

# Sustainability of the Agri-Food Chain

## 2006 EFFoST Annual Meeting / Total Food 2006

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### Scientific Committee

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Tiny van Boekel, *WUR, The Netherlands (Chairman)*  
Keith Waldron, *IFR, UK (Vice chairman)*  
Gus Atri, *Northern Foods, UK*  
Torger Børresen, *Danish Institute for Fishery Research, Denmark*  
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Leo den Hartog, *Nutreco, The Netherlands*  
Olivier Jolliet, *ETH, Switzerland*  
Jan Kees Vis, *Unilever, The Netherlands*  
Dietrich Knorr, *TU Berlin, Germany*  
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Rudy Rabbinge, *WUR, The Netherlands*  
Mike Saltmarsh, *Inglehurst Foods, UK*  
Johan Sanders, *WUR, The Netherlands*  
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Hans Ulrich-Endress, *Herbstreith and Fox, Germany*  
Broniek Wedzicha, *University of Leeds, UK*  
Jan Willem van der Kamp, *TNO, The Netherlands*

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### Local Organising Committee

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Paulus Kusters, *Provalor BV, The Netherlands (Chairman)*  
Paul Bartels, *WUR, The Netherlands*  
Jan Willem van der Kamp, *TNO, The Netherlands*  
Annemieke van Ginkel, *Nutri-akt, The Netherlands*

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### Administration

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## **THE EUROPEAN FEDERATION OF FOOD SCIENCE AND TECHNOLOGY**

The European Federation of Food Science and Technology (EFFoST) is a non-profit association, with 80 societies in 21 European countries affiliated to it. EFFoST has become a focus for European cooperation among food scientists, engineers, technologists and businesses in food and food-related areas.

EFFoST aims to:

- develop closer contact between food producers and distributors, universities and research institutes,
- enhance rapid technology transfer from ideas/research into industrial applications to improve European competitiveness,
- promote continuing professional development and educational excellence within food science and technology,
- harmonise food legislation and enforcement programmes throughout Europe,
- maintain a collaborative network of (research) organisations within the European food industry aimed at cooperation and 'knowledge sharing'.

EFFoST has developed publications (TIFS, IFSET), organises events on topical issues of industrial relevance, including new legislation and its enforcement, sets up special issue groups (education, legislation, consumer acceptance) and takes part in EU programmes.

EFFoST works together with other international organisations, such as IFT, FEMS or EHEDG, and is closely related to national organisations and societies across Europe, thereby building a strong and clearly recognised European food science and technology community.

EFFoST is the European regional grouping of the International Union of Food Science and Technology (IUFoST), an umbrella body providing contact to organisations and colleagues throughout the world.

Free membership is open to any EU professional organisation or society with an interest in Food Science and technology, but also others can contact the EFFoST.

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WAGENINGEN UR

*For quality of life*

Wageningen University and Research Centre (Wageningen UR) provides education and generates knowledge in the field of life sciences and natural resources. Wageningen UR aims to make a real contribution to our quality of life. To us, quality of life means both an adequate supply of safe and healthy food and drink, on the one hand, and the chance to live, work and play in a balanced ecosystem with a large variety of plants and animals.

Wageningen UR works on knowledge that helps us to create safe, healthy and above all tasty food. Food that is healthy and safe for us, but also for our environment.

Wageningen UR develops more efficient production and distribution methods in which wastage of natural raw materials is minimised. Wageningen UR also incorporates the newly created knowledge into its education programmes.

Nutrition research at Wageningen UR starts with plant and animal breeding. Our scientists develop breeds and varieties that are as resistant as possible to disease and that are good for processing into healthy and tasty food. For the diseases that do occur we devise responsible control methods so that consumers can be sure of finding clean and safe products on the shelves.

We reduce the toll on the environment by closing production cycles. Our technologists develop better production, harvest and storage methods that make agriculture more efficient. One particular approach to this is chain management of food production. We use molecular techniques to monitor food quality and safety in the storage, transport and processing of raw materials. Our continuous measuring methods register the slightest variation in the concentration of desirable and undesirable substances.

We develop food processing technology which enables businesses to manage their processes so that they can guarantee the quality of the end product they deliver. Further along in the chain we do research on which storage methods and packaging keep food products fresh for longer. Our researchers also investigate consumer preferences for tastes, colours and structures of food. In addition we devote considerable attention to epidemiological research on the health effects of foods.

Wageningen UR is aware that the general public is concerned about the effects of our agriculture on other world citizens, the environment and animal welfare. That is why our critical social scientists are continuously engaged in studying the societal effects of our food production. They are convinced that ultimately it is the quality of life that is the most important.

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## **NVVL Network for Food Experts**

The NVVL is the Dutch Network for Food Experts. As a member of the International Union of Food Science and Technology (IUFoST), the NVVL is directly linked to the European Federation for Food Science and Technology. Hence, the NVVL is supporting EFFoST and Reed Elsevier in organising the EFFoST annual conference 'Sustainability of the Agri-Food Chain' to be held in November 2006. To further strengthen the scientific activities in the field of food and health, the NVVL is also linked to the International Union of Nutritional Science (IUNS).

In the Netherlands, more than 650 professionals have joined the NVVL. They are active in research organisations, industry, non-governmental and governmental institutions. Expertise ranges from ingredients, end-products, processing, packaging, nutrition, diets up to health. The activities of the NVVL are therefore focused on cross-border topics such as nutritional value through processing, consumer perception, legislation and food design.

The NVVL networks are formed and further established at symposia (3 to 6 events on a yearly basis), through communication channels like the NVVL Newsletter, Dutch 'Food-Industry-Magazine' and at workshops. The latter are organised at different industrial and academic locations to provide the latest insights in new developments, findings and trends.

To further extend networks and to get more value from the NVVL membership, the NVVL has also joined forces with the Dutch Food Industry Association (FNLI, linked to CIAA, Confederation of the Food and Drink Industries of the EU), Food Valley Organisation, the Royal Dutch Chemistry Association and the NVVL sponsors.

Special emphasis is put on creating a platform for young scientists just starting their careers. The NVVL network provides opportunities for them to come into contact with experts in different areas. The motivation and enthusiasm of young scientist at joint meetings and visits is very much appreciated. Two students are awarded annually for the best thesis and scientific ideas.

Every year since 1950, highly motivated members put efforts and creativity into the NVVL by playing an active role in promoting and organising meetings, interviews, visits and other NVVL activities. Their spirit is the basis of a lively organisation.

On behalf of the board, each suggestion from abroad as well as from Dutch residents is warmly welcomed. Please feel free to contact us or visit our website at [www.nvvl.nl](http://www.nvvl.nl).

### **Huug de Vries**

Chairman of the NVVL, Network for Food Experts

## Invited Speaker Biographies

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### **Renée Bergkamp**

#### **Ministry of Agriculture, Nature and Food Quality, The Netherlands**

Renée Bergkamp Studied law at the Vrije Universiteit Amsterdam, specializations Private law and International law. Renée Bergkamp's professional career covers several domains; agriculture; nature; food; international cooperation; migration policy. At this moment Renée Bergkamp is Director-General at the Ministry of Agriculture, Nature and Food Quality.

### **Prof Tim Brocklehurst**

#### **Institute of Food Research, Norwich, UK**

Tim has published over 100 articles on food microbiology. He is Head of the Microbial Biophysics Group at the Institute of Food Research, Norwich, where he studies the effect of food structure on microbial growth in projects funded by government, industry and the European Union. He is Visiting Professor in Food Microbiology at London South Bank University, is on the Editorial Board of the *International Journal of Food Microbiology*, and is a member of the Institute of Food Science and Technology.

### **Prof Johanna Buchert**

#### **VTT, Finland**

Johanna Buchert has been a Research Professor at VTT since 2005, before that Research Manager at VTT (2000-2004) and Research Group Manager 1996-1999. In 1988-1995 she was research scientist /senior research scientist at VTT Biotechnology and Food Research/ VTT Biotechnical laboratory. During 1993/1994 she held a post-doc position at STFI and YKI, Sweden.

During the last 5 years food bioprocessing has been her major research interest, in which she exploits the knowledge on both raw material chemistry and on the enzymology of hydrolytic, oxidative and transferase type of enzymes in food matrix modifications.

### **Mr Leo Den Hartog**

#### **Nutreco, The Netherlands**

Leo Den Hartog holds the position as director Nutreco Agriculture R&D and Quality Management.

After his graduation at the Wageningen University (NL) in 1978 he worked as head of the pig group at the Advisory Service for pigs and poultry in Arnhem (NL). After two years he was appointed as associate professor in monogastric nutrition at the Wageningen University where he got his PhD in 1984. In 1986 he spent one year as visiting professor at the University of Alberta, Edmonton in Canada. In 1989 he became director of the Research Institute for Pig Husbandry in Rosmalen (NL). In 1997 he was appointed as research director of the Institute for Animal Husbandry in Lelystad (NL).

Mr Den Hartog joined Nutreco in July 2001 as Director Agriculture R&D. He is also part time professor "Animal Production" at the Wageningen University.

### **Prof Brian McKenna**

#### **University College Dublin, Ireland**

Brian McKenna is both Principal of the College of Life Sciences and Professor of Food Science at University College Dublin. A chemical engineer by training, he is currently President, European Federation of Food Science & Technology and was for 18 years the Editor of the *Journal of Food Engineering*. At UCD, he has previously spent periods as Vice-President for Planning and Development of UCD and as Dean of Postgraduate and Interdisciplinary Studies. His research interests cover physical properties of foods; rapid chilling of beef and lamb; meat texture; food safety and shelf-life prediction of foods; radio frequency heating of foods; formulation of functional drinks and the use of foods for drug delivery. His publications include 12 books and approx 100 papers.

### **Pieter C Nell**

#### **Provalor BV, The Netherlands**

Pieter C Nell grew up on a typical Dutch family run dairy farm. After finishing agricultural college in 1973, his career started in a large Dutch feed-mill making recipes for animal compound feed. After a couple of years the switch was made to the human food section of the same company. For human food they were active in grain-treatment (pressure cooking etc.). At that time he understood that there is not much difference between the digestion systems of (certain) animals and that of human beings.

After seven years in feed and food, he travelled all over the world for a dairy equipment supplier and during one of the trips learned roughly how to produce pineapple juice.



**Dirk Pottier****DG Research of the EC, Belgium**

Dirk Pottier is a principal scientific officer working at DG Research of the EC. He recently moved from the International Scientific Cooperation Directorate where he worked for almost nine years in the Food Unit of DG RTD's Food, Agriculture and Biotechnology Directorate. In this new capacity he is in charge of the environmental impact and total food chain area.

**Rudy Rabbinge****Wageningen University, The Netherlands**

Rudy Rabbinge was trained as a phytopathologist and received his PhD in Biological Control in 1976. He was professor in Theoretical Production Ecology, in Crop Ecology and in Farming Systems and is currently university professor in Sustainable Development and Food Security at Wageningen University. He co-chaired the UN Panel InterAcademy Council on Food Security for Africa and the Millennium Assessment. He is currently member or chairman of the executive committee or board of directors of numerous organisations including Tropenbos International, Asia Rice Foundation, International Soil Fertility Development Centre (IFDC), Royal Institute for the Tropics (KIT). He is also a member of the Dutch senate.

**Mike Saltmarsh****Inglehurst Foods, UK**

Mike Saltmarsh is director of Inglehurst Foods, a research and development consultancy he established in 1996 after working in the Mars group for 24 years.

He has interests in vending, additives and biologically active phytochemicals. Mike is the Technical Consultant for the Automatic Vending Association responding to members' issues on subjects ranging from water quality to product labelling. He has recently prepared a CD on food safety management for the European Vending Association and wrote most of the Guide to Good Practice in the Vending Industry to comply with the Food Safety Regulation, 852/2004.

Mike has edited, and largely wrote, the first edition of The Essential Guide to Food Additives and lectures at Birmingham University on additives. He is a past chairman of the Royal Society of Chemistry Food Group and has organised conferences on functional foods, innovation and phytochemicals. He is a member of the management committee of COST 926.

**Dr Neus Sanjuán****Universidad Politécnica de Valencia, Spain**

Neus Sanjuán is an associate professor at the Department of Food Technology of the Universitat Politècnica de València. She got her degree in Agricultural Engineering in 1991 and her doctoral degree in 1998. Nowadays she belongs to the research group of Food Processes Analysis and Simulation (ASPA) and her research is mainly focused in mass transfer modelling in dehydration and LCA applied to agri-food products.

**Dr Ulf Sonesson****SIK, Sweden**

Ulf Sonesson is senior scientist at SIK – The Swedish Institute for Food and Biotechnology. His research focuses on development of Life Cycle Methodology for food systems and environmental impact of technological development within food industries. A second research area is analyses of future food systems by use of scenario techniques.

**Dr Ann Van Loey****Katholiek Universiteit Leuven, Belgium**

Ann Van Loey obtained a PhD in Applied Biological Sciences at KULeuven, Belgium in 1996, and currently she has a research professorship at KULeuven. Her main research topic is on enzyme reaction kinetics during food (ie fruit and vegetable based products) processing influencing food functionality. As processing technologies both conventional thermal processing (blanching, pasteurisation, sterilisation, freezing, refrigeration) as well as emerging technologies based on high pressure. As functional properties both texture/structure as well as health related components are key topics.

**Jan Kees Vis****Unilever NV, The Netherlands**

Jan Kees Vis was trained as a chemist and received a PhD in Heterogeneous Catalysis in 1984. He joined Unilever in 1985, at the Unilever Research Laboratory in Vlaardingen. He held several positions there, then moved to the foods business. For more than 10 years he worked on Environmental Life Cycle Analysis, implementation of Environmental Management Systems, environmental auditing, organising environmental training courses, environmental reporting and preparation of policy proposals on environmental issues.

Since the beginning of 2001, he has been responsible for co-ordinating Unilever's Sustainable Agriculture programme.



## Programme



## Tuesday, 7 November 2006

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### Session 1 – Opening Session

Chair: B McKenna, EFFoST President, University College Dublin, Ireland

- 10:30**            **Opening presentation**  
B McKenna\*, EFFoST President, University College Dublin, Ireland
- 10:40**            **Opening presentation**  
M Saltmarsh\*, Total Food 2006, Inglehurst Foods, United Kingdom
- 10:50**    1.03        **Food industry and sustainability - a political viewpoint**  
RM Bergkamp, Director General, on behalf of C Veerman, Minister of Agriculture, Nature and Food Quality, The Netherlands

### Session 2 – Drivers for Sustainability

Chair: B McKenna, EFFoST President, University College Dublin, Ireland

- 11:15**    2.01        **The 7th Framework Programme in relation to the total food chain and food technology**  
D Pottier\*; EU Research Directorate General, Belgium
- 11:45**    2.02        **Use of resources in the agri-food chain**  
R Rabbinge\*, Wageningen University, The Netherlands
- 12:15**    2.03        **Sustainability for the agri-food business in developing countries**  
V Prakash, CFTRI, India
- 12:45**            **Lunch**

### Session 3 – Industrial Success in Sustainable Agri-Food Chains

Chair: C Krist, TNO Quality of Life, The Netherlands

- 13:50**    3.01        **Industrial approach in the global market**  
JK Vis\*, Unilever NV, Netherlands
- 14:15**    3.02        **Making money from food industry by-products**  
PC Nell\*, Provalor BV, Netherlands
- 14:40**    3.03        **A case of industrial success in sustainable soy bean production chain in Brazil**  
A Freire\*; Cert ID Ltda, Brazil
- 15:00**            **Refreshment Break**
- 15:30**    3.05        **Regional networks and sustainable agri-food chains**  
X Gellynck\*, B Vermeire, R Januszewska, J Viaene; University of Gent, Belgium
- 15:45**    3.06        **Sustainable innovation for the potato starch production chain in the Netherlands**  
RJF van Haren\*; AVEBE UA, Netherlands
- 16:00**            **Forum Discussion facilitated by Schuttelaar & Partners**
- 16:45**            **Reception and Networking Event**  
**Poster Session I**
- 19:00-20:30**        **GHI Workshop**  
[www.globalharmonization.org](http://www.globalharmonization.org)

## Wednesday, 8 November 2006

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<b>Session 4A – Technology Development Food: Whole Material Exploitation</b> Chair: MAJS van Boekel, Wageningen University, The Netherlands
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- 08:30** 4A.01 **Whole by-product exploitation: an integration of research and technology in a market economy**  
K Waldron\*; Institute of Food Research, United Kingdom
- 09:00** 4A.02 **Bioactive plant polysaccharides: an overview**  
A Femenia\*, S Simal, VS Eim, C Rosselló; Universitat de les Illes Balears, Spain
- 09:15** 4A.03 **Purification of milk fat globule membrane fragments from dairy effluents**  
R Rombaut, K Dewettinck\*; Ghent University, Belgium
- 09:30** 4A.04 **Sustainable technologies in the Dutch dairy industry – a review**  
AJ van Asselt\*, P de Jong; NIZO food research, Netherlands
- 09:45** 4A.05 **Potential of carbohydrate-degrading enzymes in valorisation of brewer's spent grain**  
P Forssell<sup>1</sup>, H Kontkanen<sup>1</sup>, J Buchert<sup>1</sup>, H Schols<sup>2</sup>, S Hinz<sup>2</sup>, V Eijssink<sup>3</sup>, J Treimo<sup>3</sup>;  
<sup>1</sup>VTT, Finland, <sup>2</sup>Wageningen University, Netherlands, <sup>3</sup>UMB, Norway
- 10:00** **Refreshment Break**
- 10:30** 4A.06 **Recycling water in food factories**  
D Napper\*, EHEDG, Euroteknik Ltd, Denmark
- 10:45** 4A.07 **Production of prebiotics and antimicrobial agents from a by-product of essential oil extraction**  
C Faulds<sup>1</sup>, G Mandalri<sup>2</sup>, R Bennett<sup>3</sup>, G Bisignano<sup>2</sup>, A Narbad<sup>1</sup>, K Waldron<sup>1</sup>; <sup>1</sup>Institute of Food Research, United Kingdom, <sup>2</sup>University of Messina, Italy, <sup>3</sup>Universidade de Trás-os Montes e Alto Douro, Portugal
- 11:00** 4A.08 **Saccharification of brewer's spent grains by using multi-enzyme-systems**  
T Herfellner\*, G Pesta, R Meyer-Pittroff, G Bochmann; TUM Weihenstephan, Germany
- 11:15** 4A.09 **Phenolic cross-linking and its application to manipulating bulk mechanical properties of cereal bran**  
J Robertson\*, C Faulds, A Smith, K Waldron; Institute of Food Research, United Kingdom
- 11:30** 4A.10 **Sustainability of novel processing technologies, a European perspective**  
T Ohlsson\*, Sweden, HSM de Vries\*, Netherlands, NovelQ
- 11:45** **Poster Session II**
- 12:00-13:00** **EFFoST Executive Committee Meeting**
- 13:00** **Lunch**
- 13:00-13:45** **EFFoST Meeting of Member Societies**

## Wednesday, 8 November 2006

### Session 4B – Technology Development Food: High Value Products

Chair: MJM Tielen, European Feed Manufacturers Federation (FEFAC)

- 08:30** 4B.01 **Use of enzymes in the food industry to improve product functionality**  
J Buchert, VTT, Finland
- 09:00** 4B.02 **The initiative POLYPRES: surplus and waste food polysaccharide polymers valorisation through high pressure processing**  
AD Molina-García<sup>1</sup>, SE Harding<sup>2</sup>, I Sousa<sup>3</sup>, M Martino<sup>4</sup>, A Pilosof<sup>5</sup>, MVE Grossmann<sup>6</sup>; <sup>1</sup>CSIC, Spain, <sup>2</sup>Univ of Nottingham, UK, <sup>3</sup>Inst Superior de Agronomía (DAIAT), Portugal, <sup>4</sup>Centro de Investigación y Desarrollo en Criotecología de Alimentos (CONICET) La Plata, Argentina, <sup>5</sup>Universidad de Buenos Aires, Argentina, <sup>6</sup>Univ Estadual de Londrina, Brazil
- 09:15** 4B.03 **EC legislation regarding production of safe food and feed**  
H Heeres\*; TNO Quality of Life, Netherlands
- 09:30** 4B.04 **Domestication of microorganisms promoting sustainability of the agri-food chain**  
J Schnürer\*; Swedish University of Agricultural Sciences, Sweden
- 09:45** 4B.05 **Autonomous salmon quality control using machine vision**  
J Hayes\*, A Pacquit, K Crowley, KT Lau, D Diamond; Dublin City University, Ireland
- 10:00** **Refreshment Break**
- 10:30** 4B.06 **Cactus pear (*Opuntia* spp.) - a source of valuable components**  
FC Stintzing\*, R Carle; Hohenheim University, Germany
- 10:45** 4B.07 **Recovery of added value pectins and phytochemicals from Brassica trimmings by hybrid processes**  
J Schroot<sup>1</sup>, K Merck<sup>1</sup>, S Hinz<sup>2</sup>, H Schols<sup>2</sup>, M Panouillé<sup>3</sup>, E Bonnin<sup>3</sup>; <sup>1</sup>Food Technology Centre, Netherlands, <sup>2</sup>Wageningen University, Netherlands, <sup>3</sup>INRA, France
- 11:00** 4B.08 **Application of computer vision to control curd and whey quality during cheese syneresis**  
C Everard<sup>1</sup>, C O'Donnell<sup>2</sup>, C Fagan<sup>2</sup>, D O'Callaghan<sup>1</sup>, M Castillo<sup>3</sup>, F Payne<sup>3</sup>; <sup>1</sup>Teagasc, Ireland, <sup>2</sup>University College Dublin, Ireland, <sup>3</sup>University of Kentucky, United States
- 11:15** 4B.09 **Enzymatic conversion of cod viscera to high-value ingredients of growth media for probiotic bacteria**  
SI Aspmo<sup>1,2</sup>, SJ Horn<sup>1</sup>, VGH Eijsink<sup>1</sup>; <sup>1</sup>Norwegian University of Life Sciences, Norway, <sup>2</sup>Maritex AS, Norway
- 11:45** **Poster Session II**

**Session 5A – Technology Development Feed**

Chair: L Den Hartog, Nutreco, The Netherlands

- 14:00** 5A.01 **Product for animal and fish nutrition: are co-products still an option?**  
L Den Hartog\*, R Sijtsma, Nutreco, Netherlands
- 14:30** 5A.02 **Optimal utilisation of fish waste for the creation of functional proteins**  
JC Arboleya\*<sup>1</sup>, J Moreno<sup>2</sup>, E Sanmartin<sup>1</sup>, M Villamiel<sup>2</sup>, P Wilde<sup>3</sup>; <sup>1</sup>AZTI-TECNALIA, Spain, <sup>2</sup>Instituto de Fermentaciones Industriales (CSIC), Spain, <sup>3</sup>Institute of Food Research, United Kingdom
- 14:45** 5A.03 **Review: sustainable use of animal by-products in the agri-food chain**  
S Woodgate\*<sup>1</sup>, M Alm\*<sup>2</sup>; <sup>1</sup>EFPIA, Belgium, <sup>2</sup>Saria Bio-Industries, Germany
- 15:00** 5A.04 **Potential use of non-marketable citrus fruits in growing lamb feeds**  
O Piquer\*, M Rodriguez, JJ Pascual; Universidad Politécnica de Valencia, Spain
- 15:15** **Refreshment Break**
- 15:45** 6A.01 **Controlling microbiological stability**  
T Brocklehurst\*; Institute of Food Research, UK
- 16:35** 6A.02 **The influence of enzyme activity on the quality of vegetable products during storage (with and without preservation pre-treatment)**  
A Van Loey, Katholiek Universiteit Leuven, Belgium
- 18:30-22:00** **Conference Dinner, Madurodam Miniature City**



**Session 5B – Technology Development Non Food and Fuel**

Chair: J Sanders, Wageningen University Research, The Netherlands

- 14:00** 5B.01 **Microbial production of fuels and chemicals from renewable resources**  
JAM de Bont\*; Royal Nedalco, Netherlands and Delft University of Technology, Netherlands
- 14:30** 5B.02 **Fatty Acid Methyl Ester (FAME) from used oils – Waste material from the food industry as fuel for combustion engines**  
N Winthuis, W Ruß\*, R Meyer-Pittroff; Technische Universität München, Germany
- 14:45** 5B.03 **Development of a novel physical process to convert fibrous materials to ethanol**  
K Muthukumarappan\*, L Bernau, JL Julson; South Dakota State University, United States
- 15:00** 5B.04 **Novel aliphatic polyesters of oleic diacid (D18:1) : Synthesis, epoxydation, crosslinking and biodegradation**  
F Lafleche\*<sup>1</sup>, P Guegan<sup>1</sup>, S Claude<sup>1</sup>; <sup>1</sup>Université d'Evry, France, <sup>2</sup>ONIDOL, France
- 15:15** **Refreshment Break**
- 15:45** 5B.05 **Production of adsorbents from coffee husks and spent coffee grounds**  
L Oliveira\*, A Franca, W Oliveira, A Latini; Universidade Federal de Minas Gerais, Brazil
- 16:15** 5B.06 **Utilization of poultry industry by-products outside of the agri-food chain**  
S Woodgate\*<sup>1</sup>, S Volooj<sup>2</sup>, C Carr<sup>2</sup>; <sup>1</sup>Beacon Research, United Kingdom, <sup>2</sup>University of Manchester, United Kingdom

## Thursday, 9 November 2006

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### Session 7A – Tools for Sustainability

Chair: T Ohlsson, SIK, Sweden

- 09:00** 7A.01 **LCA: Joining up the food chain**  
U Sonesson\*, SIK, Sweden
- 09:30** 7A.02 **Eco-efficiency analysis in agriculture. Application to orange crops in Valencia (Spain)**  
N Sanjuán\*, FJ Ribal, G Clemente, L Fenollosa, Universitat Politècnica de Valencia, Spain
- 10:00** 7A.03 **Increase of energy efficiency in companies of the food industry - methodical approach and practical examples**  
W Ruß\*, N Winthuis, R Meyer-Pittroff; Technical University Munich, Germany
- 10:15** 7A.04 **Role of advertisement in communicating corporate social responsibility (CSR)**  
C Dutilh\*; Unilever, Netherlands
- 10:30** 7A.05 **Life cycle assessment to eco-design food products: Industrial cooked dish case study**  
J Zufía, L Arana\*; AZTI-TECNALIA, Spain
- 10:45** 7A.06 **Sustainable value stream mapping: a tool for process change and waste reduction**  
A Norton<sup>1</sup>, A Fearne<sup>2</sup>; <sup>1</sup>Imperial College London, United Kingdom, <sup>2</sup>Kent Business School, United Kingdom
- 11:00** **Refreshment Break**

### Session 8 – Sustainability for the Future

Chair: P Kusters, Provalor BV, The Netherlands

- 11:30** **Poster Award Presentation as jointly selected by the Scientific Committee and NVVL**  
Dr H de Vries, Chairman, NVVL, Network for Food Experts
- 11:35** 8.01 **Substitution of meat in the human diet by plant-based alternatives to reduce the environmental impact of food production systems**  
AR Linnemann\*, RK Apaiah, MAJS van Boekel; Wageningen University, Netherlands
- 11:55** 8.02 **Comparison of scenarios on futures of European food chains**  
R Meyer\*; Institute for Technology Assessment and Systems Analysis (ITAS), Germany
- 12:20** **To be announced**
- 12:40** **Closing remarks**
- 12:45** **End of Conference**

**Session 7B – Tools for Sustainable Development**

Chair: V Prakash, CFTRI, India

- 10:00** 7B.01 **Utilization of processing waste for sustainable development**  
D Singh\*, L Wangshu, SK Moond; College of Horticulture and Forestry, India
- 10:15** 7B.02 **The growth and development of the food industry in Nigeria: poverty, food security and sustainable development strategy**  
S Osho\*; Olabisi Onabanjo University, Nigeria
- 10:30** 7B.03 **Sustainability in food miles**  
R Khosrokhavar\*, S Eskandari, N Nedaie; Food and Drug Control Labs of Iran, Iran
- 10:45** 7B.04 **Emerging sub-sectors of the poultry industry in Botswana: A case of sustainable ostrich (*Struthio camelus*) and guinea fowl (*Numida meleagris*) production**  
SJ Nsoso, AA Aganga\*; Botswana College of Agriculture, Botswana
- 11:00** **Refreshment Break**



**Posters**



## Poster Session I – 16:30-18:00, Tuesday, 7 November 2006

### Drivers for Sustainability

- P1.01 REPRO interaction platforms: promoting the exploitation and upgrading of agro-food by-products**  
J Guijarro\*, L de las Fuentes; GAIKER Technology Centre, Spain
- P1.02 Sustainable development strategy of China agri-food industry**  
Y Dong\*; Chinese Academy of Inspection & Quarantine Science, China

### Industrial Success in Sustainable Agri-Food Chains

- P2.01 Sustainability of the European sugar sector**  
K Urbaniec<sup>1</sup>, G Vaccari<sup>2</sup>, P Glavic<sup>3</sup>, M Narodslawsky<sup>4</sup>, G Pezzi<sup>5</sup>, M Bruhns<sup>6</sup>, et al; <sup>1</sup>Warsaw Univ of Technology, Poland; <sup>2</sup>Univ of Ferrara, Italy; <sup>3</sup>Univ of Maribor, Slovenia; <sup>4</sup>Graz Univ of Technology, Austria; <sup>5</sup>Cooperativa Produttori Bieticoli, Italy; <sup>6</sup>Pfeifer & Langen KG, Germany
- P2.03 Economically sustaining of food system**  
S Eskandari\*, N Nedaie; Food and Drug Control Labs, Iran

### Tools for Sustainability

- P3.01 Quality assurance system for sustainability**  
M Czeglédi<sup>1</sup>, A Ferencz<sup>2</sup>; <sup>1</sup>Corvinus University of Budapest, Hungary, <sup>2</sup>College of Kecskemet, Hungary
- P3.02 Co-products in the food chain: a delphi study**  
J Lamerichs\*, L Frewer, B Gremmen; Wageningen University, Netherlands
- P3.03 The Agrifood Technology Station as a tool for sustainability using technology**  
H Coetzee\*; Cape Peninsula University of Technology, South Africa
- P3.04 Costs of introducing and maintaining a sustainability-friendly quality assurance system into the Hungarian horticulture**  
M Czeglédi<sup>1</sup>, A Ferencz<sup>2</sup>; <sup>1</sup>Corvinus University of Budapest, Hungary, <sup>2</sup>College of Kecskemet, Hungary
- P3.05 Environmental analysis and predictive microbiology in combination as a tool for safe and sustainable process line design**  
J Berlin<sup>1</sup>, P Arinder<sup>1</sup>, K Ostergren<sup>1</sup>, P Ainsworth<sup>2</sup>, J Schroot<sup>3</sup>, U Sonesson<sup>1</sup>; <sup>1</sup>SIK - The Swedish Institute for Food and Biotechnology, Sweden, <sup>2</sup>Manchester Metropolitan University, UK, <sup>3</sup>Food Technology Center Wageningen UR, The Netherlands

### Tools for Sustainable Development

- P4.01 Exploitation of donkey meat as a source of diversification of the livestock industry of Botswana**  
A Aganga<sup>1</sup>, A Aganga<sup>2</sup>; <sup>1</sup>Botswana College of Agriculture, Botswana, <sup>2</sup>Meat Inspection Training Centre, Botswana
- P4.02 Sustainability of sheep and goat production in Botswana**  
A Aganga\*, J Nsoso; Botswana College of Agriculture, Botswana
- P4.03 Sustainability of the agri-food**  
S Eskandari\*, R Khosrokhavar, N Nedaie; Food and Drug Control Labs of Iran, Iran
- P4.04 Role of HACCP at the end of the chain**  
S Eskandari\*, N Nedaie; Food and Drug Control Labs of Iran, Iran
- P4.05 Industrial sustainability through biotechnology**  
S Eskandari\*, R Khosrokhavar, N Nedaie; Food and Drug Control Labs of Iran, Iran
- P4.06 Tasting sustainability**  
R Khosrokhavar \*, S Eskandari; Food and Drug Control Labs of Iran, Iran

- P4.08 Emerging sectors of the poultry industry in Botswana: A case of sustainable ostrich (*Struthio camelus*) and guinea fowl (*Numida meleagris*) production**  
SJ Nsoso, AA Aganga\*; Botswana College of Agriculture, Botswana

**Sustainability for the Future**

- P5.01 Image profile analysis of the Hungarian traditional horticultural products**  
G Totth<sup>1</sup>, M Notari<sup>2</sup>; <sup>1</sup>Budapest Business School, Hungary, <sup>2</sup>College of Kecskemet, Hungary
- P5.02 Research on the competitive advantages of traditional Hungarian products**  
I Hajdu, M Notari\*; Corvinus University of Budapest, Hungary

**Raw Material Quality: Stabilisation and Microbiology**

- P6.01 Mycoflora of two types of Portuguese smoked dry sausages and inhibitory effect of sodium benzoate, potassium sorbate and methyl *p*-hydroxybenzoate on mould growth rate**  
T Matos<sup>\*1</sup>, BB Jensen<sup>2</sup>, F Bernardo<sup>3</sup>, A Barreto<sup>3</sup>, O Hojberg<sup>3</sup>; <sup>1</sup>Instituto Superior de Agronomia, Portugal, <sup>2</sup>Danish Institute of Agricultural Sciences, Denmark, <sup>3</sup>CIISA, Portugal
- P6.02 Physicochemical and microbial changes in salted semipreserved cuttlefish (*Sepia officinalis*) during processing steps and storage in optimal and abuse temperature (simulating market conditions)**  
I Cisse\*, O Serafim-Dacosta, M Hernandez Herrero; Universitat Autònoma de Barcelona, Spain
- P6.05 Effect of *Bifidobacterium breve* on the survival and growth of *Enterobacter sakazakii* in rehydrated infant milk formula**  
T Osaili\*, R Shaker; Jordan University of Science and Technology, Jordan
- P6.07 Traditional processing, microbial and chemical changes during fermentation of malwa, a Ugandan fermented millet beverage**  
S Birungi, M Ahimbisibwe, J Semanda, C Muyanja\*; Makerere University, Uganda
- P6.08 Risk of contamination of grape and grape-products by Ochratoxin A**  
K Grigoryan\*, L Hakobyan, M Sarkisyan, H Hayrapetyan; Yerevan State University, Armenia
- P6.09 Effect of storage on the exploitation potential of brewers' spent grain**  
A Jay, Z Merali\*, K I'Anson, A Smith, T Brocklehurst, C Faulds, K Waldron; Institute of Food Research, United Kingdom
- P6.11 Phytase activity in seeds of *Pentaclethra macrophylla*, *Parkia biglobosa* and *Tetracarpidium conophorum***  
V Enujiugha\*; Federal University of Technology, Nigeria
- P6.12 Moisture sorption isotherms of some dry condiment powders**  
V Enujiugha\*, S Iyiola; Federal University of Technology, Nigeria
- P6.13 Utilization of tangential microfiltration in the production of sheep's milk cheeses**  
B Fernandes<sup>1</sup>, C Pereira<sup>1</sup>, M Pintado<sup>\*2</sup>, F Malcata<sup>2</sup>; <sup>1</sup>Escola Superior Agrária de Coimbra, Portugal, <sup>2</sup>Escola Superior de Biotecnologia, Romania
- P6.14 Discrimination of *Alicyclobacillus* isolates in apple juice by Fourier transform infrared spectroscopy**  
M Al-Holy\*, M Lin, S Chang, A Cavinato, DH Kang, B Rasco; Hashemite University, Jordan
- P6.15 Inhibition of *Listeria innocua* in hummus (chickpea dip) by a combination of nisin and citric acid**  
M Al-Holy\*, H Al-Qadiri, B Rasco; Hashemite University, Jordan
- P6.16 Occurrence of *Enterobacter sakazakii* in powdered infant formula, milk powders and food production environment**  
R Shaker<sup>\*1</sup>, W Al Omari<sup>2</sup>, M El Zuby<sup>2</sup>; <sup>1</sup>Jordan University of Science and Technology, Jordan, <sup>2</sup>Institute of Standards and Metrology, Jordan



## Poster Session II – 11:45-13:15, Wednesday, 8 November 2006

### Technology Development Food

- P7.01 Exploiting food processing co-products: the composition of Chinese water chestnut epidermal layers**  
T Grassby\*, A Jay, Z Merali, M Parker, A Parr, C Faulds, K Waldron; Institute of Food Research, United Kingdom
- P7.02 Interactions among fiber from citrus by-products and probiotic bacteria**  
E Sendra, P Fayos, Y Lario, J Fernández-López\*, E Sayas, JA Pérez-Alvarez; Universidad Miguel Hernandez, Spain
- P7.03 Effective and sustainable extracting method for carrageenan industry**  
R Tuvikene\*<sup>1</sup>, K Truus<sup>1</sup>, T Pehk<sup>2</sup>; <sup>1</sup>Tallinn University, Estonia, <sup>2</sup>National Institute of Chemical Physics and Biophysics, Estonia
- P7.04 Water sorption and moisture barrier properties of chitosan-methylcellulose edible films**  
M Vargas\*<sup>1</sup>, A Albors<sup>2</sup>, A Chiralt<sup>3</sup>, C González-Martínez<sup>3</sup>; <sup>1</sup>Universidad Politécnica de Valencia, Spain, <sup>2</sup>Department of Food Technology, Spain, <sup>3</sup>IUIAD, Spain
- P7.05 Structural basis of the pharmacological effects of *Opuntia Ficus-Indica* cladodes**  
C Faulds\*<sup>1</sup>, G Ginestra<sup>2</sup>, G Bisignano<sup>2</sup>, R Bennett<sup>3</sup>, M Parker<sup>1</sup>, K Waldron<sup>1</sup>; <sup>1</sup>Institute of Food Research, United Kingdom, <sup>2</sup>University of Messina, Italy, <sup>3</sup>Universidade de Trás-os Montes e Alto Douro, Portugal
- P7.06 Development of suitable indelible markers for animal by-products**  
S Woodgate<sup>1</sup>, R Margry\*<sup>2</sup>, G Geesink<sup>2</sup>, S van den Hoven<sup>2</sup>; <sup>1</sup>EFPPA, Belgium, <sup>2</sup>CCL, Netherlands
- P7.07 Optimisation of grape juice spray drying process**  
C de Torres\*, MC Díaz-Maroto, MS Pérez-Coello; University of Castilla-La Mancha, Spain
- P7.08 The effect of brewer's spent grain on the textural and functional properties of extruded ready-to-eat snacks**  
P Ainsworth<sup>1</sup>, V Stojceska<sup>1\*</sup>, A Plunkett<sup>1</sup>, S Ibanoglu<sup>2</sup>; <sup>1</sup>Manchester Metropolitan University, UK; <sup>2</sup>Gaziantep University, Turkey
- P7.09 Comparative study on antioxidative activity of yellow stripe trevally protein hydrolysate produced from alcalase and flavourzyme**  
V Klompong\*<sup>1</sup>, S Benjakul<sup>1</sup>, D Kantachote<sup>1</sup>, KD Hayes<sup>2</sup>, F Shahidi<sup>3</sup>; <sup>1</sup>Prince of Songkla University, Thailand, <sup>2</sup>Purdue University, United States, <sup>3</sup>Memorial University of Newfoundland, Canada
- P7.10 Vegetable juices – quality improvement by broccoli extract supplements**  
K Lemanska\*, M Swider, B Tyrakowska; Poznan University of Economics, Poland
- P7.11 PC based monitoring and control of black tea continuous fermentation machines process**  
S Sadistap, KSN Rao\*, MP Kausik, KK Pande; CEERI, India
- P7.12 Technology development and demonstration of controlled atmosphere storage system for Indian scenario**  
KSN Rao\*, S Sadistap, S Kumar; Central Electronics Engineering Research Institute, India
- P7.13 Production of frozen cubes from muskmelon and watermelon using inverse osmosis**  
F Shahidi\*, MN Mahallati, P Abrishamchi; Ferdwosi University of Mashhad, Iran
- P7.14 Impact evaluation of innovative and sustainable extraction technologies on olive oil quality**  
D Restuccia\*, SLM Eramo, I Iannilli, G Vinci; <sup>1</sup>University La Sapienza, Italy
- P7.15 Microbial dynamics of pig feed fermented with residues from bioethanol and dairy industries**  
M Olstorpe\*, K Lyberg, JE Lindberg, J Schnürer, V Passoth; Swedish University of Agricultural Sciences, Sweden

- P7.16 Screening for yeast strains with high phytase activity**  
M Olstorp\*, J Schnürer, V Passoth; Swedish University of Agricultural Sciences, Sweden
- P7.17 Development of potential applications of membranes and CO<sub>2</sub> supercritical fluid in separation processes for valuable products recovery from agro food by-products**  
J Guijarro\*, A Urkiaga, I Garay, L de las Fuentes; Gaiker Technology Centre, Spain
- P7.18 Effects of calcium incorporation on apple slices (var. granny smith) behaviour during osmotic dehydration**  
C Barrera\*, P Corell, N Betoret, P Fito; Polytechnic University of Valencia, Spain
- P7.20 Exploitation of wheat bran**  
M Parker<sup>1</sup>, A Ng<sup>2</sup>, K Waldron\*<sup>1</sup>; <sup>1</sup>Institute of Food Research, United Kingdom, <sup>2</sup>Gerber Foods and Soft Drinks Ltd, United Kingdom
- P7.21 Whey cheese matrices: improvement of organoleptic and textural properties**  
AR Madureira<sup>1</sup>, AM Gomes\*<sup>1</sup>, MM Pintado<sup>1</sup>, AC Freitas<sup>2</sup>, FX Malcata<sup>1</sup>; <sup>1</sup>Escola Superior de Biotecnologia, Portugal, <sup>2</sup>Marofa II - Lacticínios SA, Portugal
- P7.22 Rheological and microstructural characterization of probiotic whey cheese matrices**  
AR Madureira<sup>1</sup>, MM Pintado\*<sup>1</sup>, AM Gomes<sup>1</sup>, AC Freitas<sup>1</sup>, FX Malcata<sup>1</sup>; <sup>1</sup>Escola Superior de Biotecnologia, Portugal, <sup>2</sup>Marofa II – Lacticínios SA, Portugal
- P7.26 Optimization of dried shrimp production by intelligent systems**  
M Mohebbi\*, F Shahidi, M Akbarzadeh, M Moussavi, H Ghodousi; Ferdowsi University, Iran
- P7.27 CPF Technology - A cryogenic spray process to generate powders from liquids**  
S Gruener\*, F Otto; TU Muenchen, Germany
- P7.28 Cultivation of *Pleurotus* spp. in several agro-industrial by-products**  
J Sequeira<sup>1</sup>, M Pintado\*<sup>2</sup>, J Teodósio<sup>2</sup>, AT Panteleitchouk<sup>1</sup>, T Rocha-Santos<sup>1</sup>, T Hogg<sup>2</sup>, et al; <sup>1</sup>ISEIT-Viseu, Portugal, <sup>2</sup>Escola Superior de Biotecnologia, Portugal
- P7.29 Antioxidant activity of various wheat products**  
M Sakac\*, J Gyura, D Medic; Faculty of Technology, Yugoslavia
- P7.31 Enzymatic extraction of pectins from different plant by-products**  
M Panouillé\*, S Durand, C Garnier, J-F Thibault, E Bonnin; INRA Nantes, France
- P7.32 Composition of Iranian tea seed oil**  
M Davar\*, M Ghavami, M Ghrachorlo, P Mahasti, Science and Research University, Iran

<b>Technology Development Feed</b>
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- P8.01 Development of species of origin identification methods for use in processed animal proteins**  
S Woodgate\*<sup>1</sup>, R Margry<sup>2</sup>, S van den Hoven<sup>2</sup>; <sup>1</sup>EFPR, Belgium, <sup>2</sup>CCL, Netherlands
- P8.02 Dielectric spectroscopy studies of *Longissimus Dorsi* pork samples**  
M Castro\*, P Fito, R De los Reyes, E De los Reyes; Universidad Politécnica de Valencia, Spain
- P8.04 Quality traits of cow's milk from maize silage or grass hay based diet**  
S Segato\*, C Elia, S Balzan, C Ossensi, E Novelli, M Dorigo, et al; Padova University, Italy
- P8.05 Co-fermentation of *Rhizopus oligosporus* with lactic acid bacteria and yeast during barley tempeh fermentation**  
XM Feng\*, V Passoth, A Eriksson, J Schnürer; Swedish University of Agricultural Sciences, Sweden
- P8.06 Effect of the inclusion of citrus surplus in the diet of lactating ewes on the cheesemaking properties of milk**  
DP Jaramillo\*<sup>1</sup>, T García<sup>1</sup>, B Guamis<sup>1</sup>, M Rodríguez<sup>2</sup>, AJ Trujillo<sup>1</sup>; <sup>1</sup>Universitat Autònoma de Barcelona, Spain, <sup>2</sup>Universidad Politécnica de Valencia, Valencia, Spain

<b>Technology Development Non Food and Fuel</b>
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- P9.01**     **Edible films with bioactive characteristics against *Listeria monocytogenes***  
CMBD Pintado\*, I Sousa, MASS Ferreira; Technical University of Lisbon, Portugal
- P9.03**     **Implementation of anaerobic digestion plants in breweries – new technologies**  
T Herfellner\*, G Pesta, R Meyer-Pittroff; TUM Weihenstephan, Germany
- P9.04**     **Biomass as a heating source in breweries**  
W Ruß\*, R Meyer-Pittroff; TU München, Germany
- P9.05**     **Applications of solar heat in food processes**  
W Ruß\*, D Antoni, U Buchhauser, R Meyer-Pittroff; TU München, Germany
- P9.07**     **Production of biodiesel from defective coffee beans and waste frying oil**  
L Oliveira\*, A Franca, D Nunes, M Dinardi; Universidade Federal de Minas Gerais, Brazil
- P9.08**     **Ethanol production from dried mango peel and effect of nutrient supplementation**  
L Veeranjaneya Reddy\*, OV Sarathi Reddy; Sri Venkateswara University, India
- P9.09**     **Effect of macro-nutrients and ultraviolet on polysaccharide composition of *Silene vulgaris* cell culture**  
E Gunter\*, Y Ovodov; Institute of Physiology of RAS, Russia
- P9.12**     **Involvement of *Bacillus licheniformis* and *Micrococcus kristinae* during ripening of salt fermented Indian shad (*Tenualosa ilisha*)**  
RK Majumdar\*, BB Nayak, S Basu; Central Institute of Fisheries Education, India



**Abstracts - Oral**



[1.03]

**Food industry and sustainability - a political viewpoint**

RM Bergkamp\*, Director General, on behalf of C Veerman, Minister of Agriculture, Nature and Food Quality, The Netherlands

No abstract available.

[2.01]

**The 7th Framework Programme in relation to the total food chain and food technology**

D Pottier\*; EU Research Directorate General, Belgium

No abstract available.

[2.02]

**Use of resources in the agri-food chain**

R Rabbinge\*, Wageningen University, The Netherlands

During the last two decades considerable changes in the agri-food chain occurred. They may be characterized in five mega trends; 1. increased productivity per ha, per man hour, per kg of input, 2. from skill to a more industrial way of producing, 3. broadened objectives for the agri-food chain, 4. inversion of the production chain, from plate to spade, from shelf to soil, 5. increased interest in health related food products and production. The consequences of these mega trends for the mode of operation and the concepts in the food chain are dramatic. The results in terms of use of resources are impressive. Within the vertical chains efficiency and efficacy of use of (natural) resources have increased considerably. That vertical integration is a *conditio sine qua non* for an agri-food chain focused on sustainable development.

But there is more. When lateral interactions between chains are optimized and land use is included further improvement of use of (natural) resources by a factor 4-10 is possible.

[2.03]

**Sustainability for the agri-food business in developing countries**

V Prakash, CFTRI, India

No abstract available.

[3.01]

**Industrial approach in the global market**

JK Vis\*, Unilever NV, Netherlands

Unilever is an Anglo-Dutch manufacturer of fast moving consumer goods, both food products and products for home and personal care. Unilever has sales in over 150 countries and employed 227,000 people in 2004. In 2004, sales was €40.4 billion, pre-tax operating profit was €6.1. Consumers buy a Unilever product 150 million times a day. Unilever introduced its Vitality Mission in 2005: "To help people feel good, look good and get more out of life." Embedded in this mission is the realisation that companies such as Unilever rely on natural resources for their raw materials, and have to be embedded in thriving communities to be successful as employer, as manufacturer and as sales agent. This realisation builds on three sustainability programmes, which have been running in Unilever since the mid nineties: on water, of fish and on agriculture.

The presentation will focus on the sustainable agriculture programme. The setting up of the programme was fairly straightforward. From a definition of sustainable agriculture, four principles were derived and eleven indicators were chosen. Lead Programmes were set up with growers around the world, for five crops: oil palm, tea, tomatoes, peas and spinach. Other crops followed. In all Lead Agriculture Programmes, the same question was discussed with growers: how can we incorporate environmental and social requirements in the contracts with growers, such that environmental and social impacts actually improve, while farming economics improve at the same time.

This approach has led to the publication of Sustainable Agriculture Practice Standards for all five crops in 2003. Improvement programmes have been in place since. The standards are now being shared with ever expanding groups of growers. For some crops, e.g. oil palm and soy, Unilever participates in multi-stakeholder initiatives to introduce this sustainability approach to entire sectors Roundtable on Sustainable Palm Oil (RSPO: [www.rspo.org](http://www.rspo.org)), Roundtable on Responsible Soy (RTRS: [www.responsiblesoy.org](http://www.responsiblesoy.org)).

With these initiatives underway for a number of years, the presentation will look into the question: what type of innovation is happening here? What do these sustainability programmes and multi-stakeholder initiatives mean in terms of governance models? Are they Public-Private-Partnerships? Are they part of globalisation? What concerns are being addressed?

### [3.02]

#### **Making money from food industry by-products**

PC Nell\*, Provalor BV, Netherlands

From 1985 to 1997, Pieter C Nell was MD of three vegetable processing companies. The high percentage of non-used vegetables or parts thereof gradually became an irritating factor for me personally. The high percentage non-used vegetables was more increasing then decreasing due to the trend of the multiples to have in their shops the best part of the quality only. I experienced this trend as unfair towards the poor third world, where people are starving.

In several research-programmes it was shown that these vegetable remnants are containing interesting nutraceuticals. Due to the low dry matter contents of vegetables it was not feasible to gain these nutraceuticals out of these vegetable-remnants in an economic way. In order to get rid of these vegetable remnants, they are fed to the animals. Actually these vegetables are more or less worthless for animal husbandry, since vegetables hardly contain energy due to the low dry matter content of approx 10% only.

In North-western Europe the quantity vegetable remnants are approx. 1.6 million ton!!!!

In 1994 the idea came up to solve the problem of vegetable-waste by using the moisture content of the vegetable remnants through pressing juice out of the remnants. The idea was patented and in 1998 Provalor was founded by four private investors. Since 2002 Provalor is really active and since 2004 Provalor is a major supplier of various vegetable juices to the main European bottling companies.

#### Key words of abstract

- o Major problem in the food-industry is that all attention is paid to the mainstream and actually no attention is paid to the by-products, since they are considered as waste.
- o Nevertheless in vegetable-processing 15-30% of the raw material is thrown away due to its form etc.
- o For a good success don't look too deep in the problem and difficulties. Good solutions are not always difficult
- o Build partnerships
- o Take a high quality standard (above market average)
- o Look for a launching customer and make him partner in the development
- o Turn by-products from a loss-factor into a profit-factor

A change in mind setting is 'a must'.

### [3.03]

#### **A case of industrial success in sustainable soy bean production chain in Brazil**

A Freire\*; Cert ID Ltda, Brazil

Any productive system should take into account, in the first instance, the human aspects, in such a way that people are allowed and assured a decent and respectful life. People must have, among other aspects, equal rights, and access to housing, food, education, health care and welfare, freedom of expression and association, and leisure. In close relation to them, environmental and ecological sustainability are also imperative to ensure current and future generations the availability of natural resources necessary for a good quality of life. Social degradation, disregard for ecological and environmental aspects, modern production and processing impacts, are today issues considered at Board level by leading retailers, food brands and government. Simultaneously, there are an increasing number of consumers who take into consideration social and environmental aspects when making their purchasing decisions. To take into account these aspects means a differential in terms of access to the international market for agricultural commodities and their by-products. Such differential can only be achieved by the creation of standards of social and environmental responsibility, which can be applied, monitored and verified. The Basel Criteria for Responsible Soy production is a document developed through a cooperative work of the WWF, ProForest and COOP Switzerland to ensure purchasers that soybeans or their downstream derivatives are responsibly produced. This document served as a basis for the creation of the ProTerra Standard, which enlarges that initial concept and is applicable to different agricultural commodities, regions and levels of the chain. A large Brazilian soybean crusher is being certified against ProTerra as well as the cooperatives of soybean growers supplying the crushing



plants. This is changing the agricultural production model in the State of Paraná, Brazil, ensuring social and environmental sustainability compliance in the chain. Other crushers are starting to follow the example.

Keywords: Sustainable, Industrial, Agri-food, ProTerra

### [3.05]

#### **Regional networks and sustainable agri-food chains**

X Gellynck\*, B Vermeire, R Januszewska, J Viaene; University of Gent, Belgium

Networks play a vital role in the diffusion of knowledge and in innovation processes in the food industry. Thereby networks and innovation contribute to a sustainable food sector in two ways: first, innovation is a way for the firm to achieve a sustainable competitive advantage. Second, networks generate a pool of specific capabilities and resources which can not be easily copied by- or relocated to other regions. The region can stimulate innovation by stimulating regional networks and consequently yield the fruits through establishing a sustainable competitive advantage. This research aims at identifying the role of the region in innovation processes in the agri-food chain in general and at the catalysing role of regional networks in particular.

The theoretical framework describes the relation between regional factors, innovation and sustainability in agri-food chains. Data collection is performed through face-to-face interviews of 81 firms in regional agri-food chains. Analysis starts with the determination of firms' innovation capacity as an indicator of sustainability. The firm is classified as a leader, follower, traditional or non-innovator based on its overall innovativeness (domains and characteristics of innovation) and efforts in knowledge-acquisition. Next, factor analysis and subsequent discriminant analysis are applied to measure the impact of the different factors on the innovation capacity and sustainability.

The research findings provide a differentiated picture of the relation between regional factors and sustainability. The participation in regional networks is positively related with innovation capacity. Further, an evaluation of actual and future initiatives demonstrates that followers and traditionals attach much importance to government initiatives in networking, yet are not satisfied with actual initiatives. Innovators are significantly more satisfied. This shows that an active behaviour in interaction with a diversity of actors enables the firm to take advantage of regional factors of innovation.

In the discussion it is argued that the regional embeddedness of networks is a factor in establishing a sustainable regional competitive advantage. Considering that the regional network is a complex set of relations being a distinctive feature of the region and that participating in these networks is an integral part of the firm's innovation strategy, than the presence of networks is an argument for firms to stay in- or come to the region. For the region, consequently, enhancing the regional network is a way to develop sustainable economic performance. Further research should focus on strategies for developing regional networks which combine transparency and efficiency on the one hand with complexity and strong embeddedness on the other hand.

Keywords: innovation, network, sustainability, region

### [3.06]

#### **Sustainable innovation for the potato starch production chain in the Netherlands**

RJF van Haren\*; AVEBE UA, Netherlands

Farmers, the processing industry, research institutes and regional government have in cooperation initiated a research program, AGROBIOKON, for sustainable innovation of the potato starch production chain. Farmers and the processing industry must be prepared for coping with the effects of changes in the Common Agricultural Policy of the EU.

The economic and ecological performance of the potato cropping has to be improved in order to increase potato yields, reduce losses and anticipate upon changes in the environmental legislation on nutrient losses and crop protection agents. Knowledge for crop management improvement is disseminated to farmer knowledge networks and through interactive decision support systems. As consequence the social structure around farms is in this way reinforced. Dedicated DSS are developed in order to optimize the ecological and economical needs of the farming business regarding starch potato cropping. With these activities the profit of farms is expected to increase.

New starch based products are developed by taking the quality variation in the raw material into account. A complete chain innovation program is started in which the principles of QCM (Quality Chain Management) are used. The variation in potato starch quality is used for developing and tailoring new "clean label" products and for reduction of the amount of chemicals used in starch derivatisation. Results lead, when implemented, directly to increased ecological and economical improvement.

In conclusion, the AGROBIOKON program, results in improvement of the ecological, economical and social (knowledge) aspects of the potato starch production chain in the North East part of the Netherlands. With this the potato starch production chain is ready for the 21st century.

Keywords: sustainable innovation, decision support system, production chain, potato starch

#### [4A.01]

##### **Whole by-product exploitation: an integration of research and technology in a market economy**

K Waldron\*; Institute of Food Research, United Kingdom

Across Europe, food and beverage industries produce millions of tonnes of surplus co-products annually. These range from unused vegetable and cereal biomass through to highly-modified processed materials and waste streams with varying quantities of waste water. The quality and quantity of these can often vary throughout the year.

The "waste" issue has become increasingly important to the food industry due to legislative pressures. The EC landfill directive has led to an increase in costs and a reduction in landfill opportunities. With rising disposal costs, alternative uses of co-products are increasingly being sought. Many co-products have the potential to provide new and natural sources of nutraceuticals and functional ingredients. Indeed, there are numerous examples of research activities and scientific publications providing the basis for extracting valuable components from waste streams. Epidemiology has demonstrated that many edible plant components such as phytochemicals, have a positive impact against cardiovascular diseases and cancer. Some also appear to exhibit immunomodulatory activity. In addition, the plant cell wall components in food comprise the dietary fibre element which is accepted as having a key role in a healthy diet.

However, the exploitation of potentially valuable components of by-product streams is often attenuated by economic constraints, often arising from the subsequent disposal of further waste residues. One way to address this is to focus on whole co-product exploitation, and to ensure that all components derived from a co-product are considered. This presentation provides an overview of such a strategy, highlighting the importance of multidisciplinary and collaborative activities on an international basis through projects such as the EC STREP "REPRO", and the importance of seeking economic returns on traditionally low-value bulk residues through their transformation into novel products.

##### **Acknowledgement**

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Keywords: economics, markets, technology, acceptability

#### [4A.02]

##### **Bioactive plant polysaccharides: an overview**

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Over the last years, the amount of recent scientific literature about the bioactivity and health-promoting properties of plant-derived compounds such as polysaccharides has increased. Potentially bioactive polysaccharides have been obtained from a wide range of plant sources. Their carbohydrate composition and structural features are typical of polysaccharides of either gums and mucilages, storage polysaccharides or cell walls from prokaryotes, fungi, lower and higher plants.

Glucomannans, pectic polysaccharides and glucans are three of the most important groups of plant-derived polysaccharides which have been associated with different bioactivities. The aim of this study is to review the health benefits of these specific phytochemicals. Their sources, extraction procedures, potential applications and bioactivities are discussed.

Glucomannans are carbohydrate polymers widely distributed in both hardwood and softwood plants, where they have either storage or structural functions. A considerable amount of work based on the bioactivity of glucomannans from two interesting plant sources has been carried out: *Aloe vera* and *Amorphophallus konjac*. Many biological activities, including anti-viral, anti-bacterial, laxative, protection against radiation, anti-inflammatory and immunostimulation have been attributed to these polysaccharides. However, contradictory reports suggest that more precise understanding of the biologic activities is required to develop glucomannans as pharmaceuticals.

In recent years, pectic substances have emerged as a relevant class of potentially bioactive natural products. Pectic polysaccharides can be found in relatively large amounts in the cell walls of fruit and vegetable tissues. However, most of bioactivities associated to pectic polymers have mainly been reported for polysaccharides obtained from herbal and medicinal plants.

Further, extensive studies have demonstrated that (1→3)-D-glucans might exhibit considerably immunomodulatory activity by binding specific macrophage receptors and activating macrophages, resulting in antitumour, antibacterial, and wound healing activities.

Some industrial activity has already been settled based on the health-promoting properties, although not always scientifically supported, of several plant polysaccharides. However, as it can be inferred from the vast, recent and even sometimes contradictory, scientific literature, most of the potential of many plants and specific plant derived polysaccharides remains almost completely unexplored.

Keywords: plant polysaccharides, glucomannans, pectic substances, glucans

#### [4A.03]

##### **Purification of milk fat globule membrane fragments from dairy effluents**

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Nowadays, the biological membrane of native milk fat globules is receiving a lot of interest because of the presumed biological activity of several of its components. This natural membrane consists primarily of milk fat globule membrane (MFGM) proteins, phospholipids and sphingolipids. The latter are thought to play a role in the prevention of colon cancer and chronic colitis, and to reduce the intestinal uptake of cholesterol.

Dairy fractions were analysed on MFGM-components by one and two-dimensional gelelectrophoresis (protein) and HPLC (polar lipids), of which a new developed method enabled good separation and quantisation of glucosyl- and lactosylceramides, phosphatidylethanolamine, -serine, -inositol, -choline and sphingomyelin. Furthermore, these components were monitored upon processing of raw milk into cream, butter, buttermilk quarg and anhydrous milk fat. Balances were calculated and revealed that these MFGM-fragments are preferentially enriched in aqueous effluents like buttermilk, butter serum and whey.

The MFGM particles, with an average particle size of about 1 µm, can be further concentrated from these secondary dairy fractions by ultra- and microfiltration techniques. Starting from acid whey, different membrane pore sizes, temperatures and pH were evaluated by means of a response surface experimental setup.

Upon the direct microfiltration of butterserum, which still contained casein micelles of similar particle size as the MFGM-fragments, the retentate was only partially enriched in MFGM fragments, as casein micelles were also retained. Sodium citrate, which dissociates the casein micelle into smaller submicelles was added to butterserum. It was shown that sodium citrate seriously enhanced casein transmission through the membrane, but this at the expense of serious losses of membrane fragments. It was concluded that filtration techniques are successful for the purification of MFGM fragments out of casein free fractions like whey, but not out of casein rich fractions like buttermilk, cream- and butterserum.

Keywords: polar lipids, sphingolipids, dairy products, filtration

#### [4A.04]

##### **Sustainable technologies in the Dutch dairy industry – a review**

AJ van Asselt\*, P de Jong; NIZO food research, Netherlands

From the start of the industrialisation of the dairy process the sector has been keen on new developments to provide safe products combined with an efficient process from an environmental point of view. As a research institute NIZO food research contributed in the development and this paper gives an overview of technologies in which sustainability is leading.

Thirty years ago energy consumption was a major topic to deal with. As a result the regeneration of heat in heat exchangers is now a technology widely used. A specific example of this technology is falling film evaporation of dairy liquids. The evaporation process exists of 2, 3 or more stages in which the vapour of the first stage is used as a heating medium for the second stage. Depending on the amount of stages (N) 1 kg of steam can evaporate N kg of water having a positive effect on the steam consumption.

A second development is the upgrading of waste streams using membrane technology. Membranes can now be applied for upgrading condensate from evaporators in order to use it as processing water or removing lactose from whey. The result is a reduction of waste combined with the re-use of valuable components.

A third and more recent development is fouling prevention in processing equipment. Especially in heat treatment equipment fouling occurs as a result of denaturation of proteins thus reducing the available running time. By understanding the mechanism of fouling it can now be predicted and the process can be optimised by choosing the optimum process parameters (heating temperature, residence time). This knowledge is now available in predictive tools like NIZO Premia.

These examples show that during the years the Dairy Industry has developed itself as one of the key players with regard to self-regulation in the fields of food-safety and environment.

Keywords: Evaporators, Membrane technology, Predictive modelling

#### [4A.05]

##### **Potential of carbohydrate-degrading enzymes in valorisation of brewer's spent grain**

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Significant amount of process by-products are formed during brewing. This by-product, i.e. brewer's spent grain (BSG) is currently used mainly as cattle feed. Because of its food-grade status BSG could be exploited as a source of valuable food and/or feed ingredients (phenolics, pentoses, proteins), if

properly processed. Enzymes are potential catalysts for processing of plant based raw materials due to their specificity and mild reaction conditions needed. In this work the suitability of different enzyme cocktails for solubilization of carbohydrates was elucidated. The main issue was to investigate the efficiency of enzymes as selective solubilisation tools for the extremely complex BSG matrix. Spent grain was obtained from a Finnish brewery, where after it was dried and milled and subsequently treated with various food-grade carbohydrate-degrading enzymes. Thorough analysis of the carbohydrates and proteins present in the soluble fractions and in the residues were performed. Finally the potential of enzymatic valorization of BSG will be discussed.

Keywords: Food waste stream, Enzymes, cell wall degradation

#### [4A.06]

##### **Recycling water in food factories**

D Napper, EHEDG, Euroteknik Ltd, Denmark

Sustainability is a very interesting and often used term. Before any strategy for a value chain can be made the individual links of the system must be analysed to see where intervention can be made. This presentation looks at the link which is present in most agri-food, process water in food factories, to see where it impacts the total chain..

The food and beverage industry is the largest production sector in Europe and one of the areas targeted for research and legislation to reduce the quantity of water used. The cost of energy continues to increase. Penalties for processing effluents from industry continue to increase. As resources become ever more scarce and expensive and legislation more strict the food and beverage industry is attempting to adjust. Some companies are making careful analysis of what they are throwing out along with their wastes water and how it can be recovered. In the European Hygiene Engineering and Design Group ([www.ehedg.org](http://www.ehedg.org)) the process water group is looking at the various moves that are being made to recycle water in food factories. Reusing water demands careful observations of what can happen with bacteria growth, concentration of undesired material in the water and actions to make certain the quality of production is not compromised. A guideline to the industry will be published in the near future. At the annual meeting of EFFoST a presentation will be made about the efforts that have been reviewed in a wide range of applications.

Keywords: process water, energy, water, separation

#### [4A.07]

##### **Production of prebiotics and antimicrobial agents from a by-product of essential oil extraction**

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##### **Introduction**

Bergamot (*Citrus bergamia* Risso) is the main source of an essential oil widely used in the cosmetic, pharmaceutical and food industries. The peel is the primary by-product of the processed fruit and is rich in value-added materials. In this study we describe the potential prebiotic effect of enzyme-solubilized oligosaccharides (BOS) in comparison with fructo-oligosaccharides (FOS). The antimicrobial activity of ethanol-extracted flavonoids was also examined.

##### **Materials and Methods**

Flavonoids were extracted with ethanol, the aglycone and glycosylated forms being identified by HPLC-MS. The peel was hydrolysed for 24 h at 37°C with food-grade pectinolytic and cellulolytic enzyme preparations. The antimicrobial activity of four ethanol fractions rich in flavonoids was tested against Gram negative and positive bacteria and yeast.

##### **Results**

Sugar analysis of BOS indicated that it was mainly composed of galacturonic acid with a size distribution of d.p. 2-7. Studies with pure and mixed human gut bacteria showed that addition of BOS resulted in a high increase in the numbers of bifidobacteria and lactobacilli whereas the clostridial population decreased. A prebiotic index (PI) value of 6.90 was obtained for BOS, which was higher than that of FOS (6.12). The flavonoid profile consisted of characteristic *Citrus* species flavanone rutosides and neohesperosides, together with a number of novel flavanone and flavone glycosides not found in orange and lemon. These polyphenolic fractions were active against Gram negative bacteria (*E. coli*, *S. enterica*, *P. putida*) but not against *Sacc. cerevisiae* and the Gram positive strains (*B. subtilis*, *L. innocua*, *Lac. lactis*, *Staph. aureus*). Enzymatic deglycosylation increased the antimicrobial activity by converting the flavonoid glycosides to their more biologically active aglycones.

## Discussion

These results indicate that bergamot peel could be further utilised to produce high value compounds. Bergamot peel contains prebiotic compounds which can be easily extracted using pectinases and may be incorporated into functional foods. The fractions rich in flavonoids may be used as natural antimicrobial agents and their bioactivities can be modified using  $\beta$ -glucosidases and  $\alpha$ -rhamnosidases.

Keywords: Citrus waste, Bergamot, Prebiotic, Flavonoids

## [4A.08]

### Saccharification of brewer's spent grains by using multi-enzyme-systems

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In the case of anaerobic digestion the saccharification of brewer's spent grains proves to be difficult. Mainly the heavily biodegradable substances like cellulose, hemi-cellulose and lignin are causing a bad degradation and long staying-times. The chemical and mechanical pre treatment of brewer's spent grain is causing high costs of energy as well as a higher number of technical components. The use of enzymes is an alternative solution to digest hemi-cellulose and cellulose.

Enzymes as additives to advance the digestion in agricultural plants are offered commercially since a few years. These enzymes aim to ameliorate the digestion of releasable carbohydrates. However a commercial use was not feasible in the past because of high production costs.

A new process enables to produce specific operant enzymes with low costs. Specific operant means a substrate-adapted enzymatic activity-spectrum. During the production process this specification is realised by using a natural adaptation-process. Thereby adequate fungus cultures are cultivated on solid substrates and are coevally conditioned concerning their enzyme secretion. Multi-enzyme-systems produced in such a way are able to release more efficient their aim substrates in a short time

The effectiveness of these multi-enzyme-systems on brewer's spent grains was tested successfully in laboratory- scale at our chair. Based to these results positive statements concerning saccharification became possible. The use of multi-enzyme-systems shows a new and efficient way to shorten staying times, to reduce investment costs as well as to force up the specific biogas production of brewer's spent grains.

The oral presentation summarises a new way of enzyme-production. The economical an technological advances compared to conventional processes as well as results of practical experiments top off this oral presentation.

Keywords: biogas, multi-enzyme-system, saccharification, brewer's spent grains

## [4A.09]

### Phenolic cross-linking and its application to manipulating bulk mechanical properties of cereal bran

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#### Introduction

Extracted arabinoxylans (AX) and sugar beet pectin fractions can cross-link via peroxidase- or laccase-mediated oxidative coupling. The thermo-irreversible gel networks produced can be used as texturisers or to facilitate incorporation of 'high fibre' ingredients into food. There is little information on promoting oxidative coupling in insoluble substrates. This study compares oxidative coupling treatment on soluble AX and then on unprocessed wheat bran (WB) and brewers' spent grain (BSG) in relation to texture (sample compaction). The purpose is to establish the potential for using oxidative coupling to enhance exploitation of insoluble residues.

#### Materials & Methods

Enzymes used (Table 1) were Horseradish peroxidase (HRP:113 U/mg), *A. bisporus* laccase (*A. bisp lac*: 7.4 U/mg) and *T. versicolor* laccase (*T. vers lac*: 26.8 U/mg), with treatment at equivalent concentration (1.6 U/ml). Sugar beet pectin, rye and wheat AX were prepared as 2.5% dispersions in 50mM citrate buffer (pH 6.0). WB and BSG (5 mg/ml) were treated with up to 8 U enzyme/ml at room temperature. Samples were analysed for alkali-extractable phenolics and compaction.

#### Results & Discussion

Polysaccharide extract gelling was most effective using peroxidase (Table 1). Rye AX and wheat AX medium viscosity gelled with peroxidase and *T. vers.* laccase. The phenolic content (~0.1mg/g) was lower than the threshold (0.4mg/g) reported for gelling 1% AX. The low viscosity wheat AX (phenolics ~0.1mg/g) did not gel.

**Table 1. Isolated polysaccharide gelling characteristics**

Sample	Pectin	Wheat AX med. visc.	Wheat AX low visc	Rye AX
HRP	+++	++	-	+++
A. bisp. lac.	+?	-	-	+?
T. vers. Lac	+++	++	-	++

WB and BSG (~7mg ferulic acid/g sample) were expected to show significant changes in cross-linking following peroxidase treatment. However, changes were negligible and with no apparent effect on compaction. This study has established that whilst oxidative coupling can be induced at very low ferulic acid concentration in soluble polymers, insoluble residues appear to exhibit steric constraints and/or reaction conditions are modified. Whether such constraints can be overcome will be clarified when evaluating residues recovered from processed samples.

Keywords: phenolics, polysaccharides, cross-linking, texture

#### [4A.10]

##### **Sustainability of novel food processing technologies, a European perspective**

T Ohlsson\*, Sweden, HSM de Vries\*, Netherlands, NovelQ

Mild preservation is considered to be the approach for extending shelf life of high quality foods with characteristics close to those of raw material. High pressure processing, pulsed electrical fields and several advanced heating technologies are researched and tested at pilot scale. The results are promising in terms of overall food quality (taste, flavour, texture), functional ingredients (e.g. vitamins, fibres) and microbial safety (cells and spores). However, applications have been limited up till now.

In this presentation, the question is addressed whether the above-mentioned novel technologies are more environmentally efficient than existing technologies. If so, will this contribute to the unique selling points of NP and faster implementation at large scale? A review will be presented of the pro's and con's of NP with respect to environmental impact.

#### [4B.01]

##### **Use of enzymes in the food industry to improve product functionality**

J Buchert, VTT, Finland

Enzymes offer specific means to modify the properties of food raw materials or ingredients. Food raw materials are composed of carbohydrates, proteins and fats with different ratios depending on the origin of the raw material. The chemistry of these components can be tailored with enzymes resulting in changes in macroscopic properties. These changes can subsequently be exploited in improved processes or in products with either added or totally novel functionalities. Enzymatic reactions are generally very specific and can be carried out at mild conditions. Enzymatic processing can be carried out either with exo- or endogenic enzymes and the obtained reactions depend on the enzyme(s) selected. The structural properties of foods are of utmost importance in different application areas, such as baking, dairy or meat processing. Crosslinking reactions via proteins or carbohydrates are the key reactions involved in the structure engineering of food. Depending on the enzyme type different chemical linkages can be formed. Targeted processing with enzymes also offers means to improve the product quality. Bioavailability or functionality of the bioactive components in plant raw materials can also be enhanced, or alternatively the flavor perception can be boosted.

#### [4B.02]

##### **The initiative POLYPRES: surplus and waste food polysaccharide polymers valorisation through high pressure processing**

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Neglected crops and food resources existing in developing countries, where food supplies for local population are compromised, are potential sources of food ingredients and new value-added functional products. This is particularly true when polysaccharide polymers are considered (starch, chitosan, alginates...) contained in either processing waste, surplus or local traditional crops.

High pressure processing, an innovative technique able to induce controlled and moderate transformations on food polymers, is proposed as a mean to valorise these currently lost and even pollutant products. Additionally, this is expected increase the range of active applications of high

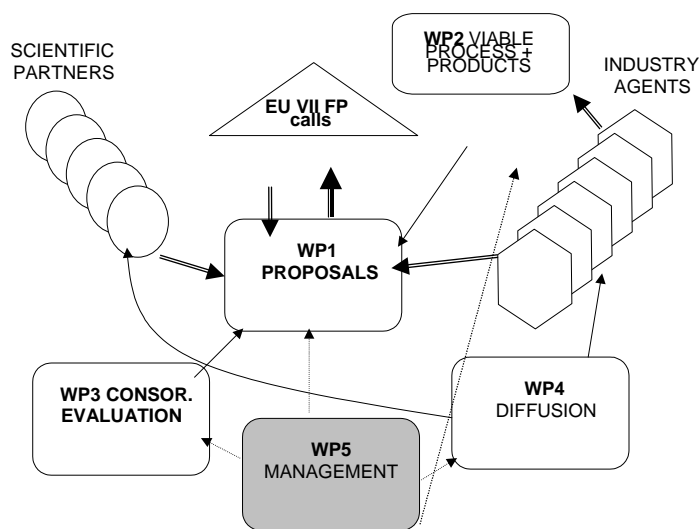
pressure technologies, contributing to its cost reduction and further industrial use. The Argentina-Brazil area is considered suitable for development on these lines, though results could be exported to other areas.

Under the acronym POLYPRES and with the same title as this contribution, a proposal has been recently presented for an INCO-DEV/SSA project. Within it, studies of feasibility and economic viability would be performed, so that, together with pre-existing knowledge, scientific background and know-how of the partners, a number of future proposals could be prepared addressing the topics considered more promising within this subject.

The new proposals, mostly intended for the EU VII-FP but not restricted to it, would include the current partners (signing this contribution) and, depending on the actual call and tasks nature, new scientific or industrial partners, contacted within this project. Consequently this proposal expects to become the seed of a number of future initiatives aiming at different concrete aspects of the valorisation of these food underexploited products and in different frames (scientific, technological, industrial, developmental).

The work carried out under this project and diffused out of the consortium can also generate a number of independent initiatives, though the interrelation of the future efforts of the scientific and industrial community on this line would be endeavoured.

### *Flow diagram of the proposed project*



Keywords: polysaccharides, high pressure, valorisation, surplus

[4B.03]

### **EC legislation regarding production of safe food and feed**

H Heeres\*; TNO Quality of Life, Netherlands

#### Introduction

Food and feed have to be safe. In the European Community, EC, there is a lot of legislation concerning the production of safe food and feed. This legislation applies to food and feed ingredients made of by-products. So it is important to know this legislation at the production and the marketing of these ingredients.

#### Methods

An overview of the applicable legislation concerning production and marketing of food and feed ingredients will be presented. Hereby the experiences at the realization of the task 'Risk assessment' of the REPRO-project, mainly the subtask Assessment of the Regulatory Acceptance<sup>1</sup> will be represented.

#### Results

Rules concerning the production have been laid down in the General Food Law, Regulation (EC) No 178/2002, GFL, and concerning hygiene in a number of (new) regulations.

The following subjects of the GFL will be discussed a.o.: the farm to fork approach, the definition of 'food', precautionary principle, risk assessment, safety of food and feed, responsibilities (recall), traceability, and (product) liability.

The following subjects of the Regulation (EC) 852/2004 on hygiene of foodstuffs will be discussed a.o.: responsibility for food safety of food producers, general and specific hygiene requirements (primary production and stages after that), HACCP (Hazard analysis and critical control points), official controls, registration and approval.

Rules concerning the use of food and feed ingredients have been laid down in several EC directives and regulations. This legislation is important at the production of food and feed ingredients as well as at the possibilities to use them in food and feed.

The following subjects laid down in EC legislation will be discussed: the authorisation of novel foods and ingredients, food and feed additives, colours, sweeteners, flavourings, processing aids.

Discussion

The legislation above will be reviewed and harmonised more and more. Future changes will be discussed, a.o. others additives and enzymes.

Keywords: legislation, safe food and feed, hygiene, risk assessment

<sup>1</sup> REPRO: Reducing food processing waste, Sixth Framework Programme, REPRO aims to develop advanced methods to recycle and upgrade food-processing organic waste co-products (by-products) into high added value food and feed products. See also web-site: <http://www.repro-food.net/phpnuke/index.php>

#### [4B.04]

##### **Domestication of microorganisms promoting sustainability of the agri-food chain**

J Schnürer\*; Swedish University of Agricultural Sciences, Sweden

Sustainable agriculture requires energy efficient and non-toxic technologies. Microorganisms can be used to reduce environmental problems, for example in biocontrol to replace chemical pesticides, in plant growth promotion to reduce nutrient leakage, in biopreservation to minimise spoilage of food and animal feed and in bioprophylaxis to prevent toxic compounds from contaminating the environment. Many applications require large-scale fermentor production of microbial inoculants, followed by formulation steps for long-term stability and to ease application at target sites. Safe use of microorganisms requires careful consequence analyses, which for commercial products may be followed by a lengthy registration procedure. Presently, the growth of novel biotechnological industries that can solve environmental problems by using microorganisms is held back by the lack of knowledge about fermentation/formulation technologies. The absence of safety assessment systems for microorganisms, suited for decision making by regulatory authorities, is an even more serious obstacle for sustainable developments.

The research programme "Domestication of Microorganisms" (DOM) is funded by Mistra - the Swedish Foundation for Strategic environmental Research - and aims to provide microbial solutions to environmental problems through cooperation with strategic partners. This is achieved by utilising the metabolic power of the natural microbial diversity through a domestication programme, focusing on safety and formulation to generate stable products with high efficacy. The research programme forms a "DOM Center of excellence" for research and development of fermentation/formulation technologies and safety assessment systems for novel domesticated microorganisms to be used in non-conventional applications. Through communication with regulatory authorities at early stages of development, the registration process will be facilitated, allowing earlier commercialisation of novel products. Since process and product safety will be assessed at an early stage, potential risks for humans and the environment can be minimised. Results from the first three years of this interdisciplinary program will be presented, with a focus on sustainable environmental solutions.

Keywords: Biopreservation, Lactic acid bacteria, Fungi, formulation

#### [4B.05]

##### **Autonomous salmon quality control using machine vision**

J Hayes\*, A Pacquit, K Crowley, KT Lau, D Diamond; Dublin City University, Ireland

A new method to classify the quality of farmed salmon has been developed. Wild salmon are pink in colour because their natural diet consists of shellfish (e.g. shrimps) which give them their characteristic colour. Farmed salmon do not have access to shellfish and are naturally grey in colour. Therefore, artificial colouring is added into their feed to give them a more natural appearance. The market value of farmed salmon partially depends on their appearance, thus a careful control of the chemical additives such as artificial colouring in their feed is required. Colour classification of salmon is performed by trained experts, which is very time consuming and subjective. In this paper, we present a method to classify salmon flesh quality automatically using machine vision. This technique is based on using a wireless digital CMOS camera that provides images of the salmon flesh. The images obtained were transmitted to a local PC where the image processing took place. Bespoke software was developed to process the transmitted images. The RGB (red, green and blue) values of the fish sample were extracted and compared to a local library of colour categories of farmed salmon. This library was constructed from the commonly used 'salmofan'. This technology provides a mean to classify the colour intensity of the salmon flesh for the appropriate market requirements. It can also be used to monitor the



amount of the astaxanthin or canthaxanthin colouring in fish feed consumed by the fish. This allows the fish farmer to safeguard the consumer from ingesting too much of these colourings. This technique helps to simplify the routine operation of fish farmers and ensures higher quality fish products.

Keywords: Imaging, Marine Culture, Quality Control

#### [4B.06]

##### **Cactus pear (*Opuntia* spp.) - a source of valuable components**

FC Stintzing\*, R Carle; Hohenheim University, Germany

Cactus pears (*Opuntia* spp.) originating from Mexico are widespread with biggest plantations in Mexico and Italy amounting to about 100,000 ha worldwide. Due to their genetic variability, *Opuntia* plants are characterised by an excellent ecological adaptability. A worthwhile feature is their high water-use efficiency in relation to other plants so that they may even be cultivated in marginal regions and used for land rehabilitation measures. Moreover, cactus pear plants have been shown to increase their biomass production upon elevated atmospheric CO<sub>2</sub> concentrations. Because of these particular characteristics and the fact that alternative uses for *Opuntia* plantations previously exploited for cochénille production are being searched, the use of cactus pear fruits as a source of valuable components presents a viable option.

Among the natural colourants, the betalains represent a most interesting albeit underrepresented pigment class. Despite being afflicted with an earthy smell, high nitrate levels, microbial contamination and a very limited range of colour nuances, exclusively red beetroots are exploited for betalain extraction today. Therefore, alternative sources are being sought. Traditionally consumed mainly as fresh produce, only recently cactus pear fruits have been proven to serve as a most promising crop for the production of colouring foodstuffs. Consequently, systematic studies on both the ingredient pattern and processing techniques have been performed to path the way for industrial processing. In addition to the betalain pigments, amino acids and readily absorbable sugars, the mucilage fraction appears to be highly valuable. Processing wastes accumulating during cactus pear juice and concentrate production deriving from peels and seeds could be exploited for pectin and oil production. Since not only the fruit, but also the green stem part may be used for many food and even medicinal applications, cactus pear represents a most valuable plant complying with a high sustainability for tomorrow's food market in every aspect.

Keywords: Cactus pear, Colour Crop, Processing, Natural colour

#### [4B.07]

##### **Recovery of added value pectins and phytochemicals from Brassica trimmings by hybrid processes**

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In the EU funded project REPRO hybrid processes are being developed for the conversion of cabbage trimmings into pectins and phytochemical rich materials for food purposes. Such a process consists of an integrated series of enzymatic and mechanical unit operations for the release and separation of the added value components. For a sustainable and safe solution the hybrid process should meet the following requirements:

- minimal amount of by-products formed
- economic and environmentally sound
- food legislative criteria being met with respect to both use of reagents, materials and processes and microbial safety

Vegetable trimmings, a -by-product from the food industry,-are currently mainly disposed of as cattle feed. Directly after processing the original vegetables the trimmings are still food-grade and could therefore serve as an interesting source of food ingredients. A major by-product from the vegetable processing industry is *Brassica* trimming: examples thereof are white, red and green cabbage trimmings. The annual industrial processing of *Brassica* in the Netherlands is about 50000 tonnes per year of which about 15 wt% ends up as by-product.

The hybrid processes discussed consist of the following unit operations: milling, extraction using organic solvents as well as aqueous enzyme solutions, membrane separation and adsorption chromatography. For this study red cabbage trimmings from an industrial food processor were used as starting material. Various process configurations were tested and the resulting data on the effect of processing conditions on yield and characteristics of pectins and colorants will be presented.

Keywords: Brassica trimmings, enzymes, process, ingredients

#### [4B.08]

##### **Application of computer vision to control curd and whey quality during cheese syneresis**

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Cheese making involves a phase separation process step known as syneresis. Syneresis is one of the most important but less understood processes in cheese making. It is a complex process involving the shrinkage of the casein micelle network that compresses the aqueous whey phase, inducing whey drainage. The kinetics and end-point of syneresis have a critical influence on curd characteristics, such as its moisture, mineral and lactose content. A study was undertaken to investigate computer vision for monitoring curd syneresis as a means of improving the control of curd moisture content in cheese making. A computer vision system was set up in a ten-litre cheese vat to monitor the visual effects of syneresis during the stirring of curd following the cutting of the coagulum. Curd syneresis kinetics were varied using a randomized factorial design combining two levels of milk pH and two agitation speeds. Milk pH and agitation speed significantly affected curd moisture content and colour changes during syneresis. Multiple linear regression involving colour difference, agitation speed and milk pH yielded correlations with curd moisture (R=0.78), the percentage of curd which was formed (R=0.73) and the solids in whey per 100g milk (R=0.73). These results demonstrated that a computer vision system has the potential to improve the on-line control of curd and whey composition, which would contribute to enhance quality and consistency of cheese and whey by-products.

Key words: Computer vision, colour difference, syneresis, cheese, whey, curd, quality control.

#### [4B.09]

##### **Enzymatic conversion of cod viscera to high-value ingredients of growth media for probiotic bacteria**

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Hydrolysates from cod viscera produced with different commercial proteases under mild conditions (neutral pH, low oxidative stress, medium temperature [1]) were tested as alternative complex nutrient sources for fastidious bacteria such as *Lactobacillus plantarum*, *Lactobacillus sakei*, *Pediococcus pentosaceus*, and *Bifidobacterium bb12*. Systematic comparative studies with MRS-like media containing commercial peptones/extracts or cod viscera hydrolysates revealed that the latter performed equally well or better than their competitors for all the selected bacteria [2,3]. Several of the tested bacteria are considered as probiotics, i.e. "live microorganisms, which upon ingestion in certain numbers, exert health benefits on the host beyond inherent nutrition" [4]. Because probiotic bacteria are generally regarded as safe (GRAS) and survive, and in some cases even colonize, the human gastrointestinal tract, they are of great interest to the food fermentation industry. They are also of interest to the pharmaceutical industry, since they may be used as delivery vehicles for e.g. antigens, antibodies and growth factors. The fastidious nutritional requirements of these bacteria form a complicating factor in their large-scale industrial production. There is a need for high quality medium ingredients, which preferably are devoid of components derived from meat or genetically modified plants such as soya. In this respect, cod viscera hydrolysates show great potential.

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Keywords: Hydrolysate, Peptone, Cod, Viscera

#### [5A.01]

##### **Product for animal and fish nutrition: are co-products still an option?**

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Co-products from the agro-food industry do play an important role in modern animal and fish nutrition. Total feed consumption by the EU-25 livestock and aquaculture industry is estimated to be approximately 450 million tonnes per year. Besides 270 million tonnes of home grown cereals and forages, farmers use about 140 and 40 millions tonnes of industrial compound feed and purchased

straight feedstuffs, respectively. The last two categories comprise about 60 million tonnes of co-products from the European agro-food industry and 35 million tonnes imported from other parts of the world (FEFAC and CIAA, 2006).

The variety of such co-products is huge, including vegetable products derived from cereals, oil seeds, fruits, tubers and roots, and animal products from the processing of milk, meat and fish. Most of those co-products represent only a small percentage of the total added value to the original raw material. However, some of the products are contributing to a major proportion of the added value, such as soybean meal from the oil crushing industry.

The major reasons for using co-products in animal and fish feed are related to costs, availability and nutrition value. Co-products have proven to be financially attractive, in particular in areas with a seaport and /or a high density of agro-food industry. Both conditions have contributed to the rapid development of the Dutch livestock industry, although a competition on the availability is foreseen with the biofuel industry. Despite most of the co-products are unfit for human consumption, the nutrition value for animals might be excellent. This can be explained by intrinsic factors related to the co-products and physiological properties of animals such as a different taste perception and digestive system. Pigs and in particular ruminants are capable to convert fibrous components into valuable nutrients finally resulting in high quality animal products, such as milk and meat. As a consequence, many co-products can be fed to those species, even high-moisture co-products. The latter is feasible because of the existence of sophisticated liquid feeding systems, especially designed for the feeding of high-moisture co-products.

Nevertheless, the use of co-products in animal and fish feed certainly has its limitations. Many species show physiological constraints which require a more specific nutrition composition, e.g. the digestion of carbohydrates is limiting in predator fish such as salmon, and the presence of complex fibre has a negative impact on the performance of poultry. Several of these physiological constraints can be and already have been superseded by technological treatment of the co-products. The use of enzymes, the application of fermentation techniques and physical treatments such as extrusion offer opportunities to make co-products more suitable for animal and fish nutrition.

Fortunately, nowadays almost all agro-food companies treat their co-products for animal nutrition in the same way as their core products for food applications. However, the past showed that co-products sometimes happened to be out of the scope of HACCP-based quality assurance programmes and incidentally even be spoiled with waste, both resulting in unacceptable feed and food safety risks. Increasing awareness in both the food and feed industry and continuously improving risk management strategies, such as the NuTrace® program, have proven to be effective to reduce the number of incidents. These measures and the reform in the European food and feed legislation, including the implementation of the General Food Law, the Hygiene Regulations and other legislation addressing quality, safety, health and environmental protection, make it possible to use co-products from the agro-food industry in a sustainable way. Nevertheless, there are still some obstacles to be clarified, such as the legal uncertainty regarding the distinction between co-products and waste for which clear criteria need to be developed.

## [5A.02]

### **Optimal utilisation of fish waste for the creation of functional proteins**

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According to European Technology Platform of Food For life which is preparing the new vision of Europe in research, the new aims for Research & Development for the future should be focused on production of new products and new processes of production, enhancement in productivity and technology transfer. On the other hand, the society should get closer to sustainability in food with economical results as well as environmental and social benefits. Identification of improvement potentials from sustainability analysis will be an important issue for innovations that are directed towards new and novel technological solutions for food processing. Therefore, one of the major research challenges is to improve utilisation of food raw materials, reduce waste throughout the production chain and reprocessing of valuable food waste to food.

Fishery processing industry produces large quantities of by-products which are normally used as animal feed. Most of this material has the potential to provide new and natural sources of high-value functional ingredients. Optimal utilisation of fishery by-products is becoming increasingly important in order to improve use of food resources for human consumption. However, the industrial applications for these by-products are limited because proteins are generally unstable and the solubility is usually very low. This work tries thereby to produce a new product from a new step of a process production which must be created between economic growth, environmental protection and social conditions.

The aim of this study is to develop an industrially feasible method by preparing Maillard glycoconjugates with optimum functionality in real food systems. The work is focused on the improvement of solubility in this fish waste and the surface properties of either a native tuna protein concentrate (TPC) in presence of carbohydrates or TPC conjugated with glucose through Maillard reaction under controlled conditions.

Conjugation with glucose greatly improved the solubility of tuna by-products. The effect of glycation degree under different conditions was related to the level of foaming capacity on these conjugates. The results revealed that the surface behaviour was influenced by the rate of glycosylation. Consequently, this change in surface properties was reflected in the foam stability behaviour.

Keywords: fish proteins, glycation, functional properties, foaming

#### [5A.03]

##### **Review: sustainable use of animal by-products in the agri-food chain**

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Approximately 17 million MT of raw animal by-products are produced in the EU each year as a result of the livestock industry supplying meat, milk and eggs to the food chain. These resources represent an important fraction of each animal's live weight, for example 40% of a pig and up to 50% of a bovine. The animal by-products are categorised, collected and treated in accordance with the EU Animal By-Products Regulation (ABPR). The valorisation of the products, mainly fats and meals is a benefit for the slaughterhouses therefore also for the farmers. Currently, the majority of the animal by-products are disposed of by incineration "as waste".

All Category 3 processed products, processed animal proteins (PAP) and rendered fats can in principle, be used in the agri-food chain in animal feeds, dependent on the controls accorded by the regulations. Regulations now in place allow certain products (for example blood products and rendered fats) to be used inside or outside of the agri-food chain. All products produced under the ABPR are subject to strict regulatory controls including full traceability systems.

In addition to the use of certain proteins and rendered fats in animal feeds, sustainable utilisation may also include use of proteins or the ash from mono incineration of proteins, as fertilisers. Rendered fats may be used as fuels in energy producing engines or boilers and for the safe production of environmentally beneficial bio-diesel.

This review considers the current regulatory framework, including new traceability systems and future controls which take account of risk to animal and human health as well as consumer protection and understanding. It is estimated that this safe and sustainable development will add economic value of circa €350 million per year to the agri-food chain.

Keywords: Animal By-Products, Livestock, Environment, Sustainability

#### [5A.04]

##### **Potential use of non-marketable citrus fruits in growing lamb feeds**

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Citrus production areas generate tonnes of citrus residues coming from marketable and non-marketable fruits withdrawn from the market, which might cause environmental pollution. The literature about the possible use of fresh citrus by-products in small ruminants –prevalent in these areas– is numerous. However, there is a lack of knowledge about the potential use of dehydrated or sun-dried whole citrus in their feeds. With this aim, 4 experimental diets for growing lambs were formulated, mainly replacing beet pulp by sun-dried whole citrus fruits (DWCF) at 0, 7, 14 and 21%, to study the effect of dietary DWCF inclusion on growth and ruminal health (colour and necrosis score) of growing lambs. Twenty five Manchega (mixed aptitude breed) and 49 Guirra lambs (rustic native breed) were allocated in 4 homogeneous groups at 4 weeks of age, and a minimum of 8 kg of live weight (LW), and fed with one of the 4 experimental diets during 8 weeks. All the groups showed a similar live weight evolution independently of the diet received, showing a similar LW at the end of the experiment (23.5, 23.2, 22.9 and 23.9 for 0, 7, 14 and 21% of DWCF inclusion, respectively). On the other hand, Manchega lambs showed a slightly greater growth than Guirra lambs during the experimental period (+12.7 and +9.9 kg, respectively;  $P < 0.05$ ), but unaffected by the type of diet received for both breeds. No significant differences were found for the colour (L, a and b parameters) and visual necrosis score of ventral and dorsal rumen wall samples obtained at slaughter with the different diets. However, Manchega lambs seem to show darker ruminal walls than Guirra lambs (saturation index:  $(a^2 + b^2)^{1/2}$ ; 11.0 vs. 7.6, respectively;  $P < 0.05$ ), in agreement with a greater percentage of highly necrotized ruminal walls. In conclusion, sun-dried whole citrus fruits can be used as an alternative to beet pulp in growing lamb feeds, not affecting neither growth nor rumen wall health.

Keywords: whole citrus fruits, by-products, lambs, rustic breed

## [5B.01]

### **Microbial production of fuels and chemicals from renewable resources**

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Both fuels and chemicals can be produced from renewable resources, including co-products from food chain activities.

Currently ethanol is produced on a large scale from mono- and disaccharides, especially in the USA and Brazil. Initiatives are on their way to use alternative feed stocks such as wheat straw. Also butanol is considered as biofuel for the transportation sector.

A traditional biotechnological chemical is lactate that is now obtained also for the production of polylactide polymers and lactate esters. A breakthrough has been obtained in the development and commercialization of a bio-process for 1,3-propanediol from sugar. Many other chemicals are considered as target molecules for bio-production, including aromatic compounds.

During the presentation some examples will be presented and an outlook for further development will be given.

## [5B.02]

### **Fatty Acid Methyl Ester (FAME) from used oils – Waste material from the food industry as fuel for combustion engines**

N Winthuis, W Ruß\*, R Meyer-Pittroff; Technische Universität München, Germany

Only 5 – 10 mass.-% of the diesel demand could be covered with rapeseed methyl ester, but in 2020 the EU wants to cover 20 mass.-% of this demand by fuel from renewable resources. To reach the quotes for fuels from renewable energy in the EU it should be aimed a spread of the raw material base. For this the possibility of used edible oils from the food industry as fuel for combustion engines were tested. Following the limited exhaust gas components while using a cogeneration plant with diesel as fuel were compared with the exhaust gas components using fatty acid methyl ester (FAME) from used edible oils as fuel. Limited exhaust gas components for cogeneration units in Germany are carbon monoxide, nitrogen oxides, particle emissions and unburned hydro carbon emissions.

It was detected, that there are no fundamental disadvantages in using transesterificated FAME from used edible oils as fuel. Often the emission values using FAME from used edible oils show lower emission values than using diesel as fuel. The only value that is not uniform is the one for carbon monoxide emission.

A reason why the emission value for carbon monoxide is not uniform could be the ageing process of the samples. In general there were no disadvantages noticeable using FAME from used edible oil as fuel in cogeneration plants. Furthermore the influence of different fatty acid spectra of used edible oil compared with rapeseed oil must be discussed. Anymore the ageing and pre-heating of the oils has to be considered when comparing exhaust gas emissions.

Keywords: used edible oils, cogeneration plant, FAME, exhaust gas

## [5B.03]

### **Development of a novel physical process to convert fibrous materials to ethanol**

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Cellulose based ethanol is derived from fibrous such as dried distillers grains with solubles (DDGS) and offers a renewable, sustainable, and expandable resource to meet the growing demand for transportation fuel. US-DOE research roadmap describes the research that will facilitate converting cellulosic material to ethanol in biorefineries. Many current processes rely on chemical treatment; future options are more likely to be based on novel physical and biological processes that may reduce cost and reduce waste byproducts. Our aim of this study was to develop a novel, sustainable and economical bioreactor to digest the DDGS and improve glucose production. High pressure liquid chromatography, HPLC, was used to analyze the effectiveness extrusion has on increasing the digestibility of (DDGS) a co-product of dry mill ethanol industry. The process parameters of temperature and residence time were evaluated for effectiveness. A single screw extruder (C. W. Brabender Plasticorder Extruder model PL-2000) with a barrel length to diameter ratio of 20:1 and compression ratio of 3:1 was used for all South Dakota State University experiments. The extrusion process significantly affected the DDGS and the extruded samples had more cellulose open to enzyme action and had 39% more glucose produced than the control DDGS. By developing new processes to digest the fibrous materials like DDGS there may be possibilities for raw material stabilisation in the cellulose based ethanol industry.

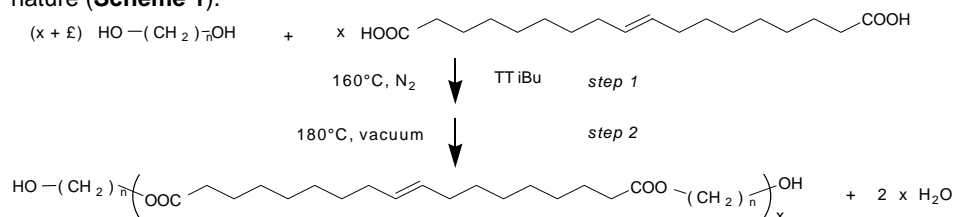
Keywords: Pretreatment, Co-Products, Dry Mill, High Value

[5B.04]

**Novel aliphatic polyesters of oleic diacid (D18:1) : Synthesis, epoxydation, crosslinking and biodegradation**

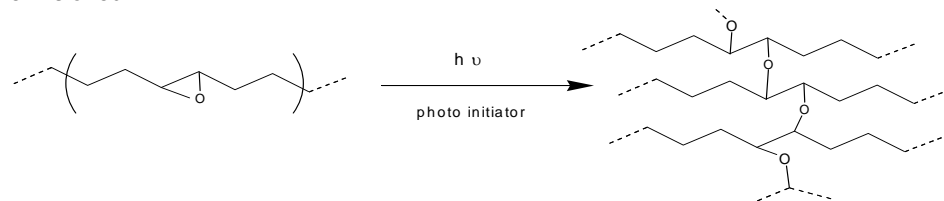
F Lafleche\*<sup>1</sup>, P Guegan<sup>1</sup>, S Claude<sup>1</sup>; <sup>1</sup>Université d'Evry, France, <sup>2</sup>ONIDOL, France

One of the main goals concerning polymer industry in the near future is its capacity to develop high production of biodegradable and easily recyclable polymers. This can be done using monomers from the biomass. As a consequence, these materials are an interesting alternative to synthetic polymers produced from petrochemical industry based on non-renewable resources. New aliphatic polyesters derived from the the octadec-9-enedioic acid (D18:1) (a colza fatty acid derivative) and aliphatic diols of different length (from butanediol to dodecanediol) have been synthesized and characterized. The polymerisation has been carried out by direct "two steps" bulk polycondensation of a diacid with a diol with or without catalyst leading to solid or viscous semi-crystalline polyesters, depending of the diol nature (**Scheme 1**).



**Scheme 1: Polyester synthesis using D18:1**

The resulting polymers were characterized by were measured by SEC and molecular weights between 20 and 40kg/mol were found. The main attractive aspect of these polyesters is the presence of double bounds on the polymer backbone (due to the incorporation of the oleic diacid). The epoxydation of these double bounds has been carried out on the macromolecular chains. A conversion of 100% was witnessed by <sup>1</sup>H NMR. Crosslinked films have been made by photopolymerisation of the epoxide units with less than 5% of extractable product (**Scheme 2**). Enzymatic biodegradation of the polyesters will be discussed. Some applications concerning polyester films for paper or packaging industry can be envisioned.



**Scheme 2 : crosslinking reaction of D18:1-based polyester**

Keywords: polyester, biodegradation, epoxydation, crosslinking

[5B.05]

**Production of adsorbents from coffee husks and spent coffee grounds**

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The processing of coffee generates expressive amounts of agricultural waste. Coffee husks (CH), comprised of outer skin, pulp and parchment, are probably the major residues from the handling and processing of coffee. For every ton of coffee beans produced, approximately one ton of husks are generated during dry processing, for which there are no profitable uses and the disposal constitutes a major problem. Production of coffee for beverage also generates high quantities of spent coffee grounds (SG) as a residue (approximately 50% of the original amount of harvested coffee, taking average losses and extraction efficiency into consideration). Thus, it was the objective of this work to propose an alternative use for such coffee processing residues as adsorbents. Both CH and SG were washed with distilled water and used directly in the adsorption tests. Adsorption was tested for removal of heavy metals and amino acids from aqueous solutions. Dry coffee husks were successfully used as biosorbents for the removal of copper from aqueous solutions. After chemical treatment, the organic leaching from the husks was reduced to acceptable levels and the biosorption capacity was maintained. The experimental data demonstrated coffee husks to be a suitable candidate for use as biosorbent in the removal of heavy metals of industrial wastewaters. The spent ground coffee from a local soluble coffee producer was successfully used as an adsorbent for amino acids in aqueous solutions. The more hydrophobic amino acids were more easily adsorbed than the hydrophilic ones. The phenolic amino acids were demonstrated to be feasibly separated from the others by adsorption in spent ground coffee.

Keywords: biosorption, adsorption, agricultural waste, coffee

## [5B.06]

### **Utilization of poultry industry by-products outside of the agri-food chain**

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Approximately 750,000 metric tonnes of raw feathers are produced annually in the EU. According to current legislation, feathers are able to be processed into hydrolysed feathermeal as a processed animal protein (PAP). However, their use as a PAP in feeds for animals in the agri-food chain is currently prohibited as part of the current feed control rules. Consequently, feather meal is used as low value fertilizer, feed for fur animals, as a fuel in power stations or is disposed as waste. All of these options result in adverse environmental and financial impacts to the poultry industry. New and sustainable options for processing feathers are therefore required.

An EU project (HIPERMAX / NMP-3-CT-2003-505790) includes the processing of feathers into no-feed uses as one of its priority areas.

This abstract describes the development of a new technique for the production of feather composites and materials for a range of uses. As a pre-requisite a 4-bath chemical washing method that proved to be efficient for cleaning, de-odorising and sterilising raw feathers prior to further manufacturing was developed. Currently research into new methods of converting the feather into fibre is ongoing, including the employment of paper production machinery. Two possible end-use routes have been identified and investigated.

Utilization of feathers into high value non-feed applications will result in an improved opportunity to increase the value of feathers from the poultry industry and therefore contribute to the sustainability of the EU poultry industry

Keywords: Poultry By-Products, Feathers, Non Food, Materials

## [6A.01]

### **Controlling microbiological stability**

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Microbiological stabilisation is an imperative that must be designed into food processing and co-product processing systems. This is essential in order to avoid the growth of microorganisms, which could result in spoilage or in illness in consumers. Accordingly, eradication of micro-organisms or control of their growth should be an integral part of processing. This lecture will define microbiological hazards and risks, and will describe strategies for their control. These include the three major tiers of microbiological safety, which are Good Hygienic Practices, Hazard Analysis and Critical Control Points (HACCP), and Risk Analysis. The lecture will then describe methods that can be included in the formulation or applied to products for the eradication or control of microorganisms.

Commonly employed methods of preservation that will be described include the use of chemical additives (organic and inorganic), adjustment of pH, control of the reduction-oxidation potential, control of water activity, use of natural preservatives, microbial antagonism, low temperature, and modification of the gaseous atmosphere.

Common treatments or processes that can be applied to kill micro-organisms or retard their growth include chilling, freezing, heating, dehydration or a combination of these processes.

## [6A.02]

### **The influence of enzyme activity on the quality of vegetable products during storage (with and without preservation pre-treatment)**

A Van Loey, Katholiek Universiteit Leuven, Belgium

Enzymes can have beneficial or detrimental effects in foods. Some enzymes, either endogenous or exogenous, are positively utilized during food processing for exploitation of co-products, for developing new food products, for achieving higher rates and levels of extraction, or for improving food functional properties. For example, lysozyme and lactoperoxidase which are naturally present in dairy products have an antimicrobial action, pectinmethylesterase might be used for controlled texture engineering of fruits and vegetables or for juice clarification. On the other hand, enzymes might also have detrimental effects. Food spoilage can be caused by enzymes naturally present in the food, or by enzymes produced from certain microorganisms. For example, polyphenoloxidase cause enzymatic browning in food products, in particular in fruit and vegetables. Often the same enzyme can cause desired effects as well as undesired effects, depending on the application under consideration. For example, myrosinase (present in *Brassicaceae*) catalyses the hydrolysis of glucosinolates into isothiocyanates which have been shown to possess anticarcinogenic properties. On the other hand these myrosinase catalysed glucosinolate degradation products also give the Brassica vegetables an often too bitter and pungent taste which is not appreciated by consumers.

Given the beneficial and detrimental effects of enzymes, in most food processing control of enzymatic activity is required. Either one wants to promote the beneficial effects of the enzyme by enhancing the enzymatic activity during processing; in this case the knowledge of enzyme stability under the relevant processing conditions is required for process design (e.g. thermostability, pressure stability, resistance towards acid environments). On the other hand, in case of detrimental enzymatic action, one wants to eliminate or retard the enzymatic reaction, which is often performed by inactivation of the enzymes by physical methods, or by inhibition of the enzymatic reaction using additives. In this context, the current presentation will discuss the role and potentials of (endogenous or exogenous) enzymes in fruits and vegetables based products, focussing on two case studies : texture improvement of plant based foods and generation of health related components in vegetables.

#### [7A.01]

##### **LCA: Joining up the food chain**

U Sonesson\*, SIK, Sweden

Sustainability contains three main dimensions; ecological, social and economic viability, and a sustainable production must consider all three pillars. Food systems in general have a wide array of environmental and socio-economic impacts, some negative and some positive. Examples of negative environmental impacts are; emissions of greenhouse gasses, eutrophication, acidification and energy use. Some positive environmental effects are landscape aesthetics, biodiversity and production of bio energy. Regarding socio-economic impacts work place accidents and hazards due to handling of pesticides are negative, while creation of jobs and wealth especially in rural areas are positive. Of course the production of high quality foods brings joy to peoples lives, which is also important. In order to be able to strive towards a more sustainable food chain, tools for assessing sustainability is needed. Hitherto, most tools for assessing sustainability have focused on one of the three dimensions in isolation, e.g. economics, environmental assessment and socio-economics. Such an approach involves the risk of sub-optimisation.

Life Cycle Assessment (LCA) is basically a tool for assessing environmental impact and resource use, even if the method principally includes some socio-economic impacts, mainly working conditions. One of the cornerstones for LCA is the "product oriented approach", which means that it is a product (or service) that is assessed, not a production system (as e.g. agriculture). The second main principle is the "cradle-to-grave approach", which means that all impacts and resource used to deliver the product under study should be included. In food applications this involves agricultural production, including all inputs as fertilisers, processing, transports, cooking and packaging production as well as waste management.

Food products have some general characteristics concerning their "environmental profile". Animal products often have higher environmental impact and resource use than vegetable products (even if exceptions occur). For animal products agriculture is the totally dominant contributor, followed by processing, cooking and sometimes packaging. For vegetable products the agricultural phase is less dominant and cooking and transports are more important. For highly processed foods, the processing obviously increases but this is often outweighed by decreased need for cooking.

In the introduction I mentioned the need for a more holistic tool, which could consider all three dimensions of sustainability. This is of course not a simple task; the complexity in the environmental assessment alone is very high, not to mention the socio-economic part. However, in some recent projects we have tried to find methods to approach the holistic assessment by incorporating socio-economic indicators into the LCA frame for products from Central America. This gives a new and extremely interesting perspective on the LCA's of these products, for example it provides insight in the differences between where emissions and resource use occur and where value is added along the chain. The next step in this process is a project analysing the sustainability of Salmon production, using LCA with partly integrated socio-economic indicators and a parallel socio-economic assessment using the same systems boundaries and products studied, as a means to widen the types of socio-economic indicators to be considered.

#### [7A.02]

##### **Eco-efficiency analysis in agriculture. Application to orange crops in Valencia (Spain)**

N Sanjuán\*, FJ Ribal, G Clemente, L Fenollosa, Universitat Politècnica de Valencia, Spain

In the last years many LCA studies have been carried out in order to show the environmental impact of agricultural techniques and to identify their hot spots. There are many options to reduce the impact of agriculture such as the selection of the fertilizers and pesticides applied, the watering system or the machinery used. Nevertheless establishing the best available practices in agriculture requires integrating not only environmental but also economical aspects.

This study presents an approach to measure the eco-efficiency of these practices. We employed data envelopment analysis (DEA) as the efficiency measurement vehicle. The input and output data were obtained from an LCA and a cost study.



The procedure is demonstrated using a case study of orange production in Valencia. Different farms (16) were considered regarding their agricultural practices (organic or integrated production, watering system, tillage practices...). The advantages and limitations of the method are discussed.

#### [7A.03]

##### **Increase of energy efficiency in companies of the food industry - methodical approach and practical examples**

W Russ\*, N Winthuis, R Meyer-Pittroff; Technical University Munich, Germany

Due to the multitude of thermal processes, the food industry belongs to the energy-intensive industrial sectors. Especially in reference to the use of thermal energy a great saving potential exists. A reduction of fuel consumption should be the aim, not only by reason of industry's responsibility for reduction of CO<sub>2</sub>-emission, but also on the basis of economic interest.

Therefore a systematic-methodical approach for increasing the energy efficiency in consideration of specific process in food production will be presented.

The initial point is the collection of in-house data in respect of the utility-streams (high temperature water, thermo-oil, steam etc.).

Starting from existing in-house data, the planning of the acquisition of further necessary information is shown. The main interest is the identification of necessary information and the selection of a data collection methodology, with the aim of an isolated examination of individual divisions. Thereby e.g. methods for the determination of the steam requirement of individual processes are illustrated.

After the collection of further data a systematisation, interpretation and visualisation of the data takes place.

This procedure is repeated until the existing data is sufficient for the identification of main-utility-consumers.

Methodical proceeding can assess energy saving potentials of individual consumers. The basis of this is formed by the requirements for the particular food technological processes.

The reduction of the utility-demand of individual consumers provokes constitutional changes inside the particular utility-networks that changes the energy efficiency of the overall network in a plant.

Furthermore modified heat generation as well as alternative combustibles and motor fuels can reduce utility-costs in the field of thermal energy supply.

All the individual steps are clarified by means of practical examples of the milk and beverage processing industry respectively.

Keywords: energy, optimisation

#### [7A.04]

##### **Role of advertisement in communicating corporate social responsibility (CSR)**

C Dutilh\*; Unilever, Netherlands

In many commercial enterprises, Corporate Social Responsibility (CSR) is considered to be an important area of business policy. Programmes are being developed and money is being spent. In that context it is not surprising that sooner or later questions come up about the business justification of the money being spent. In particular the impact of CSR-efforts on commercial results is at stake. Some people argue that engaging in CSR makes good business sense. That argument is strengthened by the fact that most companies which are considered to do well in CSR-terms, also perform above standard in business terms.

Question is, however, whether that argument can be turned around by saying that active involvement in CSR improves the business performance of a company. Or, in other words: do CSR-related claims in advertisement enhance the sales of a product?

Findings of a study conducted in The Netherlands show that the use of CSR-claims in product advertisement does not enhance sales. Consumers are only interested to hear about those product attributes, which are of direct interest to themselves. CSR-claims have a longer term and more generic nature. In that sense they are of interest to people in their role as citizen.

It can be demonstrated that advertisement containing mainly CSR-claims is always aiming at people in their role as citizen, and is intended to boost a company's reputation. The sender of those messages generally is an external relation or public affairs manager. In advertisement used by marketers to boost product sales, CSR-claims never feature as the main argument. In the few cases where CSR-claims have been used to boost product sales, a public upheaval has been the result.

The conclusion is that CSR-claims are only accepted by society in case they are used to explain a company's behaviour. As soon as they seem to be used to boost sales, they will become counterproductive.

Keywords: Corporate Social Responsibility, advertisement, business justification, consumer vs citizen

## [7A.05]

### **Life cycle assessment to eco-design food products: Industrial cooked dish case study**

J Zufía, L Arana\*; AZTI-TECNALIA, Spain

Industrial cooked dish is one of the food products with most complex agri-food chain: Its formulation has a great variety of animal and vegetal ingredients from very different geographic farming and fishing areas, it needs an important effort of transport and manufacturing of all farming raw materials, a complex cooking and conservation process, and widespread retail system, including cold transport and commercialization until final consumer.

The objective of the presented project is to carry out an ecodesign pilot experience on a tuna with tomato cooked dish as a way to develop more efficient and sustainable agri-food products along its whole life cycle. The final aim of this work is to optimize all stages of the agri-food chain and reduce associated costs and environmental impacts.

To achieve that, the followed methodology is:

- Complete definition of the product: raw materials (source, transport needs, manufacturing, etc.), manufacture and preservation process, packaging (materials, shape, etc.), preservation needs, retailing, way of final consume and disposal.
- Life cycle assessment of the product using an specific LCA software: definition of the whole agri-food chain and its stages, characterization of all inputs (natural resources, intermediate products) & outputs (emissions to air, soil and water) of each stage, eco-inventory performing and impacts definition and assessment.
- Identification of most important causes of the main impacts and costs. Location of these aspects within each stage of the whole agri-food chain.

Using this information, a lot of specific sustainability measures for the product have been identified. The main kind of measures are: Use raw material from nearer origin to reduce transport, plastic packaging substitution to another lighter, redesign the plastic container to a more efficient shape, improve the efficiency of the manufacturing process to reduce wastes, and so on.

Identified measures for sustainability have been evaluated from a technical, legal and other product aspects point of view, and selected for the new product to design. As a result, it has been re-designed a new cooked dish product much more sustainable and environmentally-friendly in its whole agri-food chain.

Keywords: ecodesign, life cycle assessment, environmental improvement, food chain

## [7A.06]

### **Sustainable value stream mapping: a tool for process change and waste reduction**

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#### Introduction

Waste reduction is preferable to waste management. All waste management methods entail some form of inefficiency, due to energy losses or additional energy usage, and emissions to environmental media. If the quantity of waste generated could be greatly reduced, the issue of how to manage unavoidable waste might be more easily resolved. This paper takes a holistic view of waste creation in the food chain and presents estimates of the scope for waste reduction through process improvement.

#### Methodology

Sustainable Value Stream Mapping (SVSM) is a recently developed methodology that has been used to evaluate carbon dioxide emissions attributable to various logistics scenarios (Simons & Mason, 2002). This paper presents an extension of SVSM and the findings from its application to the purchasing, manufacturing and distribution processes within the chilled food industry.

#### Results

Case studies are on-going in four supply chains and three different sub-sectors (fresh produce, processed meat products and ready-meals). Results to date indicate that inefficiencies in demand management, order-processing and production scheduling processes are a major cause of waste, resulting in excessive ordering of raw materials, poor stock control and demand amplification that drives a wedge between consumer demand and production (primary, intermediate and finished goods). Data relating to physical waste (food and packaging), greenhouse gas emissions and water consumption associated with different activities from the procurement of raw materials to the sale of finished products is being collected and will be used to estimate the potential savings that could be made from improvements in the respective processes to which the different streams of waste are attributed.

## Discussion

The SVSM methodology provides a mechanism for diagnosing the root causes of waste, upon which process improvement programmes can be designed. The solution requires collaboration between retailers and suppliers to ensure greater synchronisation of demand and supply.

Keywords: waste reduction, chilled food, Sustainable Value Stream Mapping, demand management

### [7B.01]

#### **Utilization of processing waste for sustainable development**

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India is one of the leading countries in production of horticultural crops with a number of processing industries, which generate 10%-60% of the raw materials as solid waste. Proper management of the waste is both a regulatory requirement as well as an economic necessity and utilization of waste rather than disposal should be the goal of the industry.

Waste from fruits is rich source of nutrients, minerals, fibres and antioxidants. Citrus wastes are source of essential oils, pectin and a variety of the by-products including cattle feeds. Seed kernel a major waste of mango is good source of carbohydrate. Drying of mango kernels and peel may make a high-class energy food for animal feed. Pineapple leaves have been used to extract high quality fibre for the textile industry. The central core of the banana pseudostem containing 5% starch may be used as vegetable. In similar way starch may also be available from mango seed kernels. Natural colours of blue grape skin, kokum (*Garcinia indica*), phalsa (*Grewia asiatica*), Jamun (*Syzygium cuminii*) have thoroughly been investigated for suitability as food colour and as antioxidant. Fruit wastes may usefully be diverted for biogas generation and preparation of manures.

Keywords: food processing, waste, colour, antioxidant

### [7B.02]

#### **The growth and development of the food industry in Nigeria: poverty, food security and sustainable development strategy**

S Osho\*; Olabisi Onabanjo University, Nigeria

This paper has reviewed the concept of poverty, food security and sustainable development in the context of the growth and development of the food industry in Nigeria. Nigeria's economic development still remains a paradox with over 65% of the population living below poverty line. The Industrial Sector have been characterised by low capacity utilization (30%), low and declining contribution to National output (6%) from 1997-1999, low value added production due to high import dependence for inputs and prevalence of unviable state owned enterprises. The deplorable condition in the Industrial sector was due to factors which include policy and policy instability, poor macroeconomic environment, bureaucratic bottlenecks lack of good governance, poor inadequate infrastructure, prevalence of obsolete technology, inadequate domestic demand and inefficient institutional framework. The food industry plays a critical role in National development. The Federal Government of Nigeria has introduced several strategies that will enhance the development of food industries to contribute to National growth, contribute to foreign exchange and government revenue earning, contribute to poverty reduction and generate employment. This strategy has achieved the following: the creation of Industries Manufacturing Initiative, reviving state owned enterprises for the purpose of expansion of viable ones, enabling privatization, export of value added products, establishment of small and medium scale Industries Development Agency (SIMIDA) to promote and address the problems of SMEs, commercialisation of research findings and rationalization and strengthening of finance institutions. The growth of food industry will generate employment, stimulate economic growth and improve the quality of life of the average Nigerian.

Keywords: Food Industry, Food Security, Sustainability, Manufacturing

### [7B.03]

#### **Sustainability in food miles**

R Khosrokhavar\*, S Eskandari, N Nedaie; Food and Drug Control Labs of Iran, Iran

Food transported across the world burns up a lot of fossil fuel and contributes to global warming. "Food miles" (the total distance in miles the food item is transported from field to plate) has become accepted as a convenient indicator of sustainability; and has led to a general movement towards local production and local consumption in order to minimize them. This raises fundamental questions about the sustainability of the globalized food trade and the increasing concentration of the food supply chain and distribution in the hands of fewer and fewer transnational corporations.

The rise in food miles has led to increases in the environmental, social and economic burdens associated with transport. These include carbon dioxide emissions, air pollution, congestion, accidents and noise. There is a clear cause and effect relationship for food miles for these burdens – and in general higher levels of vehicle activity lead to larger impacts.

It is clear, from the causes of increased food transport identified that policies are needed to minimize food import/export, to promote instead, national/regional food-sufficiency, and to reverse the concentration of food supply chains in favor of local shops and cooperatives run directly by farmers and consumers. In addition, there should be government subsidies and incentives for reducing carbon dioxide emissions on farms, and for farms and local communities to become energy self-sufficient in low or zero-emission renewables.

Keywords: food miles , Food transport, import/export, vehicle

#### [7B.04]

##### **Emerging sub-sectors of the poultry industry in Botswana: A case of sustainable ostrich (*Struthio camelus*) and guinea fowl (*Numida meleagris*) production**

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Ostrich (*Struthio camelus*) in particular and to a lesser extent guinea fowl (*Numida meleagris*) production have been two emerging sub-sectors of the poultry industry in Botswana over the last decade. These sub-sectors are likely to have a bright future in Botswana given that they are based on local adapted genetic resources, which are readily available in large numbers in the farms and wildness and these produce white meat as opposed to red meat, which is associated with human health problems. In the wild these species survive and reproduce with limited feed resources, with no disease and parasite control, no predator control and yet they still thrive. Their continuous domestication has allowed diversification of the poultry industry, which is still dominated by chicken layer and broiler production. These emerging sub-sectors provide employment opportunities, generate income, provide meat and eggs and a variety of other products such as feathers and skins to ensure their sustainability hence help reduce poverty in the country. Information on these sub-sectors is lacking in Botswana, which hampers their rapid development. The aim of this paper would be to review production systems of ostriches and guinea fowls, breeds, breeding and selection, feeds and feeding based on local available materials, marketing, constraints to efficient production and prospects in Botswana.

Keywords: Ostrich, guinea fowl, sustainable production, Botswana

#### [8.01]

##### **Substitution of meat in the human diet by plant-based alternatives to reduce the environmental impact of food production systems**

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The PROFETAS project (Protein Foods, Environment, Technology and Society) investigated whether the environmental impact of present food production systems in the Netherlands could be reduced by replacing meat in the human diet by plant-based alternatives. Technologists, environmentalists, economists and sociologists worked together with stakeholders. Two of the issues investigated are dealt with in this paper, namely the selection of the crop to be used for the plant-based foods and exergy analysis as a tool to compare environmental impact in chain design.

With respect to the selection of the most promising protein source for producing plant-based meat alternatives, the following eight crops were considered: pea, lupine, triticale, quinoa, lucerne, grasses, potato and rapeseed. The criteria on which these crops were evaluated, were the familiarity of farmers with the cultivation of the crop, perspectives for crop improvement, protein production (kg/ha), protein quality, and familiarity with usage for human food in Western Europe. Weighing the pros and cons resulted in the conclusion that pea, lucerne and grasses were most promising.

A frequently used tool to determine the environmental impact of a production system is Life Cycle Assessment (LCA). This methodology generates various classes of environmental effects that cannot be added easily to yield a single value. We opted for exergy analysis to study environmental impact. Exergy analysis identifies the links in chains where exergy destruction takes place and shows where improvements are possible. As exergy is expressed in one unit, the Joule, the inputs and outputs of each chain are easily comparable. To produce plant-based meat alternatives, the greatest input is required in the processing link, whereas for a pork meat chain, primary production and transportation require the highest inputs. Consequently, the chain for plant-based foods proved only to be slightly more efficient (in terms of exergy) than the pork meat chain.

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Keywords: food production systems, chain design, exergy analysis, pea crop

[8.02]

**Comparison of scenarios on futures of European food chains**

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The paper compares recent scenarios on the European food and agriculture sector, based on the own scenario writing in the frame of the project "Trends in food supply and demand and their consequences" of the Office of Technology Assessment at the German Parliament. The aim is to work out common points and differing assumptions so that a better understanding of possible futures for European food chains can be achieved.

Scenarios from technology assessment and foresight activities and from sustainability research activities in different European countries are included. They focus in different ways on technological developments, production systems, policy arrangements and/or societal changes. Furthermore, the food chain is not mapped always adequately, which means the main focus is partly on agriculture. The driving forces for the scenarios are more or less differentiated, with interesting analogies. Finally, nearly all compared scenario papers work with a qualitative approach and have an open time horizon. Lessons from the comparison are that the open future of European food chains depends in great parts from uncertainties in three areas:

- technological uncertainty
- societal uncertainty
- political uncertainty.

Different paths are seen for the future shaping of the Common Agricultural Policy - varying from liberalisation to enforced regionalisation. At the same time, this indicates that a comprehensive policy for the food chain is still missing and it is uncertain if such a policy can be achieved.

Furthermore, these points are also key elements to examine the realisation problems of sustainability strategies. More investigation is needed to understand better the influence of technological, societal and political framework conditions on sustainability strategies for the food and agriculture sector, to analyse conflicts between different sustainability goals, and to identify possible options for action which are robust under different and also unfavourable conditions.

Keywords: scenarios, food chain, sustainability strategies



**Abstracts - Poster**





## [P1.01]

### **REPRO interaction platforms: promoting the exploitation and upgrading of agro-food by-products**

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REPRO is a European Commission-supported project aiming at helping the Food Industry to become more sustainable. Many food processing firms produce large quantities of co-products, many of which have very low value. REPRO seeks to improve the exploitation of these co-products developing novel processing methods for their disassembly and recovery.

The main aim of REPRO is to develop advanced methods to upgrade and thereby reduce food processing co-products from vegetable processing (cruciferous and endives) and cereal grain processing (brewers' spent grain) by obtaining high value outputs: biopolymers, phytochemicals, nutrients and micronutrients.

Target organisations benefiting from REPRO outputs would be food industries from the beverage and vegetable processing sectors as well as food industries with similar waste problems and a high potential for valuable products recovery.

#### Interaction Platforms

REPRO aims at involving a large number of organisations/companies (including SMEs) by developing three Stakeholder Interaction Platforms to promote information exchange, and to enable potential research projects/business initiatives.

The main aim of the Platforms is to establish a participative forum to reach a global overview on food wastes and by products management options and to identify potential actions in this field.

The three Stakeholder Interaction Platforms are:

- Industrial interaction Platform (IP). This promotes direct interaction amongst co-product generating companies and technologists.
- Consumer interaction Platform (CP): that promotes interaction between citizens/consumers, and technologists themselves.
- Stakeholder Brokerage Platform (BP): it gathers all the stakeholders and organisations linked to REPRO topics, from food processing industries, by-products up graders, additive formulating industries, technology providers and research centres. Foresees the search of business opportunities to place and process food co-products, develop new processing methods, predict new research fields, etc.

Platform activities include:

- Continuous virtual information exchange through a web area restricted to affiliates.
- Holding of annual general meetings and workshops to favour direct contact and discussion amongst attendants.

Keywords: agrofood by-products, upgrading, interaction platforms

## [P1.02]

### **Sustainable development strategy of China agri-food industry**

Y Dong\*; Chinese Academy of Inspection & Quarantine Science, China

Agri-Food Industry was the largest supportive industry of china national economy, and the largest contributor of china import-export commerce as well. Moreover, China Agri-Food industry chain had offered five million job opportunities. Nowadays, China Agri-Food industry annual production was approximately 250 billion USD, which accounted for 11% gross domestic production. In last decade, average annual increasing rate exceeded 10%.

China was officially accepted as a member of WTO in 2001, international agri-food trade became upsoaring since then. Average annual increasing rate was 15.54% during 2001-2005. In 2005, Chinese Agri-Food import and export value reached 45 billion USD.

Whereas, some acute problems, as exemplified by the lack of production originality, the ineffective structural organization, inappropriate geographical distribution, deficient competitive capability, and food safety negligence, et al., had led barriers to the sustainable development of China Agri-Food Industry.

To address the aforementioned issues, Chinese government, competent enterprises, and major Agri-Food industrial associations, were working synergistically to draft a comprehensive development plan for China

Agri-Food industry, the core schemes will focus on the economy structural adjustment, governmental regulative guidance, reinforcement of international cooperation, NGO and enterprises involvement, food safety credit systems establishment, Agri-Food alimentary instructions, logistic management, promotion of production originality, agriculture-industry coordination, resource harmonization, environmental protection and preservation, and technique renovation, etc.

It is envisaged that, after the successful implementation of national sustainable development plan, China Agri-Food industry will achieve an annual increasing rate of 12% by 2010, annual Agri-Food production value, total annual import and export value, will approximately reach 450 billion USD and 70 billion USD, respectively.

Keywords: China, Agri-Food, Sustainable Development Strategy

#### [P2.01]

##### **Sustainability of the European sugar sector**

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The aim of the present poster is to outline an on-going SSA project under the FOOD priority of 6<sup>th</sup> Framework Programme (Towards Sustainable Sugar Industry in Europe – TOSSIE).

Sugar and its main by-products - beet pulp and molasses - being used for direct consumption and also in the food & drink industry and production of animal feed, are of strategic importance to human nutrition. Moving away from strict protection of the EU sugar market, the EC tends to reduce sugar price and admit sugar imports from least developed countries. To satisfy consumer needs in a sustainable manner at changed market conditions, new ideas on production technology, engineering & management are needed for the restructuring of the sugar sector which is of major importance to the EU economy.

Regarding competitiveness, safety and environmental impact of beet processing, results are available of recent research including EU-funded projects on: 1) alternative process technologies to improve manufacturing efficiency and eliminate environmental risks, and improve utilisation of by-products using biotechnology, 2) engineering and management tools including IPPC and BAT procedures for optimising the efficiency of raw material use, utilisation of by-products and energy & water use, 3) selection of innovative process structures for optimal, with regard to sustainability requirements, utilisation of the whole potential of renewable resources taking into account the complete value chain from raw material generation, transportation, conversion to intermediate products, to generation of marketable goods.

Research results from the three areas mentioned above will be disseminated and discussed in pursuit of the objectives of FOOD Priority and in particular working out strategy for competitiveness and environmental friendliness of the sugar sector, and interacting with relevant European Technology Platforms.

Keywords: sugar industry, value chain, environmental impact, competitiveness

#### [P2.03]

##### **Economically sustaining of food system**

S Eskandari\*, N Nedaie; Food and Drug Control Labs, Iran

A sustainable food system is one in which local farmers and area businesses are profitable, capable of supporting a good standard of living for workers, their households, and the community in general. Given the vital importance of food, producers and other workers in the food system would be guaranteed living wages and ample benefits. To assure that farmers and farming communities survive, farming must be as economically lucrative as is off-farm labor. This can be achieved by raising the remuneration to farmers and farm workers, reducing the number of work hours necessary to keep the operation intact, and increasing benefits, such as health care and vacation time. In order to support self-owned small and medium scale family farms and businesses, "producers should be paid a fair price for their goods by reducing the number of intermediaries between them and consumers." Paramount among participant comments was that the pricing of agricultural products must reflect the cost of production. Farming would also be a career path that many people had the opportunity to follow, for, a sustainable food system would "support more people financially rather than fewer."

Keywords: Economical, Sustaining, farmers, food system

### [P3.01]

#### **Quality assurance system for sustainability**

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Nowadays the most important issue connected to agriculture is food safety. Many years after that in food processing industries quality standards became expected tools these standards start to be required also in agriculture. Some of these systems is suitable not only for ensure safe raw materials for food industry but as well as help sustainable production. The topic of our study is the applicability of Eurepgap standard to sustainability and the cost of this standard. We chose Eurepgap, because it announces by its principle: "The Global Partnership for Safe and Sustainable Agriculture".

The question of our research was that in financial source-less countries such as Hungary what kind of possibilities the farmers have to introduce quality standards to produce quality and safe products in a sustainable way. How can Eurepgap help to convert production into more sustainable?

The introduction costs of EurepGAP Fruit and Vegetables standard, which is well know in the EU, was examined in the Hungarian research.

The adverse land property conditions and the inflow of cheap agricultural products after the EU accession the Hungarian farmers got into unfavourable producing conditions. They have to count upon higher costs as well as lower procurement prices, therefore many of them cannot afford to introduce expensive quality standards, but more and more agricultural cooperatives mainly vegetable, fruit and mushroom producers start to cultivate according to one of the standards trusting in better selling possibilities on the market.

The aim of the research was to demonstrate the spending of introduction of a quality system and determine these costs in proportion of all costs of a product and looking for answer to how much time is needed for this investment to clear the costs.

Keywords: quality assurance, Eurepgap

### [P3.02]

#### **Co-products in the food chain: a delphi study**

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Large quantities of food processing waste, including those produced within the cereal and vegetable food chains, are produced in the EU and internationally every year. These organic co-products contain significant amounts of valuable components (nutrients, micronutrients, colorants) which remain unexploited in current production processes, but which have the potential to increase sustainability of production processes through recycling in novel food products.

However, the success or otherwise of reprocessing strategies is contingent on consumer acceptance of novel products that are produced. Thus it is important to analyse the social implications of applying new processes and producing new food products on the basis of ingredients that might otherwise be regarded as waste. Previous research has shown that consumer acceptance of novel food processing technologies is contingent on perceptions of desirable consumer benefits, low risks, naturalness, and perceived control over consumption. Differences have also been identified between the views of different stakeholders, including consumers and those with technical expertise. Issues such as these need to be explored in the context of food waste reprocessing.

A Delphi study was conducted using a range of different expert stakeholders. The questionnaire used in the Delphi study was partly informed by input derived from explanatory interviews with consumers. An important aim of the study was to highlight differences between expert and consumers' views on issues of sustainability and waste reprocessing in relation to food quality and food safety, in order to improve our understanding of acceptability of new products and processes.

On the basis of our explanatory consumer interviews and the Delphi study, results will be presented which will highlight whether, and under which conditions consumers and expert stakeholders perceive improved sustainability as providing a substantial enough benefit to offset doubts about re-processing organic co-products in the food chain. Implications for the development of a future commercialisation strategy will be discussed.

Keywords: co-products, consumers, experts, Delphi study

### [P3.03]

#### **The Agrifood Technology Station as a tool for sustainability using technology**

H Coetzee\*; Cape Peninsula University of Technology, South Africa

Agrifood is an example of successes and solutions in the South African context. Local factors impacting on the sustainability of the food chain are : the large number of upcoming farmers needing assistance to join the food chain in establishing small and medium enterprises (SMME); skills development via training; the need for food security in a country where many people are very poor; the harsh climate in many parts of the country and the scarcity of water.

Agrifood was established in 2005 at the Cape Peninsula University of Technology. It is an initiative developed by the Department of Science and Technology. Agrifood operates in partnership with the Tshumisano Trust, the CPUT and other stakeholders.

The mission of Agrifood is to provide an affordable range of multi-disciplinary technological services to the Agrifood sector. Focusing on improving competitiveness, innovation and R&D capacity in a sustainable manner

Agrifood provides the following:

- Assistance to entrepreneurs and SMMEs
- Assistance to established enterprises
- Training and technical capacity development
- Problem solving
- Research opportunities development
- Strengthening Higher Education and industry partnerships

Agrifood also aims to extend its work to developing the skills of upcoming farmers in accordance with the AGRIBEE policy of the National Department of Agriculture. These aims can be achieved by acquiring skills and establishing new enterprises to supply food for the masses.

Keywords: Technology Station, innovation, affordable range of multi disciplinary technological services, training

#### [P3.04]

##### **Costs of introducing and maintaining a sustainability-friendly quality assurance system into the Hungarian horticulture**

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Due to the cumulative consumer demands quality standards are used widespread in agriculture for food safety. Although less people recognize but sustainability and nature conservation should deserve also distinctive attention. Some of the quality systems – like Eurepgap – endeavors to urge farmers to follow the principles of sustainable production.

The research examined how much it is to introduce and maintain an EU conform quality standard, the EurepGAP Fruits and Vegetables standard, for the Hungarian companies in different size. All incurring costs in sake of quality were collected, from which the costs of introduction and auditing cost must be emphasized. Also extant systems need consultancy and modification sometimes. The costs of annual Maximum Residue Level analysis overburden the Hungarian horticultural companies. The administrative and training costs are also high. Not all the Hungarian horticultural companies meet the requirements of EU standards therefore there are expensive tasks to improve the workers' welfare, and develop and modernize safe and healthy working conditions for them. Ensuring the production conditions all machinery must be maintained continuously. These costs affect the smaller and bigger businesses in a different scale.

Our research is based on deep-interviews with some Hungarian significant horticultural companies, which shared us their costs connected to quality assurance systems. Through the data the ratio of costs will be shown clustered by the size of the companies. During the interviews it cleared up why the companies want to tackle with quality systems after all the high costs. As a summary for the time being mainly the bigger, export-oriented and high income-productive horticultural companies tend to introduce this system.

Keywords: quality assurance system, eurepgap, sustainability

#### [P3.05]

##### **Environmental analysis and predictive microbiology in combination as a tool for safe and sustainable process line design**

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In order to optimise the performance of a process line at the same time as environmental performance and microbial safety is considered, efforts must be made already in the design phase. Traditionally, the focus is on economic performance and to some extent on microbiological safety. By using a systems analysis approach in the design phase, all three aspects can be considered simultaneously, weak points are made visible and can be eliminated in an early stage of process line design which saves efforts in later stages during process development.

Here, we describe the working procedure developed and show by examples how combination of classical engineering, environmental analysis and microbiological risk assessment including predictive microbiology can be applied in the early design phase as investigating alternative process conditions for producing a new type of extruded snack containing brewers spent grain.

The work is part of the EU-project REPRO, that aims at developing hybrid processes for upgrading and valorisation of food industry by-products in a sustainable way. Keywords: Process design, Sustainable food processing

[P4.01]

**Exploitation of donkey meat as a source of diversification of the livestock industry of Botswana**  
A Aganga<sup>\*1</sup>, A Aganga<sup>2</sup>; <sup>1</sup>Botswana College of Agriculture, Botswana, <sup>2</sup>Meat Inspection Training Centre, Botswana

Livestock production is the major agricultural activity in Botswana. The livestock sub-sector is dominated by traditional pastoralists and cattle post owners. Cattle and goats are generally well adapted to most parts of the country and survive well in the severe and harsh weather conditions of the country than crops and therefore better option in terms of income protection and food security.

A break down of animal population per region in 2003:

Name of Region	Donkey	Horse	Cattle	Sheep	Goat	Pig	Poultry
North East	27684	3692	152387	8427	104921	327	60180
North West	156206	6514	168579	38382	164642	0	60708
South West	24276	9669	240628	24653	146599	0	33064
South	83080	9302	380593	54030	248138	2002	161457
South East	71479	4283	352021	36152	245699	662	133065
Central	118047	4489	578110	40590	421527	958	181516
Total	480772	37949	1872318	202234	1331526	3949	629990

DONKEYS: Total holdings and population by size of donkey holdings (2003)

SIZE OF DONKEY HOLDINGS	NO. OF DONKEY HOLDINGS	TOTAL NO. OF DONKEYS
1-5	27170	87165
6-10	19347	144257
11-15	4121	53976
16+	3391	195374
TOTAL	54029	480772

In Botswana, the exploitation of donkeys is limited to their use as draft power and a form of transport in the rural areas. There is therefore very limited information on the use of donkeys as a source of food (meat and meat products). Botswana has relied heavily on the exploitation of cattle as boneless-beef for export to the European Union and this serves as the third largest foreign exchange earner for the country apart from diamonds and tourism. The country is aggressively exploring ways of diversifying its economy from relying mostly on cattle as an agricultural business. The concept of a donkey abattoir and the production of meat from this species can open a new area in terms of animal production system in Botswana, product use and its safety from "farm to table" and the veterinary measures relating to public health (meat hygiene and meat grading for equidae).

The donkey is free of any major epizootic diseases such as FMD, rinderpest and other communicable diseases in the O. I. E list. Epidemiological surveillance programmes are well developed in Botswana and the disease distribution of equines by district is well known.

Keywords: Donkey meat, diversification, livestock, Botswana

[P4.02]

**Sustainability of sheep and goat production in Botswana**  
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This paper describes an overview of Botswana's sheep and goat industry with specific emphasis on the production systems, rangeland resources, sheep and goat breeds, feeds and feeding, products, trade and constraints to production. The objective of the paper is to review the current status of the sheep and goat industry and provide possible solutions to production constraints. Sheep and goats provide meat and milk and also cash income for small scale farmers. The main breeds of sheep and goats available in Botswana is the Tswana breed along with boer goat and dorper sheep. The majority of sheep and goats in the country are kept extensively on rangelands where tree fodders constitute a major feed source. Tree

fodders are used as supplements to low quality grasses and straws. The tree fodders form part of the complex interactions between plants, animals and crops, the positive aspects of which help to balance a plant-animal-soil ecosystem, and from which there is a sustainable source of feeds. Most of the tree leaves and twigs contain allelochemicals such as tannins, that reduce the quantity consumed and nutrient availability. Common shrub and tree fodders in Botswana rangelands are *Acacia*, *Combretum*, *Terminalia*, *Euclea*, *Peltophorium*, *Kirkia*, *Grewia* species et c.

Botswana is self sufficient in goat meat production but mutton is imported from the Republic of South Africa (RSA), Lesotho, Zimbabwe and Namibia. Current constraints to sheep and goat production are low productivity due to poor management and diseases, inadequate nutrition and poor marketing infrastructure. Past trends in the industry reveal that small ruminant population has been increasing over time, recording annual rates of growth of 3.9% for goats and 1.3% for sheep but these rates were not matched by increased rates in off-takes. Finding solutions to production problems is a prerequisite to increasing productivity levels of the national sheep flock and goat herd. Possible solutions are farmers education on breeding and management, provision of adequate supplementary feeds, efficient extension services and improved road infrastructure to connect farms to urban centres where the markets are located. Provision of formal markets for sheep and goats throughout the country will improve off-take rates therefore reducing grazing pressure on the rangelands and reducing quantities of mutton importation. Implementation of these possible solutions will enhance sustainability of the sheep and goat industry in Botswana.

Keywords: sustainability, sheep, goats, Botswana

#### [P4.03]

##### **Sustainability of the agri-food**

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“Sustainability” is now being deployed by many different interests, in many different constructions, and for many different purposes. Those of us who are not willing to trust the transformation of our food system to the self-styled “planetary patriots” of the agri-food transnationals must be committed to constructing and promulgating our own robust and persuasive version of food system sustainability. Formulations of food system sustainability have been constructed around a fairly narrow set of elements, by a rather narrow set of analysts.

Associating a broader range of attributes with food system “sustainability” provides more dimensions for distinguishing between competing versions of that notion. People from many backgrounds and social locations are participating in initiatives and movements for food system sustainability. It is through honoring and understanding the multiple dimensions of motivation and intent that people bring to the transformative project that the project can actually be brought to fruition.

Keywords: Sustainability, Agri-food, Formulation, consumer

#### [P4.04]

##### **Role of HACCP at the end of the chain**

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HACCP is a food management system designed to prevent safety problems and can have little influence at the “user” end of supply. The HACCP principle is based on control, and such control is lost as soon as the commodity is in the hands of the consumer. The manufacture can do little more than supply guidelines on storage and use, by means of product labeling, but the chain of control which could be provided by a HACCP approach seems destined to be lost at this final stage. It should, however, be an important issue for the national food authorities to give advice to the consumer on how to avoid mould growth in food in the home, and how to act in cases where this occurs. There is generally a growing understanding of the importance of mycotoxins both in terms of acute and chronic disease, to the extent that in many countries permissible limits for relevant food groups are either planned or already in place. There is currently a large body of data available which details the mycotoxin hazards associated with a wide range of commodities.

However, for the purposes of developing a HACCP plan, where published data is lacking, mycotoxin analysis and surveillance of the product and the relevant supply chain will become necessary.

Keywords: HACCP, Food chain, mycotoxin, consumer

[P4.05]

**Industrial sustainability through biotechnology**

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Biotechnology has long played an accepted role in traditional food processes. Both traditional and modern biotechnology can be an important supportive tool for the food industry and give considerable added value to food products. When evaluating the use of biotechnology, it is necessary to balance the environmental impact of commercial agriculture with that of alternative production routes, such as growth of microorganisms in fermentors. Moreover, when evaluating the use of clean, rDNA-derived biotechnologies for foods, it is important to take social acceptability as well as economic benefits into account. The environmental benefits of producing food additives by fermentation or enzymatic routes instead of traditional organic synthesis are similar to those for other specialty chemicals. In the case of fermentation-derived preservatives, the effect is even more favorable when the fermentation broth is incorporated in the finished product. A biotechnology application with very great potential environmental benefit would convert waste streams from one process into raw materials for another, or upgrade underutilized raw materials into a more valuable form. One successful approach has been the production of lactose-fermenting yeasts as flavoring ingredients.

Keywords: Biotechnology, Industrial Sustainability, fermentation , benefit

[P4.06]

**Tasting sustainability**

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There are now emerging many initiatives intended to create alternatives to the conventional, industrialized, global food system. Additionally, in the last decade there has also emerged a widespread privileging of the transforming power of proximity:

Conceptual framings of alternative food systems have been based principally on the reflections of academics and policy specialists rather than on the views of the sustainable producers and sustainable eaters who constitute the bulk of the food localization movement. Participants envisioned a sustainable food system as relational, proximate, diverse, ecologically sustainable, economically sustaining, just/ethical, sacred, knowledgeable/communicative, seasonal/temporal, healthful, participatory, culturally nourishing, and sustainably regulated.

Keywords: Sustainability, Tasting, food system, producers

[P4.08]

**Emerging sectors of the poultry industry in Botswana: A case of sustainable ostrich (*Struthio camelus*) and guinea fowl (*Numida meleagris*) production**

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Ostrich (*Struthio camelus*) in particular and to a lesser extent guinea fowl (*Numida meleagris*) production have been two emerging sectors of the poultry industry in Botswana over the last decade. These sectors are likely to have a bright future in Botswana given that they are based on local adapted genetic resources, which are readily available in large numbers in the farms and wildness and guinea fowl produces white meat as opposed to red meat while ostrich produces red meat which is low in cholesterol. These meats are not associated with human health problems. In the wild these species survive and reproduce with limited feed resources, with no disease and parasite control, no predator control and yet they still thrive. Their continuous domestication has allowed diversification of the poultry industry, which is still dominated by chicken layer and broiler production. These emerging sectors provide employment opportunities, generate income, provide meat and eggs and a variety of other products such as feathers and skins to ensure their sustainability hence help reduce poverty in the country. Information on these sectors is lacking in Botswana, which hampers their rapid development. The aim of this paper would be to review production systems of ostriches and guinea fowls, breeds, breeding and selection, feeds and feeding based on local available materials, marketing, constraints to efficient production and prospects in Botswana.

Keywords: Ostrich, guinea fowl, sustainable production, Botswana

[P5.01]

**Image profile analysis of the Hungarian traditional horticultural products**

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Hungary joined to the European Union in 2004 and due to this accession a new restriction-free market, including 500 million consumers, opened for the Hungarian agriculture. The country must utilize this

possibility. The European Union has common agricultural policy, which means, on one hand conformity, on the other hand a chance to take part in the community according to its interests.

In this enormous competition the image and the idea of the producer country or region influences the decisions of the consumers either on internal or international markets. The positive image needs to be built consciously, continuous enhancement and renewing is necessary.

It is easier to create a new image than change an existing one. This was the leading idea when the Region of Del-Alfold (Hungary) started the image-developing. The Hungarian experience concerning images and region marketing is very modest. The aim of region marketing is to explore the competitiveness and charm of the region, the work should be based on the means of the region.

The place of origin's image is very detailed and complex, in its creation the landscape, the characteristics, the people, the past and history of the region need to be taken into account. Our region has several special, excellent quality agricultural products which could be perspectives for the region in the near future. The uniformed identity-consciousness resulted by the forming positive image of the region could help for the inhabitants to achieve their aims locally. Aligned set of measures is needed to create the image of the region, which always starts with the analysis on the present situation. This exploring analysis will be the origin of the future's decisions.

Keywords: image profile, traditional food

#### [P5.02]

##### **Research on the competitive advantages of traditional Hungarian products**

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Hungarian food industry is one of the most important fields of the national economy. The standard and the position of food industry define the market possibilities of a national agriculture, the competitiveness of agricultural products. In the world of globalization more and more people all over the world realise the importance of preserving local traditions. This especially applies to the products with excellent quality which represent national worth.

Hungary, by its geographical location, is especially suitable for the produce of special products with high quality. After the accession to the European Union, „Hungaricum” (special products can be found and produced only in Hungary) have emphasised significance. Therefore the aim of our research was to perform marketing researches on the availability, assortment, price, quality and uniqueness of special products of the Hungarian food industry.

A questionnaire was used for assessment. The data collected during primary research were evaluated by mathematical-statistical methods. The gathered data were evaluated by the following procedures: multidimensional scaling, factor analysis and confidence interval.

According to the results of our Hungarian researches the Hungarian population favour unique, special products. The consumers are willing to pay more not only for the labelled, Hungarian products, but also for the signed, foreign food. The prices are thought to be acceptable, none the less they are quite high. The consumers require high quality, substantial composition, food safety, prominent skill and Hungarian tradition. If they make sure of the existence and stability of these parameters they are consciously seeking these products.

To sum up, it can be stated that the unique, special Hungarian food products conform to the strictest food standards of the European Union. The food supply of Europe will be wider and richer by these Hungarian products.

Keywords: competitive advantages, traditional food

#### [P6.01]

##### **Mycoflora of two types of Portuguese smoked dry sausages and inhibitory effect of sodium benzoate, potassium sorbate and methyl *p*-hydroxybenzoate on mould growth rate**

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Mould spoilage in Portuguese dry smoked sausages (*chouriço*) may occur in modified atmosphere package (MAP), reducing the shelf life and causing substantial financial losses to manufacturing companies. Potassium sorbate, sodium benzoate and methyl *p*-hydroxybenzoate are recognised as effective anti-fungal agents. In Portugal, as in the EU, benzoates, sorbates and the esters of *p*-hydroxybenzoic acid (parabens) may only be used in surface treatments of dry sausages casings. Legislated values are *Quantum satis*. The main goals of this study were to identify important spoilage fungi isolated from two types of Portuguese *chouriço* after a producer-defined shelf life period (120 days at 20±5°C) in MAP (55% N<sub>2</sub> / 45% CO<sub>2</sub>), and to evaluate the effect of potassium sorbate (PS), sodium benzoate (SB) and methyl *p*-hydroxybenzoate (MHB) on the growth rate of representative mould isolates under *in vitro* conditions.

Based on morphological and physiological characteristics, the identified fungal species were: *Penicillium terrestres* (43.4%), *Penicillium* sp. (13.3%), *Fusarium* sp. (10%), *Aspergillus glaucus* (10%), *Aspergillus*



*versicolor* (6.8%), *Monilia fruticola* (3.3%) (Figure 1), *Absidia* sp. (3.3%), *Cephalosporium* sp. (3.3%), *Rhizopus stolonifer* (3.3%) and *Fusarium tricinctum* (3.3%) (Figure 2).

The fungi were grown at 25°C in 96-well plates containing culture broth (peptone water, pH 6.5). The preservatives were added at concentrations of 0.01, 0.05, 0.1, 0.15 and 0.3% (w/v). Surface growth was measured by registering increasing hyphae density (OD<sub>650</sub>) on an Elisa reader twice a day for five days. Apparent growth rates were calculated from the determined "growth curves". MHB showed greater inhibitory effect than SB and PS on all fungal isolates with the exception of *Aspergillus glaucus* [Tm30A], in which the inhibitory effect of MHB was similar to PS. At 0.05% (w/v) all fungi were inhibited by MHB with the exception of *Rhizopus stolonifer* [Tm25A]. PS inhibited mould growth more effectively than SB, with the exception of *Absidia* sp [Tm16R], in which both presented similar inhibitory growth effect.

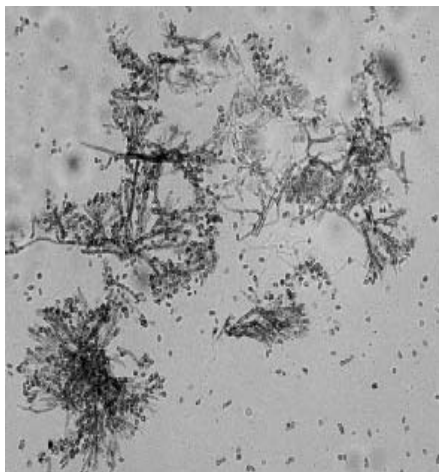


Figure 1. *Monilia fruticola*

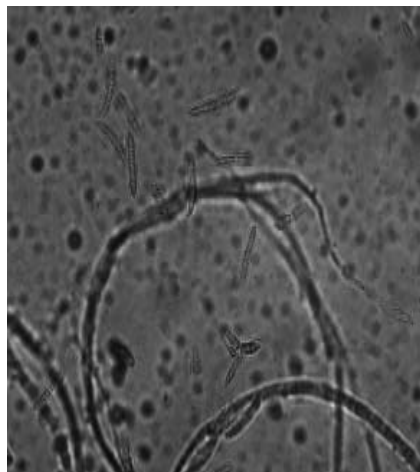


Figure 2. *Fusarium tricinctum*

Keywords: Portuguese dry smoked sausage, Spoilage fungi, Food Preservatives, Shelf Life

[P6.02]

#### **Physicochemical and microbial changes in salted semipreserved cuttlefish (*Sepia officinalis*) during processing steps and storage in optimal and abuse temperature (simulating market conditions)**

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The decrease of fish stock owing to over-fishing, has led to increasing exploitation of under-utilized marine resources such as cephalopods. They constitute an important part of the marine resources most suitable for human consumption and are common in Mediterranean and Far Eastern diets, particularly in Japan. However, cephalopods kept under refrigeration have a relatively short shelf life; they deteriorate very rapidly in comparison with fish. This is one of the reasons why cephalopods stored in ice are still not very popular with consumers. It is therefore necessary to investigate new technologies to extend the shelf life of these species, maintaining the quality of the original. A better understanding of the spoilage mechanism could lead to measures for increasing shelf-life, which could stimulate the marketability of this product. Moreover, this knowledge is greatly needed to develop adequate tests for rapid quality evaluation. Therefore, our objective was to study the chemical and microbial changes during processing steps and storage of semipreserved salted cuttlefish; and to evaluate the efficiency of chemical indices for freshness and shelf-life comparing two storage temperatures: optimal (4°C) and abuse temperature (simulating market conditions).

After osmotic treatment (maturing process) the moisture, ash and salt contents of cuttlefish increased significantly ( $p < 0.05$ ). Thereafter, during storage time in optimal and abuse temperature the moisture content remained constant while the salt and ash contents diminished gradually ( $p < 0.05$ ). Nitrogen compounds (TN, NPN, protein and TVB-N) decreased significantly after osmotic treatment. It may be caused by leakage of nitrogenous compounds chiefly of low molecular from cuttlefish muscle into thawing water and brine and by the dilution effect produced by water absorption in cuttlefish. During storage time, the protein, NPN, TBV-N content in cuttlefish muscle decreased while these compounds increased significantly ( $p < 0.05$ ) in brine. These changes were more noticeable ( $p < 0.05$ ) when semi-preserved cuttlefish was stored in abuse temperature. The peculiar format of cephalopod body, allowed brine contact with the outer and inner part of the mantle, generates a great contact surface, which facilitates the extraction of soluble nitrogen compounds from the muscle. Semi-preserved cuttlefish when stored in optimal temperature showed mesophilic and psychrotrophic counts below  $10^5$ - $10^6$  cfu/g after 20 days of storage. However negative sensory characteristics were observed after day-14-16 of storage, suggesting the enzymatic action is more rapid and effective in this species than bacterial spoilage action. In contrast, in lots stored in abuse temperature bacterial counts exceeded  $10^5$ - $10^6$  cfu/g after 8 days but day 6 was considered to be the rejection point, probably as a consequence of the simultaneous microbial and enzymatic activity.

In optimal storage temperature a higher correlation was obtained in TN and NPN content with storage time. Moreover, a linear relationship was also observed between the TN, NPN and TVB-N of the brine and the storage time. Consequently, these parameters could be considered useful indices for freshness or shelflife evaluation in semipreserved cuttlefish. In abuse storage temperature, a higher correlation was observed in TN for cuttlefish and brine, while this correlation showed a higher value only in NPN and TVB-N of brine. A value of 0,9% of TN content in cuttlefish muscle, or a value of 0,10% of TN or 0,06% of NPN or 8mg/100ml of TVB-N contents in brine would indicate a rupture of cold chain. Analyses in the brine would allow one to obtain the samples by nondestructive methods.

Keywords: Cuttlefish, semipreserved, physicochemical, microbial

#### [P6.05]

##### **Effect of *Bifidobacterium breve* on the survival and growth of *Enterobacter sakazakii* in rehydrated infant milk formula**

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The effect of *Bifidobacterium breve* on the survival and growth of *E. sakazakii* in rehydrated infant milk formula stored at different temperatures was studied. Fresh cultures of *B. breve* and *E. sakazakii* were mixed with rehydrated infant milk formula. The rehydrated formula was stored at 4, 12, 20, 30, 37, or 45 °C for 1, 2, 3, 4, 6, or 8 h. The populations of *B. breve* and *E. sakazakii* at each storage time/temperature were determined. There was a two-way interaction effect between *B. breve* and storage temperature on the populations of *E. sakazakii* in rehydrated formula at 3, 4, 6 or 8 h of storage. *E. sakazakii* did not grow in rehydrated formula at 4 °C. At 12 and 20 °C, the populations of *E. sakazakii* in the presence of *B. breve* were lower than those in formula without *B. breve* at 8 h of storage. At 45 °C, the populations of *E. sakazakii* in the presence of *B. breve* were lower than those in formula without *B. breve* at 6 and 8 h of storage. The presence of *B. breve* in the formula enhanced the growth of *E. sakazakii* in rehydrated formula at 37 °C. The inhibitory effect of *B. breve* on *E. sakazakii* is temperature dependent. If rehydrated infant milk formula is not consumed within two h of preparation, it should be discarded or stored in the refrigerator (4 °C). Caregivers should avoid keeping the rehydrated formula in water bath to keep it warm. These results will be useful to powdered infant milk processors and caregivers to ensure the safety of the rehydrated infant milk formula.

Keywords: Enterobacter sakazakii, Bifidobacterium breve, Probiotic, Rehydrated infant milk formula

#### [P6.07]

##### **Traditional processing, microbial and chemical changes during fermentation of malwa, a Ugandan fermented millet beverage**

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A survey was conducted to characterise production methods of malwa in Kampala district. Lactic acid bacteria (LAB) and coliforms were enumerated in the raw materials and during fermentation using standard methods. Changes in selected chemical parameters were also determined. The production methods were similar among the producers. All producers germinated millet grains to make green malt ('yeast'). The germination period varied between 2 and 3 days. The germinated grains were sun-dried for 2-3 days. Pit fermentation of wetted millet flour was done for one week resulting into acidified dough. The acidified dough is roasted on open fire. Fermentation ranged from 2 - 4 days. Back slopping was practised only by 5% of the producers. Majority of producers (90%) reported that consumers preferred sour malwa.

LAB numbers in the pit fermented dough, the roasted dough and green malt varied between 5.38 and 3.48, 1.49 and 2.6, and 4.45 and 6.27 log cfu/g respectively. The coliform numbers of pit fermented dough, the roasted dough and green malt varied between 4.4 and 4.19, 0 and 1.36, and 5.53 and 5.71 log cfu/g respectively.

LAB increased from 2.67 to 6.62 log cfu/g. The greatest increase was observed during the first 24h. Coliforms decreased from 2.8 to 1.19 log cfu/g after 24h with a slight increase to 1.26 log cfu/g after 48h due to further green malt addition. Coliforms were still detectable after 72h.

The pH decreased from 4.3 to 3.65 after 72h. Titratable acidity increased from 0.69 to 1.47% lactic acid after 72h.

Total soluble solids decreased from 17.7 to 7.7 obrix. Ethanol increased from 1.07 to 12% v/v. Carbohydrates and tannins decreased during the fermentation. Apparent increase in protein content was observed. The high numbers of LAB in malt indicate that these organisms play a big role during malwa fermentation.

Keywords: Lactic acid bacteria, Fermentation, Malwa, Millet

[P6.08]

**Risk of contamination of grape and grape-products by Ochratoxin A**

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Mycotoxins produced by microscopic fungi in the grape producing system and grape products have received much recent attention.

Ochratoxin A(OTA) have been reported in grapes, grapes juice and raisin which poses serious health risks due to their high stability under a variety of environmental conditions. Since 1996, the presence of this toxin has been reported in grapes and grape products such as grape juice , wine, dried fruits.

The aim of the work is to assess the real risk of presence of OTA in grape and grape products. OTA puts human health at risk because it is nephrotoxic, teratogenic, immunotoxic and possibly neurotoxic. Now OTA is classified as a carcinogen. It is number one mycotoxin produced by fungal contaminants ("mould") of food, particularly *P. verrucosum*, *A. ochraceus*, *A. carbonarius*. As formation of OTA depends on the fungal source, the type of crop, and its geographical location, control of ochratoxin A production by each fungal species was considered separately.

*A.carbonarius* is the main species thought to be responsible for OTA in grapes (Horie, 1995; Téren et al., 1996; Wicklow et al., 1996). It has been isolated from grapes in France, Spain, Italy, South America, Greece, Israel, Portugal and Australia (risk due to the high stability of OTA under a variety of environmental factors).

During 2004-2005 years most of OTA- producing fungi isolated from grapes were *Aspergillus* (88%), while *Penicillium* genus played a minor role. Among genus *Aspergillus*, section *Nigri* was dominating with species *A. niger*, *A. japonicus*, *A. carbonarius*, *A. phoenicus*, *A. aculeatus*. These species have been detected in 75 % of the investigated samples from Ararat , 58 % of raw grapes from Vayk and 88% from Eghvard regions of Armenia . Among the revealed species from this group, percentage of *A. carbonarius* makes 25-27 %. These species frequently were allocated from the damaged and overripe berries. Primary contamination of grapes occurs during vegetation since the soil is the basic reservoir of these species. In particular, the period from 15 days pre-harvest (12.50 brix) until harvest was the critical time for rapid development of *Aspergillus* rots. Also, bad hygienic conditions at winemaking and juice processing plants promote the further growth of contamination degree by fungi from section *Nigri*. Studying the basic morphological and some physiological characteristics allowing to differentiate species *A. carbonarius* from relative species, in particular species *A.niger*. Toxin-producing fungi can be deposited on crops by birds and insects or be introduced to crops from the soil. Fungal growth on grapes during storage and processing is another major source of contamination by ochratoxin A.

The problem of contamination of raisin with toxigenic microscopic fungi is very actual, especially in developing countries. Mycological analysis of 22 samples of raisin in Armenia, prepared from white and red grapes, was conducted. 15 species of microscopic fungi were isolated and identified, belonging to 5 genera: *Mucor*, *Aspergillus*, *Penicillium*, *Trichoderma* and *Alternaria*. Among isolated fungi the strains from section *A.niger* and from genus *Mucor* had a high frequency of occurrence. In some separate samples degree of contamination with spores exceeds 10CFU/gr. Strains of genus *Mucor* cause both superficial and internal contamination of raisin. The comparative analysis of fungi, contaminating raisin of Iranian and local production, has shown, that *Aspergillus carbonarius* most often is found in raisins produced in Armenia (in 62,5%), mostly prepared from red grapes. In the total of 17 strains of *A.carbonarius* were isolated. In the Iranian raisin the content of sulfur dioxide exceeded 160mg/kg, which probably has an inhibitory effect on growth of *A.carbonarius*. In samples of the Armenian raisin sulfur dioxide was not found. Influence of pH and aw on a degree of raisin contamination by fungi was studied, the positive correlation was observed.

The use of raisin as food, contaminated with *A.carbonarius*: a potential producer of ochratoxinA, represents a health hazard for the consumer.

Keywords: raisin, *Aspergillus carbonarius*, *Mucor* , sulfur dioxide, contamination

[P6.09]

**Effect of storage on the exploitation potential of brewers' spent grain**

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**Introduction**

Brewers' spent grain (BG), the main low-value solid residue which results from the use of barley (*Hordeum vulgare* L.) in brewing, represents more than 25% (w/w) of the starting material. Until now, BG has been sold as cattle feed, composted or disposed as landfill. Due to legislative drivers (e.g. EC Council Landfill

Directive 199/31/EC, 1999), the cost for the disposal of BG has increased and alternative commercial uses are being sought. BG is a moist, organic by-product, and is prone to undergo deleterious microbiological and chemical changes. This reduces the potential for exploitation as a food-grade material. As part of the REPRO (Reducing Food Processing Waste STREP) this study reports investigations into the effect of storage conditions on the microbiological and (bio)chemical characteristics of BG.

## Methods

Fresh BG was collected from the mash tun of a local brewer and stored as follows: (i) aerobically at temperatures of -20, +4 and +20°C; (ii) autoclaving followed by aerobic storage at +20°C; (iii) freeze-drying followed by aerobic storage at +20°C. Three samples from each storage regime were recovered at 0, 1, 2, 7 and 16 days, except for the frozen and freeze-dried samples, which were only sampled at 16 days. In each sampling, the three samples were treated as follows: one sample was processed immediately using appropriate microbiological techniques to enumerate the predominant components of the microflora; one sample was extracted as an alcohol-insoluble residue for chemical analysis, and the final sample was evaluated for enzyme activities.

## Results and discussion

The results will clarify the conditions under which BG may be stored safely, and discussed in relation to critical control point relevance to exploitation. Day "0" analyses have shown that the BG comprises lignified plant cell wall material, protein and starch, and that microbiological analysis indicates a food-grade material.

Keywords: Brewers' Spent Grain, Stabilisation, Plant cell walls, storage

### [P6.11]

#### **Phytase activity in seeds of *Pentaclethra macrophylla*, *Parkia biglobosa* and *Tetracarpidium conophorum***

V Enujiugha\*; Federal University of Technology, Nigeria

Introduction: Phytase action improves mineral bioavailability by lowering the phytic acid level in legumes and oilseeds.

Methods: Crude phytases from African oil bean seed (*Pentaclethra macrophylla*), locust bean seed (*Parkia biglobosa*), and conophor nut (*Tetracarpidium conophorum*) were isolated and assayed via estimation of inorganic orthophosphate liberated by the hydrolysis of phytic acid.

Results: The phytase activities and corresponding protein concentrations for the three under-exploited oilseeds were: 0.720 Uml<sup>-1</sup> and 16.85 mgml<sup>-1</sup> for *P. macrophylla*; 0.078 Uml<sup>-1</sup> and 10.65 mgml<sup>-1</sup> for *T. conophorum*; and 0.082 Uml<sup>-1</sup> and 14.00 mgml<sup>-1</sup> for *P. biglobosa*; respectively. This implies that the *Pentaclethra* seed phytase has comparatively higher activity with higher protein concentration in the enzyme molecule, followed by the *Parkia* seed phytase, and lastly the *Tetracarpidium* seed phytase. The optimum temperatures for the phytase activity were 50°C for oil bean and conophor seeds, and 60°C for locust bean seed. The optimum pH was 5.0 for oil bean phytase, 4.0 for conophor nut phytase, and 7.0 for locust bean phytase, respectively.

Discussion: The results show that locust bean phytase was more thermo active with an alkaline pH optimum; conophor nut and oil bean seeds both have acid phytases in their cotyledons.

Keywords: phytase activity, *Pentaclethra macrophylla*, *Parkia biglobosa*, *Tetracarpidium conophorum*

### [P6.12]

#### **Moisture sorption isotherms of some dry condiment powders**

V Enujiugha\*, S Iyiola; Federal University of Technology, Nigeria

The moisture sorption isotherms of dehydrated flours of four commonly consumed Nigerian condiments (namely, ugba, okpeye, ogiri and iru) were determined. The dry milled products were kept at three separate temperatures (10°C, 30°C and 40°C) and at four different relative humidities using saturated salt solutions (RH 20%, 30%, 50%, 70%) for a period of 21 days. Both the initial and equilibrium moisture contents were determined on the products, and the data obtained were used to construct moisture sorption isotherm curves.

The results reveal that higher storage temperature gave lower sorption capacities for the condiment powders. Also, the rate of moisture absorption increased at the monolayer at all the storage temperatures considered. At ambient and higher storage temperatures, ogiri had the relatively longest shelf life, followed by okpeye, then iru, and finally ugba.

Keywords: sorption isotherm, condiments, powders, stability

#### [P6.13]

##### **Utilization of tangential microfiltration in the production of sheep's milk cheeses**

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Reduction of microorganisms from milk for cheese production is generally achieved through pasteurization. However some sensorial properties are constrained; microfiltration has shown advantages because it reduces efficiently microorganisms present in raw milk without disadvantages in terms of textural or sensorial impact. In Portugal traditional cheeses are produced from raw milk, but safety features can constrain in several cases the manufacture of cheese due to reduced microbial quality of milk. The aim of this research effort was to evaluate the impact of processing raw milk, via pasteurization or microfiltration, on the physico-chemical and microbiological properties of final cheeses comparing with cheeses produced accordingly traditional protocol. Sampling was assessed at the 1, 8, 14 and 21 and 28 d of the ripening period. The sensory properties were analyzed after 45 and 65 days of ripening. Microfiltration with multichannel 1,4 µm ceramic membrane effectively removed, on average, 99,99% of total aerobic mesophiles, and 99,99% of spores from skim milk.

Cheeses made from microfiltered milk are significantly different from those of raw milk in terms of bacteriological composition showing similar levels to those obtained for pasteurized milk. Physico-chemical composition and sensory profile showed significant differences between cheeses produced from raw, pasteurized and microfiltrated milk.

The cheeses produced with microfiltrated milk were highly graded by the panel.

Keywords: Milk, Microfiltration, Sheep, Cheese

#### [P6.14]

##### **Discrimination of *Alicyclobacillus* isolates in apple juice by Fourier transform infrared spectroscopy**

M Al-Holy\*, M Lin, S Chang, A Cavinato, DH Kang, B Rasco; Hashemite University, Jordan

*Alicyclobacillus*, a thermoacidophilic bacterium, is a spoilage problem in pasteurized and heat-treated apple juice products. In this study, Fourier transform infrared spectroscopy (FT-IR: 4000-700 cm<sup>-1</sup>) was used to detect and discriminate between eight *Alicyclobacillus* isolates (WAC, 81-2, Oly#21, 51-1, KF, 1016, 1101, and A-Gala A4 ). FT-IR vibrational overtone and combinations bands reflected biochemical features of *Alicyclobacillus* bacterial cell membrane components by exhibiting characteristic "fingerprints" at wavenumbers between 1500 and 700 cm<sup>-1</sup>. Multivariate statistical method (e.g. principal component analysis (PCA)) was used to analyze the spectral data. Distinctive segregations of spectral sample clustering of different *Alicyclobacillus* isolates were observed, as well as two isolates from the same strains showed high degree of similarity, indicating that FT-IR can be used to detect and discriminate *Alicyclobacillus* isolates. This novel technique can provide a tool for fruit juice producers to detect *Alicyclobacillus* more rapidly and therefore to monitor and control the potential formation of guaiacol.

Keywords: FTIR, Alicyclobacillus, Spectroscopy, PCA

#### [P6.15]

##### **Inhibition of *Listeria innocua* in hummus (chickpea dip) by a combination of nisin and citric acid**

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The effect of nisin and citric acid (CA) or different combinations of nisin and CA on the inactivation of a cocktail mixture of three *Listeria innocua* strains in a model brain heart infusion (BHI) broth or hummus was investigated. Under aseptic conditions, 100g-samples of hummus were treated with 500 IU nisin/g, 1000 IU nisin/g, 0.1% citric acid, 0.2% citric acid, 0.3% citric acid or combinations of nisin and citric acid. Then, the hummus was inoculated with a cocktail of the 3 different *L. innocua* strains at a level of ca. 1 × 10<sup>6</sup> CFU/g. Total mesophilic microorganisms and survivors of *L. innocua* were enumerated. Also, nisin activity was determined during a storage period of 15 days.

In BHI broth, CA had a limited capability to inhibit *L. innocua* growth. Nisin initially reduced *L. innocua* levels by about three log cycles, however, *L. innocua* reached levels similar to the control after 5 days at

22°C. A nisin-citric acid combination (500 IU/ml + 0.2% CA) posed a synergistic antilisterial effect and resulted in a complete elimination of *L. innocua* in the BHI broth. But the same effect was not observed in hummus.

The inhibition of *L. innocua* in chickpea dip by nisin (500 IU/g or 1000 IU/g), citric acid (0.1%, 0.2% or 0.3%) or combinations was evaluated. Citric acid alone did not affect *L. innocua* growth or total mesophilic microorganisms (TMM). Nisin-citric acid combination (1000 IU + 0.3% CA) was effective in controlling the levels of *L. innocua* and TMM for up to six days. This combination could be adopted along with proper hygienic practices as prudent way to minimize growth of *L. monocytogenes* in hummus.

Keywords: *Listeria innocua*, nisin, citric acid, hummus

#### [P6.16]

##### **Occurrence of *Enterobacter sakazakii* in powdered infant formula, milk powders and food production environment**

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*Enterobacter sakazakii* a pathogen associated with powdered infant formula, and other food products can cause serious infections in neonates. Thirteen commercial samples of powdered infant formula, 7 commercial samples of milk powder and 10 cereal products were surveyed for the presence of *E. sakazakii*. In addition, forty four environmental samples, dry swaps, and food ingredients were drawn from food factories and tested for the presence of *E. sakazakii*.

The presence of *E. sakazakii* was detected and isolated using the current FDA method of detection using *Enterobacteriaceae* enrichment broth (EE broth) and violet red bile glucose agar (VRBG). VRBG presumptive colonies were grown for pigment production on trypton soya agar (TSA) for 24 – 72 hours followed by biochemical profile determination using oxoid API 20E test. Isolates of *E. sakazakii* were confirmed by plating them on nutrient agar, supplemented with 4-methylumbelliferyl  $\alpha$ -D-glucoside ( $\alpha$ -Mug), followed by viewing colonies under UV for the presence of fluorescence. Fluorescent *E. sakazakii* were isolated from powdered infant formula at frequency of 2/13 (15.4%), and one of 10 (10%) of the cereal product samples. *E. sakazakii* was not isolated from any of the samples collected from the food factories, although other non-*Enterobacteriaceae* species were detected.

Keywords: *E. sakazakii*, Powdered infant formula, Milk powders, Production environment

#### [P7.01]

##### **Exploiting food processing co-products: the composition of Chinese water chestnut epidermal layers**

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##### **Introduction:**

Chinese water chestnut (*Eleocharis dulcis*) is an edible corm most commonly encountered in western-style Chinese cooking. Chinese water chestnut (CWC) is a significant crop for some Asian countries, especially those that export them. The epidermal and adjacent tissues do not currently enter the human food chain and form a significant proportion of the waste produced by the CWC canning industry. This waste is probably of limited use as an animal feed, but may be suitable for further processing. Analysing the composition of the epidermal layers provides a basis for utilising this waste.

##### **Methods:**

The compositions of the epidermis, sub-epidermis and parenchyma were analysed for sugar, phenolic and lignin content. Some phenolic components were identified by LC-MS.

##### **Results:**

The compositions of the epidermal and sub-epidermal cell walls are significantly different to that of the parenchyma. Non-cellulosic polysaccharides account for ~30% of all three cell wall materials, cellulose accounts for 62% of the parenchyma cell wall material (PCWM), but only ~40% of both epidermal cell wall materials. Lignin accounts for 15% of both epidermal cell wall materials, but only 2% of the PCWM. The epidermis has the highest amount of phenolics (3%), and significantly more *p*-coumaric acid (1.4%) than the other tissues, but does not contain the 8,8'-aryltetralin form of diferulic acid (8,8'-AT DiFA), which is found in the parenchyma and sub-epidermis tissues (0.1%). Novel ferulic acid complexes have been putatively identified by LC-MS, the first report of their presence in a non-graminaceous plant.

## Conclusions:

Both epidermal (waste) tissues differ significantly from the exploited parenchyma tissues in terms of composition. They contain phenolics extractable by alkali after which the residue could form the basis of a source of dietary fibre, thereby contributing to food chain sustainability.

Keywords: Ferulic acid, Chinese water chestnut, Diferulic acid

## [P7.02]

### Interactions among fiber from citrus by-products and probiotic bacteria

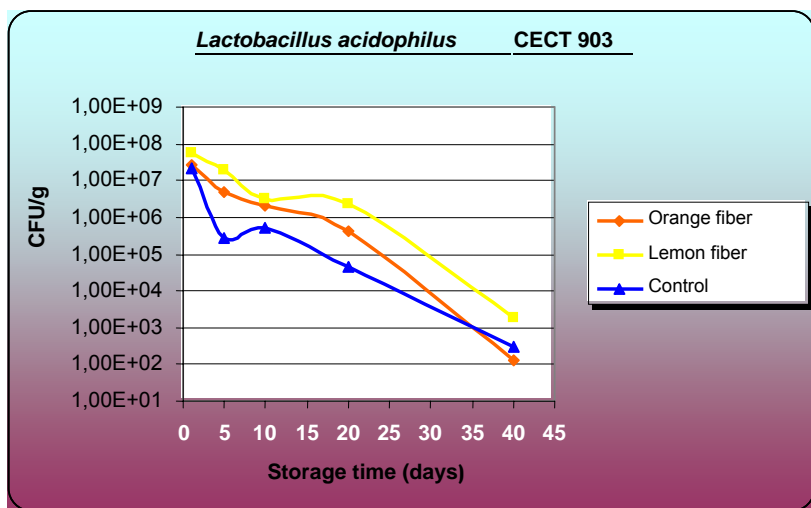
E Sendra, P Fayos, Y Lario, J Fernández-López\*, E Sayas, JA Pérez-Alvarez; Universidad Miguel Hernandez, Spain

Citrus juice industry produces wastes of about 50% the weigh of fruit used, mainly albedo, flavedo and pulp. These wastes are mainly used as animal feed of little economic value, the possibility of successfully including these by-products in the human food industry would help in enhancing the economic development of citrus producers and processors. The presence of probiotic bacteria together with fruit fibers (obtained from citrus by-products) in foods will be of great nutritional and functional interest. Fruit fibers may have prebiotic effect due to oligosaccharides content but also anti-microbial effect due to essential oils traces. The present study evaluates interactions among citrus fibers obtained from citrus by-products and the probiotic bacteria *Bifidobacterium bifidum* CECT 4549, *Lactobacillus acidophilus* CECT 903, and *Lactobacillus casei* CECT 4040.

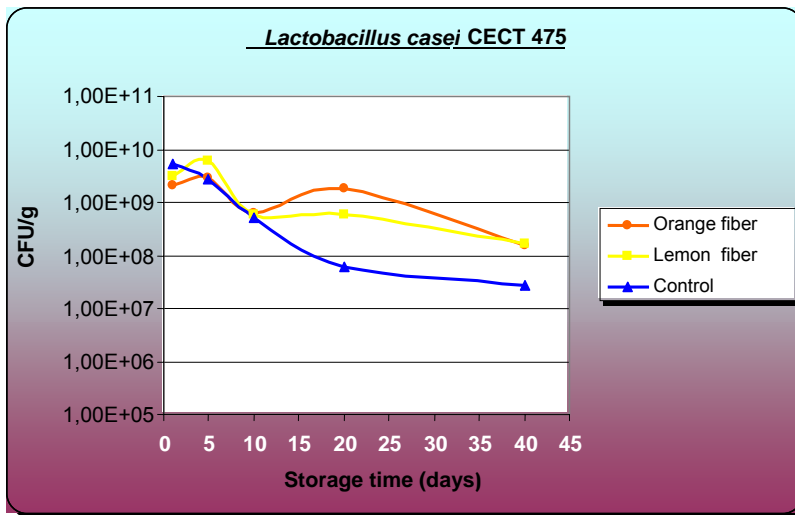
Lemon and orange fiber powders were obtained and their interactions with the probiotic bacteria were tested by (i) plate inhibitory test, (ii) obtention of massive cultures in Man Rogosa Sharp broth and evaluation of their stability under refrigeration for 45 days of storage (iii) evaluation of populations of probiotic bacteria in fermented milks formulated with citrus fibers.

No signs of inhibition were observed in the plate inhibitory test for the tested microorganisms. Citrus fibers enhanced probiotic bacteria survival in MRS broth during refrigerated storage, especially in the case of *Lactobacillus acidophilus* CECT 903 (graph 1), and *Lactobacillus casei* CECT 4040 (graph 2) uneven results were obtained for *Bifidobacterium bifidum* CECT 4549 (graph 3). In fermented milks citrus fiber presence enhanced bacterial growth and survival of the tested probiotic bacteria.

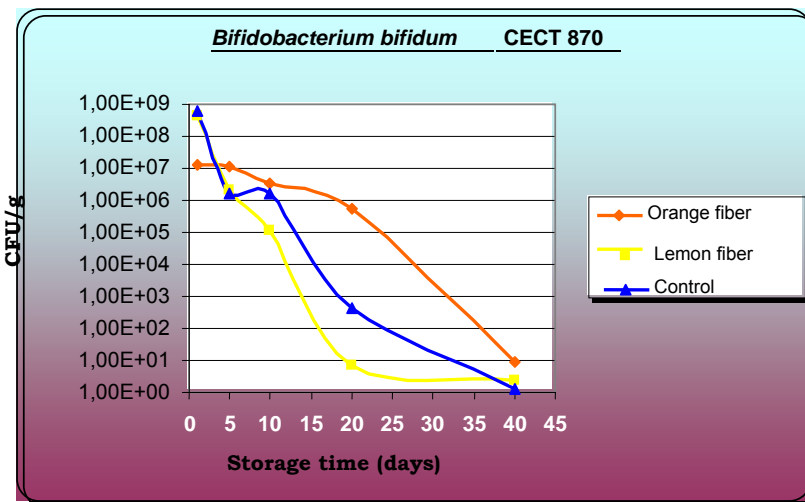
Citrus fibers favour the growth and survival of the studied probiotic bacteria. Best results are obtained for *Lactobacillus casei* CECT 4040 followed by *Lactobacillus acidophilus* CECT 903. *Bifidobacterium bifidum* CECT 4549 is also positively affected by the presence of citrus fiber by their populations dramatically decrease with storage time.



Graph 1. Evolution of counts of *Lactobacillus acidophilus* CECT 903 in MRS broth during cold storage



Graph 2. Evolution of counts of *Lactobacillus casei* CECT 475 in MRS broth during cold storage



Graph 3. Evolution of counts of *Bifidobacterium bifidum* CECT 903 in MRS broth during cold storage

Keywords: probiotics, fiber, by-products, citrus

[P7.03]

### Effective and sustainable extracting method for carrageenan industry

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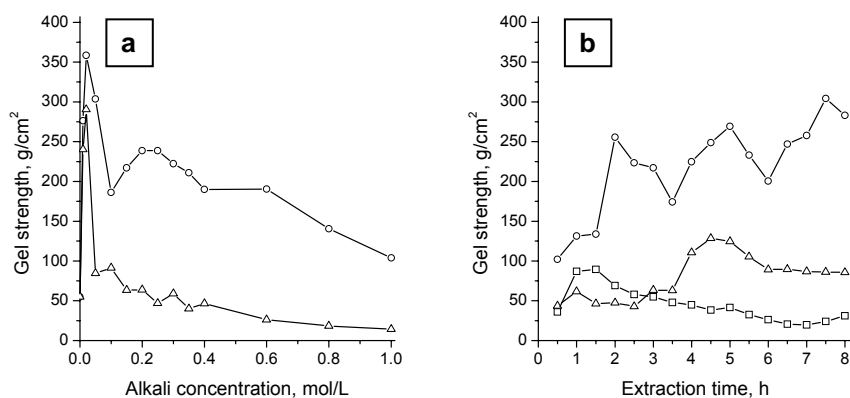
Carrageenans [1] are a family of linear sulfated polysaccharides, obtained by extraction from certain species of red seaweeds (Rhodophyta). They have a backbone built up of alternating 1,3- and 1,4-linked D-galactose residues or their derivatives. The gelling properties characteristic to some carrageenans (e.g. kappa carrageenan) make them valuable as food ingredients (E-407).

Carrageenan-bearing seaweeds *Furcellaria lumbricalis* and *Coccolytus truncatus* constitute a unique algal community (Kassari stratum) in the Baltic Sea (Estonia). This is the greatest community of these seaweed species in Europe and probably in the world [2]. The dominant species of Kassari stratum contain different undersulfated carrageenans (kappa carrageenan in *F. lumbricalis*, iota carrageenan in *C. truncatus*). The aim of this study was to elucidate sustainable processing conditions for extracting carrageenans from the biomass of the Kassari algal community.

The main isolation procedures (extraction, alkali modification, and precipitation) of hybrid carrageenan blend from seaweeds of the Kassari algal stratum were quantitatively investigated. Alkali treatment is an



obligatory step to isolate high quality (with high gel strength) seaweed galactans, causing increase in gel strength more than 5 times. The greatest gel strengths are achieved if low concentration (lower than 0.1 mol/L) alkali solutions are used as the extracting media (Fig. 1a); higher concentrations promote the degradation of polysaccharic chains and cause greater losses [3]. Surprisingly, quite high gel strengths can be obtained using long (7-8 h) extraction times in moderately alkaline (0.15 mol/L) media (Fig. 1b). In addition to the concentration of alkaline extracting medium, gel strength depends also on the ratio of algal biomass to alkali (KOH, NaOH).



**Fig. 1.** Dependence of alkali concentration in the extracting media (extraction time 3 h) and extraction time (in 0.15 M alkali solutions or pure water) on the gel strength (for 1.5% gels) of extracted carrageenans. Extracting medium: water (□), KOH (○), or NaOH (△).

Usually inexpensive alkalis ( $\text{Ca}(\text{OH})_2$ , NaOH) are employed in carrageenan industry; this requires additional treatment with potassium ions in case of kappa carrageenan type galactans. Using KOH instead of NaOH gives reasonable increase in product's gel strength and is therefore more economical; additionally, this removes one technological step in the treatment process.

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Keywords: carrageenan, gelling galactan, *Furcellaria lumbricalis*, alkali treatment

[P7.04]

### Water sorption and moisture barrier properties of chitosan-methylcellulose edible films

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Chitosan (CH), which is one of the most important by-products of the seafood industry, is a cationic biopolymer that forms a semi-permeable film, with relatively high water vapour permeability. On the other hand, methylcellulose (MC) has excellent film-forming ability, high solubility, and efficient oxygen barrier properties. Therefore, composite films based on CH-MC mixtures can be designed to take advantage of pure components, improving their functional characteristics.

To this aim, composite films were formulated by mixing solutions of 2% high molecular weight CH (at different pH, 3.8 and 5) and 2% MC in different proportions and dried films were obtained by casting in PTFE plates. Moisture sorption isotherms (MSI) and water vapour permeability (WVP) were determined at 5 °C. All film-forming solutions (FFSs) showed pseudoplastic behaviour; apparent viscosity of FFSs was higher as chitosan content increased. WSI showed a typical sigmoid shape, and at low  $a_w$  (0.113), no significant differences in water sorption capacities among all composite films were observed. Incorporation of CH into MC films significantly ( $p < 0.05$ ) increased the equilibrium moisture content of the films to differing extents, depending on the pH of the FFSs. At the highest pH, the water adsorption capacity of the films increased dramatically. At this pH, CH molecules show a lower net electrical charge, leading to a decrease in electrostatic repulsion among them, which can develop a more open structure in the film, resulting in a higher water holding capacity. These obtained results were in agreement with the values of the WVP of the composite films, which diminished with the decrease in CH content.

Keywords: chitosan, methylcellulose, edible film, water sorption

## [P7.05]

### Structural basis of the pharmacological effects of *Opuntia Ficus-Indica* cladodes

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#### Introduction

*Opuntia ficus-indica* grows in an arid climate, such as the Mediterranean. The fruits are edible while the cladodes (the green stem of the plant) are usually used as animal feed or disposed of in landfill. Cladodes are mainly water (80-95%) with solid matter comprising pectin, cellulose, protein, flavonoids and terpenoids. *Opuntia* contains pharmacological active compounds associated with antioxidant, anti-ulcer, anti-inflammatory, diuretic, analgesic, wound-healing and hypoglycaemic properties, which may be due impart to the presence of flavonoids, particularly quercetin and quercetin derived compounds (kaempferol, isorhamnetin) and to easily-extracted material (mucilage). *Opuntia* cladodes were studied for their chemical composition and for the antimicrobial activity of extracted flavonoids.

#### Material and Methods

Ethanol-extracted flavonoids (glycones and aglycones) were determined by HPLC. Carbohydrate composition, phenolic acids, lignin, protein and lipids levels in the alcohol-insoluble residue were also determined. Commercial enzyme preparations were used to reduce the total biomass and to improve the release of flavonoids and pectin. Ethanol fractions were tested for anti-microbial activity against Gram +ve (*L. innocua*, *Lc. lactis*, *Staph. aureus*) and Gram -ve (*E. coli*, *Ps. putida*, *Salm. enterica*) bacteria. Light microscopy was used to identify structural components of intact cladodes.

#### Results

Lyophilized cladodes contain 40% carbohydrate, 16% lignin, 6.42% protein, 0.63% lipids and 40% unidentified material. The main flavonoids are kaempferol and isorhamnetin glycosides (glucoside and rhamnoside). 50% of the biomass solubilisation was solubilized with a food-grade pectinase preparation. Enzymes in this preparation also deglycosylated the flavonoids. No antimicrobial activity was detected in the ethanol-released material, pre and post enzyme hydrolysis, possibly due to the low levels of flavonoids present. Polymeric interactions prevent further enzymatic breakdown of the cladodes. Light microscopy shows that the outer cells contain lignin, while the inner pith exhibit cross-linking.

#### Conclusion

*Opuntia ficus-indica* cladodes retain bioactive material tightly associated with cell wall components. Further experiments will involve the separation of the green outer layers of the cladodes from the pith and determining if the pith can be better utilized for the production of pharmacologically-active material.

Keywords: waste utilisation, flavonoids, cell wall structure, pharmacology

## [P7.06]

### Development of suitable indelible markers for animal by-products

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Approximately 17 million MT of animal by-products are produced in the EU each year as a result of the livestock industry supplying meat, milk and eggs to the food chain. These raw materials are categorised in accordance with the EU Animal By-Products Regulation (ABPR). Category 3 processed animal proteins (PAP) can be used in the agri-food chain as animal feed dependent on the levels of controls accorded by the regulations. One of the key control tools required is that category 2 and 1 materials and products are marked to prevent any possibility of cross contamination with category 3 by-products and products. Different dyes were tested for suitable marking of raw category 1 and 2 materials in the slaughterhouse. Based on the results, it can be concluded that the water-soluble dyes Patent Blue V, Tartrazine and Methylene Blue are suitable to mark raw animal by-products.

Glyceroltriheptanoate (GTH) was tested for a period of one week at nine different rendering plants as a marker for processed category 1 and 2 products. During the trial period GTH was added to the process and samples of meat and bone meal and fat were collected for GTH analysis. GTH analysis was carried out by CCL according to three different methods.

The stability of GTH in PAP during storage, was tested for 40 weeks at room temperature. During this period GTH levels were constant.

Based on the results of these studies, GTH is proposed as a marker for these products in the rendering plants.

Validation of suitable marker techniques for certain animal by-products will provide one of the controls necessary to approve the re-use of category 3 PAP in the agri-food industry. It is estimated that this safe and sustainable development will add economic value of circa € 350 million per year to the agri-food chain.

Keywords: Animal by-products, Markers, Sustainable, Feed

#### [P7.07]

##### **Optimisation of grape juice spray drying process**

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Drying food is one of the most relevant operations in the food industry. There are several drying techniques, and the most commonly applied are hot air, freeze dried and spray drying. Spray drying involves atomization of feed into spray and drying medium resulting in medium evaporation. The difficulty of this process is when the feed composition is a sticky product. The stickiness is due to the amount of sugar that products have in their composition. The sticky behaviour is attributed to low molecular weight sugars such as glucose and fructose.

This work investigates the performance to obtain dehydrated grape juice by the spray drying procedure. The grape juice is used to obtain wine in many countries. The production of must is always at the same time and the producers need mechanisms to store the juice not consumed. This type of fruit has the richest sugar in Mediterranean diet. The majority of the components of the grape juice are glucose and fructose, so the glass transition temperature (T<sub>g</sub>) of the system is very low. A consequently the spray drying process turns out to be complicated. A common strategy is to use high molecular weight additives, which have very high T<sub>g</sub> and raise the T<sub>g</sub> of the feed. Maltodextrins are typical aids for this type of process. In our work we have been using Maltodextrin DE 12, and we have studied the effect of different parameters as maltodextrin concentrations, inlet air temperature and spray flow in properties such as density, yield, aw, moisture content and solubility in grape juice, a very sugar-rich product. The data were analyzed using statistical software STATGRAPHICS, they were studied according to a complete second order factorial design with three repetitions at the central point.

Powder must obtained by spray-drying can be a very important advance in grape juice producing countries where remaining must is a great problem. This process allows to reduce considerably the costs of storage and transport of the must, and to obtain a sugary source of high quality.

Keywords: spray drying, grape juice, powder

#### [P7.08]

##### **The effect of brewer's spent grain on the textural and functional properties of extruded ready-to-eat snacks**

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The effects of BSG (brewer's spent grain) on the textural and functional properties of ready-to-eat extruded products have been studied. Dried and milled BSG at levels 10-30% was added to the formulation mix. The results of the extrudates are discussed in the terms of the interaction between the ingredients and effects of processing conditions.

The samples were processed in a twin-screw extruder with a combination of parameters including: constant feeding rate of 25 kg/h, process temperatures 80 - 150°C and screw speeds of 150 - 350 rpm. Pressure, torque and material temperature during extrusion were recorded.

The extrudate properties of sectional expansion index (SEI), water absorption index (WAI), water solubility index (WSI), protein content, bulk density and sensory evaluation of texture and colour were measured. Image technique investigations provided useful information on internal structure of the product, amount and size of bubbles, the cell wall thickness, and their contribution to the appearance and texture.

It was found that addition of BSG significantly increased protein content and bulk density, decreased SEI, individual area and total area of the bubbles in extruded products. The higher level of BSG resulted with thicker cell-walls with a rougher surface.

Keywords: Brewer's spent Grain, Extrusion, Ready-to-eat snacks

#### [P7.09]

##### **Comparative study on antioxidative activity of yellow stripe trevally protein hydrolysate produced from alcalase and flavourzyme**

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Protein hydrolysates have been found to possess antioxidative activity and are feasible to use as natural antioxidant in foods and biological systems. Protein hydrolysate can be prepared from fish muscle,

especially those with low market value such as yellow stripe trevally by enzymatic hydrolysis. However, proteinases used can affect the functional properties and antioxidative activity of the protein hydrolysate obtained. The objective of this study was to investigate the antioxidative activity of protein hydrolysate from yellow stripe trevally muscle prepared from Alcalase and Flavourzyme.

Fish protein hydrolysates from yellow stripe trevally with degree of hydrolysis of 15% were prepared using Alcalase 2.4L and Flavourzyme 500L by pH-stat method. Antioxidative activity of protein hydrolysates at different concentrations was measured by monitoring DPPH radical scavenging activity, reducing power and metal chelating activity. Thermal and pH stability of protein hydrolysates were determined in temperature range of 30-90°C and pH range of 2-12, respectively. Antioxidative activity was also determined in lecithin liposome system and  $\beta$ -carotene-linoleate system.

Fish protein hydrolysates exhibited the antioxidative activity in a concentration dependent manner. Hydrolysate prepared using Flavourzyme showed the greater antioxidative activity than that using Alcalase ( $p < 0.05$ ) as indicated by the higher DPPH radical scavenging activity, reducing power and metal chelating activity. Fish protein hydrolysates at 200 ppm were able to delay the formation of thiobarbituric acid reactive substance (TBARS) and conjugated diene in lecithin liposome system and also exhibited the antioxidative activity in  $\beta$ -carotene-linoleate model system. However,  $\alpha$ -tocopherol at 200 ppm had the greater antioxidative activity, compared to the hydrolysates at the same level. Hydrolysates prepared by

both enzymes showed the high stability when heated up to 90°C. Nevertheless, antioxidative activity decreased in very alkaline and acidic pH ranges ( $p < 0.05$ ). Therefore, the antioxidative activity of protein hydrolysate from yellow stripe trevally meat was governed by enzymes used.

Keywords: Protein Hydrolysate, Antioxidative Activity, DPPH Radical Scavenging Activity, Yellow Stripe Trevally

#### [P7.10]

##### **Vegetable juices – quality improvement by broccoli extract supplements**

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Fruits, vegetables and their juices have been reported to be an important source of antioxidants such as flavonoids, phenolic acids, carotenoids and antioxidant vitamins. These antioxidant phytochemicals when included in our diet offer protection against a variety of oxidation-related diseases like various forms of cancer and cardiovascular diseases [1,2]. The growing interest in the health implications of antioxidants has fostered research on designing polyphenol-rich plant products [3]. It is also well known that especially cruciferous vegetables, including broccoli are rich in health-promoting compounds including polyphenols, glucosinolates, vitamin C and carotenoids. The possible health benefits of dietary phytochemicals are related mainly to their antioxidant properties.

The aim of the study was to investigate the antioxidant activity of selected tomato and carrot juices, commonly consumed in Poland, enriched by the addition of polyphenol-rich extract from broccoli. The antioxidant activity of pure and enriched vegetable juices was quantified by modified TEAC assay (Trolox Equivalent Antioxidant Capacity) [4].

The results obtained show that the TEAC antioxidant activity was dependent on the kind of juice and the amount of polyphenol-rich broccoli extract added to the juice. Marked increase in the TEAC antioxidant activity was observed upon the addition of broccoli extract into mixed tomato-carrot and tomato. In contrast no difference was found between TEAC values of pure and enriched carrot juices. The results also indicate the existence of a threshold amount of polyphenol-rich broccoli extract which added to the juice increase its antioxidant activity. Above this threshold amount there is no increase in the antioxidant activity of juice despite its sensory characteristic is well accepted. The results of the study provide a basis for the application for new health-promoting food products on Polish market.

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Keywords: vegetable juices, antioxidant activity, broccoli

#### [P7.11]

##### **PC based monitoring and control of black tea continuous fermentation machines process**

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The tea fermentation is one of the important processes, which contribute in the quality aspects and taste enhancement of the black tea manufacturing. The paper presents PC based online monitoring and control of the continuous fermentation machines (CFM) processes using high performance DAS card and opto-isolated I/O card. Lab VIEW software is used for development of algorithms for on line monitoring of various process parameters viz., temperatures, RH, COB<sub>2B</sub> and OB<sub>2B</sub> using appropriate sensors at different process stage and generates appropriate control command for fan/humidifier on/off operation. In CFM process machine vision system using a digital camera is developed for detection and comparison of

the color of tealeaves in order to determine the endpoint of the fermentation process. For data storage, Oracle RDBMS is used as the back end. The data of the local machines can be stored in the individual machine (or) also in a server, which can be at remote location. The data transfer between different units and the server is done through Oracle Net 9i Configuration assistant. The developed system can be viewed on entire LAN.

Keywords: Tea fermentation process, Lab VIEW, Oracle RDBMS

#### [P7.12]

##### **Technology development and demonstration of controlled atmosphere storage system for Indian scenario**

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**Abstract:** Indian agricultural scientists have immensely contributed for the growth of Indian agriculture sector. With the increasing population and the changing global scenario, a need is being felt for a second green revolution for doubling the agricultural produce and at the same time maintaining the high quality standards. It is also felt that efforts are also to be put in to minimize losses during harvesting, storing and processing of agricultural produce. Among these losses, it was reported that storage losses amounts to 10% of the produce. In-order to address the problem of storage losses, Council of Scientific and Industrial Research (CSIR) India has initiated a Task force based programme under Electronics for societal purpose, to develop and demonstrate a technology for Controlled Atmosphere Storage applications that is suitable for Indian conditions. Central Electronics Engineering Research Institute (CEERI), Pilani, Central Scientific Instruments Organisation (CSIO), Chandigarh and Central Food Technology Research Institute (CFTRI), Mysore which are sister laboratories of CSIR, are networked to work on this project. The present paper describes the salient features of the Controlled Atmosphere Storage System developed at CEERI, Pilani under the above programme and discusses some results. Embedded technology is used to make the system cost effective and wider view concepts are implemented to make it in-tune with state-of-art technologies. Virtual Instrument concepts are used for developing the system's application software. Presently the system is under-going extensive field performance trials.

Keywords: Controlled Atmosphere Storage, Storage losses, Electronics for Society

#### [P7.13]

##### **Production of frozen cubes from muskmelon and watermelon using inverse osmosis**

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**Introduction:** Low calorie cucurbit fruits have high nutritional value due to their C and K vitamins and high levels of antioxidants with well known anti cancer effects. Despite of high demands for these fruits for fresh consumption, a considerable loss is reported. To overcome this problem research on processing methods of long life products are required. This study aims to evaluate sensory properties of frozen cubes of watermelon and muskmelon produced by inverse osmosis.

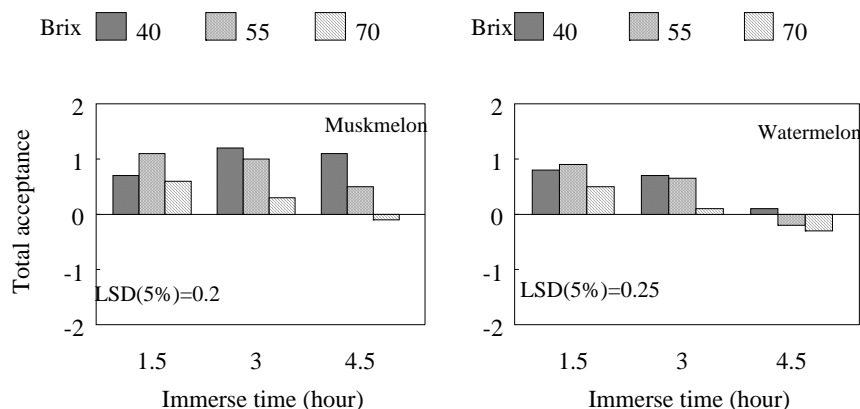
**Methods:** Fresh fruits were peeled and deseeded after washing and cut into cubes of 2x2x1 cm. Cubes were immersed in syrups with brix of 40, 55 and 70 for 1.5, 3 and 4.5 hours and preserved at freezing temperature (-20°C) for six month in sealed polyethylene bags. 10 panelists judge sensory properties of the cubes using 5-point hedonic scale in two monthly intervals. The effects of treatments were tested statistically using ANOVA.

**Results:** Taste, aroma, color and texture of both fruits were declined during the storage time, which was reflected in the scores of total acceptance. Increasing brix and immerse time led to a significant decrease in all sensory properties after 60 days of storage. Total acceptance of frozen cubes was affected by immersing time x brix interaction ( $P < 0.05$ ). For muskmelon maximum acceptance was obtained when cubes were immersed for 3 hours in syrup with brix 55. However, for watermelon cubes the best result was obtained when immersing time was reduced to 1 hour with the same brix (Fig. 1). For both fruits treating of cubes in syrups with high brix was not acceptable regardless to immerse time.

**Discussion:** Because of their high nutritional value, fruits have crucial role in sustainable food systems. To prevent their losses and to extend their consumption period all over the year development of proper technologies are required. The results of this study showed that summer cucurbit fruits could be stored over a long period of time while their sensory properties are kept unchanged using inexpensive and environmentally sound method.

**Keywords:** Watermelon, muskmelon, inverse osmosis

**Figure 1.** Total acceptance of watermelon and muskmelon frozen cubes after 6 months storage. Scores were defined as very dislike (-2); dislike (-1); neither like nor dislike (0); like (1) and very like (2).



[P7.14]

### Impact evaluation of innovative and sustainable extraction technologies on olive oil quality

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In the world there are 19 countries producing olive oil and all belong to the Mediterranean area. In particular, olive oil production in Italy boasts a thousand years old tradition and represents one of the most interesting field of Italian agriculture. At the moment the olive oil extraction is carried out with technological industrial processes continuous or discontinuous, even though the quality and the quantity of the obtained oil are still to be optimized. These mechanical systems, in fact can extract no more than 80-90% of the fruit-contained oil. It follows that the remaining oil in by-products can reach 20% producing a significant economic loss for the oil sector. Moreover, the quality of oil is often not satisfactory for the presence of organoleptic defects. To solve the problem has been proposed the possibility of biotechnological exploitation in olive oil production sector, considering also their eco-sustainability and lower environmental impact. The traditional, mechanical systems, although the relevant progress achieved in Italy by oil production technology, can surely give qualitative and quantitative (improved yield to 7.5%) answers much more significant, if supported by suitable biological enzymes systems. Composition of glyceridic fraction seems not to be influenced by the enzymatic treatment because they are limited to oil micro-drops membranes where are present only the non-glyceridic components, implying that parameters connected to productions genuineness are not almost altered. These enzymatic complexes are natural, vegetable extracts obtained from microorganisms not genetically modified and they are strongly deactivated during the critical pressing phase, probably for the formation of oxidized phenols, bonding the enzyme prosthetic group. It follows that the replacing of these enzymatic species is appropriate in relation with the role they play in determining the final product quality. At last but not least, it should be underlined that the enzymatic complexes, for their water solubility, after producing their positive effects on composition of oil analytical fractions, are found *in toto* in olive mill wastewaters.

**Keywords:** Olive oil quality, Sustainable technology, enzymatic formulation, extraction

[P7.15]

### Microbial dynamics of pig feed fermented with residues from bioethanol and dairy industries

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#### Background

Use of liquid by-products from food industry or from bioethanol production as animal feed improves nutrient circulation in agricultural systems and reduces the environmental load. Pig feed can be produced by fermenting grain with different liquid waste products. Pigs experience such feed tastier, obtain a more pathogen resistant gastrointestinal tract and show improved grain phosphorus uptake. The fermentation is a spontaneous process and not much is known about the microorganisms involved. To provide a basis to understanding the process we investigated the microbial population dynamics during fermentation of pig feeds.

#### Method

Cereal grain mix was fermented with wet wheat distillers' grain, whey or water at 10, 15 and 20 °C. Growth of yeasts, moulds, lactic acid bacteria (LAB), total aerobic bacteria and Enterobacteriaceae was monitored by quantification on selective media. The diversity of LAB and yeasts was investigated using PCR-fingerprinting and rDNA sequencing. Moulds were identified from morphology. Aerobic bacteria and Enterobacteriaceae were quantified to ensure hygienic quality. Phytate was analyzed with high-performance ion chromatography.

## Results

Microbial diversity was influenced by the substrate and to some extent by temperature. The time needed to obtain a stable microbial population was prolonged at low temperature, and some feeds never became stable. *Lactobacillus* and *Pediococcus* were dominating bacteria and yeasts were mainly *Pichia* and *Kluyveromyces*. The diversity, but not the number of moulds decreased during fermentation. *Eurotium amstelodami* and *Penicillium roqueforti* were the dominating organisms at the end of fermentation. All phytate was degraded in all fermentations.

## Discussion

A general concern about the fermentation of pig feed is its uncontrolled nature. Results indicate a temperature dependent instability of the microbial population in some feeds. This points to the necessity of using starter cultures or increased temperatures for controlling the fermentation.

Keywords: Yeast, Lactic acid bacteria, Fermentation, Pig feed

[P7.16]

### Screening for yeast strains with high phytase activity

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#### Introduction

Monogastric animal feed is mainly based on cereals, where phosphorus (P) is mostly present in inositol hexaphosphate (IP<sub>6</sub>). Only a small part of it can be utilised by animals and more available inorganic P sources are often added to meet the nutritional requirements, resulting in high excretion levels of P. The digestibility of P depends on phytase activity and amount of IP<sub>6</sub> in feedstuffs. Fermentation of feed degrades IP<sub>6</sub> efficiently, probably due to both intrinsic and microbial phytase activity. Yeast can be added to feed grain as a protein additive and to exert biocontrol of moulds during storage. It is advantageous if these yeasts also have the ability to degrade IP<sub>6</sub> and thereby increase P availability for monogastric animals. We developed a screening method to isolate yeasts that efficiently degrade IP<sub>6</sub>.

#### Methods

Yeasts were grown in microtiterplates with P (positive control), without any P-source (negative control), and with IP<sub>6</sub> as sole P-source. The growth was monitored by measuring OD during 48 hours with Hidex Chameleon microtiter plate reader on three different media. Number of strains tested was 150, descending from 23 different species. Phytase activity was thereafter measured with a colorimetric method by measuring the released P.

#### Results and Discussion

The possibility to grow on phytic acid indicates phytase production by the yeast. There was a large variation of phytase activity both between and within species. Strains of *Arxula*, *Pichia* and *Cryptococcus* had the best capability to grow with IP<sub>6</sub> as sole P-source. The biocontrol yeast *Pichia anomala* would be of interest to utilise as a protein additive and simultaneously obtain an increased P digestibility of feed grain due to the high phytase activity of this species.

Keywords: phytase activity, phytate, yeast, screening

[P7.17]

### Development of potential applications of membranes and CO<sub>2</sub> supercritical fluid in separation processes for valuable products recovery from agro food by-products

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The main aim of this research was to evaluate the potential application of membranes and CO<sub>2</sub> supercritical fluid in separation processes for the efficient recovery and isolation of biomolecules in red cabbage trimmings from the vegetable processing industry.

Specifications of physical process operation were defined for successful separation and recovery of:

- Polysaccharides, polyphenols and anthocyanins by membrane technology (UF/NF)
- Polyphenols and anthocyanins by SCF extraction technology

With respect to membrane separation processes, trials were performed with liquefied trimmings. The behaviour of such a solution in front of different membrane cut-off values to check retention of specific individual or groups of constituents was studied.

Considering the molecular size of the particles to be separated (in Daltons), the ultrafiltration and nanofiltration ranges seemed more suitable to reach the proposed objectives. Thus, three organic membranes with different pore sizes (5,000, 1,000 and 200-500 Da) were selected for testing in stirred cells. For each membrane material and cut-off, the evolution of the permeate flux with the VCF (Volumetric Concentration Factor) and time was studied. Furthermore, analyses of total polyphenols, anthocyanin content, browning index, neutral sugar and uronic acid were accomplished. In a second stage, the methodology to purify/isolate specific compounds by membrane fractionation or supporting technologies compared to the viability of commercialisation of whole extracts will be evaluated.

In the case of CO<sub>2</sub> SFE, experiments were directly accomplished on freeze dried trimmings in order to isolate total polyphenols and anthocyanins in a stable and rich extract.

The effects of both the pre-treatment of the raw material and the extraction temperature were checked with a total retention time of 270 minutes. The obtained samples were analysed to quantify their content in polyphenols and anthocyanins, obtaining a very low yield in the first trials. Next, a process optimisation will be performed to confirm the usefulness of this technology for the proposed objectives.

Keywords: agrofood by-products, membrane technology, CO<sub>2</sub> supercritical fluid extraction

[P7.18]

### **Effects of calcium incorporation on apple slices (var. granny smith) behaviour during osmotic dehydration**

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Vacuum impregnation is a useful tool to incorporate physiologically active compounds to fruits and vegetables without disrupting their cellular structure. Nevertheless, interactions between these components and the plant tissue are expected to induce changes on enriched products behaviour during their further processing.

In the present study it was analysed the role that the amount of calcium incorporated to the porous structure of 10 mm thick apple slices (0, 20 and 40% of the RDA per 200 g of vacuum impregnated product) plays on their behaviour during osmotic dehydration with an aqueous sucrose solution (55 Brix) at different temperatures (30, 40 and 50 °C). Osmotic dehydration was analysed in terms of water loss and solutes uptake, which are directly related to the process yield and the samples shrinkage. Changes in food liquid phase composition were also considered, as they are responsible of the final product quality and stability. According to the results obtained, significant reduction in net changes of mass and volume was observed in samples submitted to a vacuum impregnation, which has been explained in terms of gas replacement by liquid in the porous structure. Reduction in net changes of mass and volume were reported to increase with the concentration of calcium incorporated to the porous structure by vacuum impregnation, which has been related to calcium ions capacity to interact with the structural matrix of vegetal tissues. Increase in processing temperature promoted both water loss and solutes uptake. Despite the loss of part of the calcium incorporated to apple slices by means of vacuum impregnation, the osmotic dehydration has been considered as a useful tool to increase the stability of this kind of products without seriously depressing their nutritional value.

Keywords: Functional Foods, Vacuum Impregnation, Osmotic Dehydration, Calcium

[P7.20]

### **Exploitation of wheat bran**

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#### **Introduction**

Wheat bran is a by-product of the milling industry and is often treated as a waste stream. There is great interest in developing methods for its exploitation: it contains nutritionally relevant components including protein and cell-wall phenolics, and also has beneficial properties as a dietary fibre. This study has evaluated the distribution of cell-wall components in the different bran layers in relation to their potential for exploitation.

#### **Methods**

Bran layers were separated from mature grains of wheat (*Triticum aestivum* L. cv Avalon) to give: (i) beeswing bran (BWB), (ii) cross cells, (iii) testa (with nucellar epidermis), (iv) aleurone layer, and (v) total bran. The cell-wall materials from each layer was purified and analysed for component sugars (GLC of alditol acetates) and phenolic esters (HPLC of after saponification).

#### **Results**

Total bran cell-wall material was rich in arabinose and xylose with significant quantities of glucose and uronic acid, and relatively small amounts of galactose and mannose. The different bran layers exhibited considerable differences in the ratios of arabinose : xylose indicating differing degrees of branching. HPLC analysis of phenolic acids identified significant amounts of esterified-ferulic acid, 8-8' (aryltetralin form), 5-8', 5-5', 8-0-4' and 5-8' (Benzofuran form)-dehydrodiferulic acids. Interestingly, ferulic acid was highly concentrated in the aleurone layer, whereas dehydrodiferulates were higher in beeswing bran and cross cell layers. The beeswing bran was highly lignified.

#### **Discussion**

The component bran layers differ widely in their chemical composition, reflecting a range of structure-function relationships in the plant. The different degrees of phenolic-polymer-cross-linking are likely to influence the rate of degradation of different fibre components by colonic bacteria, and will have potentially important consequences in relation to the physiological effects of bran fibre. Furthermore, bran could provide a substantial source of feruloylated polysaccharides which might be exploited in the formulation of thermally-stable gels and composites.

Keywords: wheat bran, diferulic acid, phenolic acids, cell walls



[P7.21]

**Whey cheese matrices: improvement of organoleptic and textural properties**

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Probiotic bacteria are often used in dietary supplementation due to health promoting effects. Incorporation of probiotic bacteria has been performed in several dairy products and more recently in whey cheese matrices. Organoleptical and textural quality of these matrices can be improved by use of several selected additives in their manufacture; however the viability of the probiotic strains inoculated has to be assessed. Whey cheese matrices resulting from the combination of ovine and bovine whey mixtures with ovine milk were manufactured, via protein denaturation by heat at 90 °C. Subsequently, such additives as plain sugar, or sugar combined with strawberry jam, with aloe vera or with chocolate and chocolate fiber, were incorporated, and the resulting matrices were inoculated with *Lactobacillus paracasei* ssp. *paracasei*. Microbial viability of probiotic strains, and eventual contaminants and acidification were followed during the storage for 20 d at 7 °C. Samples were submitted to sensorial analyses using a trained sensorial panel at 2 and 15 d of storage (upon confirmation of microbiological safety).

*Lactobacillus paracasei* maintained its viability at levels of 8 log units/g throughout the 20-d storage period, irrespective of the type of whey matrix. Nevertheless, statistical analysis revealed a significant effect of both food additives and storage time on viable cell numbers of *L. paracasei*. No microbial contamination was detected in all four matrices throughout storage. In what concerns acidification, the food additive also played an important role; matrices with chocolate and strawberry jam were the most acid at the end of storage. In general, sensorial analyses were satisfactory.

Keywords: additives, functional, sensorial, viability

[P7.22]

**Rheological and microstructural characterization of probiotic whey cheese matrices**

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*Bifidobacterium* and *Lactobacillus* spp. strains have been commercially incorporated in several dairy products and more recently in whey cheese. In those matrices viability was maintained at 10<sup>7</sup> cfu/g – the minimum threshold necessary for a probiotic benefit. However, technological processing may constrain the final texture of these matrices, which in turn will affect shelf-life and viability of the probiotic strains. Hence, the objective of this research effort was to assess rheological, microstructural and sensory features of whey protein matrices, previously inoculated with such probiotic strains (separately and as a mixture). Whey protein matrices resulting from combination of bovine whey and milk were thus manufactured, via protein denaturation by heat at 90 °C. Subsequently, those matrices were inoculated (at 10 %) with *Bifidobacterium animalis* Bo and *Lactobacillus paracasei* ssp. *paracasei* LCS-1, individually or together, and duly homogenized; additives such as salt and sugar were incorporated and the resulting matrices were finally stored at 7 °C for 21 d. Oscillatory viscometric measurements were performed using a Bohlin Gemini Advanced Rheometer. Microstructural features were observed via a JEOL Scanning Electron Microscope. Viability counts were performed in selective media. Acidification was monitored via pH measurements and free acid titration. Sensory analyses were performed by a trained panel by 2 and 15 d of storage.

In general, all matrices provided a favourable environment for maintenance of viability of the probiotic strains inoculated. *Bifidobacterium animalis* Bo possessed a lower acidifying activity than *L. paracasei*. As expected, G' (elastic modulus) was always higher than G'' (viscous modulus) in all matrices, subject to rheological analyses. Addition of strains to the experimental matrices originated a decrease in those moduli. Matrices without additive and inoculated with the two bacteria were more elastic and viscous. The incorporation of additives (especially sugar) increased elasticity. These differences were confirmed via microstructural analysis.

Keywords: whey, functional, sensorial, microscopy

[P7.26]

**Optimization of dried shrimp production by intelligent systems**

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10000 tons of shrimp are annually bred in waterways and breeding farms throughout the country, while 95% of Iranian shrimp production is exported and shrimp industry in Iran is an export-oriented business. On the other hand, development of shrimp farming industry in some Iranian provinces would be capable of creating a huge number of direct and indirect opportunities. Thanks to superior quality of Iranian shrimp, it can be regarded as a novel product for export. After joining World Trade Organization (WTO), seafood industry would be benefited and this will lead to higher shrimp production. It can be mentioned with more than 1700 Km of coastal borders, Iran has the potential to turn into a top shrimp export in the world.

However due to the global decline in prices, in addition to changes in the markets and consumers demands, shrimp producing countries are trying to bring down production costs, while manufacturing new high quality products from shrimp. An optimization method, based on modeling of drying kinetic and physicochemical properties of dried shrimp is presented in this paper. Intelligent systems and machine vision are applied for optimization of shrimp drying process as a challenge in Iranian seafood industry.

Keywords: shrimp, drying, optimization, Iran

[P7.27]

### **CPF Technology - A cryogenic spray process to generate powders from liquids**

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In food industry liquids and powder form raw materials often have to be mixed to obtain the final product. This mixing could be sophisticated, especially if highly viscous liquids have to be used. Mixing of pure powder form materials is much more simple and processing times can be reduced. Therefore different methods to produce powders from liquids have been developed.

Liquids can be converted into powder form products by drying processes or combining them with powder form solids. CPF technology (Concentrated Powder Form) is a gentle high pressure spraying process which creates free-flowing powders with high liquid ratios.

A gas, normally carbon dioxide, is dissolved under high pressure (80 to 250 bar) in the liquid. The gas-saturated solution is then rapidly expanded in a nozzle. The gas is released and thus very fine droplets of the liquid are formed. During expansion a powder form carrier is added concurrently to the sprayed liquid. The expanding gas causes an intensive mixing of the fluid droplets with the solid carrier. The liquid is adsorbed onto the solid surface or in case of porous carriers, the fluid pours into the pores and soaked particles are formed.

CPF technology is a gentle process. Due to the expanding carbon dioxide the process takes place in an inert gas atmosphere and at very low temperatures (-10°C to 0°C), meaning that substances, sensitive to temperature and oxygen, can be processed with negligible changes to their quality. The product remains unaffected by oxidation or thermal stress.

The CPF process was successfully applied to different vegetable oils, which are sensitive to oxygen due to a high content of unsaturated fatty acids. Vegetable oils are used in food industry as an additive for powder form mixtures for breads, bakery products, soups, sauces and snacks. Mixing of oils with powder form materials can cause problems like undesired agglutination, changing of particle sizes and inhomogeneity. Therefore powder form oils are preferred. Products from spray drying or fluid bed agglomeration are still available on the market, but quality losses due to oxidation during processing have to be accepted. Powder form oils from CPF process, manufactured in inert gas atmosphere without heating are a promising alternative.

Keywords: powder form oils, cpf, pulverization, high pressure

[P7.28]

### **Cultivation of *Pleurotus* spp. in several agro-industrial by-products**

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Edible mushroom cultivation using alternative by-products of agroindustries one possible contribution to promote sustainability of the whole chain. Accordingly, the objective of this work was to perform axenic cultivation of *Pleurotus* spp. in such residues as rye straw, grape stems, and a mixture of pinus and eucalyptus wood sawdust (at various proportions).

Cultivation of specifically *P. ostreatus* and *P. sajor caju* followed four stages: i) primary matrix production; ii) secondary matrix production; iii) inoculant production (spawn); and iv) mushroom growth. Biological efficiency (BE), total solids, organic matter, ash, protein and several elements were analysed.

High values of BE were achieved by *P. sajor caju*, 63 and 94%, using substrates composed by 25:25:50 of white grape stem, black grape stem and rye straw, and in plain rye straw, respectively. Conversely, low values of BE were attained using plain wood sawdust. Total solid contents were 9 - 11% for mushrooms cultivated in the various substrates. High contents of organic matter, as well as of ash were found for mushrooms cultivated in rye straw only, and in rye straw mixed (50:50) with wood sawdust. Conversely, high values of protein were observed for mushrooms cultivated in grape stem, and in plain wood sawdust. Iron and phosphorus were the main elements detected in mushrooms cultivated in all substrates. In straw based substrates (i.e. plain or in mixture with other substrates), high values of BE were obtained, hence showing that such a residue may increase yield of the mushroom cultivation process. In terms of nutritional values and concerning protein content only, substrates that include grape stems appear more adequate for cultivating mushrooms.

Keywords: Pleurotus, by-products, Mushrooms, Agroindustries

[P7.29]

**Antioxidant activity of various wheat products**

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One of the possibility to suppress undesirable reaction of lipid oxidation in food industry as well as in health protection is to use antioxidants, first of all natural antioxidants, or to preserve the natural antioxidative potency of raw material during the application of some technological procedure in food industry.

Knowing that many food products (first of all bread as frequently used product) or meals contain flour it is interesting to determine the antioxidative potential of some wheat products with the scope to assume the participation of these components in specific health benefit as the prerequisite to select some of them in category of functional food.

With the aim to determine the antioxidative potency of several kinds of wheat products we investigated ethanolic extracts of wheat flour type 400, 500 and 850, integral wheat flour and wheat bran to evaluate the free radical scavenging capacity of these extracts using DPPH test. Besides, total phenolics contents of investigated samples were determined since there are numerous literature data of their significant antioxidative nature.

As shown in Table 1, the ethanolic extracts obtained from all investigated samples showed the similar scavenging activities that suggested that all kinds of wheat products contained the similar antioxidative compounds with the similar molecular structure.

Table 1. ED<sub>50</sub> of ethanolic extracts of wheat flour type 400, 500 and 850, integral wheat flour and wheat bran against DPPH· radicals and total phenolic contents of investigated samples

Extracts	ED <sub>50</sub> (mg extract/mL)	Total phenolic content (µg/g as gallic acid equivalents)
Wheat flour type 400	39.70	19.45
Wheat flour type 500	31.79	36.94
Wheat flour type 850	30.00	50.32
Integral wheat flour	39.34	135.68
Wheat bran	34.62	403.37

Since, there are distinct differences in total phenolic contents of investigated samples, it could be expected that the usage of products with higher phenolic content will contribute to the food functionality.

Comparing the results shown in Table 1 with DPPH effect achieved using ethanolic extracts of BHT and  $\alpha$ -tocopherol as the commercial antioxidants (0.1 mg/mL of those antioxidants bring about DPPH effect of 74.56%, 78.07% respectively) it can be concluded that the investigated extracts obtained from wheat products exhibit much lower antioxidant activity by donation of H-atoms than BHT and  $\alpha$ -tocopherol. This indicates relatively low antioxidant potency of the investigated products. It points out necessity of enriching flours with additives with better antioxidative effects, if such products wanted to be regarded as functional food.

Keywords: wheat products, antioxidants, DPPH, total phenols

[P7.31]

**Enzymatic extraction of pectins from different plant by-products**

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Plant cell wall is a complex assembly that surrounds plant cells. It is composed of an entanglement of three different networks (cellulose and hemicellulose, pectins and proteins). Pectins are a family of complex and heterogeneous branched polysaccharides. In food industry they are obtained from citrus peel or apple pomace and are commonly used as a thickening or gelling agent.

The aim of this study is to extract pectins from different plant by-products (chicory roots, cauliflower and red cabbage) with enzymes. Chicory roots result from hydroponic chicory production and 700 000 tons are produced each year in EC. Cauliflower and red cabbage by-products come from freezing or transformation plants. As these by-products are rich in pectins, they could be an interesting source of pectins for food industry.

Pectins have been extracted with enzymes, but also with acid for comparison. The acidic extraction (with hot HCl) is a classical method generally used in pectin industry. The enzymatic way is an original approach, which consists in using proteases and cellulases to deconstruct the cellulose and protein networks and thus isolate pectins.

Concerning chicory roots, the enzymatic extraction gives a higher yield (36%) than acidic extraction (27%). Chemical compositions, as well as macromolecular and functional properties of pectins, have been compared. The degree of methylation of pectins is around 60% for both extractions. Pectins extracted with enzymes have a lower molecular weight and a lower intrinsic viscosity than pectins obtained with acid. Enzymatic extraction method seems to be a promising way for pectin industry.

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[P7.32]

#### **Composition of Iranian tea seed oil**

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Tea seed is a neglected by-product in tea processing. It is possible to harvest approximately 3500 tons per year of tea seed in the northern farms of Iran. Considering 20% oil content in tea seed, about 6500 ton oil can be extracted per year.

In this study tea seed is focused due to the composition of the oil content because it is an available oil source which could pose nutritional and pharmaceutical uses.

The characterization of fatty acids (FAs), and also antioxidant compounds in oil extracted from seed were analyzed.

The results showed that seed oil contains a high concentration of unsaturated fatty acids; the majority fatty acid was oleic acid. Also a monounsaturated fatty acid (55-83% of total fatty acids) was detected. It is observed that Tea seed oil contains further saturated fatty acids (range: 8-14%), polyunsaturated fatty acids (range: 4-20%), and other important minor constituents, particularly antioxidants, such as vitamin E and polyphenols. On average, these simple phenols account for 4.2 mg/100g in tea seed oil.

The content of phenolic compounds in the oil depends on the cultivar and the ripeness of the seeds at the time of harvest, which may cause greater resistance against oxidation for long-term storage.

It is concluded that tea seed oil has nutritional characteristics comparable to the other natural sources of oil. Its availability and beneficial healthful effects-due to both its high content of monounsaturated fatty acids and its high content of antioxidative substances- brings up the need to have more focus to this by-product.

[P8.01]

#### **Development of species of origin identification methods for use in processed animal proteins**

S Woodgate\*<sup>1</sup>, R Margry<sup>2</sup>, S van den Hoven<sup>2</sup>; <sup>1</sup>EFPR, Belgium, <sup>2</sup>CCL, Netherlands

Over 2 million metric tonnes of category 3 processed animal proteins (PAP) are produced every year in the EU. In accordance with the EU Animal By-Products Regulation (ABPR) they are in principle, able to be used in the agri-food chain. However, the utilisation of PAP in animal feed is dependent on the levels of controls accorded by the veterinary regulations. Currently, these controls are still under development, and as a result no PAP is used in feed

One of the key controls required is to be able to identify the species of origin used in the production of the processed animal protein. This identification prevent cross contamination with certain proteins and to avoid the use of the certain proteins in the feed of the same species.

The absence of validated techniques is characterised by the fact that the rendering process operates at high temperatures and pressures in the presence of high levels of fat, protein, minerals and water.

As a preliminary, the production of pure reference materials of individual species, (bovine, ovine, porcine and avian) was completed. Each sample was produced under controlled and defined temperatures, pressures and time.

With these pure and (in feed) mixed materials are more than 15 techniques selected and tested on suitability for species identification. One immunochemical method for species specific protein detection and two DNA detection techniques (real-time PCR) are promising until now for detection of ruminant material. Variants of these techniques are being validated now for detection of porcine and poultry tissues. Validation of suitable species identification methods for PAP's will provide one of the controls necessary to approve the re-use of animal by-products in the agri-food industry.

It is estimated that this safe and sustainable development will add economic value of circa € 350 million per year to the agri-food chain.

Keywords: Species Identification, Processed animal protein, Sustainable, Feed

[P8.02]

#### **Dielectric spectroscopy studies of *Longissimus Dorsi* pork samples**

M Castro\*, P Fito, R De los Reyes, E De los Reyes; Universidad Politécnic de Valencia, Spain

Fisico-chemical properties such as water content, water activity, soluble solids content and fat content are related to dielectric properties. Dielectric Spectroscopy studies have been performed on *longissimus dorsi* pork meat samples as a first step in a further quality control. Two trays of *longissimus dorsi* pork meat samples were bought in the supermarket. Each tray had eight slices of about 50 g of weight approximately. Dielectric properties were measured in meat slices, minced meat and in the dripped liquid in the frequency

range 200 MHz-20 GHz by a coaxial probe (HP 85070E) connected to a Network Analyzer (HP E8362B). The dielectric properties were measured at 10°C in a refrigerated incubator Hotcold C (JP Selecta). The results showed differences between the spectra of meat slices, minced meat and in the dripped liquid. This can be a very useful method for quality control in meat industries.

Keywords: dielectric spectroscopy , dielectric properties, pork meat, processes control

#### [P8.04]

##### Quality traits of cow's milk from maize silage or grass hay based diet

S Segato\*, C Elia, S Balzan, C Ossensi, E Novelli, M Dorigo, et al; Padova University, Italy

Dairy farming systems sustainability depends on nutrients balance, economic results and quality of products. Among management factors, feeding method is one of the main technique that influences nitrogen farm gate balance and milk quality traits. In the North of Italy, there are two prevalent cropping systems: permanent meadow (grass hay) vs. arable land (maize silage). Thus, the aim of this study was to evaluate the effect of the inclusion of maize silage (MS) in substitution of grass hay (GH) on productive performance and milk quality of dairy cows. According to milk production ( $28.5 \pm 6.4$  kg/d) and days in milk ( $212 \pm 99$ ), 14 Holstein dairy cows were assigned to two dietary treatments in a 2x2 cross over design. Compared isonitrogenous and isoenergetic diets were formulated including 40% or 0% of maize silage. Samples of milk were collected the third week of each experimental period and analyzed for pH, chemical composition and lactodynamographic parameters (clotting time: r; curd firming time:  $k_{20}$ ; curd firmness:  $a_{30}$ ). Data were submitted to ANOVA by using Proc Mixed of SAS (1999). Dietary treatment did not affect productive performance such as dry matter intake (DMI) and milk production. An inclusion of maize silage as roughage source till to 40% of the diet (on dry matter basis) had not effect on milk chemical composition or dairy technological property (table 1). Since the advanced stage of lactation, the absence of significant differences between the two diets could be related to the relative low milk production. At a high productive level, maize silage could lead to higher energy intake than grass hay varying reological properties of milk and curd. Considering the lower cost of MS than GH, these results seems to indicate that MS-systems are more sustainable, even if potential denitrification and leaching are higher in arable land than in permanent meadow.

Table 1. Effect of the dietary level of inclusion of maize silage on milk quality

		MAIZE SILAGE		P	SEM
		40%	0%		
pH		6.64	6.65	ns	0.02
Crude protein	%	3.51	3.51	ns	0.10
Casein	%	2.70	2.72	ns	0.08
Fat	%	4.17	4.03	ns	0.22
Lactose	%	5.0	5.0	ns	0.1
Urea	mg/100 ml	27.3	28.1	ns	0.8
Clotting time, r	min	14.7	15.6	ns	1.0
Curd firming time, $k_{20}$	min	5.1	4.5	ns	0.6
Curd firmness, $a_{30}$	mm	32.3	34.7	ns	2.6

ACKNOWLEDGMENTS – Research supported by FONDAZIONE CARIVERONA

Keywords: milk quality, dairy cow, maize silage, grass hay

#### [P8.05]

##### Co-fermentation of *Rhizopus oligosporus* with lactic acid bacteria and yeast during barley tempeh fermentation

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##### Introduction

Meat production on average requires 11 times more energy than plant production in terms of protein contents (Pimentel and Pimentel, 2003). Therefore, using plant-based materials as human food can save energy, and develop sustainable agriculture. Plant materials contain nutritional inhibitors, i.g. phytate and protease inhibitors. To increase the availability of nutrition, fermentation, i.g. tempeh fermentation, is an alternative. Tempeh is a traditional food in Indonesia made from substrates fermented with *Rhizopus oligosporus*. Barley tempeh is now developed in Sweden (Berg et al., 2001). Co-fermentation with lactic acid bacteria (LAB) and yeast could increase the nutritional value and hygienic safety. In this study, the growth abilities of LAB and yeasts and their effects on the growth of *R. oligosporus* and nutritional value of barley tempeh were estimated.

##### Methods

Pearled whole barley kernels were soaked in 0.12 M lactic acid solution for 6 h at room temperature. After draining, the barley was boiled for 10 min in 0.8% (w/v) NaCl solution. The drained and cooled (42 °C) barley was inoculated with *R. oligosporus* and/or yeasts or LAB at approx  $10^4$  spores (cfu)/g wet weight. The inoculated barley (60 g wet weight) was packed into disposable, sterile petridishes (9 x 1.5 cm), which were individually wrapped in plastic bags and incubated at 35 °C (Feng et al., 2005). Colony-forming-units

were used for estimating the growth of LAB and yeasts, ergosterol for estimating the growth of *R. oligosporus* when inoculated alone or together with LAB, and a developed real-time PCR quantification method for determining the growth of *R. oligosporus* when co-inoculated with yeasts.

### Results

*L. plantarum* and *L. fermentum* increased from 4.8 to 7.4 log cfu/g dry tempeh and 4.4 to 6.8 log cfu/g, respectively, during 24 h incubation at 35 °C, while *L. reuteri* and *Lc. lactis* slightly increased from 4.8 to 5.6 log cfu/g and 5.0 to 5.4 log cfu/g, respectively. *Saccharomyces cerevisiae*, *S. boulardii*, *Pichia anomala* and *Kluyveromyces lactis* grew well during the barley tempeh fermentation and even during cold storage of tempeh. The growth of yeasts increased the ergosterol (provitamin D) contents. LAB and yeasts did not inhibit the growth of *R. oligosporus*.

### Discussion

The growth of LAB and yeasts indicate the possibility to increase the barley tempeh nutrition and safety through selecting specific strains of LAB and yeasts. Real-time PCR is a selective and fast quantification method for mixed fungal culture.

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Feng, X.M., A.R.B. Eriksson, and J. Schnürer. 2005. Int J Food Microbiol 104:249-256.  
Pimentel, D., and M. Pimentel. 2003. American journal of clinical nutrition 78:660S-663S.

Keywords: Barley Tempeh, *Rhizopus oligosporus*, lactic acid bacteria, yeast

## [P8.06]

### Effect of the inclusion of citrus surplus in the diet of lactating ewes on the cheesemaking properties of milk

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The aim of this study was to evaluate the use of entire citrus as part of the diet of lactating ewes on the coagulation properties of milk. For this purpose 28 Guirra ewes (a native breed from the Valencian Community) were distributed in four groups fed with diets containing 0, 10, 20 and 30% of entire citrus replacing the amount of hay and beet pulp offered to the control group. Physico-chemical and technological properties of milk were evaluated through the analysis of bulk milk samples (Control, M1, M2, M3) collected three times during the lactation period. To determine the influence of diet on the technological properties of milk, the following parameters were obtained during small cheese productions: rennet clotting time (RCT), rate of curd aggregation (RCA), gel firmness at 30 min (F<sub>30</sub>), and cheese yield (CHY). Physico-chemical characteristics of cheeses through the ripening period (60 days) were also studied. In addition, a cheese sensory analysis was performed to evaluate differences due to the diet. Overall, the inclusion of citrus in the diet did not change significantly the cheesemaking properties of milk (Table 1), nevertheless it was observed a slightly decreased in CHY of the milk samples from the groups fed with 20 and 30% of citrus. Cheese composition was different only for fat content of cheeses made with milk from ewes fed with 30% of citrus. Instrumental color evaluation showed that the yellow compound of cheeses, increased with the amount of citrus in the diet and with the advance of ripening. The sensory panel did not found differences between cheeses. Our results showed that the inclusion (up to 30%) of entire citrus in the diet did not affect the coagulation properties of the Guirra ewe milk, suggesting an additional use of citrus surplus of the Valencian Community.

**Table 1.** Coagulation properties of bulk milk samples and cheese yield

Milk	RCT (min)	F <sub>30</sub> (Δ%T)	RCA (Δ%T/min)	CHY (%)
Control	11,45±1,43	3,09 <sup>a,b</sup> ±0,38	0,45 <sup>a,b</sup> ±0,08	30,07 <sup>a,b</sup> ±3,50
M1 (10%)	12,24±0,58	2,81 <sup>b</sup> ±0,24	0,42 <sup>b</sup> ±0,05	31,32 <sup>a</sup> ±2,89
M2 (20%)	11,13±1,40	2,80 <sup>b</sup> ±0,31	0,41 <sup>b</sup> ±0,08	27,58 <sup>a,b</sup> ±1,97
M3 (30%)	11,37±1,44	3,64 <sup>a</sup> ±0,31	0,58 <sup>a</sup> ±0,11	25,88 <sup>b</sup> ±2,04

<sup>a,b</sup> Mean values with the same letter do not show significant differences (p<0,05)

Keywords: coagulation properties, citrus surplus, ewe milk

### [P9.01]

#### **Edible films with bioactive characteristics against *Listeria monocytogenes***

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Postprocessing contamination of microorganisms on the surface of food products such as cheese is a reality and *Listeria monocytogenes* is a pathogenic bacterium frequently isolated from dairy products. Whey protein isolate (7%, w/v) was utilized as a biopolymer and glycerol (3%, w/v) was used as a plasticizer to produce transparent and flexible edible packaging with bioactive antilisteric activity to wrap cheese produced from raw ewe milk.

Different organic acids (citric, acetic, malic, formic and lactic, at 1.5% and 3.0%, w/v) were used to set pH at  $3.00 \pm 0.40$  and these acids were investigated with respect to rheological (viscosity, viscoelasticity, tensile strength and elongation) and antimicrobial properties. The inhibitory effect of nisin added in combination with these organic acids were also investigated.

The films antimicrobial activity was determined by the zone of inhibition it produced on the medium TSYEGA pH6.2, inoculated with *L. monocytogenes* NCTC 11994, *L. innocua* NCTC 11288 and nine strains isolated from the rind of ewe cheese and characterized by AFLP typing, PFGE typing, serotyping and phagetyping.

These biodegradable films can replace conventional plastic packaging with improving food safety, are biodegradable and use a by-product of cheese manufacture – whey protein.

Keywords: Edible Packaging, Bioactive coating, Cheese, *Listeria monocytogenes*

### [P9.03]

#### **Implementation of anaerobic digestion plants in breweries – new technologies**

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During the last years legislative restrictions concerning waste treatment and environmental protection have been aggravated. Among others, companies of the food industry were forced to think their waste management over. Especially the beverage industry, e. g. breweries, represents an extreme water consumptive branch of industry. Besides its exceeding use of fresh-water it produces above-average amounts of wastewater and other liquid or solid organic residues like brewer's spent grains, malt dust, yeast, hot or cold break and paper/labels.

In general breweries residues are inhomogeneous. Therefore it is necessary to develop a special and efficient technology for the anaerobic digestion of these residues. In general there are two possibilities. The treatment of organic residues with enzymes enables to increase the specific biogas production and secondly the amelioration of the digestion steps by using the two-step fermentation system in combination with liquid-solid-separation.

Anaerobic digestion (AD) of organic brewery-residues combines two effects. On the one hand it represents an effective treatment of these residues to reduce wastewater fees and costs for disposal. On the other hand AD produces a renewable energy source, biogas, which is more than a simple by-product.

Biogas is a mixture of Methane ( $\text{CH}_4$ , 50-85 vol.-%), Carbon dioxide ( $\text{CO}_2$ , 15-50 vol.-%) and trace gases, e. g. water ( $\text{H}_2\text{O}$ ), Hydrogen Sulfide ( $\text{H}_2\text{S}$ ) or Hydrogen ( $\text{H}_2$ ). Dewatering and the removal of  $\text{H}_2\text{S}$  are necessary before biogas is utilisable. The calorific value (c. v.) of biogas depends on its  $\text{CH}_4$  content and

varies between  $4\text{-}7.5 \text{ kWh/m}_n^3$ . The average c. v. of  $6.0 \text{ kWh/m}_n^3$  is equivalent to 0.62 l fuel oil.

Biogas is used in combined heat and power plants (CHP) to generate electric power and thermal energy. It substitutes natural gas in gaseous fuel steam vessels to produce steam. Besides reducing the consumption of fossil fuels the use of biogas also reduces  $\text{CO}_2$ -emissions. In addition to the  $\text{CO}_2$ -trading guidelines the combustion of biogas has an emission-factor of zero tons  $\text{CO}_2$  per TJ – compared to fuel oil with 78 t and natural gas with 56 t  $\text{CO}_2$  per TJ.

The oral presentation summarises the difficulties and benefits of implementing an anaerobic digestion plant. Additional to "classic" AD of liquids the AD of solid wastes, e. g. brewer's spent grains, will be thoroughly described.

Keywords: anaerobic digestion, biogas, brewery, combined heat and power plant (CHP)

### [P9.04]

#### **Biomass as a heating source in breweries**

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The price level at the crude oil market tripled since october of 1998. Beside of actual world political crises the growing demand for energy, especially in china and third-world countries, is responsible for this price development.

As an antipode for this the price level for wood chips leveled off throughout the last 4 years. Thus the caloric price of wood chips is actually 40 % based on the price of light fuel oil.

The lecture shows the possibilities, but also the arising problems of an usage of biomass as an alternative to fossil fuels considering as examples.

Altogether with pellets from wood, wood chips are the major alternative to fossil fuels in use in industrial, automated combustion plants.

Indeed the energy density of wood chips is three to four times lower than this of light fuel oil. Therefore it has huge stock requirements.

For the usage of biomass you have to exchange not only the combustion plant but also the store. In addition you have to install a special transport equipment for the combustible.

Due to this assets and drawbacks results a higher investment for the usage of biomass instead of fossil fuels. But even without cogeneration this investment amortises at the actual price level for light fuel oil after about 7 years.

As there is an rising of the fuel costs expected wood chips present as a promising alternative to fossil fuels.

Keywords: biomass, energy, wood chips, fossil fuels

#### [P9.05]

##### **Applications of solar heat in food processes**

W Ruß\*, D Antoni, U Buchhauser, R Meyer-Pittroff; TU München, Germany

In order to decrease the steady rising energy costs of the food industry, a rethinking in consideration of the energy supply has to occur. A remarkable cost reduction, against the background of energy-intensive processes in the food industry, can be achieved through the application of solar energy. The lecture should point out possibilities for implementation for solar process heat in food processes considering as example the "brewing process".

A central point is the application of steam, which is generated via solar energy. Thereby amongst others the brewhouse as the main energy consumer in the brewery could be supplied with energy from a regenerative source, if a appropriate plant- and process optimization is guaranteed.

The brewing process features also possible applications for low temperature ranges. The cleaning-in-place system (CIP) that is applied in most breweries in the meantime operates in a temperature range from 80°C to 90°C. The bottle washer can also sufficiently be heated with hot water tempered at 95°C. Thus a covering of 30-50% based on the total heat demand can be reached through the design of the solar plant at low temperature range.

An energy saving of about 30 MJ/(hl\*a) is possible at a mean thermal energy consumption of a German brewery of 70 MJ/hl. Besides possible applications of solar energy, the lecture shows also the procedure for the creation of the optimal concept for the respective firm using the parameters energy survey, simulation of the demand and solar radiation.

Keywords: solar, energy, optimisation

#### [P9.07]

##### **Production of biodiesel from defective coffee beans and waste frying oil**

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Brazil is the largest coffee producer in the world. However, approximately 20% of its production consists of defective beans, which upon roasting decrease beverage quality. These beans are physically separated from the healthy ones prior to commercialization in international markets. However, since to coffee producers they represent an investment, these defective beans are put in the internal market in Brazil, where the roasting industry uses them in blends with healthy ones. Thus, the quality of the roasted coffee consumed in Brazil is depreciated. In view of this situation, studies are being conducted in order to find alternative uses for defective coffee beans. The alternative considered here is biodiesel production from the oil obtained by screw pressing defective coffee beans. Alcohol-to-oil molar ratios, time and temperature were the reaction parameters studied. Sodium methoxide was used as alkaline catalyst.

Direct transesterifications of triglycerides from refined soybean oil (reference) and from oil extracted from defective coffee beans were performed with both methanol and ethanol. The highest values of ester yields were 96% and 74% for soybean and coffee oils, respectively. Removal of the unsaponifiable matter prior to transesterification increased the ester yield from 74 to 87%. Waste frying oil was also studied as potential oil source for biodiesel production. The study was built upon available information on the literature with modifications in the transesterification and product separation processing steps. Ethanol was used as transesterification agent. The transesterification was carried out in two steps, with the first using solid niobic acid as esterifying catalyst for removal of free fatty acids and the second employing sodium methoxide as alkaline catalyst. A novel technique was introduced for the product separation step, where alcohol is easily recovered while glycerin is completely separated from the produced ethyl esters of fatty acids. Ester yields were in the 92-98% range.

Keywords: biofuel, defective coffee beans, frying oil, transesterification



### Ethanol production from dried mango peel and effect of nutrient supplementation

L Veeranjaneya Reddy\*, OV Sarathi Reddy; Sri Venkateswara University, India

#### Introduction:

Mango fruit processing industry produces two types of waste namely solid waste of peel and stones, liquid waste of juice and wash waters. In mango fruit processing the amount of waste generated can be very high (30-50%). Mango fruit waste will be available in large quantities during the season. The annual availability of these wastes amounts to 1005 million tons (Grohman et al 1995). Disposal of the mango fruit waste creates environmental problems. Drying the mango peel helps in storing the peel for longer duration. The dried mango peel contained good amount of reducing sugars (Madhukara et al 1993; Reddy and Reddy 2005). In this paper we have investigated the suitability of dried mango peel for ethanol production. Value added products from agro-industrial and food processing wastes are now focussing area because; in addition to waste to energy generation it reduces pollution.

#### Materials and Methods:

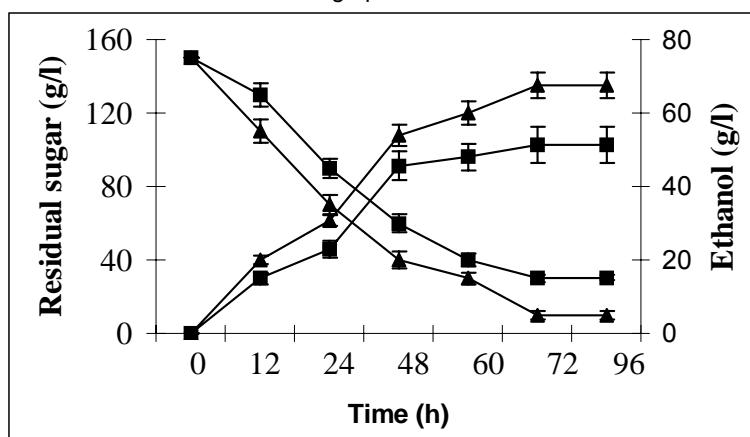
Yeast, *Saccharomyces cerevisiae* was isolated from mango peel.

Reducing sugars was estimated by DNS method. Fermentation was carried out in batch mode with dried mango peel extract with distilled water. Nutrients (yeast extract, peptone and ammonium phosphate) were supplemented in dried form to avoid dilution of fermentation broth. In case of wheat bran extract (WBE) supplementation, mango peel powder sugars extracted into instead of distilled water.

#### Results:

The dried mango peel extract was contained 25 to 30% w/w sugars. It was observed that the direct fermentation of mango peel extract produced low quantities of ethanol (up to 5% w/v). Left over sugar concentration was high in this condition. It was found that the supplementation of nutrients (yeast extract and peptone) was not only increased the quantity of ethanol to 7.5% w/v, but also the fermentation rate from 4 days to 2 days. Ethanol quantity and performance of yeast in the wheat bran extract medium was comparable to the expensive nutrient supplements (yeast extract and peptone) (Fig 1).

Fig: 1. Effect of Wheat Bran Extract on mango peel to ethanol



fermentation

▲ - Mango peel extract medium supplemented with WBE; ■ - control (un-supplemented medium).

#### Discussion:

The good amount of sugar present in dried mango peel extract, which were useful for ethanol fermentation. Direct fermentation of mango peel gave low quantity of ethanol may be of low nutrients which is necessary in the final moment of fermentation. Supplementation of nutrients produced high ethanol compared to the control. Wheat bran extract successfully replaced the expensive medium components like yeast extract and peptone. Our results clearly shown that the supplementation of nutrients increased the ethanol production from dried mango peel significantly. Finally it concluded that the integrated management of mango peel produced from mango pulp industries would provide cheap non-food material source for energy production and conversion into value added products like ethanol.

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Keywords: Mango peel, Fermentation, Ethanol production, Nutrient Supplementation

[P9.09]

**Effect of macro-nutrients and ultraviolet on polysaccharide composition of *Silene vulgaris* cell culture**

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Production of raw materials for isolation of pectic polysaccharides with desired properties and exact structure remains a topical problem. This problem may be successfully solved using new plant raw materials and developing biotechnology of polysaccharide production by plant cell cultures. Preliminary studies of the campion (*S. vulgaris*) callus and intact plant have shown an occurrence of biosynthesis of polysaccharides possessing immunomodulating activity. Polysaccharides of callus have been found to represent an acidic arabinogalactan and pectin named silenan. In this work the influence of external factors, such as macro-nutrients and UV light, on the polysaccharide composition of campion callus was studied.

The maximum yields, productivity per litre of medium of arabinogalactan and silenan were achieved using glucose, galactose or sucrose as carbon source. Increasing sucrose concentrations led to the biomass accumulation but failed to enhance efficiency of the substrate utilization. Increasing sucrose concentrations in the medium failed to influence essentially on the polysaccharide yields while the polysaccharide productivity per litre of medium enhanced due to promotion of culture productivity in the biomass. Multiplication of the sucrose concentrations up to 50-100 g/l led to a diminution of the galacturonic acid contents in silenan and to the changes in contents of the neutral monosaccharide residues in silenan and arabinogalactan. Optimization of cell growth and production of polysaccharides by cell cultures was achieved using macro-nutrients such as calcium, phosphorus, nitrogen and by variation of ratio of nitrate to ammonium. Alteration of an intensity of UV light (280-315 nm) from 1.4 to 7 Wm<sup>-2</sup> was shown to enhance cell growth. Cell lines produced polysaccharides with increased yields and productivity were obtained. The contents of galactose and arabinose in pectin were decreased after irradiation. This work is considered to be useful for further optimization of cell growth and regulation of biosynthesis and production of polysaccharides possessing physiological activity.

This work was supported by the grant No.1260.2003.4 of the Russian President support of the leading scientific schools, by the grant of the Presidium of the RAS «Molecular and cellular biology» and by the grant of the Urals Branch of the RAS.

Keywords: polysaccharides, cell cultures, macro-nutrients, physiological activity

[P9.12]

**Involvement of *Bacillus licheniformis* and *Micrococcus kristinae* during ripening of salt fermented Indian shad (*Tenuulosa ilisha*)**

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'Lona ilish' is a salt fermented fish product, prepared exclusively from Indian shad (*Tenuulosa ilisha*), a high fat fish. It is very popular in northeastern parts of India and Bangladesh due to its typical flavor and texture. The uniqueness of this product remains in the fact that despite the presence of salt and metals coming from the container used for fermentation, the rancidity of this highly unsaturated fatty acid containing fish is kept under control, and is not manifested as long as the fish chunks are kept immersed in the fermenting brine. No detailed scientific study has been made on 'lona ilish' so far. In order to understand the science behind this indigenous preservation method, the traditional technology was understood and reproduced in the laboratory in a controlled condition. The biochemical and microbiological changes during the fermentation period of 150 days were studied at fifteen days interval. From 45<sup>th</sup> day of fermentation onwards, the microbial flora in the product was composed of only two species. They were isolated and tentatively identified to be *Bacillus licheniformis* and *Micrococcus kristinae*. *Bacillus licheniformis* showed some atypical biochemical reactions, on the basis of which, it was tentatively suggested as *Bacillus licheniformis* var. III. Both the bacterial species either singly or collectively were involved in the fermentation process.

Keywords: Indian shad, salting, traditional technology, fermentation

**Presenter Index**



## Presenter Index

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