A mass spectrophotometry was carried out in Agilent 5973N equipment, operating in the electronic ionization mode (70 eV), under the same separation conditions described above, with helium (1.0 mL/min) as carrier gas. The substances were identified by comparing the mass spectra obtained with those from the Wiley 6<sup>th</sup> library and by the retention indices calculated based on literature data. Of a total of 56 volatile substances, 19 could not be identified. Ethyl hexanoate was the most abundant in the cagaita pulp, followed by the ethyl butanoate, which also confers the fruity aroma of fruit juices and pulp. The results obtained revealed that a greater concentration of esters, mainly ethyl hexanoate and butanoate, are responsible for the fruity aroma.

## Migration from cap-coating material into liquid food via package headspace

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In some parts of food packages where there is no direct contact of food product surface with the packaging material (i.e. package headspace), indirect migration could be occurred. Some types of migration phenomenon was investigated by many researchers well but there is a few reports on indirect migration in literature study. In this mode of transfer, at first the migrant can transfer into the package free space and then will migrate into the food product. In this research migration of di-2-ethylhexyl phthalate (DEHP), which was detected as a main plasticizer of plastisol via headspace into two food simulants (acetic acid 3% w/v and sunflower oil) at 25°C in a sealed simulated system was studied. The amount of migrated DEHP during the exposure time (90 days) at different time intervals in food simulants were determined by using gas chromatography coupled with mass spectroscopy. The experimental data were compared with a developed mathematical model and in the case of sunflower oil as food simulant a good agreement was observed. The amount of indirect (vapor phase) migration of DEHP in acetic acid was much lower than direct migration but in the case of sunflower oil the vapor phase migration was considerable and the observed difference with direct method was not significant ( $P > 0.05$ ). The results showed that in both types of migration, the concentration of DEHP in acetic acid after equilibration was below the SML of DEHP (lower than 3 ppm).

## Deformation and impregnation properties of whole Red and Golden Delicious apples

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Vacuum impregnation (VI) is a valuable process of fruits and vegetables for developing new products or modeling and optimization of dehydration-impregnation processes. The effectiveness of VI depends on the porosity and mechanical characteristics of the food tissue. The objective of this study was to determine the deformation and impregnation properties of whole Golden and Red Delicious apple. VI treatments started by introducing sodium chloride isotonic solution (IS) and whole apples (golden or red) into a dissicator and a vacuum being pulled to a specific value ( $p_v = 15 - 50$  mm Hg) for a period of time ( $t_v = 2-60$  min), and then exposing the system to the atmospheric pressure for a time  $t_r$  (0.5-12 h). The  $t_v$ ,  $t_r$ ,  $p_v$  levels were determined by a 5-level, 3-factor central composite design. For golden or red apple, each experimental condition was simultaneously replicated twice, in order to have an apple sample to determine its volume and weight at the end of the vacuum and atmospheric pressure steps. Apparent density of the apple ( $\rho_a$ ), real density of the apple pulp ( $\rho_r$ ), real porosity ( $\varepsilon_r$ ), volume fraction of the apple occupied by the IS ( $X$ ,  $\text{cm}^3 \text{ IS}/\text{cm}^3 \text{ apple}$ ), effective porosity ( $\varepsilon_e$ ), the relative volume deformation of the apple at the end of the vacuum pressure ( $\gamma_1$ ) and atmospheric pressure ( $\gamma$ ) stages were determined. Predicted  $X$  values for golden and red Delicious apples were up to 0.25 and 0.30  $\text{cm}^3 \text{ IS}/\text{cm}^3 \text{ apple}$ , respectively, at the highest values of  $p_v$  and  $t_v$  and 6 hours of relaxation. The highest deformation was observed in red apple ( $\gamma_1 = 3.4\%$ ,  $\gamma = 11.6\%$ ) in comparison to golden apple ( $\gamma_1 = 0.7\%$ ,  $\gamma = 9.5\%$ ). In the studied experimental domain, it was found that  $\varepsilon_r > \varepsilon_e$  for both red ( $\varepsilon_r = 0.476 \pm 0.016$ ) and golden ( $\varepsilon_r = 0.491 \pm 0.044$ ) Delicious apples. Considering the achieved  $X$  values, whole red Delicious apple seems to be more appropriate to VI treatments, in spite of being more sensitive to deformation phenomena.

## The change of phenolic substance distribution of rowanberry fruit during ripening

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Rowanberry (*Sorbus aucuparia*) belonging to Rosaceae family is a wild fruit. Harvesting is done before the complete ripening as ripening of fruits takes long time. During harvesting, fruits have a sour taste of an inconsumable level and it gets a consumable taste at the ripening periods that occurs after harvesting. In this study, change of content of fruit has been studied at the period between harvesting and consumption. Amount of phenolic substance in unripened rowanberry was determined as 134.17 mg/100 g. Total amount of phenolic substance increased to 225.72 mg/100 g by fourteenth day of ripening. After fourteenth day, amount of phenolic substance decreased to 90.90 mg/100 g by twenty day of ripening. Neochlorogenic, chlorogenic acid and rutin were determined as phenolic compounds in rowanberry. At the beginning of ripening, neochlorogenic acid, chlorogenic acid level were found as 50.96 mg/kg and 6.73 mg/kg respectively. The amount of these compounds showed an increase until 14<sup>th</sup> day of ripening (275.69 mg/kg and 36.11 mg/kg, respectively) and afterwards, till 20<sup>th</sup> day of ripening it decreases down to 100.66 mg/kg and 9.84 mg/kg level, respectively. For rutin, although it can be said that there's a similar change, the increase in level stopped at 8<sup>th</sup> day; then the amount decreased day by day. The amounts of beginning, 8<sup>th</sup> day and 20<sup>th</sup> day are 30.01 mg/kg, 48.89 mg/kg and 11.33 mg/kg respectively.

## Regulation and metabolic analysis for the fermentation of succinic acid from crop straw hydrolyte

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As a member of the C4-dicarboxylic acid family, succinic acid can be utilized not only as an end product, but also as a precursor for a variety of fine chemicals. Comparison with the bioalcohol production, the succinic acid fermentation has prominent advantage, considering its substrate conversion yield over 100% theoretically and its character of fixing CO<sub>2</sub>. This fermentation technique would set up a green platform by converting those crop straw to succinic acid. In this paper, a succinic acid producing strain was isolated. API biochemical reactions and 16S rRNA sequence analysis were carried out for identification, and then the strain's metabolic pathway and its relevant enzymes were considered for metabolic flux analysis. The X-ray of synchronous radiation and site-directed mutagenesis were imported for decreasing those byproducts, and the metabolic techniques were also modulated. Identification showed that the succinic-acid-producing strain S.JST belonged to the *Actinobacillus succinogenes* species. Metabolic pathway analysis indicated that this strain utilizes glucose and xylose simultaneously, which is advantageous, considering the fact that most crop straw hydrolyte included glucose and xylose. Metabolic flux analysis showed that acetic acid and alcohol competed with the flux of succinic acid, and the analysis of [H] reducing power balance investigated that the [H] electronic donor produced in the cell was not enough for the metabolism of succinic acid. X-ray mutagenesis showed that the flux of byproduct acetic acid was decreased from 1.233 mmol/(g DW h) to 0.666 mmol/(g DW h) and that two mutated sites were found in *pta* (gene of phosphotransacetylase) from mutant strain M.JSTP, but less succinic acid was produced due to the lack in the supply of [H] reducing power. The site-directed mutagenesis showed that the flux of byproduct alcohol was successfully decreased from 1.303 mmol/(g DW h) to 0.029 mmol/(g DW h). Then, surrounding the flux ratio of HMP to EMP, the metabolic techniques were modulated with citrate to improve the balance of [H] reducing power; the succinic acid flux of the mutant M.JSTA was increased to 3.163 mmol/(g DW h) from 2.480 mmol/(g DW h) compared with the parent strain S.JST. The mutant strain obtained in this paper warrants further study.

## Controlling textural, microbiological and biochemical attributes of fruits and vegetables during prolonged storage prior to processing

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Fruit and vegetable crops are naturally seasonal, though readily available commercially through extended transport and storage. There are opportunities to process fruits and vegetables as ingredients to develop naturally structured products with improved stability for transport and storage and to valorise nutrient-rich co-products, such as broccoli stems, currently lost as waste materials. However, it is important to ensure the acceptability and safety of nutrient-rich foods obtained. Texture is important for food acceptability and the resident microbial flora may influence food safety. The plant cell wall is important in the control of texture and as a source of dietary fibre. The effects of storage and associated food processing on the texture and structural characteristics of carrot and broccoli tissues have been measured in association with monitoring the tissue-associated microbial flora. Texture measurement, as penetration force, has been related to cell wall structural features using detailed physical techniques, such as FTIR spectroscopy, and biochemical analysis. Experiments on the storage of carrot have shown that tissue-specific changes in the microflora can arise, with enhanced proliferation associated with phloem parenchyma, but with no apparent change in texture during prolonged storage. However, changes in cell wall biochemistry, notably an increase in cell wall bound phenolics and a decrease in pectic polysaccharide components were detected. Similarly, storage of broccoli over a 3 week period showed little change in texture, but distinct differences were found between component tissues. The microflora on broccoli was shown to proliferate in floret tissues, from  $\sim 10^4$  –  $10^6$  cfu/g, during storage and also through colonisation of cut stem surfaces produced during harvesting. The results illustrate the potential and limitations of using fruit and vegetable crops and associated co-products to produce microbiologically safe and texturally acceptable products.



## Drying characteristics of scallop

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Scallop is important market seafood in the eastern region of Hokkaido, Japan. Dehydrated adductor muscle of scallop is manufactured to improve preservation, convenience, and to increase commercial value and consumption, and for the effective use of resources, and so on. In this study, the drying characteristics (changes of moisture content, drying surface area, size, volume, and color of the sample during drying) for scallop were measured at selected operating conditions (temperature, relative humidity, and absolute pressure). The scallop was dried by the two kinds of drying methods, i.e., hot air drying method and continuous vacuum drying method. The drying rates of the sample were obtained by numerical differentiation of measured moisture content values, and increased with increasing temperature. From the figure of the drying characteristics curves for the sample (the relationship between drying rate and moisture content), it was estimated that the hot air drying process of the sample was in the falling rate period. The continuous vacuum drying process was composed of the two periods, i.e., the constant rate period and the falling rate period. To estimate the appropriate drying model, the measured values of moisture content change for each measurement condition of the sample were fitted to several kinds of mathematical models. The effect of temperature on the drying rate constant was examined. The drying rate constant increased as temperature increased and was related to temperature by an Arrhenius-type equation. Changes of volume and drying surface area of the sample during drying were determined by measuring density and sample size. Based on these results, the relationship of the shrinkage of the samples to operation time of drying was examined, and an empirical equation relating the moisture content of the sample during drying and temperature to specific volume was derived. In addition, the drying surface area of the sample was expressed as a function of moisture content.

## Production of cellulases by filamentous fungi and characterization of the crude enzyme

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Lignocellulose is the most abundant renewable natural resource and substrate available for conversion to fuels. It is an inexpensive raw material too. Furthermore, enormous amounts of cellulose are available as agricultural waste, wood chips and municipal and industrial wastes which today contribute to our pollution problems. The cellulose-to-ethanol route involves little or no contribution to the greenhouse effect and has a clearly positive net energy balance. Besides, it is an excellent transportation fuel, in some respects superior to gasoline. A great deal of effort has gone into the development of methods for conversion of cellulose to sugars. In order to make the enzyme hydrolysis route for conversion of biomass to ethanol economically feasible, it has been postulated that an improvement of 5-10 times in current enzyme performance would be required. As a result of such considerations, microorganisms that produce cellulase efficiently have gained prominence in recent years. In this work, two *Aspergillus* and one *Trichoderma* strains were tested for cellulases production by semi-solid fermentation in aerated columns. The process of enzyme production has involved the use of experimental design. A set of six variables, namely: aeration, moisture, temperature and concentrations of nitrogen, cellobiose and inoculum, was studied, according to Plackett-Burman planning. The obtained enzymatic extracts were characterized in terms of protein and activity of the following enzymes: carboxymethylcellulase, Fpase, beta-glucosidase, xylanase and polygalacturonase. The results demonstrated an increment in the enzymatic activity of cellulases when compared to those obtained in Erlenmeyer and even in aerated column, on standard condition. A first test related to cellulases concentration process was carried out in liophylization equipment and the enzyme was 8 times concentrated, without significant loss of the enzymatic activities. Future studies will be carried out to select the best cellulolytic filamentous fungus aiming to apply the enzyme in lignocellulose ethanol production. Financial support: Embrapa-Macro Programa 1-Florestas Energéticas

## Screening of lipolytic filamentous fungi and study of lipase production using three different reactors

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Lipase consists of a class of enzyme that has a great importance as biocatalysts to be applied in food, waste water treatment, cosmetics, oleochemical, pharmaceuticals, detergents and in the fuel sector. The aim of this work was to select the best strains of filamentous fungi able to produce lipase. Twenty-nine filamentous fungi strains isolated from lipid sources and different environments were selected for lipase production. This production was evaluated in three steps: 1) measurement of the growth and hydrolysis diameters of the colonies cultivated on olive oil agar medium, containing Rhodamine dye after 96 hours for enzymatic index (EI) determination and lipase production by solid-state fermentation (SSF) in tubes containing seven grams of medium for 48 hours using the fungi strains; 2) a kinetic profile of the three best lipase producers selected in the step 1, were carried out for 96 h, in 500 ml Erlenmeyers flasks containing 40 g of the sterilized medium; 3) the best strain was selected and used for lipase production in trays and aerated columns. The test of lipase production was carried out using sterilized medium (100 g of wheat bran was moistened with 60 ml of 0.91% w/v of ammonium sulphate pH 7.0 and 2% w/w of olive oil) and the enzyme was extracted sodium phosphate buffer pH 7.0. Lipase activity was determined by the titulometric method using pH 4.0 and pH 7.0 buffers. The EI and the lipase activity obtained in tubes varied from 1.00 to 1.68 and from 0.00 to 85.18 U/g of dry substrate (gds), respectively. It was observed that there was no relation between IE and the enzyme activity. The best enzyme producers were the fungi isolated from butter B maintained inside the building ( $85.18 \pm 13.09$  U/gds), margarine 2 ( $80.76 \pm 14.93$  U/gds) and mayonnaise 3 ( $77.00 \pm 10.55$  U/gds) incubated at 30°C. After the tests in Erlenmeyers flasks the butter B isolated fungus showed to be the best strain. The lipase activity results demonstrated that the columns were the best strategy among the tested: 186.0 U/gds against 26.1 U/gds in trays, after 48 h of fermentation. Financial support: FAPERJ, CNPq and Embrapa

## Sensory study of astringency threshold in persimmon after tannin removing treatment

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The interest in the crop of persimmon is justified by an extraordinarily adapting to the soil and climate in some regions of Brazil and the characteristics of the fruit, ensuring its successful market acceptance. Since it is most consumed in natura, the fruits of some cultivars require an artificial removal of the astringency, due the high levels of tannin, prior to consumption. The removal of astringency is being done by exposing the fruit to anaerobic conditions or to products of anaerobic respiration. Several studies have been proposed to optimize the parameters of the astringency removing treatments or to establish a relationship between the astringency level and changes in the cell wall structure. However, none of them have used the sensory techniques to correlate the perceived astringency with tannin levels. Therefore, this study aimed to determine the astringency threshold in persimmon submitted to different times of ethanol vapor exposure. Persimmon fruits were exposed from 1 to 7 days to ethanol vapor in two positions inside the container: upper and lower. Using a refractometer and fruit pressure tester, the firmness, solids soluble and also acidity of the pulp were observed. The astringency threshold of persimmon was evaluated by 24 panelists through the limit test. The seven samples were presented to panelists in a monadic sequential order of descending time exposure. It was requested that each judge indicated the detection (or no detection) of astringency, using the software FIZZ for data collection. The average astringency threshold in persimmon fruits was 0.9725 mg/100g for the lower position in the container, and 0.8161 mg/100g for the higher position. Applying the linear regression on the reduced tannins concentration versus the exposure time of the fruits in both lower ( $R^2 = 0.805$ ) and higher ( $R^2 = 0.935$ ) position, a time of 3.3 days and 2.8 days was estimated to reach the above threshold concentration, respectively. With 3 days of exposure, the firmness of the pulp was reduced from 4.87 to 3.02 kgf (38%) for the lower and from 5.37 to 2.62 kgf (51%) for the higher position. The results of this study indicated that the astringency resulting from levels above 0.81 mg tannins/100 g of persimmon is able to be perceived by consumers, and that there was influence of the position of fruits inside the container in the condensed tannins' content and firmness.

## Nutritional and antioxidant characteristics of tomato fruit during ripening

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Tomato is an important food crop world-wide. It is a rich source of several nutritional and phytochemical compounds, and contributes very significantly to human nutrition and health. For example, pigments especially lycopene, have been associated with the prevention of some cancer types such as prostate cancer. We have characterized the changes in antioxidant capacity (AC), chlorophylls, total carotenoids, total phenolic content and ascorbic acid during ripening of 'Caiman' tomato fruit, and have correlated them with the objective changes in color. AC was determined by FRAP (ferric ion reducing antioxidant power), DPPH (2,2-difenil-1-picril-hidrazil), and N,N-dimethyl-p-phenylendiamine assay (DMPD). Chlorophylls lost very drastically, carotenoids increased drastically, total phenolic contents increase slightly throughout the ripening period, and ascorbic acid increased and reached a maximum at a color relation of about 1 a/b, and then declined consistently. Results on AC were different depending on the method used. AC measured with DPPH declined consistently. However, AC determined by FRAP and DMPD increased and reached a peak at a color relation (a/b) of about 1. Generally, lipophylic extracts had higher AC than hydrophilic extracts. A detailed discussion will be given in relation to the importance of these changes from the standpoint of ideal stage for tomato consumption, and also the correlation of the AC with some of the important phytochemicals present in tomato fruit.

## Nutritional content and anti-oxidant capacity in ten cultivars and lines of prickly pear cactus fruit

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Prickly pear fruit are harvested from various species of the prickly pear cactus, genus *Opuntia* of the cactus family (Cactaceae), and are produced and consumed in several countries. The fruit is characterized by high sugar content and low acidity, and contain considerable amounts of pigments, vitamin C, among other important nutritional components. We have characterized the nutritional content and antioxidant capacity (AC) of the fruit of ten cultivars/lines of distinct pulp colors. AC was determined by FRAP (ferric ion reducing antioxidant power) and DPPH (2,2-difenil-1-picril-hidrazil). Ascorbic acid, dihydroascorbic acid, tocopherols, and  $\beta$ -carotene were determined by HPLC. Total carotenoids, anthocyanins, betalains, chlorophylls, and total phenolic compounds were measured spectrophotometrically. 'Camuesa' had the highest betalains, total carotenoids,  $\beta$ -carotene, ascorbic acid, and was one of the highest in anthocyanins and total phenolic compounds. However, being very rich in these nutritional compounds, its AC did not demonstrate outstanding differences with some other cultivars/lines that were not as rich in these compounds. In fact, AC of this cultivar, measured with DPPH, was low compared to most other cultivars/lines. 'Roja Pelota' had high AC when measured with DPPH, but had low carotenoids,  $\beta$ -carotene and total phenolic content. 'Reina' had slightly low AC (as measured by FRAP) and also had practically no betalains, and low anthocyanins, vitamin C, tocopherols,  $\beta$ -carotene, and total phenolic content. A detailed characterization of the 10 different cultivars/lines with respect to their nutritional and phytochemical contents, and the relation of these with AC will be discussed.

## Mechanical system control in biological farming for protected crops

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The widespread indiscriminate use of highly persistent and toxic plant protection products has, over a long period of time, highlighted the negative aspects of the chemical defence of crops (accumulation of residues at the top of food chains, ecological impairment caused by pollution of water beds, etc). Once the effect of the plant protection product wears off, there is an inevitable increase of phytophagous and sometimes outbreaks of attacks by species considered unimportant since they are efficiently controlled, in normal conditions, by natural rivals. This explains the reason why, in the long term, there has been an increasing use of plant protection products in parallel with an increasingly intense outbreak of adversities against crops. The distribution of useful insects on crops without doubt represents a crucial phase in biological control strategies and at the same time the most critical as the particular biological characteristics of useful insects must always be taken into consideration. Furthermore, as well as being envisaged in a number of public or private disciplines, biological control represents the only means of averting the phenomena of chemical resistance without resulting in incidents of phytotoxicity in non-targeted living organisms as well as man. Distribution is usually carried out manually and is quite a demanding task for the operator. In addition to aspects linked to the inexpensiveness of this type of intervention, the manual distribution of living organisms also affects the efficiency of the distribution of the useful insect above all if it is not very mobile or in particular biological phases. Indeed, special attention must be given to the choice of distribution quantities (which differ for each organism released and depend on the crop and type of breeding) and the uniformity of distribution which varies also in relation to the size of the plants in question and the plant layout. The use of an operator can be considerably reduced by substituting manual with mechanical distribution, resulting in higher work capacity, improved intervention speeds and reduced running costs compared with manual means. From this derives the importance of mechanize the operation and therefore the value assumed by the prototype, used in this study, for the distribution of useful organisms. In this study was analyzed a prototype for a mechanical distribution of entomophages, in laboratory and in a protected crop, and have been checked the functional and working parameters in the modern productions.

## Effect of moisture content on physical properties of canadian flaxseed

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Knowledge on physical properties of seeds and their dependence on moisture content are of paramount importance in designing equipment for handling, storing and processing. In view of this, the effect of moisture content on physical properties of flaxseed (*Linum usitatissimum*) was studied in the moisture range of 6.85-21.85% (dry basis). The length, width, thickness, geometric mean diameter, angle of repose and thousand grain mass increased linearly from 4.64 to 4.78 mm, 2.37 to 2.53 mm, 1.0 to 1.16 mm, 2.21 to 2.41 mm, 24.4 to 41.14° and 5.77 to 6.60 g, respectively with increase in moisture content from 6.85-21.85% d.b. Sphericity and porosity increased from 0.48 to 0.50 and 16.83 to 30.43%, respectively, with increase in moisture level from 6.85-21.85% d.b. The bulk density decreased linearly from 652.16 to 580.21 kg m<sup>-3</sup> while the true density increased from 784.36 to 834.01 kg m<sup>-3</sup>. The coefficient of static friction increased linearly against the surfaces of six structural materials (stainless steel, galvanized sheet iron, aluminum sheet, plywood, rubber sheet, plastic sheet) with increase in moisture content from 6.85-21.85% d.b. The coefficient of static friction was found to be least in case of plastic sheet while it is highest for rubber sheet.



## Interactive effects of genotype and fertilizer application on the flour making properties of cassava roots

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Nitrogen supplementation to grow field crops has been reported to affect composition, quality and end uses of various food crops except cassava. The study was conducted to determine how genotype and Nitrogen supplementation affect the flour making properties of some selected CMD resistant cassava clones. Fertilizer dosages of 0 and 160 kg/ha were applied during the raining season in a completely randomized trial plot located in Mokwa, in the Guinea savannah belt of Nigeria. Genotypic differences significantly (at  $p < 0.01$ ) affected all the flour properties measured. Nitrogen supplementation caused significant reduction in the starch and amylose content of flour in about 40 to 50% of the clones ( $p < 0.01$ ). Similar reduction was observed in the diastatic activity, water absorption capacity of the flour and the breakdown viscosity of the flour paste in about 70 to 80% of the clones. However, Nitrogen supplementation did not influence the protein content, the final and setback viscosities as well as the peak time. In addition, the interactive effect of the independent factors significantly ( $p < 0.05$ ) affected most of the flour properties except the starch damage. This study has shown N supplementation and its interaction with varietal difference could lead to significant modification of starch based flour properties from cassava roots and as such highlighted the need to conduct a systematic study to explain how nutrient environment affects polymeric synthesis in cassava tissue in order to further give insight to how best to grow cassava for prospective end uses.

## Effects of essential oils on sprout suppression and global quality of potatoes cv Monalisa

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Potato (*Solanum tuberosum*) is a vegetable with a great importance in our diet. It is a product with a long-term storage which means that the tubers have to be stored in really good conditions to preserve their quality throughout the whole storage. It can be achieved using low temperature and high relative humidity. The most important problem during this period is the sprouting. For this reason, sprout inhibition is an important factor to save the quality and food value of the potatoes. In recent years, some efforts have been made to replace synthetic pesticides such as chlorpropham (CIPC) due to their toxicity and environmental problem. The replacement with effective potato sprout suppressants that have negligible environmental impact is needed due to increased concern for consumer health and safety. Plant derived essential oils have been investigated as alternative synthetic sprout inhibitors on potatoes. As a part of our on going investigations, the effect of essential oils in the sprouting inhibition and how they could affect to the global quality of the tubers were studied. Sprout suppressant properties of the three essential oils like *Mentha iperita*, *Carum Carvi* and *Eugenia Caryophyllata* were assessed in the cv Monalisa. The tubers were stored in darkness at 25°C and approximately 85% relative humidity in each treatment with natural essential oil for 10 days. During this time, the level of the CO<sub>2</sub> and O<sub>2</sub> were controlled (O<sub>2</sub> > 20%, CO<sub>2</sub> < 2%). The experiments were developed through 70 days (10 days in treatment and 60 days after the finish treatment) and were analyzed each 15 days respect to the control samples. Sprouting, sprout growth, external and internal colour, external and internal texture, pH, dry matter and soluble solids content were carried out over 60 days of storage at 8°C and approximately 85% relative humidity after each treatment. All treatments in general, reduce the sprouting and sprout growth of tubers as compared to control. The essential oils could be used as sprouting inhibitor on potato cv. Monalisa.

## Microstructure and flowability parameters of starches

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Starch, the main storage component in many plants, is not only an important energy source for developed seedling, but also a valuable material for food due to its unique structure forming properties. Cereals, pseudo-cereals, legumes, roots and tubers are the raw materials for starch extraction. Research was conducted to recognize interrelations between morphology and mechanical properties of starches used in food and pharmaceutical industry (potato starch, 6 kind of dextrans, CERAMIX 1230HS, CERAMIX 1150HS, luboterm, lubostat, LUBOX S, LUCET, TEXAMYL, cardboard glue, dried potato protein, granulated starch, gelatinize starch, pudding flour and 2 starch concentrators). Microscopic examination, determination of particle size distribution as well as direct shear tests were performed. Single particles of dextrans were of the same shape and dimension. Unconfined strength of dextrans and for materials of trade names were characteristic for easy flowing materials and cohesive material. There were no oscillations of experimental curves during shearing. The highest values of unconfined yield strength from 4.5 to 8 kPa were found for dried potato protein for adequately 4 and 10 kPa of major consolidation stress. The lowest and characteristic for easy flowing and easy flowing materials were found for potato starch and for granulated potato starch. Results of reported study confirmed the relevance of morphology to the mechanical properties of starch materials.

## Antioxidant and free radical-scavenging activities of rapeseed protein hydrolysates

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Rapeseed protein hydrolysates (RPH) were obtained by enzymatic hydrolysis of rapeseed protein using Alcalase 2.4 L FG. The degree of hydrolysis (DH) of RPH was about 25% using pH-stat method. The antioxidant activities of RPH were investigated by employing several in vitro assay, including the 1,1-diphenyl-2-picrylhydrazyl (DPPH) /superoxide/ hydroxyl radical scavenging assays, and reducing power assay. RPH showed scavenging activity against free radicals such as DPPH, superoxide, and hydroxyl radicals. The radical-scavenging effect was in a dose-dependent manner, and the EC<sub>50</sub> values for DPPH, superoxide, and hydroxyl radicals were found to be 0.71, 1.05 and 4.92 mg/mL, respectively. In addition, the RPH also exhibited notable reducing power, which was 0.87 at 20 mg. The data obtained by in vitro systems obviously established the antioxidant potency of RPH. Combined with the results of the amino acid profiles, RPH were believed to have high nutritive value in addition to antioxidant activities.

## Methods of funding for the industrial application of experimental food production and conservation techniques

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There is a huge need within the global agro-food sector to increase both the quality and quantity of foodstuffs. As a result, on the one hand, research and development centres from across Europe and worldwide are generating research results that are scientifically viable for solving problems and improving processes in agro-food production. On the other hand, the industry needs to implant these scientific advances in order to improve its production processes. Furthermore, the agro-food sector is made up of many small and medium sized enterprises (SMEs) that are typically limited in their capacity to invest in research and development and to uptake new technologies, especially in view of the significant financial risks that such investments represent for them. The Seventh Framework Programme (FP7) represents one of the numerous options currently available in Europe for funding the application of scientific studies in the industrial field, whereby the European Commission (EC) supports the carrying out of R&D activities from a comprehensive range of scientific fields, as well as areas of applied research in industry. In the case of SMEs, a programme called "Research for SMEs" is specifically aimed at boosting the uptake of research and development results in the SME sector. The basis of this investigation centres on diffusing the channels for obtaining different funding for these types of applications, following a suitable methodology. In many occasions SMEs view such funding opportunities as out of their scope, due to such barriers as limited access to information on calls, language, the complexity and volume of the documentation surrounding calls and guidelines, as well as the work involved in preparing a proposal. In this paper we outline a suitable and effective methodology for managing and presenting applications to the EC that will open up an interesting opportunity for the SME sector to uptake scientific research and development results. To date the procedures outlined in this paper have delivered six successful projects in the first calls of FP7, four of which are aimed at new methods of food processing for SMEs within various fields of the agro-food sector.

## Application of NMR & MRI in food quality and stability improvement

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NMR and MRI are non-destructive and non-invasive techniques. They are capable of providing assessing problems at molecular level. In this study, NMR and MRI techniques were used to monitor food processing and storage and quality control related issues. Physiochemical properties and their relationships to food quality and storage stability have been important research subjects over the years. Moisture is known to influence the stability of food products in many ways. Various foods with the same water content differ in stability. NMR techniques were applied to measure relaxation time parameters during food processes and storage to evaluate the relationships between physiochemical properties and quality of food. Nuclear magnetic resonance (NMR) relaxometry and NMR state diagram were used to calculate glass transition related parameters, namely transition temperatures,  $T_g$ , slopes before and after transition temperature,  $K$  before  $T_g$  and  $K$  after  $T_g$ . These NMR state diagram parameters are able to provide food manufacturers with an efficient way of designing food ingredient formulations based on quality and shelf stability concerns. MRI allows real-time observation of many dynamic processes non-destructively and non-invasively and enables researchers to study the response of food materials non-destructively as they go through different processing and storage conditions. In this study, MRI technique was applied to acquire food images with high resolutions to monitor moisture and fat distributions, to model and construct temperature mapping,  $T_2$  mapping, and  $T_g$  mapping during food processes including heating, cooling, Ohmic heating, drying, and steeping. MRI technique was also applied to monitor moisture migration in multi-component food systems during storage.

## Solar drying of food materials: developments and potentials

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This paper presents developments and potentials of solar drying technologies for drying of food materials. Previous efforts on solar drying of food materials are critically examined. Recent developments of solar dryers such as solar tunnel dryer, improved version of solar dryer, roof-integrated solar dryer and greenhouse type solar dryer for fruits, vegetables, spices and fish are also critically examined in terms of drying performance and product quality, and economics in the rural areas of the tropics and subtropics. Experimental performances of different types of solar dryers such as solar tunnel dryer, improved version of solar tunnel dryer, roof-integrated solar dryer and greenhouse type solar dryers which have demonstrated their potentialities for drying fruits, vegetables, spices and fish in the tropics and subtropics are addressed. Simulated performances of solar tunnel dryer, improved version of solar tunnel dryer and roof-integrated solar dryers were assessed for drying fruits, vegetables, spices and fish. The agreement between the simulated and experimental results was very good. The simulation models developed can be used to provide design data and also for optimal design of the dryer components. A multilayer neural network approach was used to predict the performance of the solar tunnel drier. Using solar drying data of jackfruit and jackfruit leather, the model was trained using backpropagation algorithm. The prediction of the performance of the drier was found to be excellent after it was adequately trained and can be used to predict the potential of the drier for different locations and can also be used in a predictive optimal control algorithm. Finally, prospects of solar dryers for food materials in the tropics and subtropics are discussed.

## A novel method of Pattern recognition for honey source base on visible/near infrared spectroscopy

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A novel non-destructive method of model pattern recognition for honey source was developed base on visible/near infrared spectroscopy. Visible/ near infrared spectroscopy (Vis/NIRS) appears to be a rapid and convenient nondestructive technique that can measure the quality and compositional attributes of many substances. In this study, the honey source attribute to four categories which is Tilia, Astragalus, Leguminosae and Wild Chrysanthemum. The calibration set consists of 48 sample and the predict set consists of 10 sample each source. The significant feature wavelengths using GA-classify algorithm were acquired. Using PCA-SIMCA algorithm, The classify result was Compared with between the full spectrum model and the significant feature wavelength model, It occur the phenomena of false negatives and false positives. To improve the correction rate of classify sample, the PCA-SVM classify method was developed. The result indicated the GA-classify combined with PCA-SVM algorithm offer a new approach to pattern recognition for honey source.



## **Aeration behaviour evaluation in a horizontal silo utilizing CFD tool**

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Storage in vertical and horizontal silos is commonly used worldwide, and its better understanding is essential to acquire and maintain product quality. Environmental temperature inside the silos is a high impact factor that drives mass loss, grain biological activity, pest development, and respiration. Therefore, the study of temperature behavior at several layers of the products throughout time is necessary to diminish loss and in order to achieve higher storage time with minimum quality loss, profit and yield. Aeration is a formidable tool to maintain temperature and consequently an important preventive method to avoid these problems. Direct measurement of temperature in all directions inside the silo requires numerous expensive equipments and labor force, and requires a large amount of time in order to provide information. Computational fluid dynamics (CFD) was utilized to solve this problem. CFX software satisfactory demonstrated velocity behavior within the horizontal silo filled with wheat, however the aeration ducts configuration did not offered support to the correct silo aeration.

## **Analysis of residual Bisphenol A, Bisphenol F and their epoxy derivatives in food cans coating by high performance liquid chromatography**

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A method was developed for determining residual Bisphenol A (BPA), Bisphenol F (BPF) and their epoxy derivatives by high-performance liquid chromatography (HPLC) with a fluorescence detector. BPA, BPF and their epoxy derivatives in samples were extracted with acetonitrile. Then the extract was dried and dissolved in acetonitrile/water (v/v:50/50). For the HPLC determination, a Lichrospher C18 and mixture of acetonitrile-water was used as the mobile phase under fluorescence detector with excitation and emission wavelengths of 230 nm and 301 nm, respectively. The peak area of BPA, BPF and their epoxy derivatives and concentration achieved good linear relation,  $r > 0.9999$ , the detection limits were 0.5660~6.5496  $\mu\text{g/L}$ . The recoveries at the addition of 80~400  $\mu\text{g/L}$  were 85%~107% with relative standard deviations  $< 7.4\%$ . The result indicated that this method was suitable for determining residual BPA, BPF and their epoxy derivatives in food cans coating.

## Characterization of collagen from the skins of Anglerfish (*Lophius litulon*) and other species fish: a comparative study

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Acid-soluble collagen (ASC) from skins of Anglerfish, Crucian carp, Snakehead and Pomfret were compared on the basis of their chemical properties (molecular composition, amino acid composition, denaturation temperature, viscosity and solubility). The collagen obtained from Anglerfish contained two alpha components ( $\alpha 1$  and  $\alpha 2$ ) and were classified as type I collagen by SDS-PAGE, so as the collagen from other fish. Imino acid content of collagens from Anglerfish was 14.69 in total amino acid; lower than those from Pomfret (18.04), Crucian carp (17.93) and Snakehead (17.91), and the hydroxylation degree was show similar tendency. Denaturation temperature of the collagens from Anglerfish was 22.09, similar with Pomfret (21.91), but lower than those from Crucian carp (28.36) and Snakehead (28.73), which were freshwater fish. Viscosity of all collagens was decreased with an increasing temperature, and decrease rate speed up when the temperature close to some specific point. Maximum solubility of Anglerfish collagen in 0.5 M acetic acid was observed at pH 3, so as the collagen from Crucian carp and Pomfret, different from the from Snakehead which at pH 2. No obvious changes in solubility of all collagens were observed in the presence of NaCl until up to 2% (w/v), a sharp decrease of solubility occurred when continue increasing the NaCl concentration.

## Simultaneous determination of 13 quinolones in fish tissue by high-performance liquid chromatography with fluorescence

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An analytical method for the simultaneous determination of thirteen quinolones (QNs) in fish samples was developed. The analytes were extracted from the sample using McIlvaine buffer by ultrasonic bath, and purified by solid-phase extraction cartridge. The extract was analyzed by high performance liquid chromatography with fluorescence detection (HPLC–FLD). The mobile phase was composed of acetonitrile and 0.2% formic acid aqueous solution, using a gradient elution. The limits of detection (LOD) were 0.008~1.112 µg/kg. The recoveries were 72.76~102.79% and the relative standard deviations of the method were below 10%. These values of LOD were lower than the maximum residue limits established by the European Union for these compounds in fish tissue. Various QNs could be determined by HPLC-FLD because of high sensitivity and simple operation.

## Non-destructive monitoring procedure based on qPCR for the estimation of aerobic microbial load on minimally processed lettuce

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Quality loss and shelf life of minimally processed or fresh cut fruit and vegetables is highly related to microbial load at the moment of packaging. Preparation of fresh cut products demands a quick and consistent method for detection of contamination from bacteria in order to discard unsafe product before marketing. The purpose of this study was to develop a fast quantitative PCR (qPCR) based method for aerobic bacterial enumeration in fresh-cut lettuce. Romaine lettuce (*Lactuca sativa* L. var. longifolia) was minimally processed in a pilot processing plant at 10°C, following standard industry procedures: removal of external and core leaves, shredding of the remaining leaves in pieces of about 4 cm size by a sharp stainless steel knife, disinfection in a NaClO water solution (100 ppm), drainage, rinsing in tap water a 4°C and centrifugation at 600 rpm. Bacterial load in the centrifugation water was analysed in order to determine initial lettuce contamination, which in turn affects recontamination during salad preparation and chilling storage. After disinfection procedure, lettuce pieces (except control) were artificially inoculated with  $3.4 \times 10^8$ ;  $3.4 \times 10^5$  and  $3.4 \times 10^2$  cfu ml<sup>-1</sup> of a streptomycin resistant *E. coli* strain ('top 10') that allows selective quantification on streptomycin supplemented LB plates. Lettuce pieces were again disinfected and bacterial DNA was easily extracted from centrifugation water and used in qPCR. For standard enumeration, samples of inoculated lettuce as well as collected centrifugation water (previously concentrated by centrifugation), were homogenized in sterile buffered peptone water and diluted 10 to 100 times for replica plating on LB agarose plates supplemented with streptomycin. Initial inoculation was related to bacterial counts in the centrifugation water both in plate assays and qPCR. The proposed protocol, which includes sample taking, DNA extraction and qPCR from centrifugation water, can be performed within less than five hours, allowing direct intervention measures before product is shipped from the factory. This protocol could be used by the fresh cut industry as an alternative to time consuming plate assays, representing an economic advantage as well as increasing food safety for consumers.

## Adjusting steam deacidification parameters for oil quality improvement

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Buriti oil (*Mauritia flexuosa*), obtained from the fruit of a Brazilian native palm tree, is a rich source of  $\beta$ -carotene and tocopherols. The high acidity (usually above 2.0%) in conjunction with their low levels of phospholipids (below 10 ppm) enables buriti oil to physical refining. Thus, this work aimed to study the physical refining of buriti oil, maintaining nutraceutical compounds and minimizing trans fatty acids formation. The experiments were conducted in a batch deodorizer developed by the research group conjunctly with MARCONI Company (Brazil), following a full factorial experimental design with two independent variables, which are temperature (ranging from 150 to 260°C) and steam flow rate (from 0.5 to 8.5%). Samples were removed after 30 and 60 minutes of stripping, getting two factorial plans. Results were analyzed using response surface methodology (RSM). Acidity, expressed as oleic acid, was determined in the samples of oil by titration according to IUPAC official method. Carotenoids and tocopherols content was determined by HPLC, following methodology developed during this work. Trans fatty acids content was determined by gas chromatography according to AOCS official method. The response surface obtained for acidity shows that it decreases with high temperatures and high steam flows. Assays that used temperatures above 244°C and steam flows higher than 4.5%, obtained final acidity below 1.0%, when the stripping time was 60 minutes. A stripping time of 30 minutes could not decrease acidity to safety levels for human consumption. Temperature was the only significant variable on  $\beta$ -carotene degradation, remaining at the final oil less than 1.0% of the initial content when temperatures above 244°C were utilized. It was not possible to obtain a model for tocopherols, evidencing that temperature and steam flow can not explain the losses at the studied levels. In fact, tocopherols losses were very low (less than 5.0%). Cis-trans isomerization was significant only at one assay, which used 260°C. In all others, the values found for trans-isomers were very low. The physical refining is an appropriate process for reducing buriti oil acidity, but the use of high steam flows should be preferred in comparison to high temperatures, since this option minimizes carotenes degradation and tocopherols loss.

## Effect of microwave pasteurization on orange juice color and carotenoid pigments

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In this paper changes in pigment content and juice colour due to microwave (MW) pasteurization of orange juices were studied. Thermal processing extends shelf life of orange juice, but it often leads to detrimental changes in the nutritional and sensory qualities of the product. Despite numerous mild processes like high pressures, pulsed electric fields and microwaves are proposed as alternatives to heat pasteurization to better preserve orange juices quality. Traditional heating by means of full or flash pasteurization are still the most widely thermal treatments adopted. In the above context, microwave (MW) heating seems a very attractive heating technique, owing to the well-known advantages of such volumetric heating process over conventional heating ones, particularly because the foods are directly and rapidly heated without contact with hot surfaces which turns in fast, effective and economical treatments. Non-uniform heating patterns and difficulties in temperature control that limit the MW industrial applications were overcome by realizing a MW heating pilot plant allowing real-time temperature control of batch stirred samples. Trials were performed, at different temperatures (60-70-75-85°C), on 250 ml orange juice samples by realizing real-time closed-loop temperature control. Carotenoid content in fresh juice after MW heating at different levels of temperature, decreased of about 13% (70°C, 1 min), 44% (75°C, 1 min), and 52% (85°C, 1 min). Zeaxanthin and  $\beta$ -carotene are responsible for visual colour of the fresh and pasteurized juices. After 1 min of MW heating,  $\beta$ -carotene decreased about 28% (70°C), 44% (75°C), and 55% (85°C). As expected the orange juices processed at 75°C and 85°C showed higher colour differences than the orange juices heated at 60°C and 70°C.

## Effect of homogenisation of milk on physico-chemical properties of Kunda

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Kunda is a sweetened, slightly granular product made by heat desiccation of milk in a steam kettle. It has a typical brown colour and a characteristic grainy texture. Normally, unhomogenised milk is used for manufacture of Kunda, however, sometimes dairies tend to utilize homogenized milk for its manufacture. This will lead to uncharacteristic product with little consumer acceptance. In this study, effect of homogenization of milk on the physico-chemical characteristics of Kunda was studied. Milk was standardised to 5.5 percent fat and 9 percent SNF and homogenized at 60°C under the following conditions: homogenization pressure 70 and 140 kg/cm<sup>2</sup>, homogenization in the presence and absence of fat and sugar. Similarly skim milk with less than 0.5% fat was also treated as above. Kunda was prepared as follows: The milk was taken in a steam kettle and desiccated to a semi-solid mass called Khoa. Cane sugar at 9.0% (w/w on milk basis) and potable water at 15 to 25% (w/v) were added and the kettle contents desiccated to a semi-solid 'pat' stage. Then another lot of potable water was added and desiccation continued. The steps of addition of potable water and desiccation were continued till a typical brown colour product (Kunda) was formed. It was observed that Kunda made from homogenized milk did not develop satisfactory browning, while that made from unhomogenised milk possessed typical brown colour and glossy appearance. This was attributed to retarded Maillard browning in the product made from homogenized milk. There was a decrease in browning index from 0.35 OD (at 550 nm) in unhomogenised milk product to 0.05 OD in the homogenized milk product, with a seven times decrease in the latter product. The browning intensity decreased with increasing homogenization pressure. Further, browning was observed to more when milk was homogenized in the absence of sugar than in the presence of sugar. Homogenisation also deteriorated the textural quality of Kunda, the body became more chalky and non-cohesive, which could be attributed to numerous weak points developed in the product as a result of spreading of smaller size fat globules. Hence, it was concluded that homogenized milk was not suitable for manufacture of Kunda.



## Extraction and chemical characterization of mucilage from mesquite, aloe vera, maguey and prickly pear cactus cladodes (nopal) and evaluation of its prebiotic effect on the growth of 2 probiotic bacteria

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Functional components such as dietary fiber, natural colorants, and antioxidants are some of the nutrients sought to include in the daily diet. Several plant species are promising sources of such components, such as the case of *Opuntia spp.* and other cactus species. Several species of cactus are growing in arid and semi-arid zones, most thrive well under high temperature, little water and poor soils, conditions unfavorable for the production of many other crops. Recently the amount of food and health supplements containing probiotics and prebiotics have increased considerably. Fibers have been used as the main source of prebiotics, and lactic bacteria have been widely used as probiotics in foods. Some cactus plants contain abundant mucilage, which is a complex carbohydrate, and in some plants such as nopal it is thought of as a possible ingredient for several applications such as thickening agents and natural additives. The objective of this study was to develop an adequate method for the extraction of mucilage from 4 types of arid plants, and to evaluate if their mucilage can act as a prebiotic promoting the growth of 2 lactic probiotic bacteria: *Bifidobacterium lactis* (BL) and *Lactobacilli acidophilus* (LA). The highest yield of mucilage was obtained with ethanol in maguey, acetone in nopal, acetonitril in *Aloe vera* and dried and ground pods of mesquite. The mucilage of the 4 plants is conformed by 7-11 polysaccharide fractions with a molecular weight ranging from 92827.7 and 1050.3 Da, and 2 to 3 fractions commonly make the major part of the mucilage of each of these plants. The bacteria were cultivated in 2 types of media: MRS broth and enriched MRS broth with 1% mucilage. After serial dilutions, both bacteria were cultivated in Petri dishes with Agar-MRS, and incubated at 32°C for 24 hrs. Growth was evaluated by spectrophotometry and by total count of colonies, and amount of colonies presented in enriched media was higher compared with the regular media. The amount of bacterial colonies presented in media enriched with mucilage was higher compared with the regular media without enrichment with mucilage.

## The antioxidant capacity in 40 horticultural commodities and correlation with the content of phenolic compounds and carotenoids

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Evidences are accumulation associating the intake of fresh fruits and vegetables with better health and prevention of several chronic diseases including cardiovascular disease and some types of cancer. Fruits and vegetables contain many phytochemicals, such as phenolic compounds and carotenoids, many of them act as antioxidants. The objective of this work was to determine the antioxidant capacity (AC) of 40 horticultural commodities sampled from the markets in Queretaro, Mexico, and correlates it with phenolic and carotenoid content. AC was determined by FRAP (ferric ion reducing antioxidant power) and DPPH (2,2-difenil-1-picril-hidrazil). Total carotenoids and total phenolic compounds were measured spectrophotometrically. Results showed great variations between the different commodities. Fruits that had the highest AC were red bell pepper, guava, Ataulfo mango, yellow bell pepper, Manila mango, green bell peppers, and soursop. Those that had the lowest AC were carrots, lettuce, black sapote, cucumbers, and celery. Hydrophilic extracts of most commodities had higher AC than the lipophilic extracts. Commodities that had the highest carotenoids content were carrots, celery, yellow and red bell peppers, and papaya. Commodities with the lowest carotenoids content were radish, prickly pear fruit, pineapples, pears, anions, black sapote, banana and apples. Most commodities had high phenolic content. Those with low phenolic content were carrots, limes, and white anions. AC measured by FRAP correlated positively with total carotenoids content in red bell peppers, Red Delicious apples, limes, and guava, and correlated positively with total phenolic content in avocados, soursop, tomato, Manila mango, papaya and pears. AC measured with DPPH correlated positively with total phenolic content in hot peppers, limes, Tommy Atkins mangoes, melons, oranges, and papaya, and correlated positively with carotenoids content in guava, tomatoes, lettuce, limes, and yellow bell peppers.

## Textural characteristics of probiotic yoghurt produced by transglutaminase addition

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Application of transglutaminase in low fat yoghurt manufacture is one of the recent modern technique. The enzyme transglutaminase (TG; EC 2.3.2.13) is a transferase that forms both inter- and intra-molecular isopeptide bonds in and between many proteins by cross-linking of the amino acid residues. The cross-linking of proteins modifies their functionality in order to improve protein based food structures. The aim of this paper was to investigate, the effect of transglutaminase concentration: 0.02%, 0.06% i 0.12%, with and without activation on textural properties of low fat probiotic yoghurt after production and during 5 and 10 days of storage. Firmness, consistency, cohesiveness and index of viscosity of probiotic yoghurt samples were analysed by texturometar Texture Analyser TA XT plus (Stable Micro System, England) at 5°C. Transglutaminase addition to milk direct or after activation for probiotic yoghurt manufacture significantly influence its textural properties.

## Effect of *Lactobacillus casei* on fatty acids in models of ripening cheese slurry

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The study followed the changes in fatty acid profile in models of cheese slurry inoculated with *Lactobacillus casei* DN-114001. The control slurry was prepared only with starter cultures of the fermentation process – *Lactococcus lactis ssp. lactis* (R-603). Models were submitted for ripening at 14°C during 8 weeks. The concentration of individual fatty acids in glyceride fraction, as also the free fatty acids (FFA) content after SPE–NH<sub>2</sub> fractionation and methylation were investigated using GC-MS. Ripening process resulted in increase in the levels of palmitic and oleic acid in glyceride fraction, respectively from 31.8 to 32.6 (g / 100 g fatty acids) and 18.6 to 19.1 (g / 100 of fatty acids). Also the content of stearic acid showed the increasing tendency but it was not statistically important alteration ( $\alpha = 0.05$ ). At the same time the levels of linoleic and linolenic acid slightly decreased. In probiotic models the content of conjugated linoleic acid (18:2 cis - 9, trans – 11) was statistically higher at the end of ripening time (530 mg / g fatty acids) comparing with the 45 (mg / 100 g fatty acids) at the beginning. CLA changes were not correlated with linoleic and linolenic acids, while positive correlation was noticed in case of oleic acid ( $r = 0.587$ ). After 8 weeks of ripening the concentration of FFA amounted to over 1300 (mg / 100 g of fatty acids) and was about 2.5 times higher in models with *Lactobacillus casei* comparing with control slurry. The predominant free fatty acids were palmitic and stearic (over 360 mg / 100 g fatty acids) while the individual concentration of miristic, oleic and butyric acids averaged 100 mg / g fatty acids. The linoleic, linoleic and CLA free fatty acids were present as trace (between 7.7 – 19.0 mg / 100g fatty acids).

## Durum wheat bread: old Sicilian landraces and new varieties

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In Mediterranean countries and particularly in southern Italy, durum wheat is traditionally used for bread production. Market globalization has involved, also in these regions, the diffusion of bread made with soft wheat flour (*Triticum aestivum*) standardizing this product and flattening taste consumers. Dealing with the problems of genetic resources erosion, among its main aims the Experimental Station for Cereal Crops in Sicily has to maintain and increase the value of old Sicilian durum wheat landraces. In the belief that preserving and enhancing plant biodiversity means preserving and enhancing food diversity, the Institute has promoted revaluation actions of these landraces for production of Sicilian traditional durum wheat bread. Nowadays, craft bakers use semola of new improved varieties spread on Italian national area for preparing durum wheat bread. With the aim of comparing the bread made with the old Sicilian local varieties and the one made with the modern cultivars, some landraces, chosen from the genebank of the Institute, have been multiplied on farmers' fields to have enough material for making bread. Before milling in pilot plant, the grain of the different wheats was characterized for its merceological indexes. The semola obtained was analyzed for its color and content in ashes, proteins and gluten. Rheological tests were conducted on dough and, finally, using standardized methods, one-variety breads were produced. On the bread slices, computerized image analysis was performed to measure color and morphological parameters of crumb and crust. Sensory analysis, achieved through a descriptive profiling test, was conducted with trained judges using touch, fragrance and taste attributes for the different bread types. The correlations between chemical and technological characteristics of raw material and semola, rheological properties of dough and morphometric and sensory attributes of bread prepared using some old landraces (Bufala, Cappelli, Margherito, Russello, Timilia) and actual durum wheat varieties (Ciccio, Dulio, Iride, Mongibello, Sant'Agata, Simeto) were investigated.

## **Sourdough effects on the crumb texture and shelf-life evaluated with dynamometer and Image analysis measurements in the Dittaino Pagnotta P.D.O., a durum wheat bread produced by a Sicilian bakery industry**

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Sourdough or “the mother sponge”, more formally, natural leaven or levain, refers to the process of leavening bread by capturing wild yeasts in a dough or batter, as opposed to using domestic, purpose-cultured yeast such as *Saccharomyces cerevisiae*. The use of sourdoughs in the industrial bread productions as natural rising agents offers many advantages respects to purpose-cultured yeast. Among the benefits founded, was noted an higher acidity during leavening that decreased the mould growth and consequently a longer shelf-life. Over many years, selected microorganisms culture isolated from traditional breads are used by many speciality bakeries, for their appreciated physiological, biochemistry and organoleptic characteristics. The natural leaven is a biological system in equilibrium, it guarantee the good growth of all microorganisms inside it, thank to the specific interaction among themselves, this assure a good and equilibrated leavening of batter. The Pagnotta del Dittaino PDO production (2008/C 283/10 and L. 143, 20 June 2008), about 800 g for each loaf, was produced by Pandittaino using sourdoughs, following the disciplinary. In this report results are presented regarding the effect on shelf-life and crumb structure of two doses of sourdough (10%, 16%) treatments, by means of image analysis technique and dynamometrical measurements. Twelve Pagnotte lots of the same batch, six for each treatment, were evaluated, one lot per day, for a six day period. All images were acquired and digitalized with a flatbed scanner at 200 dpi resolution in RGB colour model. Moreover, the first day lot of each treatment was scanned, non destroyed, and re-scanned every day for the entire experimental time. Dynamometric values showed a crispness significant increment related to the amount of sourdough, crumb consistence and uniformity as evidenced by image analysis of bread slices too. It is well-known that the bread made with sourdough tends to be relatively resistant to spoilage and mold. In this report we confirm the trend for durum wheat bread, as in the case of the industrial baked Pagnotta del Dittaino PDO, assuring a better quality and a longer shelf-life, for consumer satisfaction and market acceptance.

## The path of food safety in tuna production chain

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In all areas of food production has become a priority to ensure the quality, safety and security products. For this reason was born the food traceability: those technologies and methods of production and control to monitor a food product from farm to consumer in all steps from preparation to processing and distribution. The recent legislation in the food, both at European and international, sees at the heart of the interests the protection and information for consumers. In 2000 and 2001 were issued two regulations, which are derived from decrees and circulars of the Ministry of Agriculture and Forestry, on the market in fishery products and aquaculture. These regulations introduced information on the area of capture, as the FAO (for the species caught) or country of origin (for the species fished in freshwater or farmed). Currently, the consumer information required by the legislation thus provides an indication of macro regarding the origin of fish caught. The producer may, in addition to this source, give a more detailed, to establish the supply side, but is not obligated to do so, so long the chain whose origin is uniform. After the acquisition, traders can create lots of new products with different origin and hence the origin of species is maintained only with certainty until the fish market of production. Given that, on based of EC Regulations, since January 2005, it's started the path to the traceability of all food products, and thus the fish. This also involves the assumption of direct responsibility of producers, thus forcing the operators of food (from production to consumption) to have systems and procedures to identify the "path" that the product has made in the food production chain. Recently the European Union is promoting measures to control fisheries organizations responsible (ICCAT: International Commission for the Conservation of Atlantic Tunas) in order to activate a pathway leading to the sustainability of tuna stocks, such is special interest Regulation 178/2002 concerning the food traceability. This research aims to reconstruct the path of this food for marketing through all stages of production, processing and distribution, analyzing the critical points and defining the rules for the food safety of the product. These rules, applied to fisheries and aquaculture are reflected in the importance of providing information on the trade name of the species, the method of production and area of capture, processing and marketing. The proposed methodology has been applied in the study of a representative of the territory in question, the leader in Italy and Europe in the field of processing, marketing and distribution of canned tuna.

## Studies upon the influence of some macro elements on the quality and durability of yogurt

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The effectiveness of the enzyme lactase ( $\beta$ -D-galactosidase) in the obtaining of the yoghurt from raw cow milk in the presence of some macro elements ( $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Ca}^{2+}$ ) was studied. Hydrolysis of the lactose was indicated by the decreasing of milk pH at different temperatures (35°C-47°C) and by the relative activity of the lactase. The experimental data suggest that the bivalent cation ( $\text{Ca}^{2+}$ ) in a range of 0.5-2 mM activate the enzyme activity (also the coagulation time being shorter than in the case of blank and the coagulation pH was 5,0). As the temperature increase the enzyme became more active, i.e. at 47°C the formation of yogurt was accomplished at 120 min. Instead  $\text{Na}^+$  and  $\text{K}^+$  addition inhibited the  $\beta$ -D-galactosidase activity at all temperature but at 47°C the sodium chloride addition inhibit completely the enzyme activity, the pH-value being greater than 5.0 even after 300 minutes. The RP-HPLC method was used to established a relation between the cation concentration and the production of lactic acid during the fermentation and storage period. Obtained data shown the  $\text{Ca}^{2+}$  concentration added to milk from (120 mg/100 mL - 300 mg/100 mL) enhanced the growing production of lactic acid from 0.262% to 0.634% during the first 60 min. of fermentation, even at temperature below 42°C. No significant difference was observed in amount of lactic acid between sample with more than 300 mg/100 mL  $\text{Ca}^{2+}$  and control. It has been also noted that while storing, the lactic fermentation was active and potential acidity increases significantly even at an increase of Ca concentration of 10%. The variation of  $\text{K}^+$  from 25 mg/100 mL to 100 mg/100 mL increased the lactic acid concentration in yogurt from 0.254% to only 0.300% during the first 60 min of fermentation at 43°C. Regarding the storage period (20 days) of the yogurt, the variation of the lactic acid concentration increased with only 2% when the  $\text{K}^+$  was added in 100 mg/100 mL



## Effect of F0-value and retort temperature on quality in Thai red curry paste

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The objective of this research is to optimize the heat processing conditions to obtain a healthy substances and also have satisfactory qualities. Response surface methodology with central composite design (CCD) was used to investigated effect of retort temperature between 114-120°C and F0 value between 6-20 on total phenolic compounds, DPPH radical scavenging activity and ferric reducing antioxidant power. The processed paste had higher total phenolic compounds, DPPH radical scavenging activity and ferric reducing antioxidant power with lower lightness value compared to the fresh paste. The optimize condition to obtain the maximum total phenolic compounds, DPPH radical scavenging activity and ferric reducing antioxidant power is processed at low temperature (114°C ) and high F0 value (over 18).

## Changes on dough rheological properties and bread quality as result of addition soy isolate and starter acidity on sour dough bread

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The increasing interest in functional and healthy products has promoted the use of soy proteins in the manufacture of foods for human consumption; however its acceptance is still low, due to its strong flavour that is not fully accepted by consumers. Sour dough breads can be considered as an interesting option to be added with this kind of protein, as the strong flavour of bread could be masked by the off flavours of soybean, however the effect of this addition on baking technological properties must be first assessed. Farinograph and extensograph tests were used to study the effect of adding soybean isolates at different concentrations (0, 12.5, 25%) to wheat flour and sour bread full formulation on: water absorption (WA), maximum consistency time (MCT), dough stability (S), maximum resistance to extension ( $R_{max}$ ) and dough extensibility (L). Baking tests were also performed to evaluate the effect of this addition on bread characteristics: loaf volume, texture (firmness, compression force, resilience), colour ( $L^*$ ,  $a^*$ ,  $b^*$ ), crumb-grain structure (cell density, mean cell area, shape factor) and consumer acceptance (sensory analysis). Also the effect of starter acidity level was tested. Results showed that dough rheological properties were affected by the soy isolate addition as well as by starter acidity. WA increased for the samples prepared with wheat flour and soy isolate in 0.6% per 1% of protein addition, while dough stability decreased from 19 min to 6.5 min as protein level was risen. When rye flour was added, WA decreased at the largest level of soy protein substitution. Samples added with starters at maximum acidity presented the longest stability time, while  $R_{max}$  decreased. Bread quality results showed that as soy isolate was increased in the formulation, the bread specific volume decreased, while crumb firmness and compression force increased, without modifying resilience results. Crumb structure analysis showed that shape factor decreased with the increasing addition of protein isolate while the other crumb features remained invariable. Sensorial evaluation showed that the best sample was the one added with 12.5% of soy isolate.

## Sweet bread crumb structure characterization and their relation with fractal texture evaluated by image analysis

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In bread-making practice, image analysis has been proposed to quantify crumb features such as: cell size, cell size distribution, number of cells per unit area, cell wall thickness, void fraction and shape factor. Another parameter that can be obtained by IA is the fractal dimension which provides a numerical descriptor of the morphology of objects with complex and irregular structures such as bread crumb. A broad variety of breads with different crumb characteristics can be produced, which depends on wheat flour characteristics, the ingredients used, as well as the process conditions applied, so a simple and cheap methodology to evaluate bread crumb structure, such as IA methodology, would be useful for bakeries. The aim of this work was to compare different image scanning resolutions and thresholding techniques to quantify the differences in crumb features of three different types of sweet breads and their relation with fractal dimension. Nine different scanning resolutions (75, 100, 150, 200, 300, 355, 435, 515, 555 dpi) were tested and two segmentation methods were applied (Otsu algorithm and the manual thresholding). Three crumb grain features were obtained: cell area, cell density and shape factor. Fractal dimension was evaluated by power-law scaling using the Shifting Differential Box Counting method. Results showed that increasing resolution had larger effects on the detection of objects with areas equal or smaller than  $0.1 \text{ mm}^2$  for both thresholding methods. Differences among breads' structure were detected, showing "panque" bread the largest cell density. Results were influenced by the range of cell sizes considered in the evaluation, varying in at least ten times as compared to the smallest result. Smaller cells presented the largest shape factors and as cell size increased, shape factor decreased. Fractal texture for the three kinds of bread was different; having the "panque" bread the smallest values which indicate smoother crumb texture. The range of particles selected to evaluate crumb structure significantly modified cell density, shape factor and mean cell area results, while fractal dimension did not depend of the thresholding method used. Image analysis and fractal texture were useful to evaluate bread crumb structure, however it is very important to select the range of cell sizes that is going to be considered in the evaluation and the scanning resolution applied during the image acquisition

## Extra virgin olive oil phenolic concentration as a function of mixing speed during malaxation: preliminary results

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The preliminary results of a lab-scale investigation aimed to verify the relationship among mixing speed during olive paste malaxation and hydrophilic phenols profile (HPLC) of the extracted oils were reported. Two levels of mixing speed were compared: 20 and 30 rpm (values which fall within the range usually adopted in the mill). At different time intervals during malaxation olive pastes were sampled. After 40 min an increase of total phenols concentration (about 70 mg/kg) was recorded as a function of the higher speed of mixing. On the basis of these results was hypothesized that the release and distribution of phenols in the oil phases is probably related with the intensity of the mixing mechanical action and the extent of the contact between solid and oil phase. The specific phenolic fractions were affected in different way: a marked increase was recorded both for DMO-da and O-agl, a smaller increase for lignans and a slightly variations for DML-da and L-agl. Future investigations should be performed both to evaluate in most comprehensive way the effect of this parameter on olive oil quality and to consider mixing speed values out of the conventional range so to evaluate the possible occurrence of emulsions and the related consequences on oil extraction yield.

## Effects of short-term and long-term changes in water status on produce texture

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Texture is an important, very complex parameter of fruit and vegetable quality. It is related to the physical and chemical cell wall properties and to tissue water status. The produce water status, the overall tissue structure and the physiological product status, and their development also affect various mechanical properties such as elasticity, toughness, strength and others. Maturation and ripening, senescence or decay in storage and retail may affect strength and stiffness. Exact knowledge of the effects of the above parameters on mechanical properties and breaking susceptibility of the produce can help to diminish reduction of quality in fresh vegetables and to improve minimally processing. A better understanding of the physiological base of water status effects on mechanical properties may prevent unnecessary tissue damage and reduces the risk of pathogen infection. It can help to improve quality maintenance of minimally processed fresh products thus increasing shelf life and reducing economical losses. Tissue elasticity is interdependently determined by water status and cell wall mechanical properties. Short-term changes under unfavourable storage conditions mainly result from a decline in water potential or water volume while elastic properties remain unchanged. It is known that bruising, splitting or breaking susceptibility of fresh fruits and vegetables may increase at high produce water contents. A positive correlation between relative tissue turgor and cutting energy or elasticity has been found in many produce. However, produce development and growth may largely influence these interrelationships. Processing quality could thus be optimized if this interaction is better understood. Because comprehensive and systematic studies on these effects on processing related mechanical properties are rare and their results are equivocal, we combined the acoustic impulse-response technique, force-deformation measurements, the pressure-volume technique and cutting-strength measurements to study these interactions using fresh small radish (*Raphanus sativus* L.) as model produce having a relative simple tissue structure mainly consisting of thin-walled xylem parenchyma. We aimed to characterize the fundamental effects of produce development and water status on the elastic properties and strength of whole intact fresh radish tubers at various developmental stages.

## Application of digital imaging to evaluate slicing quality on fresh cut produce

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During recent year the market for minimally processed fresh vegetables and salads increased world wide. Quality and self-life of fresh cut products is, however, not always satisfying. Especially the process of cutting itself which inevitably destroys tissues still needs to be optimized. Design and consistency of the edge, cutting speed and movement but also the produce status affect the quality of the cut and hence of the end product. Up to now cutting quality was evaluated by the analysis of shelf-life, tissue electrolyte leakage, enzyme activity or cutting force. The actual cutting force depends on tissue structure and produce water status. An objective evaluation of the degree of damage due to the cut is only possible using labour and time intensive microscopic techniques. A digital three-dimensional scanning of the fresh-cut surface with an electronic micro-topographic system allows to complexly evaluate the extent of the resulting wounding. This helps to quantify the effects of product water status and produce tissue structure on cutting quality by directly assessing the occurring tissue and cell wall damages. The results obtained provide valuable information for optimizing the cutting process. The micro-topographic system NEMESIS V (Precitec Optronik GmbH, Rodgau, Germany) with the optical distance sensor CHR 150 contactlessly determines surface profiles. The sensor with an effective range of 600 µm has an optimal resolution in x- and y-direction of 1 to 2 µm and in z-direction of 0.02 µm. Data analysis using the methods implied in the system software allows the evaluation of surface roughness by applying standardized parameters like the arithmetic mean  $R_a$ . Various parameters of the cutting process were included in the examination. Interrelations between these parameters and the consistency of the cut surface will be analysed and the results as well as the possibility of further optimization of the cutting process will be discussed.

## Antimicrobial activity of whey protein based edible films with essential oils incorporated

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Edible films based on whey protein isolate (WPI) have good mechanical properties and are excellent oxygen, lipid and aroma barriers. These coatings can potentially be used as carriers of antimicrobial agents, aim to extend food product shelf-life. Antimicrobial activity of essential oils (EO) has been previously recognized, but their application as natural antimicrobial has recently received increased attention in the food industry. Application of EO against food borne pathogens is a promising technology as a supplement to other preservation methods. Little published data exist on the incorporation of them into edible films. The main objective of this study was to determinate in vitro the antimicrobial activity of WPI films enriched with different EOs (Oregano, Rosemary and Coriander). The microbial targets selected were *Listeria innocua*, *Staphylococcus aureus*, *Salmonella enteritidis*, and *Pseudomona fragi* common targets in the meat industry. Films were formed using water solutions of 10% (w/w) WPI and 5% (w/w) glycerol as plastizicer. The solutions were heated at 90°C during 30 minutes. EO were added at 1%, 2% and 4% (w/w). After homogenizing, solutions were filtered and degasified. Then, solutions were casted on glass dishes and dried at ambient conditions for 24 h. Finally circular discs of 17 mm of diameter were prepared. Antimicrobial effects of pure EOs and of WPI-EO films were determined by an agar diffusion test. Firstly, antimicrobial activity of the EOs was tested by the filter paper disk diffusion method. Secondly, the obtained WPI – EO films were placed on the same solid media inoculated with microbial target cultures. The plates were incubated at 37°C for 24 and 48h. Antimicrobial WPI-EO based films were obtained. All EOs used in this study showed antimicrobial activity against the microbial targets. As expected, the higher the concentration of EO, the higher the antimicrobial activity. Furthermore, at the same concentration of EO different inhibition zones against microbial targets were estimated.

## Comparison between defatted and non defatted grape seeds extracts

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The interest in the research of polyphenols from different natural sources has grown due to the tendency of substituting synthetic antioxidant with natural ones. Polyphenols also benefit human health in different ways: scavenging free radicals, inhibiting the progression of atherosclerosis, preventing cancer, among others. One source of polyphenols grape seeds from the wine industry by-products. In addition to the antioxidants, polyunsaturated oil can be obtained from the grape seeds. Grape seed oil can be used as a functional ingredient in the food and cosmetics industry. The aim of this work is to compare the amount and quality of polyphenols from two different grape seed extracts (GSE), one from defatted and one from non defatted grape seeds. The seeds were collected from an alcohol distillation plant, ground and frozen at  $-80^{\circ}\text{C}$ . The oil was extracted for 1.5 h with n-hexane at a ratio of 10:1 (v/w). The GSE was obtained stirring the grounded seeds with aqueous ethanol 57% during 45 minutes in three stages. The total amount of polyphenols was obtained by IPT at 280 nm and Folin-Ciocalteu technique. The flavonoid content was measured with a wave scan from 230-700 nm of an acidified sample. The antioxidant power of the GSE was measured by the evolution of the peroxide value of a virgin olive oil with 150 ppm of GSE and by the DPPH technique. For all the indexes the defatted GSE showed significant higher values ( $p < 0.05$ ). This is perhaps due to a larger contact area, because after the oil extraction there was observed less agglomeration of the seeds powder. Regarding the DPPH measures as it was expected the defatted GSE showed more free radical scavenging power. Comparing the GSE antioxidant activity in the olive oil it can be concluded that there is no difference in the oxidation evolution between the extracts and the control sample. In conclusion it is feasible to obtain two healthy products from the grape seeds without compromising the quality of the antioxidants.



## Study of two parameters of cooking quality in rice

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Rice is one of the three most important cereals worldwide remains a staple food in many countries. Generally, in the world, there are two cultivated subspecies. One of them is *O. sativa* ssp. *indica* which is identified by long grains. *O. sativa* ssp. *japonica* is the other one which are medium or small grains. As rice is consumed by different sectors of the population and is intended for various uses, their attributes of quality must be assessed for each case according to their specific end-use and their consumers. The rice processing industry evaluates attributes of quality as: amylose, protein and fatty acids content, gelatinization temperature, gel consistency, among other. The characterization of rice is essential to choose which of the varieties is optimal to obtain the best industrial results. Nowadays, there are many studies that analyze the attributes of quality in *O. sativa indica*. However, in Spain, *O. sativa japonica* is the most common specie used, so the importance to know cooking quality of different varieties of this specie, since there are a few researches developed. The two main parameters to establish the quality cooking are the gelatinization temperature (GT) and the gel consistency. The first determines the cooking time of rice kernels and the second shows stickness the cooled paste of cooked rice flour is and used as criterion for evaluation of cooked rice texture. The aim of this study is to analyze the gelatinization temperature and gel consistency from different rice cultivars used in Spain. Five varieties (Bahia, Meratelli, Gleva, Guadiamar and Senia) have been studied. The GT was determined with differential scanning calorimeter and gel consistency was analyzed by the method developed by Cagampang, Perez and Juliano in 1973. The results of gel consistency are classified as soft (61-100 mm), medium (41-60 mm) and hard (26-40 mm). On the other hand, the values of GT are categorized as low (55-69°C), intermediate (70-74°C) and high (75-79°C).

## Influence of organic matter on sanitation during vegetable washing

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To prevent cross-contamination with human pathogens as well as with plant pathogens wash water sanitation is recommended for vegetable processing. In recent studies limits in bactericidal effects of chlorinated water and aqueous ozone were presented. Usually wash and rinsing water in washing plants are loaded with organic substances (chemical oxygen demand (COD)) up to 10,000 mg l<sup>-1</sup> of COD, which limit the sanitation effect of oxidizing agents. For example 1 g of carrot per litre water represents already about 100 mg COD. The task of this experimental study was therefore to investigate the remaining inactivation potential of chlorine and ozone when applied to *Pectobacterium carotovorum* and *Escherichia coli* suspended in tap water and loaded with different concentrations of COD. Fresh carrots were mashed (0.1 to 10 g l<sup>-1</sup>, 70 mg g<sup>-1</sup> COD) and then mixed with *P. carotovorum* or *E. coli* suspension (10<sup>4</sup> to 10<sup>6</sup> cfu ml<sup>-1</sup>) and added to chlorinated (1000 ppm free chlorine) or ozonated (up to 4 ppm ozone) water. In a second trial the mashed carrots were filtrated and the juice put to the oxidants. After dilution the suspensions were stirred for 5 minutes. Then aliquots of the mixtures were plated. *E. coli* was determined on McConkey agar after 48 h incubation at 37°C and *P. carotovorum* were plated on McConkey agar and incubated for 48 h at 30°C. The threshold for inactivation of *P. carotovorum* was about 2 g l<sup>-1</sup> mashed carrots for the chlorinated water and 0.7 g l<sup>-1</sup> for ozonated water. The threshold for *E. coli* in chlorinated water was about 1 g l<sup>-1</sup> and ozonated water about 0.5 g l<sup>-1</sup>. The results were comparable for carrot juice. For higher concentrations of COD the effect was negligible. The results show that already little concentrations of organic matter in washing or rinsing water in vegetable processing plants inhibit the effect of sanitation treatments. It is assumed that the oxidizing agents first react with the organic matter without influencing bacterial growth. Consequently, the application of high hygienic standards, i.e. closed cool chain, fixed cleaning cycles and frequent water change is recommended to effectively prevent unwanted bacterial growth.

## Isohalic sorption isotherms of codfish

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Dry-salted codfish has a considerable consumption by Portuguese consumers that supports an expressive industry in Portugal and other European countries but little has been published about the drying of salted codfish. The main product is produced after drying of almost salt-saturated codfish (green salted codfish). A second type, called yellow cured codfish, is made from drying of medium salted codfish. Working isotherms of salted codfish are an important tool to predict the drying behaviour of these products. The objectives of this work were to obtain experimental working isotherms in the temperature range of usual salted codfish drying (20 to 25°C), of green salted codfish and green salted codfish soaked once for 16 h in an equal weight of water, and to study its prediction by the Ross model, the only mathematical model tested in the literature to predict isohalic isotherms. The green salted codfish muscle and the soaked green salted codfish possessed average ratios of grams of sodium chloride per gram of non-salt solids of 0.87 and 0.37 respectively. Isotherms were obtained by the gravimetric method using sulphuric acid solutions to obtain water activities between 0.1 and 0.9. For each curve were used duplicate samples of slices of approximately 2 mm thickness and weight of 2 grams of samples. The samples were of the muscle of codfish of the *Gadus morhua* species. Isohalic isotherms of salted codfish muscle were predicted by the Ross model based on physical properties of sodium chloride solutions and sorption data of non-salted muscle of raw codfish. The water activities of the salted samples were obtained for each water content by the product of the corresponding water activity of non-salted muscle and the water activity of the salt solution in the fish sample. These isotherms present a sharp change of the water content around the water activity of 0.75, the water activity of a saturated sodium chloride solution. This simple model was used with good predictions when comparing with experimental results with  $R^2$  between 0.989 and 0.841. Results obtained in this study can be used in the mathematical modelling of drying of codfish to optimize this operation.

## Determination of the potential of essential oils of *Clausena anisata* and *Plectranthus glandulosus* to ensure the post harvest keeping and safety quality cereal grains

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The quality and the safety of the foods processed from cereals depend to a significant extent on the postharvest storage technology applied to the grains. Maize occupies an important place in the resolution of food insecurity problems in the sub-Saharan region of African. However due to poor post harvest technology, more than 35% of annual crop yield is very often lost during storage as a consequence of insect attack. While chemical pesticides constitute a very efficient tool for reducing these losses, current excessive usage runs the risk of modifying the quality and safety of foods produced from these grains. The use of essential oils of plant origin for grain storage has been advocated as a non invasive method with limited or no effect on the quality and safety of the grains or their products. *Clausena anisata* and *Plectranthus glandulosus* are excellent sources of essential oils. In the Northern parts of Cameroon, the plants are traditionally used to reduce or prevent insect infestation of grains during storage. The present study was carried out using a factorial design with four repetitions to verify the hypothesis that their potency for use as insecticide in grain storage is due to their content of essential oils. Imidacloprid, a commonly used grain storage insecticide served as the control. Results of the study show that when applied to 200 g of grains at the rate of 370 ppm and 270 ppm respectively for *C. anisata* and *P. glandulosus*, grain weight loss during storage due to insect attack was reduced by 86.3 for *C. anisata* and 98.0% for *P. glandulosus* compared to 86.7% in the case of imidacloprid. When applied at DL25, the essential oils reduced the appetite of insects by 70% (*C. anisata*) and 90% (*P. glandulosus*). The residues of the essential oils applied to the grains were found to make significant contributions to the antioxidant activity profile of the grains and their flours. These results strongly suggest that the essential oils studied can serve as good and safe alternatives for use as insecticides in maize storage prior to processing.

## Evaluation of the potential of bambara groundnut (*Voandzea subterranea*) powders as ingredient for the preparation of Koki

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Koki is a nutritious steam-cooked bean cake in Africa, usually processed through a laborious process of soaking, dehulling, milling cowpea to a fine paste and mixed with red palm oil before cooking. The present study was carried out to evaluate the potential of powder made from bambara groundnut (*Voandzea subterranea*) as a convenient starting raw materials for the preparation of koki. The powder of legumes were produced through soaking, dehulling drying at varying temperatures (50, 60 and 70°C) and grinding of the dehulled seeds into flour of varying particle size (500, 1000 et 1500 µm). Using a screening design, koki was steamed cooked from different mixtures of the powder with drying temperature, particle size, water, and kanwa levels as variables. Cooked koki samples were evaluated for the textural and sensory properties. Particle size was observed to significantly influence the flow properties as the consistency of the paste made from them. In all cases the texture of the cooked koki was found to be significantly influenced by each of the variables in the experimental design. A modeling of the hardness of the koki was observed to be significantly influenced by particle size of the powder. Irrespective of the recipe used, koki produced from bambara groundnut powder was well accepted by a panel of judges and can be use as a convenient starting raw materials for the preparation of koki.

## Taro (*Colocasia esculenta*) powder and pudding quality as influencing by processing methods

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The present study was carried out to evaluate the physico-chemical properties of pre-cooked taro (*Colocasia esculenta*) powders and the quality of pudding produced from them. The taro was processed into powders using four different methods each with a different cooking method. The powders obtained were reconstituted into pudding using three different methods and the texture of the resulting product analysed by double compression techniques. Significant variation ( $p < 0.05$ ) were observed in the physico-chemical parameters of the food powders produced and also in the texture of the puddings made from them. The compressibility of the powders, their equilibrium moisture content and the cohesiveness were found to be highly correlated to the adhesivity, the hardness, cohesion of reconstituted pudding. Use of principal component analysis helped to identify the method of processing that gives the best taro pudding.

## Effects of pulsed electric field and elicitors on productions of phenolic acids and anthocyanins from grape (*Vitis vinifera*) cell culture

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Plant cell cultures provide a large potential for the production of secondary metabolites. Phenolic acids are compounds that have powerful health-promoting properties. Anthocyanins provide some of the coloring or pigments of plants, which can be used as a natural alternative to synthetic dyes. Through the applications of different cell stress, e.g., pulsed electric field (PEF), elicitors, we try to enhance the productions of these secondary metabolites. Effects of PEF and ethephon (as elicitors) on productions of phenolic acids and anthocyanins from grape (*Vitis vinifera*) cell culture and exudation were investigated. Harvested grape cell cultures were treated with PEF and ethephon. Phenolic acids from the growing medium on the 1<sup>st</sup>, 4<sup>th</sup>, 7<sup>th</sup>, 10<sup>th</sup>, and 14<sup>th</sup> days after treatments were extracted and determined in high performance liquid chromatography. Compounds were identified by using standards and by performing LC-MS. Anthocyanins were extracted quantitatively from fresh filter dried suspension cell cultures, and measured by spectrophotometer absorbance at 535 nm. The results show that, after the treatments with PEF and ethephon, the concentrations of phenolic acids and anthocyanins in grape cell culture exudation are higher than in the control. On the 4<sup>th</sup> day after the treatments, the total concentrations of phenolic acids reached the highest. Compared to the control, ethephon treatment and PEF + ethephon treatments were 1.6 and 2.0 folds, respectively. On the 9<sup>th</sup> day after the treatments, the concentrations of cinnamic acid reached the highest. Compared to the control, PEF treatment and PEF + ethephon treatments were both 1.3 folds. Application of PEF causes membrane permeabilization, allowing loss of cell content or intrusion of external media. The use of PEF with very low intensity as an external stress source induces a stress reaction of the cells with a possible stimulation of secondary metabolite production. Generally it is known that both biotic and abiotic stress causes plants react in this manner. This is of high interest since many secondary metabolites are proposed to have beneficial effects on human health.

## Functional properties of protein hydrolysates from poultry by-products produced by Alcalase

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Poultry by-products (head and leg) was used to produce hydrolysates with 10% degree of hydrolysis (DH) using the commercial protease Alcalase 2.4L (Novozymes). PH, solubility, water holding capacity, fat absorption, isoelectric point, buffering capacity, emulsifying and foaming properties of protein hydrolysate were measured. Protein recovered in soluble fractions yielded  $58.6 \pm 1.8$ . PH of hydrolysate was 8.64. Freeze-dried hydrolysates presented 100% solubility and good water holding capacity ( $2 \pm 0.4$  ml/g). Fat absorption was  $4 \pm 0.2$  ml/g and isoelectric point was at pH 7.5. Buffering capacity was 1400  $\mu$ mol NaOH. Emulsifying capacity and emulsifying stability was  $1.5 \pm 0.3$  ml and  $33.3 \pm 1.2\%$  respectively. Amino acid profile and molecular weight also measured. Results suggest that hydrolysates from poultry by-product can be produced with good functional properties for food ingredients.



## Prediction of oil content in tortillas chips using computer vision

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Several maize derived products such as tortillas (fried or without frying) are highly consumed in several Latin-American countries. The economic, cultural and social importance of these products is evident and engineering studies are relevant to design tortillas with better nutritional and sensorial quality. Computer vision is a valuable tool which helps to improve the automatic evaluation of food quality. The objective of this research was to study the relation between the oil content of tortillas chips under different processing conditions (time and pre-cooking) and some textural, chromatic and geometrical properties obtained from tortilla images by using computer vision. Tortillas of 2 mm of thickness prepared using nixtamalized moist dough called “masa” from maize were pre-cooked at 215°C during 1.5 min (pre-cooked tortillas). Tortillas without pre-cooking (control) and pre-cooked were fried at 175°C until reached a water content of 2% (wet basis). Digital images captured at each frying time were processed by computer vision. Surface oil was removed by immersion in petroleum ether for 10 seconds. Chips where superficial oil was removed were used to quantify structural oil content. Surface, structural and total oil content was determined using Soxhlet method and the results showed a lineal correlation ( $R > 0.95$ ) between oil content (surfacel, structural and total) and some parameters of texture obtained by computer vision such as: Fourier, Hu and Haralick moments. A high correlation among different parameters of texture during time frying with oil content and oil distribution was observed in tortillas chips indicating that computer vision could be used to improve the quality evaluation of the frying process of tortilla chips.

## High pressure effect on papaya purée antioxidant activity

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Papaya is one of the most important tropical fruits cultivated in the world. Papaya fruits are perishable and have fresh marketing hampered by the long distances between production and commercialization areas, which make the frozen purée a key ingredient for manufacturing other papaya products. Vitamin C, malic acid, citric acid, carotenoids and phenolics are some antioxidant compounds present in papaya fruits. Antioxidants can produce an effective protection action against the oxidative processes that happen in human's organisms. Several diseases have been associated with the damages caused by the low consumption of antioxidants. In this sense, the maintenance of the antioxidant compounds in the papaya purée along the preservation process and storage can be important for consumers and industries. In this way, hydrostatic high pressure (HHP) can be an alternative emerging technology to potentially preserve papaya purée by maintaining its sensory and mainly its nutritional characteristics. The aim of this study was to evaluate the effect of high pressure processing on the antioxidant activity of papaya purée by varying the pressure and pressurization time. The antioxidant activity was measured by spectrophotometer using free radical DPPH. The results showed that not only pressurization time but also the combination of pressure level and time significantly ( $p < 0.05$ ) affected the antioxidant activity of papaya purée, but without resulting in a major reduction of such property. The study suggests that the high hydrostatic pressure can be an interesting alternative for the preservation of papaya purée by highly maintaining the antioxidant activity.

## Detection of xenon gas hydrate formation in onion tissue for the application to chilling temperature storage

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It is well known that Xe is an anesthetic gas which can form the gas hydrate in water. Furthermore, it was suggested that the anesthetic mechanism may relate to the formation of gas hydrates. This is one clue for us to aim to develop the chilling temperature storage combined with the application of Xenon gas (Xe) for the preservation of fresh vegetable. In the process, it was shown that the quality of fresh vegetable could be kept for a long time under a certain pressure of Xe atmosphere at chilling temperature compared with ordinary chilling temperature storage. The mechanism of quality maintenance of fresh vegetable by application of Xe has been investigated from the view point of metabolism, such as respiration and protoplasmic streaming rate. The result showed the suppression of vegetable metabolism under Xe atmosphere, which is like an anesthetic phenomenon. In order to understand this mechanism in more detail, it is needed to solve a physicochemical questions that 1) can the gas hydrate form in vegetable by applying Xe ?, and 2) can Xe dissolve in intracellular water passing across cell membrane and cell wall ? In order to solve these questions, the formation of Xe gas hydrate in a onion tissue, 4 x 4 x 10 mm, was investigated through proton relaxation time by using a 25 MHz pulse NMR spectrometer (MU25A, JOEL) under Xe gas pressure up to 0.8 MPa at 5°C. Particularly, in this study, solid echo pulse sequences were used to measure transverse relaxation time T<sub>2</sub> of proton in the solid gas hydrate. By using this method, it was confirmed that Xe gas hydrate formed because the short T<sub>2</sub> (=7 μs), indicating the existence of solid component, was detected after applying Xe gas, whereas such a short T<sub>2</sub> component did not appear in the onion tissue without Xe gas. Adding to this, analysis of the NMR data suggested that over 10% of water in the onion tissue contributed to form the Xe gas hydrate crystal. Once the gas hydrate microcrystal formed, it gradually grew in the onion tissue with time. However, when around 30% of water in the onion tissue was drawn into the gas hydrate, the growth of gas hydrate in onion tissue stopped almost.

## Effect of active ultrasound treatment on the tenderness of beef during the aging process

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Appearance and gastronomic value of raw meat largely depends on the composition of the tissue, on its structure and on the effects of aging conditions after slaughter. The process of aging takes place in the course of storage. The aim of aging is to complete the effect of proteolytic enzymes. In the case of beef the aging time is 2-3 weeks. During this time the structure of beef becomes looser. Disadvantage of the long time is the appearance of undesirable alterations, such as rind formation or colour changes. These can be eliminated by the application of vacuum packaging, but this does not shorten the aging time. Beef frying without aging leads to undesired organoleptic characteristics. The surface gets dry and the slice loses its water content, so it becomes tough and firm. In practice different methods are used to accelerate aging processes of beef, but these are slow and hard to control. In the present work the objective was to reduce the aging time with ultrasound treatment. During the application of active ultrasound such acoustic effects (cavitations, atomization) occur that can promote meat softening. It is supposed that cavitations are the main effects of this action. The medium cavitations move the cells and myofibril into positive or negative direction via pulsating shock waves, so decreasing the connecting strength and increasing the space between them. This process can affect the texture of meat (softness and tenderness). Besides these textural effects the active ultrasound (above 1 W/cm<sup>2</sup> energy input) is advantageous because it may destroy microbes, too. Raw material of the investigations was beef strip loin. The traditional aging lasted 3 weeks at (-1)-(+1) °C. The samples were vacuum packaged. A part of the vacuum packaged samples were treated by ultrasound for 1, and 1, 5 hours, respectively. The changes in colour, texture, and pH were measured. Meat tenderness was tested with sensory analyses, too. Results showed that the most tender texture was found on the 11-14<sup>th</sup> days at this storage temperature. The texture of ultrasound treated samples was softer than that of the traditionally aged meat. The sensory analyses were suitable for monitoring the aging of meat.

## Production of the lactic acid by *Rhizopus oryzae* using semi-continuous fermentation

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Lactic acid is a commonly occurring organic acid, which is valuable due to its wide use in food-related industries, and its potential for the production of biodegradable polylactate polymers. Lactic acid can be produced using bacteria and fungi. As the fungal *Rhizopus* species can generate L-lactic acid as a sole isomer of lactic acid, they have been recognized as suitable candidates for lactic acid production. Recently a semi-continuous fermentation of *Rhizopus* species to produce lactic acid was developed. During the semi-continuous fermentation the mycelia can be repeated used for many times, the fermentation cycle was shortened more, and the productivity was improved. In searching for the best condition of the semi-continuous fermentation, we researched the effects on production of lactic acid by *Rhizopus oryzae*, such as the seed medium, feeding medium, inoculations, addition time of CaCO<sub>3</sub>, temperature, work volume, shake speed and aeration. In the end of the fermentation, we drained out the broth and added fresh medium to the fermentor, repeated the fermentation. We confirmed the stability of the semi-continuous fermentation by the self-immobilized *Rhizopus oryzae* in a 7 L magnetic stirred fermentor, and the agitation was 300 r/min, the aeration was 1.25 L/(L min) and the temperature was 32°C. Enzyme determination showed that the activity of the lactate dehydrogenase was low along the process and not changed more about 2.0 U/mg protein, but the activity of alcohol dehydrogenase changed a lot, in the end of the 20<sup>th</sup> batches its activity was very low about 3.5 U/mg protein. During the process lactic acid yield was stability about 80%, product of lactic acid by *Rhizopus oryzae* was improved. It was a basis study for the magnification production of lactic acid by *Rhizopus oryzae* with semi-continuous fermentation.

## Use of hydrolysates from yellowfin tuna (*Thunnus albacares*) heads as a complex nitrogen source for lactic acid bacteria

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Two different peptones obtained by enzymatic hydrolysis of yellowfin tuna (*Thunnus albacares*) head waste have been shown to be effective in promoting the growth of lactic acid bacteria (*Lactobacillus bulgaricus* PTCC 1332, *Lactobacillus acidophilus* PTCC 1643, *Lactobacillus casei* PTCC 1608, *Lactobacillus delbrukii* PTCC 1333, *Lactobacillus plantarum* PTCC 1058, *Lactococcus lactis* PTCC 1336, and *Lactobacillus sakei* PTCC 1712). Peptones from the enzymatic hydrolysis by Alcalase or Protamex were used instead of standard peptones used in commercial MRS media. Peptones produced by Alcalase and Protamex had 34 and 19% degrees of hydrolysis, respectively. The results showed that the peptones from Alcalase and Protamex were better at promoting LABs growth compared to commercial MRS media ( $P < 0.05$ ). The choice of the proteolytic enzymes used to produce the fish hydrolysate had a considerable impact on the performance of the resulting hydrolysate, both in terms of maximum growth rate and biomass production. Peptone from Alcalase, with a higher degree of hydrolysis induced better growth than peptone from Protamex. Generally, the peptones produced by Alcalase performed better as an LAB-substrate than those from Protamex.

## Comparative study of the separation of eleven selected quinolones on three HPLC columns and one UPLC column

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Quinolones (QNs) are a group of synthetic antibacterial agents intensively used in human and veterinarian medicine as well as in industrial farming as feed additives. Efficient multiresidue methods are required for monitoring residue levels to ensure safety of the food supply. High-performance liquid chromatography coupled with fluorescence detection (HPLC-FLD), one of the more preferred analytical techniques for routine QNs residue analysis, was chosen for the determination procedure. In this study, separation of selected eleven QNs on three HPLC columns including an Agilent ZORBAX Eclipse XDB-C18 column (20 mm×3.0 mm i.d., 1.8 µm), a Waters X Bridge TM C18 column (150 mm×2.1 mm i.d., 5.0 µm), a Waters Symmetry Shield TM RP18 column (250 mm×4.6 mm i.d., 5.0 µm) and a Waters Acquity UPLC TM BEH C18 column (50 mm×2.1 mm i.d., 1.7 µm) were developed. The analyzed QNs were piperidic acid (PIP), enoxacin (ENO), norfloxacin (NOR), ciprofloxacin (CIP), lomefloxacin (LOM), enrofloxacin (ENR), gatifloxacin (GAT), difloxacin (DIF), oxolinic acid (OXO), nalidixic acid (NAL), flumequine (FLU). Special attention was paid to the resolution of the structurally very similar analytes like NOR and CIP, ENR and LOM. Different gradient were optimized and best separation were achieved on each column under their optimal flow-rates with a conventional mobile phase of 0.2% aqueous formic acid and acetonitrile. Sensitivity, performance characteristics, analysis time and method validation were reported for these columns, column efficiency were comparative studied based on these parameters. HPLC and UPLC separation of eleven QNs on four columns which increase the efficiency of analysis are available for routine regulatory fluorescence analysis and could be applied to the determination of the selected quinolones in commercial available sample.

## Small-scale wet expanded preservation key technology of rice bran

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It is difficult to store the rice bran because it contains lots of lipases which are easy to be rancid and get deterioration. According to the actual conditions of rice production enterprises of China, small-scale wet expanded preservation key technology of rice bran was on study creatively. Expanded preservation of rice bran was carried on at the first time when it left off the production line. This technology craft connected the craft of the rice production enterprises perfectly. It was proved from the practice the acid value of the fresh rice bran could be controlled at 10 mg KOH / g and the acid value of the crude oil after extracting could be below 15 mg KOH / g. It enhanced the oil yielding and oil refining rate greatly and resolved the preservation problem effectively. As well it provided the available ways for the increment and deep processing of rice bran. This technology is suitable for application and popularizing in the rice processing enterprises in China and has good economy and society benefit.



## Detection of fungal infestation in citrus fruits using hyperspectral imaging

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Early fungi infection detection is especially important in citrus packinghouses because a few infected fruits can disseminate the infection to a whole batch, causing great economic losses and affecting further operations. *Penicillium digitatum* sp. produces the most important postharvest damages in citrus packinghouses. Nowadays, detection of this problem in the packing lines is carried out visually and fruits are removed manually. Rottenness causes damages in the skin of the fruit that are very difficult to detect in the early stages using visible lighting. Hyperspectral computer vision systems can be used to investigate the contribution of the different individual wavelengths to detection of the damages. However, the high amount of redundant information generated by these systems makes necessary the use of data mining techniques. Hyperspectral imaging has been employed in this work to detect citrus oil glands breakage caused by fungal infestation, in order to replace traditional UV illumination, which is the common method implemented in current packing houses. UV light is potentially harmful for the skin and eyes of human operators and for this reason important security measures must be adopted. In this work, different data reduction techniques and segmentation procedures were employed. Results showed that an algorithm based on classification and regression trees detected 91% of decayed fruit, providing a safer method for this inspection procedure than using induced UV fluorescence. These results are compared with other obtained using a standard colour imaging system, being considerably better.

## **Crispness detection by the evaluation of force-displacement characteristics - correlation to pore size distributions**

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One of the quality determining parameters of extruded products, as for example snacks, is the crispness. Whereas normally for crispness detection often sensory panels are used, a more objective method could be the evaluation of force-displacement characteristics. Several parameters of these force-displacement characteristics have been proposed for this task in literature and are evaluated in this work. Additionally correlations between the crispness and the underlying pore structure (e.g. the pore size distribution) as measured by magnetic resonance imaging are presented.

## Effect of ultrasonic waves on flux enhancement of milk microfiltration

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One of the most important problems encountering membrane applications in industrial separation processes is fouling. It causes membrane flux to decline and as a result, separation capacity of the plant reduces rapidly. Furthermore, the processes must rupture periodically in order to clean or replace the membranes. In recent years, various methods have been used for treatment of the fouled membranes. One of the newest techniques is irradiation of membranes surfaces by ultrasonic waves. In this research, effect of ultrasonic waves on permeation flux of a microfiltration membrane (cellulose ester) fouled with fresh cow milk as feed was studied. Also, various parameters such as feed pressure and the distance between the irradiation source and the fouled membrane surface were studied and permeation flux variations were recorded. The best flux enhancements were obtained at lower pressures and at shorter distances. Also, SEM analysis confirmed that ultrasonic irradiation has no destructive effect on the membrane surface.

## Inactivation of *Bacillus atrophaeus* spores and Pixuna Virus by a combination of high pressure, heat and chemical reagents

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Spore forming bacteria from the species *Bacillus* and *Clostridium* cause massive risk in the food industry due to the production of toxic substances and off-flavour which contribute to food spoilage. Furthermore their bacterial spores exhibit large-scale resistances against various forms of preservation techniques, which include heat, chemical reagents and high pressure treatment. *Bacillus anthracis* has long been considered as a potential biological warfare and is moved closer to public notice since the last Anthrax bioterrorism in 2002. Human pathogen viruses were also used as biological warfare agent. We investigated the combination of high pressure (600 MPa), moderate heat (60°C) and chemical reagents for inactivation of *Bacillus atrophaeus* - spores, an Anthrax surrogat, and Pixuna Virus as a possible decontamination method for biological warfare agents. Simultaneous the processed samples should be preserved analysable by two independent detection methods (PCR and ELISA). Currently, detection methods for biological warfare often failed because of the commonly used, high intensive thermal or chemical inactivation. The combination of high pressure and chemical agents like hydrogen peroxide, alkylating substances, Nisin and Lysozym led to increased spore inactivation up to 6 log at different treatment times (10, 20, 30 min). These combined treatments reduced also the required treatment time for complete quantitative spore inactivation. Nevertheless the treated samples remain analysable by PCR and ELISA detection methods. Only high treatment intensities or addition of alkylating substances in combination with 600 MPa/ 60°C affected the ELISA detection significantly. Very high pressure (800 MPa) at elevated temperatures (90°C) resulted in a complete quantitative spore inactivation up to 6 log<sub>10</sub> in pure water at considerable reduced treatment times (one minute). Pixuna Virus was not significantly reduced in pure water at 150 MPa and 37°C. However, increased treatment intensities at 600 MPa/ 60°C or addition of alkylating reagents like Beta-Propiolacton or Beta-Ethylenimine with moderate or high pressure yield a complete virus inactivation in the range of 8 log<sub>10</sub>. The PCR detection of the processed virus samples rested mostly unaffected by high pressure processing unlike the virus detection by ELISA. Our results confirmed that high pressure plus moderate heat in combination with harsh or mild chemical substances lead to high inactivation level and detectable post-samples. These results suggest the combination of high pressure, heat and chemical reagents as a powerful tool for decontamination and post-analysis of biological warfare as well as a promising food preservation technique.

## One step partial purification of $\beta$ -galactosidase from *Kluyveromyces lactis* using microemulsion droplets

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The ability of the  $\beta$ -galactosidase to break down lactase, converting it to the sweeter and more soluble glucose and galactose, gives the enzyme considerable commercial importance. Perhaps most importantly, it can significantly enhance the availability of milk and dairy foods to consumers suffering from some degree of lactose intolerance. In order to obtain a technical enzyme, yeast cells of *Kluyveromyces lactis* were disrupted by mini-beadbeater and an innovative reverse micellar extraction technique was tested for the recovery of  $\beta$ -galactosidase. Water-in-oil microemulsions, also known as reversed micellar solutions, are organic solvents containing nanometer-sized droplets of water, stabilized by a monolayer of surfactant. The water-containing microemulsion droplets can selectively extract protein molecules depending on the pH and [salt] of the system, which tune the size of droplets and protein-surfactant charge interactions. These microemulsions are largely immiscible with water, and can potentially be used to effect a liquid-liquid separation of the protein from other components in the cell broth. We recently designed a one-step separation process based on this concept. The aqueous protein mixture is first added to the microemulsion. In that solution, the droplets take up most of the water, most of the impurities, but expel the lactase into an excess water pool because of its large size. A 5.4-fold purification factor was achieved with 96% activity recovery. Total protein concentration of the applied sample affected purification and reverse micellar extraction performance. The results presented show our one-step separation process to be an interesting method for the production of  $\beta$ -galactosidase as a technical enzyme, since it can also be applied on a continuous large scale partial purification of enzyme and it reduced the number of steps required in downstream processing.

## Bovine cathepsin D activity under high pressure

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The application of high hydrostatic pressure offers some interesting opportunities for the processing of muscle based food products. It is well known that high pressure processing can prolong the shelf life of meat products in addition to chilling, but the pressure labile nature of protein systems limits the commercially range alternative of applications. Alternatively, high pressure has been reported to affect the texture and gel-forming properties of myofibrillar proteins and hence, has been suggested as a physical and additive-free alternative to tenderise and soften meat and fish products. However, the rate and magnitude at which pressure and temperature effects take place in muscles are variable and depend on a number of circumstances and conditions which are still not fully known and understood. It has been suggested that the synergic activity of proteolytic systems, particularly cathepsins, could be responsible for the changes occurring during meat tenderisation under pressure. The objective of this study was to determine the high pressure/temperature combinations that maximise the catalytic activity of bovine cathepsin D in a model system. The kinetics of enzyme inactivation and conversion of a model substrate in Tris-bis buffer (pH 6.0) in different pressure-temperature domains (0.1-650 MPa, 20-75°C) were investigated and described with mathematical models. Cathepsin D inactivation was generally accelerated with increasing pressures and/or temperatures. However, at 60°C cathepsin D showed the highest stability at 100 MPa indicating anagonistic effects of pressure and temperature on enzyme stability in the low pressure domain (< 150 MPa). The catalytic activity of cathepsin D was found to be increased with temperature, but drastically decreased at high pressure conditions. The possible reason for this phenomenon is an alteration of the substrate used and/or a change of cathepsin D structure, which could disturb the recognition between the enzyme and the substrate. For a 20 min process, highest catalytic activity of cathepsin D was found at 60°C and ambient pressure conditions. Thus, the combination of high pressure and temperature was not found to improve the catalytic activity of cathepsin D and does not provide an explanation for the mechanism of meat tenderisation under pressure.

## Comparative study of different antibrowning treatments in fresh-cut potato (cv. Monalisa)

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Fresh-cut vegetable industry has undergone an important growth due to the increasing demand for fresh, healthy and convenient foods. Consumers have become more critical to the use of artificial additives in order to preserve food or enhance characteristics such as colour, flavour and nutritional value. Minimally processed potatoes involve peeling, slicing and immersion prior to packaging and storage. That processing of tubers promotes a faster physiological deterioration, biochemical changes and microbial degradation of the product, which may result in degradation of the colour, texture and flavour. In the case of fresh-cut potatoes one of the main limit factors is the enzymatic browning which appears for the action of polyphenol oxidase. Traditionally sodium disulphite has been used on slicing potatoes, but it presents some healthy problems in asthmatic people so there is an interest to find an alternative to this compound. In this study were evaluated 4-hexylresorcinol (HR), as a new generation of antibrowning compounds and derivate of a natural compound, which was combined with ascorbic acid (vitamin C) for a synergetic action. On the other side, an extract of green tea, as a natural alternative because is an excellent source of polyphenols, which are natural antioxidants. Finally, both of them were compared with the action of an optimized solution of sodium disulphite plus citric acid. The samples were disinfected, washed, peeled, sliced, treated with preservative solutions, packed and stored for 14 days at 4°C. The analysis developed were texture (texture analyzer with a knife blade), colour (CIELab, spectrophotometer CM-2500d), pH, soluble solids content and moisture content. Significant differences were observed among the treatments mainly on texture and colour. It is possible to conclude that sodium disulphite could be substituted for more natural preservative agents but it is important developing deeper research to achieve accurately characterisation of the product and to find the optimum concentrations to obtain the higher quality of fresh-cut potatoes (cv. Monalisa).

## Application of planetary roller extruders for food and non-food processing

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The application of extrusion processes is part of the state of technology in different fields of food processing. This technology is aimed at the disintegration of essential components, e.g. starch and/or protein of various raw materials. During this process the structure of the raw material is changed significantly. The restructuring takes two directions: The expansion of raw materials which is achieved by cooking extrusion (e.g. peanut flips and other snacks), and gelatinization (at reduced temperature profile) which produces solid “horny” products (e.g. semi-finished products for frying). For these processes short-screw and long-screw extruders with one screw (one-screw extruder) or two screws (twin-screw extruder) are used which are tipped with various working elements (screws). The planetary roller extruders are relatively new. They are characterized by planetary screws which are arranged around a central spindle. Compared with conventional one-screw and twin-screw extrusion, significantly greater surface actions are achieved. The combination of planetary configuration, the external energy input, and the speed range brings about intensive mixing and kneading processes. Fields of application which are apparent already now, are the confectionery industry and the production of gelatinates and reactive additives. In the field of technical products applications for the development of bioplastics and wood plastic compounds are seen.



## Determination of polyphenols by means of nondestructive fluorescence analysis in oil inside olive genetic breeding programmes

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The fluorescence spectroscopy may provide a powerful tool for analyzing nondestructively characteristic components constituting the quality of olive oil. Polyphenols are the essential compounds in the prominent 'Mediterranean diet', owing to their interactance as natural antioxidants reducing cardiovascular disease and providing anticancerogenic properties. In the present work, a total of 65 samples of olive oils from a genetic breeding program (IFAPA-Junta de Andalucía, Spain) were analyzed by HPLC obtaining the polyphenols data [ppm] after calibration. The fluorescence spectroscopy was carried out in the Horticultural Engineering Department of the Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB), exploring different ranges regarding the excitation ( $\lambda_{ex}$ ) and emission ( $\lambda_{em}$ ) spectra in raw oil and diluted 1/10 in hexane, using a fluorimeter (LS55, Perkin-Elmer, USA) equipped with a xenon flash lamp serving as light source and photomultiplier tube as detector with two grating monochromators for excitation and emission path with a resolution of 0.5 nm. For analysing the oil spectra, different methods of data pre-processing such as multiplicative scatter correction, standard normal variate, and the Savitzky-Golay algorithm in first derivative were applied. Calibration models were developed using partial least-squares (PLS1) regression analysis to evaluate the potential of fluorescence spectroscopy in olive oil quality monitoring. In the calibration, correlation coefficients in the range of  $r = 0.88$  were found for polyphenols, while the standard error of cross-validation was  $SECV = 71.48$  applying the first derivative of oil fluorescence spectra with  $\lambda_{ex} = 200-500$  nm and  $\lambda_{em} = 525$  nm in diluted samples. The statistics were improved when outliers were removed obtaining calibration results of  $r = 0.98$  and  $SECV = 19.74$ . Concluding, these results demonstrate the potential of fluorescence spectroscopy for monitoring specific quality parameters in olive oil, being a rapid and cost efficient method, e.g. as a selective tool in olive breeding programs where a high number of samples have to be evaluated every year.

## Differentiation of Spanish honeys by potentiometric electronic tongue

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The honey packaging and commercialization industry need simple, fast, and reliable techniques to allow the determination of the origin and authenticity of honey; before, throughout the industrial process, and in the final product. The aim of this study was to introduce the usage of a potentiometric electronic tongue as a possible alternative for botanical honey differentiation. Four types of Spanish honey; three of floral origin (citrus, rosemary and polyfloral) and one from honeydew (forest origin) were used in this study. The botanical origin of the samples was ascertained by melissopalynological analysis. These four varieties were chosen as they represent the most popular types of honey consumed in Spain. An electronic tongue system was developed using several potentiometric sensors built around eight metallic electrodes: three with pure metal (gold, silver, and copper) and five with oxidized metal electrodes (CuO<sub>2</sub>, AgO<sub>2</sub>, AgCl, AgCO<sub>3</sub> and Ag<sub>2</sub>SO). A measurement system was developed for this specific application in order to quantify the potentiometric response of the electrodes. In essence, it is formed by: a set of potentiometric electrodes, a signal conditioning system, equipment for digitalization and acquisition of the signal (performing an automatic sampling of signals at predetermined times) and lastly appropriate software for data analysis. Measurements were made by submerging the set of electrodes in a flask containing a sample of honey for the required time to achieve the electrochemical balance. Once this balance had been reached, the final values for each sample and electrode were calculated as the average of the corresponding data sampling. The measurements were repeated eight times on different days and a data matrix was compiled in order to perform a multivariate analysis. Despite the fact that the electrodes act as non-specific sensors, data can be treated with principal component analysis, thus leading to the differentiation of honeys according to the botanical origin. The clearest separation observed was between honeydew and floral origin honeys. In conclusion, the results obtained show a potentially effective tool to facilitate the differentiation of honeys, complementing or replacing the traditional analytical methods used to this end. If proved effective and reliable, it could be used by the industry as a continuous quality control system to achieve significant savings in terms of manpower and time.

## Effect of deviation in storage temperature on the shelf life of a food product

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Deviations in the temperature of the storage environment from its expected or intended level will produce unwanted excursions in the temperature of any stored food product. This in turn will cause permanent changes to any temperature-sensitive quality parameters of the product and thus affect shelf life. This paper reports on how three such deviations influence the behaviour of mushrooms in storage. These deviations include a saw-tooth storage temperature profile due to the on-off operation of a temperature controller, a time varying random component to storage temperature and thirdly unpredictable interruptions due to opening and closing of the storage chamber door. The first of these deviations is deterministic in nature while the latter two require statistical characterization. A theoretical analysis is conducted to quantitatively describe each these deviations. A simple model of heat transfer to a mushroom is presented and used to predict the influence of these disturbances on the temperature of the product. The whiteness of the mushroom is taken to be the quality parameter of interest and the data for its Arrhenius temperature sensitivity obtained. Experiments were carried out to validate the thermal model of the mushroom and to determine the nature and level of temperature deviation that can occur in a storage room with a nominally controlled temperature. Data from the experiments is used to validate the deterministic model and provide input to the theoretical equations that describe storage temperature deviations. Simulations are then carried out to investigate how mushroom colour and predicted shelf life is affected using the measured data. The deviation from the expected ideal response (that is obtained with a known and invariant storage temperature) is quantified in two ways. The first is by the average temperature difference between the ideal and actual product temperature over a given storage duration; the second is by the difference in colour between the two cases at the end of the same storage duration. Results demonstrate that the relative effect of each type of deviation on mushroom temperature and colour depends on both the magnitude of the storage temperature excursion associated with each deviation and the characteristic duration of the excursion compared to the thermal response time of the product. For the data pertaining to this study, random door opening and closing occurrences make the greatest contribution to adverse quality.

## **Device for composition, concentration, and volume batching of food liquids**

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The paper presents a spectrometric portable modular system for applications in water, juices, and wines. The use of this device allows liquids aspiration, determination of composition, and concentration. This complex system offers the possibility of composition and concentration determination in both, greasy and uncoloured liquids.

## **Contributions in wines quality determination by a modular portable spectroscopic system**

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The purpose of researches is to demonstrate the importance of a modular portable system for wine quality monitoring. Using the experimental technique and mentioned devices two problems are tackled: one refers to the tracking of wines falsification and another to the influence of light radiation upon red and white wines quality.

## Detection of milk coagulation using ultrasonic technique

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In the case of set yogurt mass-produced in the dairy plant, the inoculated milk is filled into the final package and incubated to the desired degrees of acid, flavor and texture, and then rapidly cooled for stopping fermentation. Too long or too short a fermentation lower quality of yogurt. The timing of stopping fermentation by rapid cooling is determined by sampling inspection of titratable acidity. This test is, however, destructive and takes some time to complete the test. This study focused on auto-detection of the timing for stopping fermentation by using ultrasonic technique in order to automatically operate the yogurt manufacturing process. In our previous study, the phase velocity and amplitude of 1.5 MHz ultrasonic signal increased with incubation time and reached to steady state values. The changing trend of phase velocity was almost same as that of acidity, and the hardness rapidly increased when the acidity reached to the steady state level. In this presentation, the reason for a high correlation between phase velocity and pH is discussed. Skim milk was filled in a sterile plastic container, on whose both side walls a pair of ultrasonic transducers (AE-900F2, NF corporation, Japan) were placed in a temperature controlled environment. Lactic acid was dropped to the milk by increments. An ultrasonic pulse generated by one transducer propagates thorough the milk to the other transducer. The detected signals were digitized by a DSO (DL1200, Yokogawa Electric Corporation) and then stored on a PC. Several containers filled with the same material were incubated in parallel for measuring pH, acidity, viscosity, density and hardness during fermentation. Coagulation of milk is occurred at pH 4.6 which is the isoelectric point of milk casein. The intrinsic density and the partial specific adiabatic compressibility calculated from phase velocity data changed rapidly at this isoelectric point of milk casein. It is believed that they are caused by decrease in casein micelle hydration at this point. Therefore, the phase velocity should have a close relation to pH which determines hydration state of casein micelle.

## Optoelectronic systems for fresh-cut salads evaluations: a preliminary study

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Fresh ready to consume salads represent a new pulling segment of the vegetable industry at national and international level (Bacarella 2002). Since the high perishability of the raw materials, quality is a fundamental attribute for good conservation and appearance on shelf during commercialization (Watada 1996). Nowadays quality is committed only to human evaluation. The improvement of non intrusive techniques, able to analyze fastly and in a repeatable way food products, suggests their utilization. Aim of this study was to evaluate the use of optoelectronic techniques (colorimetric, spectral and chlorophyll fluorescence) to characterize ready to eat salads when delivered to wholesalers (packaged) and to establish the trend of the monitored parameters during conservation (shelf-life). Samples were provided by the producers "Ortomad" (Pontecagnano, SA, Italy). The tests interested Lettuce (*Lactuca sativa*) baby leaf, escarole (*Cichorium endivia* var. *latifolium*) and rocket (*Eruca sativa*), evaluated during conservation times (T<sub>0</sub>=packaging day, T<sub>1</sub>=T<sub>0</sub>+2days; T<sub>2</sub>=T<sub>0</sub>+5days; T<sub>3</sub>=T<sub>0</sub>+7days). Colorimetric and spectral data were acquired through a Spectral Scanner (DV, Padova, Italy) covering the spectral range 400-975nm, returning data following the CIE L\*a\*b\* colorimetric standard (CIE 1976) following the standard illumination-optical device geometry  $\beta_{45/0}$ . Spectral values were expressed in terms of relative reflectance (R) and were elaborated through multivariate analysis PLS-DA (Partial Least Square Discriminant Analysis) to discriminate among different conservation times. The colorimetric comparison between T<sub>0</sub> and T<sub>3</sub> shown correspondingly (L\*a\*b\*) variations of: 8.17, 1.05 and 1.75% (baby leaf); 5.01, 2.05 and 2.9% (escarole); 9.82, 5.89 and 1.09% (rocket). The PLS-DA model produced good performances of correct classification among conservation times for baby leaf, escarole and rocket respectively equal to: 91.6, 83.3, 91.6% with respective errors in terms of RMSECV of 0.393, 0.377 and 0.2911. Chlorophyll fluorescence was measured by IMAGING-PAM Chlorophyll fluorometer (Walz GmbH, Germany) providing the pulse-amplitude-modulated measuring light, followed by a saturation pulse (2400  $\mu\text{mol quanta m}^{-2} \text{s}^{-1}$ ) in order to determine F<sub>v</sub>/F<sub>m</sub> (maximal quantum yield) and calculate the photochemical parameters at different values of PAR (Photosynthetic Absorption Rate). Photochemical parameters obtained from kinetic and light curves showed significant differences between salad samples during conservation times. Linearly correlating the colorimetric parameters with fluorescence data, it emerges a correspondence between b\* and F<sub>v</sub>/F<sub>m</sub> with r ranging from 0.64 to 0.75. Thus the proposed optoelectronic techniques allow a classification of the products on the base of its conservation time.

## **Graphical representation method of discharging profile of agro-food bulk solids extracted with geometric variable design screw feeders**

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Screw feeders are devices suitable for handling a wide variety of bulk solids materials that have good flow ability characteristics and are often used as dosing feeders in food industry and agriculture. The manner in which material flows into the screw feeder affects the flow characteristics of the feeding hopper, the residence periods of the material in various locations in the bunker and thus the properties of the dosed material. The present paper will present some experimental results regarding the discharging profile of the mass flow screw feeders with variable geometrical design.

## Optimizing conditions of smoked operation to obtaining chipotle peppers

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Chipotle pepper is a valued product because of its flavor and aroma, being used for the preparation of marinade sauces and purees. However its industrial production has some drawbacks because is produced in a relatively uncontrolled process, specially during the smoking-drying process resulting in a product with a wide-variable quality. The aim of this study was to found the optimal time and smoking temperature of red jalapeno peppers to obtain a dried chipotle peppers with the desired physical, chemical and properties of the final product. Batches of washed and scarified red jalapeno peppers were smoked under different temperatures (65.8, 70, 80, 90, 94.1°C) and times (0.96, 2, 4.5, 7, 8). Then were dried at 80°C in a cabinet dryer with through flow at a speed of 3 m s<sup>-1</sup> until a moisture content between 0.123-0.204 kg H<sub>2</sub>O•kg<sup>-1</sup> dry matter was reached. Dried and smoked peppers were evaluated for moisture content, viscosity, phenols, rehydration ratio, firmness and color. The study was optimized using a second order rotatable central composite design and results were analyzed using response surface methodology. Firmness of rehydrated peppers and viscosity of smoked and chipotles pepper were affected (p 0.05) by both smoking temperature and time. The behaviors of these variables were adjusted adequately to a second order model. Phenols content in smoked peppers were of 181-537 mg kg<sup>-1</sup> d.b. and for chipotles results in values of 51-130 mg kg<sup>-1</sup> d.b. Rehydration ratios of 2.5 to 4.3 for chipotles were obtained. Process conditions caused notables changes in chipotles color. Best smoking process conditions were in a temperature range of 84-91°C, with times between 4.6-6.8 hours. The results of this process can be used to decrease significantly the smoking time and energy consumed maintaining the quality attributes of this product.



## Selecting the most suitable packaging technology for liquid foods using an analytic network process model

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The aim of this paper is to provide a model which allows identifying, for several different liquid foods the most appropriate packaging technology that is the industrial process by which the product is hygienically coupled with the container. In order to achieve this aim, several factors were examined, such as cost, safety, quality of product and plant reliability, which may directly or indirectly affect the resulting efficiency of the process. The first step of the work was thus to exhaustively investigate commercial liquid foods and to classify them on the basis of their chemical and physical properties, relevant to identify the most suitable packaging technology. Examples of such properties include CO<sub>2</sub> concentration, viscosity, presence and size of solid particles, and foaminess of the product during filling operations. Based on the above properties, cluster analysis was exploited to group the products into 4 sets; as a further step, a mathematical model was developed to predict the group membership for a new product, not previously classified. For each group of products, several different filling and packaging procedures are considered as possible alternatives, and pondered based on criteria that emerged as relevant for the feasibility industrial of the process. Analytic network process (ANP) is used as a viable decision tool to this extent. Decision matrixes were completed based both on pieces of information available in literature, and interviews with experts. Results of the study provide a quantitative assessment of the most suitable packaging technology and equipment depending on the liquid foods considered.

## The extraction of essential oils by instant autovaporization

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In order to intensify the operation of essential oil extraction, improve the quality of both extract and residue, the instant controlled pressure drop (DIC) treatment was used as a direct extraction – separation treatment. DIC treatment allows volatile molecules to be removed by both evaporation during the high temperature – high steam pressure stage, and autovaporization by instantaneously dropping the pressure. This treatment also allows the compact vegetal pieces to be expanded, and the second extraction of non volatile molecules to be possible and its kinetics to improve avoiding the local high temperature generally due to the crushing. The final extracted essential oil could answer the various quality requirements in terms of absence of solvent and thermal degradation. In addition, the great kinetics (Processing time is about 4 minutes instead of some hours in hydro or steam extraction) is linked to low heat energy consumption.

## Heat transfer modeling in soft foods inline processes by fractals meteorology

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At the present time, the productive systems have been evolving every day and the process engineering should be more active about the process control as the globalize world demands it, since it allows to optimize the raw materials and the power sources necessary to produce a food. The food's thermal properties are fundamental for the agro-alimentary industry. This thermal properties allows or makes difficult the thermal transference between the heating source and the food it self; the main characteristic anisotropism of the vegetal fiber makes difficult the behavioral modeling or the prediction of such product, therefore has been worked with certain associate error. On the other hand, the incorporation of the Koch's vortexes (fractals meteorology), as well of the full study of the three associated phenomena in the heat transfer, gave as result a two dimensional simulation of the different thermal distributions at the inside of an infinite cylinder that compared with the electronic sweeping microcopies are irrefutable and consistent than the used postulates. For the data collection it was used a linear heat source. The data acquisition it was realized through/by mean the USB protocol for the distinct temperatures zones with K type digitals thermocouples (DS2760), that were connect to a central PIC SX48DB/TQ with RS232 protocol. The PIC SX48DB/TQ was connected to a PL2330 SSOP PIC that converts the UART signal to USB 1.1. The USB 1.1 signal is captured for software interface that was developed with Microsoft Visual Basic 6.0 ®. The interface makes possible the collection and the analysis of the collected data. The methodology shows to be much more efficient in computational time and resources, opening a window for future online and inline instrument for thermal analysis in food and soft materials.

## Kinetics of CO<sub>2</sub> production of blueberries (*Vaccinium corymbosum* L.) 'Elliott' harvested from conventional and organic orchard

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The behavior of the CO<sub>2</sub> production kinetics in postharvest of the high blueberry (*Vaccinium corymbosum* L. 'Elliott'), harvested from organic and conventional orchard, was studied. The blueberries samples were stored at 10, 15, 20, 25 and 30°C, and the production of CO<sub>2</sub>, was measured, once the respiration will reach a constant rate. The method of constant gas flow was used. To be able to determine the pattern that could describe the behavior of the production of CO<sub>2</sub> and the temperature dependence of the respiration, the Goro and Arrhenius constants were calculated. In the treatments, one observes a bigger rate of production of CO<sub>2</sub> in organic blueberries, which reached an activation energy from 101.0 KJ mol<sup>-1</sup>K<sup>-1</sup> smaller to the one reached by conventional blueberries that reach a value of 153.6 KJ mol<sup>-1</sup>K<sup>-1</sup>. The differences among the activation energy and the CO<sub>2</sub> production behavior show the effect that can have the organic and conventional handling, on the rate of production of CO<sub>2</sub> in the fruits in postharvest at storage temperature conditions. According to the opposing differences, the blueberries of organic origin are sensitive to the changes of temperature that can take place during the storage and transport from the orchard to packing house and to the port of destination.

## Study on chlorophyll distributing rule of rice and its nitrogen status quantification using Vis/NIR spectroscopy

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The estimation of nitrogen status non-destructively in rice was performed using spectral reflectance with visible and near infrared reflectance (Vis/NIR) spectroscopy, all the research were carried out at experiment field in the Zhejiang University during growth season of 2007 to 2008. The SPAD 502 chlorophyll meter was applied to investigate the distribution rule of chlorophyll concentration in the rice during different growing periods. The correlation between SPAD value and nitrogen content of leaf was analyzed, and the correlation coefficient was high which can depict by the formula  $Y = 0.2344X - 5.7486$ . The nitrogen content for leaves were studied, and spectral reflectance for a total of 122 leaf samples were collected by Vis/NIR spectroscopy at 325-1075 nm using a field spectroradiometer, and chemometrics of partial least squares (PLS) was used for regression. The correlation coefficient ( $r$ ), root mean square error of prediction (RMSEP) and bias in prediction set by PLS were 0.8545, 0.7628 and 0.0521. In addition, the chlorophyll value (chlorophyll a, chlorophyll b, chlorophyll a+b) for the top three leaves were measured, and spectral reflectance for a total of 192 leaf samples were collected. The  $r$ , RMSEP and bias in prediction set by PLS were 0.8545, 0.7628 and 0.0521 for chlorophyll a, 0.9034, 0.5603 and 0.0921 for chlorophyll b, 0.8632, 0.7469 and 0.0324 for chlorophyll a+b, respectively.

## Fast discrimination of varieties of liquorice using visible and near infrared spectroscopy based on principal component analysis and back propagation neural network model

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Liquorice is widely used in herbalist doctor, and it's also the important material in fine chemicals. The chemical components of liquorice is very complex, especially the different varieties liquorices which do not have the same chemical components. But each kind of chemical component in liquorice has different functions in drug or fine chemicals. In order to apply more scientifically and configure different kinds of liquorice prescription, the rapid identification of licorice varieties becomes much more important. To achieve this purpose, this paper provide a new nondestructive method for discriminating varieties of liquorice by visible and near infrared spectroscopy (Vis/NIRS) which was developed. First, the spectral data were analyzed by principal component analysis (PCA) for varieties clustering. Then diagnostic information was obtained from original spectra, and the information was used for pattern recognition based on back propagation neural network (BPNN) mode1. The score plot provided the reasonable clustering of the varieties of Liquorice. Small quantities of principal components from PCA were used as inputs of a back propagation neural network (BPNN) with one hidden layer. 120 samples were selected randomly from four varieties. Then they were used to build back propagation neural network (BPNN). This model was used to predict the varieties of 20 unknown samples. The recognition rate of the model for the unknown sample was 90%. So this paper could offer an effective pattern recognition way to the fast discriminating varieties of liquorice.

## Steam deacidification of the model system of refined palm stearin + refined palm olein + oleic acid

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Palm oil is one of the major vegetable oil sources and current world palm oil production has reached 41.12 million of metric tons. The palm oil composition is formed by 50% of saturated fatty acids and 50% of unsaturated fatty acids. On this way, it has the flexibility to be used as it or in fractionated forms namely, palm olein and palm stearin to produce a wide range of products. Only a small number of crude fats and oils is suitable for human consumption before it has been processed in some manner. Deodorization and/or physical refining are mass transfer purification process that aims to vaporize odoriferous compounds and FFA from the oil. They are based on the large differences in volatility between the oil and the majority of its unwanted substances and are accomplished by applying high temperatures and low pressures by addition of live steam as a stripping gas. However, these conditions allied with the oil composition also allow the vaporization of an acylglycerol fraction from the oil, known as neutral oil loss (NOL). Then, this work aimed to verify the effects of three operating parameters i.e., final oil temperature (ranging from 200°C to 260°C), steam flow (from 0.5% to 6.5%) and stearin percentage (from 0.262% to 0.900%) in the removal of the acidity and losses of neutral oil, following a 23 factorial design. The model system was composed by refined palm stearin + refined palm olein+ oleic acid. It also aimed to validate the simulation tool by comparison between experimental results and computational ones. The composition of the model system, an input of the simulation program, was considered in a rigorous way. The effects of process variables upon the selected responses, final oil acidity and neutral oil loss, were evaluated. The comparison between the experimental and the simulation results revealed a good reproducibility with a mean absolute deviation of 1.44 for acidity and 1.96 for neutral oil loss. These results showed that a computational simulation program can be used as a tool to perform previous studies about processing conditions in an industrial plant.

## Application of Monte Carlo simulation in estimation of anisotropy of fruit tissue

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The propagation of laser light in kiwifruit (*Actinidia deliciosa*) and apple (*Malus x domestica*) tissue was measured with backscattering imaging and simulated using the Monte Carlo method. The sensitivity of the camera (8 bit/channel), the resolution of acquired images (27.42  $\mu\text{m}/\text{pixel}$ ) and the diameter of the laser beam ( $\varnothing 1$  mm) were utilized as initial parameters of the simulation. The amount of  $2.49 \times 10^8$  photons, emitted quantity in 1 ns pulse from the light source of 785 nm and 45 mW, were traced in the tissue. The effect of scattering coefficient ( $\mu_s$ ), absorption coefficient ( $\mu_a$ ), and anisotropy factor ( $g$ ) on the backscattering signal was evaluated within their  $\pm 20\%$  range relative to the expected mean values. Complete block design was applied to select the values of the optical parameters for simulation. The multi-factor ANOVA test pointed out that anisotropy factor contributed the most ( $p < 0.001$ ) to the photon flux and backscattering signal with significantly higher scores than scattering and absorption coefficients. The effect of varying anisotropy affected the sharpness of the intensity gradient and caused rotation of the computed profiles. The backscattering signal observed on the fruit surface was compared to simulation results to estimate anisotropy. Classification of fruit samples based on estimated values of anisotropy factor supported the assumption that this optical parameter may add valuable information to quality assessment, although sample groups had very high variance and overlapped with others.



## Characterization of Cupuaçu (*Theobroma grandiflorum*) pulp

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The native fruits from Amazonian have been subject of great interest, as for its nutritional and flavor characteristics as well as for their commercial potential. Cupuaçu is native from Amazonian region that presents better technological characteristics when compared to others Amazonian fruits as the high pulp yield and acidity. This acidity is responsible for the high dilution factor of the pulp for the elaboration of juice and other industrialized product and for the low pH that decreases the risk of microbiological growth during processing. Cupuaçu from Amazonia state - Brazil was characterized regarding its physical and chemical characteristics. The fruits were submitted to the usual steps of the fruit pulp processing: selection, washing and depulping (accomplished in a finisher with a sieve of 0.6 mm). The pulp was conditioned in plastic bags of 500 g and maintained at -18°C until the characterization. Five samples were gotten for each characterization. The following analyses were realized: pH, soluble solids contents and titrable acidity, ascorbic acid content, according to Tillman's method. Carotenoid content was analyzed by a spectrophotometry method in 453 nm after extraction with solvent (petroleum ether and acetone). It was verified that the mean pH value was 3.5, 12.3°Brix and 14.5 g / 100 g for soluble and total solids content, respectively. Vitamin C content ranged from 17 to 21.8 mg ascorbic acid / 100 g and the total carotenoid content was 480 µg / 100 g. The antioxidant capacity was 5.75 mmol Trolox / g. These properties show the nutritional importance of Cupuaçu and following the study the influence of freezing during the storage of the pulp will be evaluated.

## Determination of tannin and total amino acid contents in tea for taste assessment by a fluorescent analyzer

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A novel fluorometric flow-injection analytical system is utilized to determine tannin and total amino acid levels in tea for taste assessment of astringency and umami, respectively. The quenching effect on fluorescence of 3-aminophthalate was employed to determine tannin levels, and the fluorogenic reaction of o-phthalaldehyde (OPA) was applied to quantify amino acid content. Both reactions were measured by a single fluorescence sensing system with same excitation and emission wavelengths (340/425 nm). A three-way valve was introduced to switch reagents for sequential determination of tannin and amino acids levels. Parameters of operational conditions were optimized, and the effect of tannic acid on OPA-based amino acid determination was also investigated. The linear dynamic ranges for tannic acid and theanine are 50–250  $\mu\text{g mL}^{-1}$  and 0.1–1.0  $\mu\text{g mL}^{-1}$  (CV < 5%, n = 3), respectively. Each sample throughout was 20 samples  $\text{h}^{-1}$ . This system was also applied to quantitatively assess the quality of partially fermented teas.

## Influence of feed on meat quality of broiler chicken

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Factors that affect meat quality are complex, and occur throughout the production chain. Previous studies describe feed as one of the main factors that influence poultry meat quality. The aim of the current study was to establish the influence of two types of feed on poultry meat quality – chemical composition (fat, proteins, moisture content and pH) and appearance of meat (colour and texture). The study object was poultry meat obtained from chicken of two different feeding systems. One group of chicken was fed with compound feed while the other group received compound feed with added grain. Both groups of broiler chicken were kept on industrial base of poultry meat production. After slaughter chicken was stored for 24 hours at  $+1\pm 0.5^{\circ}\text{C}$  temperature prior the analysis. The following indices of chicken breast meat (musculus pectoralis), thigh (femur together with the surrounding musculature) and drumstick (tibia and fibula together with the surrounding musculature) were evaluated: pH (3510pH Meter – JENWAY), total protein content (LVS ISO 937:1978), fat content (LVS ISO 1443:1973), ash content (ISO 936:1996), moisture content (LVS ISO 1442:1997), colour (Color Tec-PCM; software ColorSoft QCW) and texture (TA.XT.Plus Texture Analyser; software Texture Exponent 32). The results proved the differences between ‘white’ and ‘red’ meat, and among various ‘red’ meat samples. Meat obtained from broiler chicken fed with combined feed mixed with grain had higher fat content comparing to meat obtained from chicken fed purely with combined feed. The differences were established in protein content as well. Protein content was by 0.74% and 6.16% lower in breast meat and thigh, respectively, while it was by 4.64% higher in drumsticks of chicken fed with diet including grains. The moisture content was lower in chicken meat from group fed with grain and differences in colour and texture were observed.

## Assessment of oxidases activities in different parts of cereals

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The human activities influence the soils in many industrial regions by contamination with various pollutants and affect the cultivated plants. In order to improve the plant's protection it is important to understand the mechanisms contributing to the stress tolerance. The molecular defence systems of the plants are composed of different metabolites and oxidative enzymes. The purpose of this paper was to reveal the particularities of the activity of some oxidases in plants subjected to a stress treatment. Therefore samples of cereals harvested from heavy metals contaminated fields were analyzed in order to assess the activities and the distribution of these enzymes in different parts of the plants. The activities of superoxide dismutase and peroxidase and the content in proteins were measured in grains, stalks and roots of wheat and rye. The obtained results showed that the specific activity of superoxide dismutase was higher than the peroxidase activity in the analyzed plants, both in grains, stalks and in roots. The comparative study of the enzymatic activities in different parts of the cereals demonstrated that both superoxide dismutase and peroxidase were more active in roots than in the other analyzed parts. Moreover, the peroxidase registered very small values both in the stalks and in the grains of wheat and rye.

## Influence of hydric stress on some valuable biocompounds in cereals grains

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Drought stress is a worldwide production constraint for cereal crops, so that became a serious problem in that regions where maize, wheat, barley and other small-grained cereals are part of the staple diets. The purpose of the present work was to evaluate the effect of the hydric stress on the quality of the maize yield. Therefore some biochemical compounds were analyzed in grains of maize cultivated under different watering conditions. Twenty-five maize hybrids cultivated in two agricultural Romanian regions were subjected to optimal and stress treatment of watering during the growth period. Content in dry matter, in proteins, starch and carotene were measured postharvest in the grains of maize using proper biochemical methods. As a result, it was noticed that the exposure to the hydric stress caused a significant decrease of the dry matter accumulation to all the studied maize hybrids. Also, the hydric stress induced a decrease of content in starch, but an increase of the content in proteins and in carotene was registered. Some differences between the maize hybrids were noticed.

## ISEKI Mundus 2 – A contribution to international exchange of expertise in food safety research

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The main objective of the ISEKI\_Mundus 2 project is to continue to contribute for the internationalization and enhancement of the quality of the European higher education in Food Studies, and to work towards the network sustainability, by extending the developments undergoing through the Erasmus Academic Network ISEKIFood3 (ref. 142822-LLP-1-2008-1-PTERASMUS- ENW; <http://www.esb.ucp.pt/iseki/>) to other countries, and developing new activities towards the promotion of good communication and understanding between European countries and the rest of the world. This project is coordinated by the ISEKI\_Food 3 (with 96 partners, from 28 European countries) and includes a total of 53 institutions, from 30 Non-EU countries of the 5 continents. An example of the potential for worldwide research exchange in food safety via such a network is demonstrated for two ISEKI partner institutes - Leibniz Institute for Agricultural Engineering (Germany) and the Institute of Environmental Science and Research (New Zealand) – who have complimentary research expertise in the rapid detection and control of food-borne pathogens. Examples are given for research studies on flow cytometry and bio-control in Germany and New Zealand.

## Investigation of internal gas in apple tissue

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The volume of internal gas in fruit tissues has an important impact not only on physical properties of fruit, such as porosity, density, mechanical resistance or juiciness, but it can play a considerable role in minimal processing of fruit and modified atmosphere storage as well. A volumetric apparatus based on the thermal release of gas was developed and verified for apple tissues investigation. The total gas volume and concentrations of oxygen and carbon dioxide were determined in consumer ripe apples, stored previously at 5°C in normal atmosphere. For six different varieties of apple examined, the gas volume ranged between 26.6 and 37.4 ml per 100 g of fruit flesh (without skin and core). The inner concentration of permanent gas differs significantly from atmospheric composition of the air. Oxygen concentration have been found from 15.5% to 18.8%, the content of carbon dioxide ranged between 3.6% and 6.4% of total gas. The gas concentrations changed significantly after packaging the whole fruits in an impermeable film under modified atmosphere. Vacuum packed fruits reached very quickly (in dependence on the storage temperature) high concentration of carbon dioxide with typical manifestations of anaerobic respiration. Fruits packaged in the atmosphere high in oxygen (80% of oxygen and 20% of carbon dioxide) showed increased inner content of both oxygen and carbon dioxide, without any evidence of respiration disorders. Nevertheless, the sensorial properties such as flavor or sweetness of the apple were more developed, which indicates the acceleration of ripening. Surprisingly, no direct correlation between the rate of gas changes and skin thickness or number of lenticels has been found.

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