final report

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International association for food protection (IAFP) conference and Danish Meat Research Institute

BACKGROUND

The Annual Meeting (conference) of IAFP has become the leading venue concerned with the protection of the worldwide food supply. Each meeting is attended by over 1,500 of the top industry, academic and government food safety professionals. This broad mix of attendees includes professionals in quality control, processing operations, regulatory inspections, consulting groups, risk assessment, research and development, microbiological research, plant management, technical services and HACCP management.

With a reputation for quality content, the Annual Meeting features over 500 technical papers, posters and symposia, detailing current information on a variety of topics relating to food safety. The quantity and quality of contributed presentations provide information on the latest methods and technologies available.

The Danish Meat Research Institute (DMRI) is a leading research group in meat technology, where researchers have been developing predictive models for shelf-life of meat, including those for organoleptic and microbiological characteristics of meat. They have been developing a model for MLA, but this is only a small part of their knowledge.

OBJECTIVES

1. Prepare a paper on the work sponsored by MLA in the area of shelf-life communities and predictive modelling and present it on behalf of MLA at the International Association for Food Protection (IAFP) conference in Anaheim in August 2010.

2. Attend selected scientific sessions at the IAFP conference, and prepare a report for submission to MLA, regarding recent food safety developments highlighted at the conference.

3. Visit the Danish Meat Research Institute (in conjunction with MLA's manager, market access science and technology) to discuss the University's research on shelf-life, international approaches to modelling and how predictive tools can be accepted by regulators, and provided to the scientific community and industry.

RESULTS

1. Prepare and present a paper at the International Association for Food Protection conference in Anaheim

A presentation titled "Evaluation of a Predictive Model for Total Viable and Lactic Acid Bacteria on Refrigerated Vacuum-Packed Beef Primals" was presented at the IAFP conference on 2 August 2010 in a session titled "Antimicrobial and Microbial Food Spoilage Technical Session."

Appendix 1 contains the abstract of the presentation. The PowerPoint file is attached separately.

2. Attend selected sessions at the International Association for Food Protection conference and prepare a report on recent food safety developments highlighted at the conference

Appendix 2 contains a list of presentations directly related to meat food safety and spoilage. Various sessions were attended and selected highlights noted below.

Filamentous forms of bacteria: one of the more novel findings was shown in a University of Wisconsin-Madison study where stressed *Salmonella* cells were shown to produce filamentous growth. Interestingly, under favourable conditions, single filaments septated and produced up to 100 individual cells per filament. These findings may have significant implications on interpretation of stressed-cell studies that use plating versus microscopic methods of enumeration, as well as infective dose-response models.

Network science: one session, and a talk in another, reported the use of network science tools to identify links/associations between events in complex food systems. An example of an application in a UK diary system was presented, however there wasn't an evident short-term benefit as this is a young discipline within the food arena. A more applied use of this modelling technique was reported, whereby network maps were used to measure the number and strength of links in the world food supply (via data provided by FAO).

Evolutionary properties of *E. coli* O157:H7 and implications for detection methods: this paper presented an interesting approach to methods development by considering potential genetic variation in target genes. Such an approach, using multiplex PCR, is attractive for its potential to identify more "positive" samples.

Listeria monocytogenes transcriptional responses to potassium lactate and sodium diacetate: this paper aligns with research being conducted at the FSC by A/Prof John

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Bowman and may help explain the cellular events that extend Lm in lag phase. John Bowman's approach is focused on proteomics and might find interesting links to data generated at the transcription level.

National Institute of Food and Agriculture Showcase: several senior scientists at USDA described the structure and intent of the NIFA program and where research has been targeted. This approach is similar to the EU Framework projects, where large multidisciplinary teams with millions of dollars of investment address food safety issues. Australian linkages into these projects may, at the very least, provide early insights into data.

Tools for predictive microbiology: this session provided an overview on predictive microbiology and risk assessment tools. No significant new developments were reported for the USDA Pathogen Modeling Program. Of particular note were process risk models being developed by FAO for use in poultry applications. This effort will help leverage the considerable investment in FAO/WHO risk assessment into risk management tools.

3. **Visit the Danish Meat Research Institute to discuss the University's research on shelf-life, international approaches to modelling and how predictive tools can be accepted by regulators, and provided to the scientific community and industry.**

A meeting was held with researchers at the Danish Meat Research Institute (DMRI) on 9-10 August 2010 to discuss MLA-sponsored predictive microbiology research conducted at DMRI and the University of Tasmania Food Safety Centre. Meeting participants were Dr Niels Madsen (DMRI), Dr Hardy Christensen (DMRI), Mr Ian Jenson (MLA) and Dr Mark Tamplin (UTAS). Primary goals were to understand the experimental design and data underpinning DRMI models, and to explore ways that these models could be aligned for universal applications.

DMRI provided a tour of their facilities and an overview of research activities. One topic highlighted was recent DMRI work on the effect of steam-vac on reducing lamb carcase contamination and the possibility of expanding this into a new MLA project. DRMI explained the experimental design behind the MAP and vacuum-packaged meat models, model limits, and validation studies. It was found that DRMI and UTAS models shared a similar temperature range (-0.3 to 8ºC versus -1.5 to 7ºC, respectively), the number of abattoirs for sourcing meat (i.e. six) , and mutual use of striploin, although DMRI also used cuvette and topside. It is noteworthy that DMRI said the 80-20 CO_2-O_2 MAP atmosphere produces similar microbial responses as vacuum packaged meat.

UTAS provided an overview of MLA-sponsored research, including development of TVC and MRS predictive models, lamb shelf-life study, TVC methods comparisons, and analyses of microbial communities using molecular methods. DMRI offered to assist

MLA/UTAS with further development lamb and minced meat models, share their data and co-author a future publication.

It was agreed that UTAS follow-up activities included providing DMRI with tRFLP and clone library protocols, outlining a joint paper on TVC/psychrotrophic model, and comparing predictions of DRMI and UTAS models under similar interpolated conditions. Other considerations included additional studies comparing growth rates of TVC in mince versus whole meat cuts, incorporating untrained sensory panel (based on DMRI approach) for future shelf-life studies, and using similar size cuts of primals (500-700g).

Appendix 1. Presentation at the International Association for Food Protection Conference.

Evaluation of a Predictive Model for Total Viable and Lactic Acid Bacteria on Refrigerated Vacuum-Packed Beef Primals

Authors: Mark Tamplin, Alison Small, Sheila Peddell, Olivia McQuestin, Bianca Porteus, Danielle O'Callaghan, John Sumner and Ian Jenson

Abstract:

Introduction: The shelf-life of fresh beef is affected by intrinsic and extrinsic factors including temperature, pH, packaging atmosphere and microbial species. The storage life of meat can be controlled, in part, by understanding the kinetics of microbial growth that contributed to spoilage. Such information can be converted into predictive models that aid in managing cold chains.

Purpose: The purpose of this study was to produce and validate a predictive model for the viability of total viable count (TVC) and lactic acid bacteria (LAB) on vacuum-packed beef primals.

Methods: TVC and LAB models were produced by studies of microbial growth on commercially-packed primal cuts, and separately for cuts irradiated and then inoculated with a 6-strain spoilage cocktail. Microbial counts and surface pH were measured at selected time intervals on samples stored at -1.5, 0, 2, 4 ad 7ºC for up to 30 weeks. Growth parameters were estimated for lag time, growth rate and maximum population density, and then transformed into secondary models. Model estimates were compared to independent data of growth rates in the published literature, ComBase and industry data.

Results: The model based on laboratory-inoculated meat over-estimated TVC and LAB levels when compared to data in ComBase and the published literature. For example, the bias and accuracy factors were 2.8 and 3.1 for TVC, respectively. Producing the model from commercially-packed primal cuts improved bias and accuracy factors to 1.6 and 2.8 for TVC, respectively. However, growth rate predictions for TVC and LAB were still 3 to 4 times higher than the rates observed for whole beef primals produced by six Australian abattoirs and stored at -0.5ºC.

Significance: These findings demonstrate that microbial communities, and their interactions, are likely complex in fresh beef, and that these differences may affect the validity of model applications for commercial products.

Appendix 2. IAFP presentations related to meat food safety.

Data Deluge, Interacting Players and Complex Networks in Food Sciences — Computational Tools to Tackle Food-related Complexities

Complex Networks Permeating Society and Science — RÉKA ALBERT, Pennsylvania State University, University Park, PA, USA

Revealing Networks of Interactions between Foods and Foodborne Organisms in ComBase — MARK TAMPLIN, Food Safety Centre, Hobart, TAS, Australia

Food Safety Scenarios, Probabilistic Networks and Source Level Inferences — GARY BARKER, Institute of Food Research, Norwich, United Kingdom

Potentials of Network Science in Food Safety and Security — JÓZSEF BARANYI, Institute of Food Research, Norwich, United Kingdom

Government, Academic and Industry Collaborations to Advance the Development and Use of Microbiological Risk Assessments

Interagency *Listeria* Retail Risk Assessment — RÈGIS POUILLOT, Food and Drug Administration, College Park, MD, USA

A Web-based Comparative Risk Assessment Tool: iRISK — STEVEN M. GENDEL, Food and Drug Administration, College Park, MD, USA

Applied Laboratory Methods and Novel Laboratory Methods Technical Session

Aspects of Systems Theory in the Analysis of Molecular-biological Based Detection Methods —PETER ROSSMANITH and Martin Wagner, University of Veterinary Medicine Vienna, Christian Doppler Laboratory for Molecular Food Analytics, Vienna, Austria

Utilization of Evolutionary Model, Bioinformatics and Heuristics for Development of a Multiplex *E. coli* O157:H7 PCR Assay — FRANK R. BURNS and Jim Bono, DuPont, Wilmington, DE, USA

A Novel Colorimetric Screening Assay for *E. coli* O157:H7 in Raw Ground Beef and Trim Utilizing Simultaneous Capture and *In Situ* Labeling during Automated Re-circulating IMS — Nicole Prentice, John Murray, Paul M. Benton, Katarzyna Brzegowa, Brooke V. Houston, Ian Sheldrake, Michael F. Scott, Christine Aleski and ADRIAN PARTON, MATRIX MicroScience Ltd., Cambridgeshire, United Kingdom

Sensitive and Rapid Detection of *Escherichia coli* O157:H7 in Food and Water — PEIXUAN ZHU, Shuhong Li, Platte T. Amstutz, Daniel R. Shelton and Cha-Mei Tang, Creatv MicroTech, Inc., Potomac, MD, USA

Identification of Shiga Toxin-producing *Escherichia coli* on DNA Microarrays by Using a Novel Photo-induced Signal Amplification Method — BEATRIZ QUIÑONES, Ronald P. Haff, Amber W. Taylor and Erica D. Dawson, USDA-ARS, Western Regional Research Center, Produce Safety and Microbiology Research Unit, Albany, CA, USA

Rapid Identification of *Listeria* Species: Comparison of a Real-time PCR Assay Versus Biochemical Galleries — Nicolas Desroche, Jean Guzzo and PATRICE ARBAULT, BioAdvantage Consulting, Food Safety and Analytical Methods, Orliénas, France

Detection of *Listeria* spp. from Pooled Environmental Swab and Food Samples within 24 Hours Using Pathatrix Automated Re-circulating IMS Linked to Real-time PCR — John Murray, Nicole Prentice, Katarzyna Brzegowa, Paul M. Benton, Brooke V. Houston, Ian Sheldrake, Michael F. Scott, Marcie Van Wart and ADRIAN PARTON, MATRIX MicroScience Inc., Golden, CO, USA

Combined Thin Agar Layer and Centrifugation plating Method for Enumeration of Injured *Salmonella* — Sangha Han and JULIAN M. COX, University of New South Wales, Faculty of Science, Sydney, NSW, Australia

Development of Multi-parametric Tools for the Detection and Identification of Sporeforming Bacteria in the Food Chain — PATRICE CHABLAIN, Florence Postollec, Stephane Bonilla, Daniele Sohier and Sylvie Hallier-Soulier, Pall GeneSystems, R&D, Bruz, France

Pathogens, Sanitation and Seafood Technical Session

Variation in Desiccation Tolerance among *Salmonella* Strains — REGINA C. WHITEMARSH, Aaron M. Gnas and Charles W. Kaspar, University of Wisconsin-Madison, Bacteriology, Madison, WI, USA

Characterization of the *Listeria monocytogenes* Transcriptional Response to Synergistic Growth Inhibition by Potassium Lactate and Sodium Diacetate — MATT STASIEWICZ, Teresa M. Bergholz and Martin Wiedmann, Cornell University, Food Science, Ithaca, NY, USA

Phenotypic and Genotypic Characterization of Antimicrobial Resistance in *Salmonella* Serotypes Isolated from Retail Meats in Canada — MUEEN ASLAM, Valerie Bohaychuk, Gary Gensler, Richard Reid-Smith, Brent Avery and Patrick Boerlin, Agriculture and Agri-Food Canada, Lacombe Research Centre, Lacombe, AB, Canada

Comparison of the rfb Cluster in 16 Rare *Salmonella* Serotypes — MATTHEW L. RANIERI, Andrea Moreno Switt, Henk C. den Bakker, Martin Wiedmann, Lavorka Degoricija, Craig A. Cummings, Elena Bolchacova, Greg Govoni and Manohar R. Furtado, Cornell University, Food Science, Ithaca, NY, USA

Sequences in the *comK* Prophage Junction Fragments Cluster *Listeria monocytogenes* Isolates of Epidemic Clones II, III and the 2008 Canadian Outbreak into Subclones That are Unique to Individual Meat and Poultry Processing Plants — MEI LOK, Yi Chen, Bindhu Verghese, Peter Evans, Sophia Kathariou and Stephen Knabel, Penn State University, Dept. of Food Science, University Park, PA, USA

An ABC Transporter Regulates Biofilm Formation by Controlling the Expression and Modification of Cell Surface Proteins in *Listeria monocytogenes* — Xinna Zhu, Weibing Liu, René Lametsch, Frank M. Aarestrup, Chunlei Shi, Qunxin She, XIANMING SHI and Susanne Knøchel, Dept. of Food Science, School of Agriculture and Biology, Shanghai Jiao Tong University, Shanghai, China

Characterization of Food and Clinical *Listeria monocytogenes* Isolates Collected in Portugal — JOANA BARBOSA, Vânia Ferreira, Rui Magalhães, Isabel Santos, Gonçalo Almeida, Paul Gibbs and Paula Teixeira, Escola Superior de Biotecnologia-Universidade Católica Portuguesa, CBQF, Porto, Portugal

Antimicrobial and Microbial Food Spoilage Technical Session

Prevalence and Antimicrobial Resistance of *Campylobacter* Isolated from the National Antimicrobial Resistance Monitoring System Retail Meat: 2002—2007 — SHAOHUA ZHAO, Linda English, Jason Abbott, Emily Tong, Niketta Womack, Sharon Friedman and Patrick McDermott, U.S. Food and Drug Administration, Laurel, MD, USA

The Effect of Heat on the Antimicrobial Efficacy of Cinnamic Aldehyde, Carvacrol, and Eugenol —GRISHMA KOTWAL and Faith J. Critzer, University of Georgia, Food Science and Tech., Griffin, GA, USA

Cinnamaldehyde Induces Cell Elongation in *Escherichia coli* O157:H7 — Richard A. Holley and VISVALINGAM JEYACHCHANDRAN, University of Manitoba, Food Science, Winnipeg, MB, Canada

Analysis of Plasmids and Mobile Elements Carrying Antimicrobial Resistance Genes in *Salmonella* Isolates by Whole Genome Sequencing — ANDREA I. MORENO SWITT, Matthew Ranieri, Henk den Bakker, Lovorka Degoricija, Craig A. Cummings, Gregory Govoni, Elena Bolchakova, Manohar Furtado and Martin Wiedmann, Cornell University, Dept. of Food Science, Ithaca, NY, USA

Considering the Design and Analysis of Efficacy Trials for Antimicrobial Treatments of Raw Meat and Poultry — MARK POWELL, USDA, Washington, D.C., USA

Evaluation of a Predictive Model for Total Viable and Lactic Acid Bacteria on Refrigerated Vacuum-packed Beef Primals — MARK TAMPLIN, Alison Small, Sheila Peddell, Olivia McQuestin, Bianca Porteus, Danielle O'Callaghan, John Sumner and Ian Jenson, University of Tasmania, Food Safety Centre, Sandy Bay, TAS, Australia

National Institute of Food and Agriculture Showcase

Overview of National Institute of Food and Agriculture Food Safety — Related Programs and Activities — ISABEL WALLS, National Institute of Food and Agriculture, USDA, Washington, D.C., USA

Example of Extension Program Funded by NIFA. Good Agricultural Practices: A Successful Extension/Outreach Program — BOB GRAVANI, Dept. of Food Science, Cornell University, Ithaca, NY, USA

Significance and Detection of STEC or Non-O157:H7 *Escherichia coli*

The Epidemiology of Shiga Toxin-producing *Escherichia coli* as Human Pathogens — PINA FRATAMICO, ARS-USDA, Atlanta, GA, USA

Development of Novel Methods for the Detection of STEC — CHRISTINE ROZAND, Global R&D Industry, bioMérieux Industry, Marcy L'Etoile, France

Canada's VTEC Research Network — ALEX GILL, Bureau of Microbial Standards, Health Canada, Ottawa, ON, Canada

STEC in the EU — STEFANO MORABITO, Dipartimento di Sanita Pubblica Veterinaria e Sicurezza Alimentare, Istituto Superiore di sanita, Roma, Italy

Meat and Poultry Technical Session

Time-temperature Dependent Growth Patterns of *Salmonella* spp. in a Model Food System with Natural Microflora — AMIT MOREY, Shelly R. McKee and Manpreet Singh, Auburn University, Dept. of Poultry Science, Auburn, AL, USA

Analysis of ALLRTE and RTE001 Sampling Results for *Salmonella* Species, Calendar Years 2005—2008 — Kristina E. Barlow, Stephen W. Mamber, TIM B. MOHR and Evelyne Mbandi, USDA-FSIS, Washington, D.C., USA

Persistent and Sporadic *Listeria monocytogenes* Strains in Fermented Meat Sausage Processors —VÂNIA FERREIRA, Joana Barbosa, Kitiya Vongkamjan, Andrea Moreno Switt, Tim Hogg, Paul Gibbs, Paula Teixeira and Martin Wiedmann, Escola Superior de Biotecnologia, CBQF, Porto, Portugal

Impact of Chlorine and Temperature on *Listeria monocytogenes* Survival Growth Behavior on Ready-to-Eat Meats — SHIOWSHUH SHEEN, Cheng-An Hwang and Vijay Juneja, USDA-ARS-ERRC, Wyndmoor, PA, USA

Comparison of Data from FSIS Routine and Intensified Sampling Programs for *Listeria monocytogenes* from Ready-to-Eat Establishments — KRISTINA E. BARLOW, Stephen W. Mamber, Evelyne Mbandi and Tim B. Mohr, USDA-FSIS, Washington, D.C., USA

Comparison of a Novel Sample Collection Device and Cellulose Sponge for the Collection of *Escherichia coli* from Beef Carcasses — KEVIN CHURCH, Jared G. Maughan, Kelly M. Tesar and Amanda S. Vos, Microbial-Vac Systems, Inc., Jerome, ID, USA

Three Sampling Methods to Recover Bacterial Populations on Beef Trimmings in Commercial Settings — MICHAEL DE LA ZERDA, Mansour Samadpour and Mohammad Koohmaraie, IEH Laboratories and Consulting Group, Meat Division, Lake Forest Park, WA, USA

Prevalence of *Clostridium difficile* in Various Types of Ground Meat and Poultry Products — Jeff Bussey, Clarissa Sugeng, Jeffrey M. Farber and JOHN AUSTIN, Health Canada, Bureau of Microbial Hazards, Ottawa, ON, Canada

Validation of a High Throughput DNA Extraction and Real-time PCR Detection of *Escherichia coli* O157:H7, *Salmonella* spp., *Listeria monocytogenes* and *Listeria* spp. — WENDY LAUER and Jean-Philippe Tourniaire, Bio-Rad Laboratories, Hercules, CA, USA

Way Before the Fork: Impact of Pre-harvest Management Programs and Supply Chain Influences on the Control of Shiga Toxin-producing *Escherichia coli* Contamination in Beef

Risk Assessment of *E. coli* O157:H7 and Other STEC on the Farm — JAMES DICKSON, Dept. of Animal Science and Interdepartmental Program in Microbiology, Iowa State University, Ames, IA, USA

What's Working and What's Not Working to Reduce STEC Contamination of Beef with Pre-harvest Management Practices and Knowledge Gaps — GUY H. LONERAGAN, West Texas A&M University, Canyon, TX, USA

Global Perspective on Pre-harvest Food Safety to Minimize the Risk of STEC Contamination of Beef Products — STUART REID, Veterinary Medicine, University of Glasgow, Glasgow, United Kingdom

Control Strategies Aimed at Reducing the Prevalence of *E. coli* O157:H7 in Cattle Feces — DAVID SMITH, University of Nebraska-Lincoln, Lincoln, NE, USA

Lessons Learned from the Evaluation of Pre-harvest Food Safety Programs to Minimize the Risk of STEC Contamination in Meat, in Some French Operations — PATRICE ARBAULT, BioAdvantage Consulting, Orlienas, France

Impact of *E. coli* O157:H7 on Public Health and the Possible Impact of Pre-harvest Control Programs in Cattle Operations in Decreasing Human Infections — PATRICIA M. GRIFFIN, Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, Atlanta, GA, USA

Risk Assessment and Epidemiology Technical Session

Application of Kinetic Models to Describe Heat Inactivation of Selected New Zealand Isolates of *Campylobacter jejuni* — ALI M. AL-SAKKAF, Goeff Jones and John Mawson, Massey University, Institute of Food, Nutrition and Human Health, Palmerston North, New Zealand

FSIS *Escherichia coli* O157:H7 Beef Establishment Risk-assessment Project — James L. Withee, Eric D. Ebel, W. T. Disney, Dare Akingbade, Michael S. Williams, Wayne D. Schlosser, Nathan J. Bauer, Janell R. Kause, John M. Hicks, William K. Shaw, Jennifer Webb and DENISE R. EBLEN, USDA-FSIS, Washington, D.C., USA

Predictive Modeling for *Listeria monocytogenes* Transfer during Slicing of Delicatessen Meats — KEITH VORST, Lindsey Keskinen, Gary Burgess, Jeff Danes and Elliot Ryser, Cal Poly State University, Industrial Technology and Packaging, San Luis Obispo, CA, USA

Sources and Settings: Contaminated Food Vehicles and the Settings of Foodborne Disease Outbreaks — DANA COLE, Karen Herman and Barbara Mahon, CDC, Enteric Diseases Epidemiology Branch, Atlanta, GA, USA

The Potential for Cross-contamination of Foods through Improper Storage in Home Refrigerators — SANDRIA GODWIN, Fur-chi Chen, Richard Stone, Edgar Chambers and Delores Chambers, Tennessee State University, Family and Consumer Sciences, Nashville, TN, USA

A Mathematical Survival Model for *Escherichia coli* O157:H7 and *Staphylococcus aureus* on Stainless Steel Surfaces — FERNANDO PEREZ RODRIGUEZ,

Antonio Valero, Elena Carrasco, Ewen Todd, Guiomar Denisse Posada Izquierdo, Andrés Morales Rueda, Rosa Maria Garcia-Gimeno and Gonzalo Zurera, University of Cordoba, Dpto Bromatologia y Tecnologia Alimentos, Cordoba, Spain

The Value and Challenges of Providing Sound, Effective and Timely Risk-based Scientific Advice for International Food Safety Standard Setting — Sarah M. Cahill and MARIA DE LOURDES COSTARRICA, Food and Agriculture Organization of the United Nations, Nutrition and Consumer Protection Division, Rome, Italy

Foodborne Disease Outbreak Update

Multi-drug Resistant *Salmonella* in Ground Beef Outbreaks — SHAUN COSGROVE, Colorado Dept. of Public Health and Environment, Communicable Diseases, Denver, CO, USA

FSIS Investigation of Multidrug-resistant *Salmonella* Outbreak — SCOTT SEYS, USDA-FSIS, Office of Public Health, Minneapolis, MN, USA

Tools for Predictive Microbiology and Microbial Risk Assessment

An Update on USDA Predictive Microbiology Information Portal, Pathogen Modeling Program and ComBase — VIJAY JUNEJA, USDA, Wyndmoor, PA, USA

Emerging Decision Support Tools for Food Safety in the U.S. — LEE-ANN JAYKUS, North Carolina State University, Dept. of Food, Bioprocessing and Nutrition Sciences, Raleigh, NC, USA

FAO/WHO Risk Assessment Tools — SARAH CAHILL, FAO, Rome, Italy

Prioritizing Foodborne Risks Using Risk Ranger for Risk Profiling — PANAGIOTIS N. SKANDAMIS, Agricultural University of Athens, Dept. of Food Science and Technology, Athens, Greece