

Conference Report

Bio-based technologies in the context of European Food Innovation Systems: Outcomes from the EFFoST Annual Meeting 2013, Bologna, Italy

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The 2013 European Federation of Food Science and Technology (EFFoST) conference took place in Bologna, Italy on 13–15 November. Three parallel oral streams and nine different sessions were organised by the conference Scientific Committee in cooperation with the EFFoST committee. Emphasis was on research topics which reflected the themes of the EU Horizon 2020 programme where food quality evaluation and innovative technological themes are strongly related to healthy foods and consumer wellbeing. The conference had 21 keynote lectures, 62 other oral presentations, 210 posters and over 280 attendees. The oral sessions corresponded to the three conference themes (i) omic approaches for consumer wellbeing and technology innovations; (ii) healthy ageing, lifestyle, food–consumer interactions and trust; (iii) education in food science and public–private partnerships.

The Conference Chair (Professor Marco Dalla Rosa) stressed the changing food science/technology scene where

consumer wellbeing, sociology and related topics are increasingly coming to the fore together with emphasis on crossing different fields and on the importance of a better understanding of the role of food science and technology by the general public. This was followed by four plenary lectures. The first outlined the structure of the European Food and Drink (EF&D) industries. The EF&D industry has an annual turnover of €1017 trillion and employs about 4.3 million people in 287,000 companies. Participation by food and drink small to medium sized enterprises (SMEs) in public/private partnerships must be made more attractive. The European Technology Platform Food-for-Life is addressing these issues with focus on best practice, mobilisation, thinking locally, acting globally and helping SMEs adopt new skills. The second lecture was on the EU Horizon 2020 Framework Programme. It is an innovation friendly single programme which couples research to innovation, addresses societal challenges and has simplified access for would be participants. The overall budget of €79 billion (2014–2020) is framed around the priorities, (i) excellence in science, (ii) industrial leadership and (iii) societal challenges. The first call for project proposals was launched on 11 December 2013. The third lecture outlined the Almafood Integrated Research Team (Almafood IRT) which coordinates the expertise of the University of Bologna in the bio-economy field. IRT is an innovative tool, a unique point of access, has critical mass and is interdisciplinary and complementing. The fourth presentation focused on unlocking the full potential of biomass, especially agricultural waste, thereby creating new value chains for the food and feed ingredients sector, e.g. decomposition of cellulose to produce fuels, materials and chemicals; conversion of hemicellulose into higher value food and feed ingredients; conversion of lignin into higher value carbon fibres. Ongoing research is targeting nature's own biomass hot spots, e.g. in the rumen of animals. The message is 'go for added value discoveries'.

Omic approaches for consumers' wellbeing and technology innovations (sessions 1, 2 and 3)

Session 1

The first part of the session 1 was on microflora/food design relationships. The keynote lecture addressed the current status in understanding the food fibre–microbiota–health triangle. The small intestine and colon contain over 10^{14} bacteria. The microbiota fingerprint

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is highly personal, is shaped in early life and can change as a result of stress, antibiotics, intolerance to certain food compounds, side effects of drugs, pathogenic infections and eating patterns. Oligo and polysaccharides appear to have a high impact on the composition of the human microbiota as have fibres such as β -glucan (FIBEBIOTICS project). Three further lectures followed: (i) physical and chemical approaches for modulating the responsiveness of structured emulsions to digestion; (ii) production of double emulsions and microcapsules with entrapped polyphenols; (iii) novel *in vitro* human gut digestion model to study host–microbe interactions including immune effects of dietary fibres. The second part of session 1 dealt with molecular determinants/food formulation. The keynote lecture was on developing the next generation of molecular nutrition with mapping brain, metabolic and gut health major priorities. New analytical assays will shed light on metabolic and genetic individuality in relation to diet and nutrients thus leading towards the next generation of targeted nutrition. Three oral lectures followed: (i) survival of smear-ripened cheese microflora following ingestion (some strains survived); (ii) food-structure–property relationships in the design of foods for health, wellness and pleasure; (iii) carrageenan is a good stabiliser but can induce inflammation in laboratory animals. An EU Commission funded study has said ‘safe’ but only for carrageenans of a certain molecular weight.

Session 2

The first part of the session 2 was on safety of food associated microorganisms. The keynote presentation dealt with risk assessment of biological hazards as the basis for EU regulations on food safety. Over 320,000 human cases of food-borne diseases are reported annually in the EU. The EU has adopted an integrated risk analysis approach to food safety from farm to fork to protect consumers. It consists of both data collection/analysis and legislative measures and the European Food Safety Authority (EFSA) is the responsible body. Three further presentations followed: (i) antimicrobial properties of selected essential encapsulated oil components; (ii) mechanisms of *Bacillus* spore germination and inactivation during high pressure processing; (iii) lowering glycaemia in animals and humans by HepG2 cells.

The second part of the session 2 was on probiotics from a genomic and functionality standpoint. The keynote lecture used probiotics as a case history to illustrate what happens when research crosses regulations. Data on the properties of single strains and on characterization of the whole bacterial population of the human gut and their genes (microbiota and microbiome) provides the basis for developments in both basic science and applications. Guidelines for evaluation of safety and efficacy of probiotics have been provided by FAO/WHO as well as scientific societies. These guidelines are now the reference scheme for approval of these new foods in a large number of countries. New

food product health claims communicated to consumers are different and sometimes opposite, depending on regulatory environments prevailing in different countries, e.g. USA versus Europe. Three oral presentations followed: (i) role of *Lactobacillus paracasei* LMGP22043 carried by artichokes in influencing faecal bacteria and biochemical parameters in human subjects; (ii) bio-efficient inactivation of endospores on whole black pepper by indirect and direct plasma treatment; (iii) inactivation of Shiga toxin-producing *Escherichia coli* 0104:H4 and 0157:H7 outbreak strains by isostatic high pressure.

Session 3

The first part of session 3 dealt with enzymes and biocatalysis. The keynote paper stressed that use of enzymes as biocatalysts in processing of food has been aimed at efficient raw material utilization and consistent product quality. Improved sustainability has been an added advantage. This scene is changing as sustainability and health trends become the primary drivers for enzyme development, e.g. for reducing/preventing acrylamide formation in coffee and breakfast cereals. Three oral presentations followed: (i) use of L-arabinose isomerase from *Geobacillus stearothermophilus* for the production of the sweetener D-tagatose; (ii) exploitation of citrus and wheat processing by-products for the production of food ingredients and food products (NAMASTE EU); (iii) ion exclusion chromatography as a valuable bio-refinery technology for complex fluids – fruit juices as a case study. The second part of the session 3 dealt with bio-refinery biomasses and biopolymers. The keynote lecture addressed the eco-design of safe and sustainable bio-based packaging for food. Packaging can contribute to reducing huge worldwide food losses and waste (>33% of food production) by improving food preservation via tailor made modified atmosphere packaging technology. The European EcoBioCAP research project will develop the next generation of food packaging using advanced structures based on bio-polyesters and fibres derived from food industry oil, dairy and cereal by-products. The keynote was followed by two further presentations: (i) use of fruit and vegetable residue flour in developing biodegradable films; (ii) water resistance and oxygen barrier properties of microfibrillated cellulose used in packaging applications.

Healthy ageing, food–consumer interaction and trust (sessions 4, 5, 6, 7, 8 and 9)

Session 4

This dealt with gut microbiota and ageing. The first keynote lecture described the ELDERMET study which focuses on diet-health microbiota in older persons. Analysis of the faecal microbiota composition of 161 older persons showed a core microbiota and aggregate composition that was distinct from younger persons. In a follow-up study the microbiota composition of 178 elderly subjects revealed distinct microbiota composition groups and clustering of

subjects was distinguishable by analysis of faecal metabolites and metagenomic data. Thus it may be possible to modulate or improve the health status of older people by programming the microbiota through dietary interventions. The second keynote stressed that microbiota is affected by modifications in lifestyle, nutritional behaviour, and functionality of the host immune system. Also, age-related physiological changes, including the development of chronic, low grade, inflammatory states named “inflammaging”, could modulate the structure of the intestinal microbial community thus compromising health status. The EU NU-AGE project is aimed at counteracting inflammaging through a one year Mediterranean whole diet approach which meets the nutritional needs of the elderly. Six oral presentations followed: (i) cohort study of the prevalence of total and central obesity among Sharpeville elderly living in a village in South Africa; (ii) case study on obesity and its association with iron deficiency in elderly subjects in Sharpeville; (iii) age tailoring the digestive fate of food hydrocolloids using infant, adult and elderly *in vitro* digestion models; (iv) the role of red wine in longevity of centenarians; (v) anti-inflammatory, anti-oxidant and protective effects of a *Pulicaria incisa* infusion on brain cells; (vi) anti-oxidant and hypolipidaemic activity of pectin and dietary fibre from *Cucurbita maxima* (pumpkin).

Session 5

This focused on metabolomics and food characterisation. The keynote lecture described the nutrikinetics of black tea in the human superorganism and the implications for cardiovascular health. Many black tea polyphenols are poorly absorbed in the small intestine but persist in the colon. Nutrikinetic modelling has been proven critical for defining nutritional phenotypes related to gut microbial bioconversion capacity and establishing relations between gut microbial functionality and circulating metabolites. The keynote was followed by 11 lectures: (i) expression analysis of pH- and salt-stressed *Listeria monocytogenes* in simulated gastric and pancreatic conditions; (ii) DNA-based biotechnical solutions in the authentication of canned foods; (iii) ATR-FTIR spectroscopy for studying nutrient supplementation during alcoholic fermentation; (iv) application of chemical gas sensors to food analysis; (v) Atlantic network (LABELFISH) on genetic control of fish and seafood labelling and traceability; (vi) chemical fingerprints for carrots processed by thermal and high-pressure–high-temperature procedures; (vii) biotechnological and health potential of wild non-starter lactic acid bacteria isolated from Italian traditional Malga cheese; (viii) assessment of food and biodegradable packaging interactions by 1H NMR profiling; (ix) changes in water holding capacity and drip loss of Atlantic salmon muscle during superchilled storage; (x) assessment of the effects of simulated gastric conditions on spores of *Bacillus subtilis*; (xi) impact of vine bio-control on the ochratoxin A contamination of grapes.

Session 6

This addressed structural proteomics. The keynote lecture was on the proteome/peptidome of bananas, avocados and mangos. In general only a few allergens have been identified in these fruits. In avocado, the total number of unique gene products identified amounted to 1012 proteins. The known allergen Pers-a-1 was also detected. In bananas the allergens Mus-a-1, pectinesterase, superoxide dismutase, and several enzymes involved in degradation of starch granules were identified. In mango, both pulp and peel proteomes were captured. The keynote was followed by eight oral presentations: (i) insights from infant *in vitro* digestion of bovine lactoferrin and some of its Maillard reaction products; (ii) immunoreactivity of food proteins; (iii) isolation of novel rapeseed protein-derived antihypertensive peptides is protease specific; (iv) tracing allergenic species in commercial candies; (v) bio-based active packaging film with synergistic effects from starch, chitosan and lauric acid; (vi) functional characterisation of the bitter/sweet Janus head of *Stevia rebaudiana* Bertoni using bio-based approaches; (vii) berberine improves insulin sensitivity and adjusting adiponectin in high-fat diet-fed rats; (viii) early detection of mould contamination in green coffee.

Session 7

This addressed diet and physical activity. The keynote lecture discussed the role of diet modulation and physical exercise in the prevention and counteraction of sarcopenia. Guidelines from scientific societies mainly address the quantitative aspects of protein and energy needs. Further nutritional strategies to promote muscle protein synthesis and prevent sarcopenia include pulse feeding, the use of fast proteins and the addition of leucine or citrulline to dietary protein. Further issues include the identification of the genetic determinants of protein wasting in elderly. Four further oral lectures followed: (i) role of spatial prediction models to study the prevalence of hypertensive heart disease mortality in Europe; (ii) a versatile tool for monitoring oxidative stress; (iii) food safety knowledge of the informal food sector in Owerri city and its suburbs in Nigeria; (iv) effect of tomato juice on microbiota composition of Sprague–Dawley rats on a hyper-caloric hypercholesterolaemic diet.

Session 8

This session was on genomics and metagenomics in the evaluation of food safety. The keynote lecture addressed the genomics of food pathogens and the implications for food safety. When a contaminated meal is consumed some individuals may have no symptoms, others may become sick and others may even die. The variables contributing to this heterogeneity include health and age of the host, the identity and amount of the contaminating microbes consumed. These underpin much of the food safety legislation in this area. Risk assessment guidelines include aspects such as dietary components and genetic variability. Eight

oral presentations followed: (i) matching probiotic traits to genetic content; (ii) determining antimicrobial activity of encapsulated essential oils using silica supports and cyclodextrins; (iii) biofilm formation by *Staphylococcus aureus*; (iv) electrolysed water and UV-C illumination as eco-effective disinfection systems for minimally processed pears; (v) PCR-based analysis of genetically modified organisms for food authenticity and safety assessment; (vi) application of the electronic nose to assess the development of Lactobacilli in food matrices; (vii) extending the shelf life of chilled strawberry cubes using osmotic and high pressure technologies; (viii) simultaneous identification of *S. aureus* enterotoxins A & B using on-line SPE-UPLC-MSMS.

Session 9

The focus was on process ecology/sustainability. The keynote presentation dealt with assessment of the life cycle of greenhouse gas (GHG) emissions in the food industry in industrialised countries. Based on GHG inventories and technical literature, agricultural production appears to be the hotspot in the life cycle of food products. Carbon footprint (CF) studies were summarised to assess the relative contribution of all the stages of the life cycles for selected food products. CF data were also used to show how the so-called Mediterranean diet might promote sustainable lifestyles in developed countries with a more favourable impact on the environment and on health. Eight oral presentations followed: (i) sustainable protein supply by algae bio-refinery concepts; (ii) bioconversion of cheese whey; (iii) comparison of novel and thermal processing on different juices using headspace GC–MS fingerprinting; (iv) *Geobacillus stearothermoophilus* spore inactivation mechanisms as key for new multi hurdle preservation combinations; (v) microwave cooking of fish; (vi) reducing food waste in Europe; (vii) environmental impact of edible oil supply chain; (viii) composting conditions for food packaging.

Education in food science and public–private partnerships

This embraced three keynote lectures and a round table discussion. The first keynote outlined the ISEKI_Food 4 network (www.iseki-food4.eu) and the Iseki Food Association (www.iseki-food.net) and their role in enhancing food professional impact on society determinants. Education and training provide the necessary skills and knowledge; improving “soft” skills is an imperative. The ongoing

ISEKI_Food 4 project contributes to the modernization of food studies via: (i) tools promoting personal skills in the future generation of food technologists; (ii) implementing educational abilities of the university teaching staff; (iii) implementing entrepreneurship and professional qualifications of doctoral students. The second keynote outlined the TRACK_FAST Framework 7 project (www.trackfast.eu) on identifying training and career requirements of future European food scientists and technologists. TRACK_FAST was built on the assumption that restoration and maintenance of EU’s food industry leadership in the global economy can only happen through promoting a higher degree of innovation and competitiveness in the food sector. This can be achieved by a profound change in Europe’s food workforce. The third keynote cited the opportunities for public institutions and private companies to merge mindsets and work together for stronger joint research under the headings targets, budgets, confidentiality, measurement of results, and timing.

The round table session involved discussions around public–private partnerships. The main outcomes were: (i) big companies proactively contribute to the formation of the food research agenda, SMEs can only have a limited input; (ii) a change in mindset is required of both researchers and food company personnel in order for innovation to flourish; (iii) in universities ‘the powers that be’ will always prioritise research papers over patents; (iv) being strategic is difficult when dealing with small companies; (v) public funding of food research must move down the food chain towards the consumer; (vi) the expert base of industry is largely missing from European Food Safety Authority (EFSA) discussions re health claims.

Poster presentations

These covered a wide range of topics and complemented the oral presentations. They are broadly divided in 12 sub-groups within the framework of the first two conference themes and numbers were: processing and bio-refining (45); anti-oxidants and bioactives (26); physicochemical tests and properties (25); consumer health and wellbeing (19); food safety (18); enzymes and enzyme systems (16); antimicrobials (14); sensory quality (10); functional foods (9); probiotics (6); genes and genetic pathways (5); general (17). The conference gave ample opportunity for networking and there was active discussion of the oral presentations and at the poster assembly sessions. Keep in touch with EFFoST; see details of the 2014 Conference (Sweden) at www.fffostconference.com.