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IS1304

EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

Food Safety and Food Security Workshop

DUBROVNIK, CROATIA

11-13 APRIL 2016

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UNDER AUSPICIES

Faculty of Food Technology and Biotechnology
University of Zagreb
Pierottijeva 6,
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CROATIA

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Workshop Organising Committees

Organizing Committee

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Andy Hart (UK Food and Environmental Research Agency)

Mirjana Hruškar (University of Zagreb)

Simon French (University of Warwick)

Tim Bedford (University of Strathclyde)

Workshop Schedule

The workshop will start on the morning of Monday April 11th and finish in the early afternoon of April 13th, 2016. It is expected that most delegates will arrive in Dubrovnik on Sunday 10th April.

Programme Outline

Monday 11th April 2016

09.00 – 10.00:	Registration & coffee	
10.00 – 10.15:	Welcome	
10.15 – 13.00:	Morning session	**Session 1**
13.00 – 14.00:	Lunch	
14.00 – 16.00:	Afternoon session	**Session 2a**
16.00 - 16.20:	Coffee	
16.20 – 17.40:	Afternoon session	**Session 2b**
17.40 – 19.00:	ESR Methodology Discussion session	
19.00 onwards:	Dinner and free evening	

Tuesday 12th April 2016

09.00 – 11.15:	Registration & morning session	**Session 3a**
11.15 – 11.30:	Coffee	
11.30 – 13.00:	Morning session	**Session 3b**
13.00 – 14.00:	Lunch	
14.00 – 17.00:	Afternoon session	**Session 4**
17.00 – 18.00:	COST Action IS1304 Full Management Team Meeting and/or city tour	
19.00 onwards:	Workshop Dinner	

Wednesday 13th April 2016

09.00 –10.30:	Morning session	**Session 5**
10.30 –11.00:	Workshop Summary	
11.00 –13.00:	Coffee & working group sessions	
13.00 –14.00:	Lunch	
14.00 –15.00:	Reports from Working Groups and Closing session	

Session Outline

Session 1

165 minutes: 3x (50+5)

A) **Simon French**

Introduction to Structured Expert Judgement: history, notable uses and methodologies

B) **Olaf Mosbach**

EFSA's experience to introduce and use Expert Knowledge Elicitation in administrative risk assessments

C) **John Ingram**

A Food Systems approach to Food Safety

Session 2

200 minutes: 5x40

A) **Andrea Gross-Boskovic**

Food Safety Framework in Croatia with an accent on Risk Assessment – case study

B) **Tine Hald**

World Health Organisation estimates of the relative contributions of food to the burden of disease due to selected foodborne hazards: a structured expert elicitation

C) **Cristina Silva**

Overview of Global Food Safety Issues – The role of Food Science and Technologists

D) **Charis Galanakis**

Challenges and opportunities of the agri-food sector: the second life of wastes

E) **Emel Aktas**

Factors Driving Waste in the Food Supply Chain

Session 3

225 mins: 5x45

A) **Andy Hart**

Use of expert judgement when addressing uncertainty in risk assessment

B) **Rachel Loopstra**

Food Insecurity from the household perspective in OECD countries

C) **Nicole Darmon**

Nutritional quality and carbon impact of diets in France: what have we learnt from nutritional epidemiology and diet modeling?

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D) **Kitty Verhoeckx**

Allergenicity assessment strategy for novel proteins

E) **Martine Barons**

Integrating decision support for food security

Session 4

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180 mins: 4x45

A) **Dietrich Knorr**

Food safety and food security aspects of emerging technologies

B) **Ann Nicholson**

Delphi expert elicitation of Bayesian networks

C) **Anca Hanea**, Melbourne University CEBRA, developer (with Mark Burgman)

Classical meets modern in the IDEA protocol for structured expert judgement

D) **Martine Barons & Anca Hanea**

An IDEA for pollinator abundance decision support

Session 5

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90 mins: 2x45

A) **Danny Williamson**

Do we trust elicited prior judgement and, if not, what value can we extract from a Bayesian analysis?

B) **Kenisha Garnett**

Using scenario planning methods to explore plausible, alternative future states of the UK Food system

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Abstracts

1. **Simon French**
   Warwick University

Introduction to Structured Expert Judgement: history, notable uses, and methodologies

Although expert judgement had been implicit in many statistical and risk analytic methodologies for many decades, it first began to be discussed explicitly during the 1960s. The next twenty years saw many conceptual, philosophical, psychological and mathematical studies on how expert judgements might be elicited, combined and used; and there were a few applications. However, it was not until Cooke developed the Classical method in the mid-1980s that practical applications really began in earnest. Today expert judgement is used as input to many analyses, and it is becoming recognised that such input has to be gathered and managed in a structured, fully auditable manner. The European Food Safety Authority has reviewed current methodologies and provided comprehensive guidance on its use in food risk and safety studies. This paper will review the state of the art and identify current research fronts.

2. **Olaf Mosbach-Schulz**
   European Food Safety Agency

EFSA's experience to introduce and use Expert Knowledge Elicitation in administrative risk assessments

3. **John Ingram**
   Oxford Martin School, University of Oxford

A Food Systems approach to Food Safety

4. **Andrea Gross-Boskovic**
   Croatian Food Agency (HAH), Osijek, Croatia

Food Safety Framework in Croatia with an accent on Risk Assessment – case study

The free movement of food that does not have harmful effects on human health, is the basic feature of trade and greatly contributes to the health and welfare of the citizens and their social and economic interests. Therefore, it is necessary to equalize the food safety requirements in Member States in order not to distinguish between them and to harmonize concepts, principles and procedures that are implemented in the system of food safety. To achieve that, Member States adopted measures based on the **concept of risk analysis**, with the basic objective to avoid and reduce the food risk. They include three components - **risk assessment, risk management and risk communication**. This concept is ensuring a systematic methodology for the determination of effective, timely and targeted measures in order to preserve health of all citizens. The term "food safety" means comprehensive and dynamic policy that is conducting in order to assure **health protection and consumers interests** on the basis of strategic documents, and to provide **free movement of food in the market**. The Republic of Croatia has included food safety as a priority issue in their political programs. Through a number of regulations and the application of the European legislative, Croatia has ensured the implementation of all those programs that guarantee food safety on the market. In that sense, a responsibility is laid down to the food business operators in the entire chain "**from farm to fork**", at different levels, as an effective way of reducing the risks arising from food. The competent authority for food safety issue, the Ministry of Agriculture, in co-operation with the Ministry of Health carries out the official controls of food and

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feed safety and ensures the implementation of all relevant regulations in this field. From the view of food safety, it is also necessary to ensure that consumers and all other stakeholders in the system of food safety, maintain the **confidence in the risk management process**, which base is on existing, well-structured legal framework and relay on the scientifically based risk assessment to achieve the ultimate goal - protection of health and consumer interests. Within the food safety system in Croatia, the Croatian Food Agency (HAH) is legal entity that performs scientific and technical tasks in the field of food and feed safety and it is national referent point for risk assessment in same area. The process of risk assessment itself is based on scientific evaluation of known and potential adverse effects on human health arising from exposure to hazards originating from food. At the same time, it is a complex multidisciplinary process consisting of four steps including **hazard identification, hazard characterization, exposure assessment and risk characterization**. Risk characterization, as the last step of a risk assessment, can include both quantitative and qualitative information, and includes a discussion of mathematical uncertainties related to that information. Due to the different characteristics of harmful factors, risk assessment is carried out through specific assessment, depending whether hazard is microbiological, chemical or physical. Thus, the various assessments carried out in the field of viruses, bacteria or parasites. Similar is for chemical assessment in the case of pesticides, mycotoxins, food additives, and other chemical hazards. Special assessments are conducted for genetically modified food and novel food. **Risk Assessment methodology** is constantly improving, becoming highly specialized, and many methodologies varies from case to case.
Key words: food safety, risk assessment, Croatian Food Agency

5. Tine Hald
DTU
T. Hald, W. Aspinall, B. Devleesschauwer, R. M. Cooke, T. Corrigan, A. H. Havelaar, H. Gibb, P. R. Torgerson, M. D. Kirk, F. J. Angulo, R. Lake, N. Speybroeck, S. Hoffmann.

World Health Organization estimates of the relative contributions of food to the burden of disease due to selected foodborne hazards: a structured expert elicitation

Background

The Foodborne Disease Burden Epidemiology Reference Group (FERG) was established in 2007 by the World Health Organization (WHO) to estimate the global burden of foodborne diseases (FBDs). This estimation is complicated because most of the hazards causing FBD are not transmitted solely by food; most have several potential transmission routes including transmission from animals, humans, and environmental routes including water. This paper describes an expert elicitation study conducted by the FERG Source Attribution Task Force to estimate the relative contribution of food to the global burden of diseases commonly transmitted through the consumption of food.

Methods

We applied structured expert judgment using Cooke's Classical Method to obtain estimates for 14 sub regions for the relative contributions of different transmission pathways for eleven diarrheal diseases, seven other infectious diseases and one chemical (lead). Experts were identified through international networks followed by social network sampling. Final selection of experts was based on their experience including international working experience. Enrolled experts were scored on their ability to judge uncertainty accurately and informatively using a series of subject-matter specific "seed" questions whose answers are unknown to the experts at the time they are interviewed. Trained facilitators elicited the 5th, and 50th and 95th percentile responses to seed questions through

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telephone interviews. Cooke's classic method uses responses to the seed questions to weigh and aggregate expert responses. After this interview, the experts were asked to provide 5th, 50th, and 95th percentile estimates for the "target" questions regarding disease transmission routes.

Findings

A total of 72 experts were enrolled in the study. Ten panels were global meaning that the experts should provide estimates for all 14 sub regions, whereas the 9 panels were sub regional, meaning that experts were allocated to provide estimates for one or more sub regions depending on their experience in the region. The size of the 19 hazard-specific panels ranged from 6 to 15 persons with several experts serving on more than one panel.

Pathogens with animal reservoirs (e.g. non-typhoidal *Salmonella* spp. and *Toxoplasma gondii*) were in general assessed by the experts to have a higher proportion of illnesses attributable to food than pathogens with mainly a human reservoir, where human-to-human transmission (e.g. *Shigella* spp. and Norovirus) or waterborne transmission (e.g. *Salmonella* Typhi and *Vibrio cholerae*) were judged to dominate. For many pathogens, the foodborne route was assessed as relatively more important in developed sub regions than in developing sub regions. The main exposure routes for lead varied across sub regions, with the foodborne route being assessed most important only in two sub regions of the European region.

Conclusions

For the first time, we present worldwide estimates of the proportion of specific diseases attributable to food and other major transmission routes. These estimates are essential for global burden of FBD estimates. While gaps exist, we believe the estimates presented here are the best current source of guidance to support decision makers when allocating resources for control and intervention, and for future research initiatives.

6. Cristina Silva

Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Arquiteto Lobão Vital, Apartado 2511, 4202-401 Porto, Portugal

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Overview of Global Food Safety Issues – The role of Food Science and Technologists

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. The food safety can be compromised due to biological, chemical and physical hazards, and can be caused by humans, the environment or processing. Food safety is primary a health crucial issue, but not least a socio-economic problem as well. Therefore, food safety issues are of direct interest to everyone, and are global in nature, affecting international trade.

This presentation includes a comprehensive description on global food safety issues, from farm to table. Food defense is a national and international priority for the food industry and governments, and involves product developers, researchers, management professionals, regulators and academics as well. Food safety and quality requirements originate from government regulations, customer requirements, needs and expectations or companies self-imposed requirements. Food safety needs a holistic approach, and researchers, academics and professionals of the food sector have a major role in sharing the knowledge and developing and applying the needed skills.

KEYWORDS: food safety, food chain, main actors, food technologists

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7. Charis Galanakis
Coordinator of Food Waste Recovery Group, ISEKI Association, Greece

Challenges and Opportunities of the agri-food sector: the second life of wastes

This lecture will present a global perspective, challenges and opportunities of the agri-food sector. Strategic areas of intervention in the agro-food industry such as bioeconomy, bio-based products, food by-products valorization and the biorefinery concept will be denoted. Fundamental indications, both theoretical and practical, that need to be taken into account when recovering high added-value compounds from food waste will also be explored. Finally, an introduction to the book "*Food Waste Recovery: Processing Technologies and Techniques*" (Academic Press, 2015) will be discussed. This book acts as a guide to recover valuable components of food by-products and recycle them inside the food chain, in an economic and sustainable way.

8. E Aktas[a], Z Topaloglu[b], T van 't Wout[b], Z Irani[c], A Sharif[c], S Huda[d]

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[b] Georgetown University, School of Foreign Service, Education City, Doha, Qatar
[c] Brunel University, Business School, Kingston Lane, Uxbridge, Middlesex, UB8 3PH, UK
[d] Western Sydney University, School of Science and Health, Penrith NSW 2751, Australia

Factors Driving Waste in the Food Supply Chain

Global food production is under great pressure to feed the increasing population, which UN estimates to reach 9.7 billion by 2050. Owing to increasing levels of urbanisation and changing consumption patterns, there is a growing demand for livestock products such as meat or milk. Consequently, countries with limited natural resources to provide for their people will be faced with stronger threats to their food security. On the other hand, each year 1.3 billion tonnes of food, about a third of all that is produced, is wasted, with a split of about 45% of all fruit and vegetables, 35% of fish and seafood, 30% of cereals, 20% of dairy products and 20% of meat. In this paper we focus on the factors driving waste in the food supply chain, from a resource-constrained country, Qatar, which is located in a region that has a relatively low capacity to be self-sustaining in food. Qatar is importing 90% of the food consumed in the country and wastage along the food supply chain has been an issue in relation to food security as well.

We report preliminary findings from the Safeguarding Food and Environment in Qatar (SAFE-Q) project, funded by the Qatar National Research Fund, and jointly undertaken by Georgetown University School of Foreign Service in Qatar, Cranfield University and Brunel University in the UK and Western Sydney University in Australia, where we undertake a detailed analysis of food supply chain with focusing on waste occurring in demand and supply processes. We examine the causes of food waste occurring during distribution, transportation and storage as well as during food preparation, cooking and consumption. For that purpose, we collect qualitative data from commercial food consumers (such as restaurants, hotels and catering firms) as well as end-consumers, and food suppliers (large-scale food importers, distributors, and retailers). In this talk, we focus on the results from companies on the supply side of the food chain.

In the interviews conducted from September 2015 to March 2016 we asked our participants whether the food was being discarded in the day-to-day operations of the company, followed by the main reasons for this food waste. We also presented the participants with factors that were identified in an earlier stage of the research as being contributors to the food waste and asked the cause and effect relationships between these factors. Following the factor-specific questions, we inquired about

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initiatives to reduce food waste in the company, as well as the relevant stakeholders that should be reached out to minimise food waste in general. Finally, we asked about potential solutions to food waste situation, and how the participant observes the future of food waste in Qatar. We will be presenting the results of these interviews in the workshop.

"This abstract was made possible by NPRP grant # [NPRP 7-1103-5-156] from the Qatar National Research Fund (a member of Qatar Foundation). The statements made herein are solely the responsibility of the author[s]."

9. Andy Hart
FERA Science Ltd.

Use of expert judgement when addressing uncertainty in risk assessment

This presentation discusses the role and treatment of expert judgement in EFSA's draft Guidance for addressing uncertainty in scientific assessment (EFSA, 2016), which is published on EFSA's website and currently being tested by EFSA's Panels and Units. The guidance is applicable to all EFSA's assessments, including risk assessment.

The draft Guidance on uncertainty emphasises the importance of expert judgement in scientific assessment. This includes not only elicitation of parameters for which data are limited, but also many other aspects of scientific assessment including the selection and analysis of data, when available, and the choice of models for conducting the assessment.

EFSA has previously published a separate Guidance document on expert knowledge elicitation (EFSA, 2014), also available on EFSA's website, which is focussed on formal elicitation procedures for estimating uncertain parameters. The elicitation Guidance recognises that, due to limits on time and resources, it will often not be feasible to conduct formal elicitation for all uncertain parameters in an assessment, and therefore includes advice on how to prioritise which parameters to subject to formal elicitation. The uncertainty Guidance adds to this by offering draft guidance on semi-formal elicitation procedures to be used for less important parameters or when time is more limited. It also recognises that, given the vast number of judgements involved in a typical assessment, some will necessarily made by a simpler process of expert discussion and offers some advice on how to improve the rigour of this.

EFSA's elicitation Guidance does not include specific procedures for eliciting judgements on variables, which are common in EFSA assessments, nor for qualitative questions, nor joint distributions of correlated parameters. It contains only limited advice on dealing with imprecision of elicited probabilities. EFSA (2016) recommends that consideration be given to developing more guidance on these topics in future.

EFSA's draft uncertainty Guidance further recognises that, in any assessment, only some of the identified sources of uncertainty will be quantified individually. It emphasises the importance of including these 'NQI' (not quantified individually) uncertainties in a combined assessment of uncertainty for communication to decision-makers. It is suggested that assessors do this by listing the NQI uncertainties, assessing their collective impact on the outcome of the assessment, and combining this with the contribution of those uncertainties

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that have been quantified individually. This might be done by formal or semi-formal elicitation or expert discussion, depending on the relative importance of the NQI uncertainties and the time and resources available. The draft Guidance recognises that assessors may not be able to include all the identified uncertainties in their quantitative assessment, and emphasises the importance of describing those that are not quantified.

References

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EFSA, 2016. Guidance on Uncertainty in EFSA Scientific Assessment. Revised draft for internal testing. http://www.efsa.europa.eu/en/topics/topic/uncertainty

10. Rachel Loopstra
University of Oxford

Food Insecurity from the household perspective in OECD countries

Drawing from research using data from household surveys in Canada, area-level data in the UK, and cross-country data in the EU, in this presentation, I will outline key findings on household risk factors for insecure access to food and emerging findings on macroeconomic and social policy drivers of this problem. Data challenges will be highlighted, especially as they relate to assessing food insecurity, understanding local and country-level determinants, and designing effective intervention and prevention.

11. Nicole Darmon
NORT, Aix-Marseille Université, INRA, INSERM, 13000, Marseille, France

Nutritional quality and carbon impact of diets in France: what have we learnt from nutritional epidemiology and diet modeling?

The Food and Agriculture Organization defines sustainable diets as nutritionally adequate, safe, healthy, culturally acceptable, economically affordable and with low environmental impact. We used a nutritional epidemiology approach i) to estimate the environmental impact of diets self-selected by French adults ; ii) to assess the relationship between nutritional quality, environmental impact and cost of self-selected diets, and iii) to identify those individuals with the most sustainable diets. Then, we used a diet modeling approach to analyze how low can dietary greenhouse gas emissions (GHGE) be reduced without impairing nutritional adequacy, affordability and acceptability of diet.

In a first study (Vieux et al., 2012), we found that the mean diet-related GHGE was 4170 g CO2eq/day. Beyond this average, a wide inter-individual variability was observed, mainly related to a variety in the quantities consumed. Hence, significant and positive relationships were found between diet-related GHGE and daily caloric intakes (r-squared=0.57), and between diet-related GHGE and daily quantities consumed (r-squared=0.29). The meat and deli meat food group represented the strongest diet-related GHGE contributor, but the impact of different meat reduction scenarios was modest. In particular, when fruit and vegetables were isocalorically substituted for meat, either null or even positive diet-associated GHGE variations were observed because the needed amounts of fruit and vegetables to maintain the caloric content of the diet were high. Thus, while reduction of meat consumption was confirmed as one of the main factor to mitigate the diet-related environmental impact, the choice of meat replacement foods is crucial.

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In a second study (Vieux et al., 2013), indicators of bad nutritional quality, such as the mean excess ratio and the energy density of diets, were found to be negatively correlated with diet-related GHGE, while the mean adequacy ratio, an indicator of good nutritional quality, was found to be positively correlated with diet-related GHGE. Moreover, after adjustment for energy intake, high-nutritional-quality diets had significantly higher GHGEs (+9% and +22% for men and women, respectively) than did low nutritional-quality diets, showing possible incompatibility between the nutrition and environmental dimensions in existing diets.

In a third study (Masset et al., 2014b), we adopted the principle of positive deviance to explore the food choices of individuals with "More sustainable" diets, defined as having daily GHGE and a nutritional quality score respectively lower and higher than the sex-specific median values. "More sustainable" diets were already consumed by 20% of French adults, showing that they were socially and culturally acceptable. Their GHGE values were 18% lower than the population. The daily cost (€/d) was lower than the average, although the cost per kcal was not different. Two main factors were identified to result in those "More sustainable" diets: reduced energy intake and reduced energy density. The energy contribution for starchy foods, and fruit, vegetables, and nuts was higher than in the average diet, whereas the energy contribution for meat, mixed dishes and alcoholic drinks was reduced. Although statistically significant, the magnitudes of the above listed differences were quite small and there was no difference in the energy share of dairy products and of sweets and salted snacks. Hence, dietary choices allowing reaching more sustainable diets were not dramatically different from the average observed diets.

In the last study (Perignon et al., 2016), linear programming was used to model nutritionally adequate diets with stepwise GHGE reductions, minimizing departure from the observed diet. Imposing all nutritional recommendations increased the fruits and vegetables quantity, reduced energy density and slightly increased diet cost, without additional modifications induced by the GHGE constraint up to 30% reduction. Higher GHGE reductions required non-trivial dietary shifts from observed diet, thus compromising acceptability.

As food GHGE were previously found to strongly correlate with 2 other indicators of environmental impact (water eutrophication and air acidification) (Masset et al., 2014a), the above results would also apply for these indicators. Overall, these studies showed that high nutritional quality is not necessarily associated with lower environmental impact. Hence, when identifying sustainable diets, each dimension needs to be considered and assessed though relevant indicators.

Masset, G., Soler, L.G., Vieux, F., & Darmon, N. (2014a). Identifying sustainable foods: the relationship between environmental impact, nutritional quality, and prices of foods representative of the French diet. *J Acad Nutr Diet*, **114**, 862-9.

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Vieux, F., Darmon, N., Touazi, D., & Soler, L.G. (2012). Greenhouse gas emissions of self-selected individual diets in France: Changing the diet structure or consuming less? *Ecol Econ*, **75**, 91-101.

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Vieux, F., Soler, L.G., Touazi, D., & Darmon, N. (2013). High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults. *Am J Clin Nutr*, **97**, 569-83.

12. Kitty Verhoeckx

Scientist Food Allergy & Analytical Chemistry, TNO

Allergenicity assessment strategy for novel proteins

To market novel protein sources for food supply, a comprehensive risk assessment is needed according to European legislation. Performing a risk assessment on allergenicity might pose some difficulties, since detailed guidance on how to assess the allergenic potential of novel foods is not available.

In case of allergenic safety, two questions have to be answered. Will an already allergic population be at risk when consuming the novel protein source (cross-reactivity) or is the new protein source able to induce new allergies (de novo sensitization). For the assessment of risks due to cross reactivity with already existing allergens various approaches have been developed and published. The joint Food and Agriculture Organisation and World Health Organisation (FAO/WHO) Expert Consultation developed an approach for assessing this risk for products derived from genetically modified organisms, "weight-of-evidence approach", which was later updated by EFSA's Genetically Modified Organisms Panel and was incorporated into the Codex Alimentaris. TNO in collaboration with the UMC Utrecht developed a more broadly (not only for GM-products) applicable approach. The applicability of this approach was recently demonstrated in a study to assess the allergenicity of mealworm protein (Tenebrio molitor), a sustainable and protein rich candidate novel food. The second question (de novo sensitization) is more difficult to answer, since it will be difficult to find sensitized persons that are already exposed to the new protein. Therefor new initiatives are started, 1) Shared Research Program, where Industry and TNO are working on methods that can predict for sensitization and 2) COST Action ImpARAS (FA1402), an European network discussing the gaps in the current allergenicity risk assessment strategy and possible improvements.

13. Martine Barons & Jim Smith

Warwick University

Integrating decision support for food security

We recently-developed a paradigm for networking expert judgements in a coherent manner suitable for decision support when that support is based on the evidence provided from many different agents each with their own particular domain of expertise. One of the motivating examples for this new technology was the support needed for addressing Food Poverty within the UK. In this presentation, after reviewing some of main aspects of this methodology I will report some of the aspects of ongoing work in building a decision support system designed round the needs of a local government council. The purpose of this support is to helping them evaluate the potentially deleterious impacts of the council enacting in different way the funding cuts imposed by central government with special regard to their effects on malnutrition. The support is designed t give them coherent evidence based support to help them choose the way forward which is least harmful to those households in their care. Expert judgements are currently being elicited on a number of different elements, including the elements of their subjective utility, the factors affecting the outcomes of interest and the relationships between these factors. Further on in the development process, it will be necessary to supplement the available

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data with expert judgements on conditional probability distributions relevant to the structure of the problem. I will discuss the new paradigm through the lens of its application to the specific needs and judgments of Warwickshire County Council, describing some recent structural elicitations and our plans for future embellishments to the system.

14. Dietrich Knorr
Technische Universität Berlin, Department of Food Biotechnology and Food Process Engineering, Koenigin-Luise-Str. 22, D-14195 Berlin, Germany
dietrich.knorr@tu-berlin.de

Food safety and food security aspects of emerging technologies

The presentation will concentrate on non-thermal processing technologies including high hydrostatic pressure, pulsed electric fields, ultrasound and atmospheric plasma.

These gentle, low waste technologies will be presented with regards to basic principles, advantages, disadvantages, applications and state of industrial development and application.

Food safety and security effects will be emphasized with special reference to vegetative microorganisms and spore forming ones as well as virus inactivation and sustainability.

The need to develop science-oriented and science based processes rather than empirical approaches to be able to understand and utilize these processes at their fullest potential as well as knowledge gaps and research needs will be discussed.

15. Ann Nicholson
University of Monash

Delphi expert elicitation of Bayesian networks

Bayesian networks have become a state-of-the-art modelling technology to support decision-making under uncertainty, and have been recently applied to modelling food security. Bayesian networks are typically constructed using a combination of data (where available), information from the literature, and expert knowledge. One common method for eliciting BDN structure and probabilities from experts is via elicitation workshops. However these involve considerable expense, and the availability of experts at the same time and place. Furthermore, there are well known issues with expert elicitation in group situations, such as bias towards the views of dominant participants (based on age, gender, reputation and personality). The Delphi method was proposed to mitigate such factors. Instead of direct confrontation and debate between experts, Delphi uses communications routed through a moderator, undertaken in rounds and interspersed with feedback derived from other members, providing opportunities for experts to revise their opinions. In this talk, I will describe an online Delphi process for constructing a Bayesian network that involves the structured elicitation of knowledge from a group of experts and present results from a medical risk assessment case study.

16. Anca Hanea & M. Burgman
Centre of Excellence for Biosecurity Risk Analysis; University of Melbourne

Classical meets modern in the IDEA protocol for structured expert judgement

This talk presents a fairly novel structured expert judgement (SEJ) protocol for quantifying parameter uncertainty using multiple experts. Generally, multiple expert opinions need to be aggregated. The two main flavours of aggregation, behavioural and mathematical, define two main classes of SEJ protocols. A third one, the so-called “mixed” approach combines aspects of both behavioural and

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mathematical methods. The IDEA protocol proposed here mixes specific elements from the three SEJ classes of approaches mentioned above, such that their disadvantages are minimised and their respective advantages cumulate. The acronym IDEA arises from the combination of the key features of the protocol that distinguish it from other structured elicitation procedures: it encourages experts to Investigate, Discuss, and Estimate, following which judgements are combined using mathematical Aggregation.

The experts give their individual opinions in subsequent rounds of elicitations, in a remote manner. In the first round, the experts are required to answer the questions without engaging in any (virtual) discussion with the other experts. They are then given the opportunity to discuss differences of opinion and reconcile the meaning of questions and context. The debate is remote (using an online platform) rather than face-to-face. This has the advantage of promoting the wisdom of crowds, whilst avoiding the tensions associated with group discussion between dominating personalities. The second estimate is again individual and strictly anonymous. At the end of the second round the output is a set of estimates that should further be mathematically aggregated. Several aggregation rules, many of them performance based, can be used and compared. Experts' performance may be measured in terms of accuracy, calibration and informativness.

17. Anca Hanea and Martine Barons
Centre of Excellence for Biosecurity Risk Analysis; University of Melbourne
Warwick University

An IDEA for pollinator abundance decision support

Ecosystems services, and in particular pollination services, are a key element of food security. However, a system which encompasses pollination services is multi-faceted, complex, managed by many sectors, and hence it engages diverse interrelated domains. These domains and sectors include environmental management, weather and climate, markets for a wide variety of foodstuffs, agricultural and food safeties regulatory bodies, etc.

Many aspects of this system are well-researched and good data is available for modelling the system. However, for many other aspects, and particularly where the domains intersect, information is sparse or non-existent. In such cases, the gaps can be suitably filled using expert judgement. In this talk we report the use of the IDEA protocol for eliciting expert judgements to populate an integrating decision support system based on a Bayesian network

18. Danny Williamson
University of Exeter

Do we trust elicited prior judgement and, if not, what value can we extract from a Bayesian analysis?

When interested in decision support for complex problems, it is natural to wish to apply Bayesian methods in order to describe a decision maker's own uncertainty through probability that can be updated in the light of data that is or can be obtained during the decision making process. When probability describes a decision maker's own uncertainty, the theory of decision making under uncertainty provides a clear pathway to action (if the decision maker is prepared to consider or quantify their utilities) or decision support, in more complex cases.

So do Bayesian methods, eliciting prior distributions and updating them using data, quantify a decision maker's own uncertainty for complex problems? Can we elicit prior judgments that reflect *anyone's*

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true beliefs? If not, what can we extract from the Bayesian procedure? In this talk I will argue that elicited prior judgement need not come in the form of a single prior, nor that every statement in the prior must be believed before we can do inference that can be used in decision making. I present a methodology for obtaining these inferences and do so in the context of a real world policy problem.

19. Kenisha Garnett
Cranfield University

Using scenario planning methods to explore plausible, alternative future states of the UK Food system

Investigating the likely consequences of future changes in the food system and the risks associated with food processing and preparation is important to protect consumers, ensuring food is safe for human consumption. Scenario planning is among a suite of futures research tools used by regulators and businesses to understand the social, economic and environmental impacts on food systems, using this knowledge to determine where future intervention is best directed. Scenario planning presents an important tool for policy-makers to deal with increasing levels of uncertainty associated with a complex food system. Exploring these uncertainties over long-term time horizons require a robust methodology that will consider future states of the entire food system, and the influence of interactions and relations between sub-systems.

This talk summarises outputs from a research initiative between Cranfield University and the Food Standards Agency to consider three possible states of the UK food system between 2015 and 2035. Employing morphological analytical methods, the three scenario states assume the future will be fundamentally different from today.
Each scenario presents an alternative, but plausible future that embodies a rise in uncertainty and assumes a consequence of actions that becomes increasingly unpredictable. The built scenarios are used to explore long-term challenges for the food system to inform strategic planning and provide information upon which to test the resilience of policy options against the scenarios. Case studies of representative food types are used to illustrate the added utility of the scenarios in exploring triggers for change in UK's food production and supply over the next 20 years, and what the emerging food safety implications might be under each scenario.

References:
Garnett, K., Delgado, J., Lickorish, F., Shaw, H., Rathe, A., Chatterton, J., Prpich, G., and Pollard, S.J.T (2014). Plausible Future Scenarios for the UK Food and Feed System – 2015 & 2030. Report for the Food Standards Agency (FSA).
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Late abstract

3. John Ingram

Oxford Martin School, University of Oxford

A Food Systems approach to Food Safety

The widely-cited FAO definition of food security states that it is met "when all people, at all times, have physical, economic and social access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life". Food safety is therefore acknowledged to be a critical aspect of food security. How will food safety be affected by plausible changes in climate and extreme weather, and in socioeconomic conditions?

The seminar will introduce the notion of the food system, noting the range of activities from primary production through to consumption. It will also introduce the range of actors involved and their governance structures, the nature of the social, environmental, political, technological and economic factors that influence their activities, and the outcomes of their activities for food security. It will then discuss how climate change and variability will have an impact on the occurrence of food safety hazards at various stages of the food system. Food safety 'drivers' include changes in temperature and precipitation patterns, increased frequency and intensity of extreme weather events, ocean warming and acidification, changes in contaminants' transport pathways, and changes in socioeconomic conditions. Climate change may also affect socio-economic aspects related to food systems such as agriculture, animal production, global trade, demographics and human behaviour which all influence food safety. Impacts of these drivers on food safety include, for example, mycotoxins formed on plant products in the field or during storage; residues of pesticides in plant products affected by changes in managing increased pest pressure; marine biotoxins in seafood following production of phycotoxins by harmful algal blooms; and pathogenic bacteria in foods during heat waves.

The seminar will also introduce the prospects of future food security given food demand trends and consider how this could also affect food safety.

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Anca Hanea	Australia	Melbourne University
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Andy Hart	United Kingdom	FERA Science, Ltd
Ann Nicholson	Australia	University of Monash
Bekir Cetintav	Turkey	Dokuz Eylul University
Bo Lindqvist	Norway	Norwegian University of Science & Technology
Charis Galanakis	Greece	Galanakis Laboratories
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