Targeted Technologies for Sustainable Food Systems: Outcomes from the EFFoST Annual Meeting 2016, Vienna, Austria

The 30th European Federation of Food Science and Technology (EFFoST) conference took place in Vienna, Austria on 28–30 November 2016 under the theme: *Targeted Technologies for Sustainable Food Systems* (http://www.effostconference.com/). It was organised by Professor Henry Jäger (Conference Chair) from the University of Natural Resources and Life Sciences (BOKU), Vienna, Austria together with a local organising committee and the international scientific committee in association with Professors Dietrich Knorr (outgoing EFFoST President) and Lilia Ahrné (incoming EFFoST President). The conference had a multidisciplinary focus addressing issues in new raw materials, ingredient functionality, targeted food engineering, decontamination via non-thermal treatments, cereal science/technology, sensor technology/modelling/simulation, microencapsulation, food safety, SMEs/regulation, consumer science, and food/health. There were 149 oral presentations embracing 17 plenary lectures, five additional keynote lectures and 127 other lectures in 16 theme areas (see Section 3). Poster presentations numbered 165 and there were over 370 attendees. In addition: (i) there were special sessions with supporting organisations; (ii) a Bilateral Networking Forum took place, and (iii) a range of exhibitors displayed new equipment/food products and also scientific journals. These were aimed at strengthening fruitful networking and collaboration beyond borders of disciplines and organisational structures and enhancing academia and industry synergism. The Conference Chair welcomed the delegates on behalf of the Organising Committee and his comments were reiterated by Dietrich Knorr and Lilia Ahrné.

1. Plenary lectures

The 17 plenary lectures were spread over the three days of the conference in six sessions.

1.1. Plenary sessions 1 and 2 (day 1)

Five plenary lectures (PL) 1–5 were presented on day 1:

PL1 (H. Watzke, Switzerland) discussed 'the raw and the cooked' i.e. food as a signal. Cooking has shaped human evolution as high performing human organs (e.g. brain) need high quality diets. The ability to transform raw food into tasty meals inspired the primal pattern of raw and cooked and has served for separating processed from natural ever since. Palatability played the central role and food science and technology grew from these humble beginnings inheriting its fixation on palatability. Linking food and metabolic health one nutrient at a time has fallen short in the wider health context whereas it was a winning strategy when dealing with vitamins and minerals. Foods, not ingredients, are the units of health and inspecting specific evolutionary inventions in our mammalian past will help build this new perspective. Lactation and mastication distinguish mammals from other species i.e. the human gut matures via breast milk. Breast milk goes beyond nourishment and controls its own digestion, regulates metabolism, and trains the immune system. It is the epitome of 'raw food' and provides proper microbial inoculation and ecology in the gut. An attempt must be made to develop an insight about processed foods as composite signals for the gut. This approach may enable a closer understanding of food as a unit of health.

PL2 (A. van der Goot, Netherlands) outlined directions towards more sustainable food production. The current way of producing food products is not sustainable due to inefficiencies in food production, increased use of products of animal origin, inefficient use of food products once produced, and the current set-up of food processes and processing chains. A shift towards ingredient functionality instead of purity can contribute to a more sustainable production of food products, e.g. using dedicated functional fractions in the case of meat analogues i.e. from a taste point of view some animal fat should be included to a meat analogue instead of purified oil which was solvent extracted from an oilseed crop. Such an approach will influence the set-up and design of current food production chains. This approach is a promising route to make production of food ingredients more sustainable.

PL3 (S. Salminen, Finland) dealt with the current status and future possibilities for probiotics and gut microbiota. Knowledge of microbiota composition and activity has increased thus redefining host-microbe relationships. Intestinal colonization is initiated during the foetal period and continues during delivery and through infancy. When the adult microbiota is reached, a relative balance and resilience to change may be present until the gut microbiota is modified in parallel with the ageing process. Deviations in microbiota composition have been associated with allergic diseases, diet-related diseases and even obesity. Administration of probiotics, prebiotics or other microbiota modulators during the first months of life and beyond may benefit the composition and development of microbiota thereafter i.e. programming the infant gut microbiota and immune development towards later health. New tools for microbiota modulation include both microbes (probiotics) and their combinations, which up to now have not been extensively used in the food supply or in therapeutics. Such development may promote health and well-being and also influence the

system faces a 'perfect storm' with the double burden of malnutrition/hunger and obesity. There is also underinvestment in R&I in Europe being only 50% of that in the USA and 66% of that in Japan. Weathering the storm raises issues of land/water availability, food production systems, GHG production/global warming, and the cost and logistics of food distribution. Food 2030, therefore, is a political opportunity and is about R&I for tomorrow's nutrition and food systems, and will embrace pillars on nutrition, climate, circularity and innovation. It will build on the outcomes of World Food Day 2016 and on COP21 commitments and the drivers will be open innovation, open science, research breakthroughs and open to the world. The core of FOOD 2030 is: (i) a food systems approach; (ii) new partnerships between Member States and business; (iii) close the investment gap, (iv) game-changing technologies; and (v) new global platforms. For more information tweet #FOOD2030EU and/or visit the EC Bioeconomy Directorate website.

2. Keynote lectures

Five additional keynote lectures (KL) were given in the parallel sessions.

KL1 (A. Sessitsch, Austria) dealt with ecology and functionality of bacterial endophytes and how plants can benefit. Plant-associated microbiota such as rhizosphere microorganisms and endophytes are diverse and many of them have beneficial effects on plants and may provide nutrients, antagonize pathogens and reduce plant stress symptoms. Cultivation-independent metagenome and community analysis was conducted to obtain insight on the functioning and ecology of endophyte communities. Results showed that the plant genotype, tissue, the vegetation stage, as well as stress factors influence the structure and possibly the functioning of plant microbiomes. Metagenome analysis and comparative genomics revealed plant growth promoting characteristics, cellulolytic enzymes, quorum sensing, and degradation of aromatic compounds. Some strains tested in detail efficiently colonized many plants (e.g. maize), strongly promoted plant growth, reduced drought stress, and induced systemic resistance responses. The studies showed that interaction between plants and endophytes is highly complex involving a range of different bacterial characteristics.

KL2 (P. Fryer, UK) discussed fouling and cleaning in the food industry with emphasis on pipes, tanks, pumps and products. The formation of fouling deposit on process surfaces is a major problem in the food industry and is controlled in practice by complex and expensive cleaning-in-place protocols; however, few, if any of the protocols/processes are optimised. In addition, some cleaning formulations cannot be.produced efficiently. New developments in food manufacture, such as distributed and additive manufacture, may be limited by the need to clean. The cleaning problem, spans many orders of length scales, with nm-scale of individual chemical events affecting the behaviour of the process plant at m-scale. Classifications of both fouling and cleaning problems have been produced to aid design solutions. Recent work on developing understanding of cleaning pipes and tanks, using jets and fluid flows is showing potential as are models that define how cleaning happens/occurs. The immediate need is to build understanding that can be used to predict cleaning performance; in the longer term it may be possible to design inherently hygienic surfaces for the food industry.

KL3 (K. Fikiin. Bulgaria) outlined cryogenic energy storage for renewable food refrigeration and power supply. Cryogenic energy storage (CES) enables on-site accumulation of renewable energy during periods of high generation and its use at times of peak grid demand. Thus, the cryogen serves for grid energy storage and is boiled, when needed, to drive a power generator and restore electricity to the grid. CES applications have been limited due to poor efficiency caused by unrecovered energy losses. The CryoHub project was designed to maximise CES efficiency by recovering energy from cooling and heating through a RES driven cycle of cryogen liquefaction, storage, distribution, boiling and power regeneration. CryoHub is an intelligent technology capable of converting a conventional refrigerated warehouse from a simple power consumer to an interactive energy hub, thus providing substantial economic and environmental benefits for both the food refrigeration and energy sectors. CryoHub brings together the advantages of mechanical and cryogenic refrigeration principles and overcomes most of the existing bottlenecks in one step, thereby broadening the market prospects for sustainable energy technologies across Europe.

KL4 (J. Abecassis) outlined challenges for future food security and sustainability in the cereals and grains area. Within the EU, wheat production and quality will remain a key future question as combining a sustainable agricultural system with a sustainable food production system is not so obvious after such a long period of adaptation of agronomical practices to food industry requirements. Today, the actual wheat agri-food system exhibits many contradictions that need to be solved through an integrated approach. Three main questions emerge: (i) how to maintain high quality in cereal grains while reducing nitrogen inputs; (ii) how to lower levels of pesticides and other contaminants in end-products; (iii) how to improve the nutritional value of cereal products. Improved plant breeding will partially address these issues by producing varieties that use less nitrogen, are more inherently resistant to pests, and produce grain with higher levels of minerals, vitamins and other bioactives while minimising anti-nutrients and removing protein fractions such as gluten which cause problems for many consumers. There is also a policy need for less intensive cereal production as intensive production requires heavy inputs. Organic production is the other extreme but is not a realistic sustainable system for the future. A half-way-house between intensive and organic production coupled with plant breeding may offer the best long-term sustainable solution. However, such solutions require close cooperation between researchers, farm advisory personnel and industry.

KL5 (M. Brncic, Croatia) focused on the effects of sonication on structural properties and functionality of food components. Ultrasound is one of the promising innovative non-thermal treatments in food technology and has a low impact on the environment. Low frequency high power ultrasound processing has shown potential in tailoring structure and functional properties of new food ingredients and food products. Modelling and analytical tools for predicting process parameters and responses are based on previous knowledge including applied thermodynamics, transport phenomena and unit operations of food systems. Functional properties of starch, proteins and other food constituents can be significantly influenced by the physical and chemical effects generated by acoustic cavitation, shear, micro-jet and acoustic streaming. Sonication influences the structure and molecular weight of starch, and also other properties including solubility, viscosity, digestibility, swelling and pasting properties. The application of different sonotrodes with various diameters, amplitudes, duration and cycles has potential for the preparation of stable nanoemulsions.

3. Theme lectures

The remaining 127 lectures were classified under 16 themes and presented in four parallel sessions over three days. The themes (T) are listed below and the title or keywords for each lecture are listed.
T1: Emerging agricultural concepts and new raw materials (6 lectures): insect biorefinery; mealworm larvae as sustainable food;