

Food Research Institute 2002 Annual Meeting

29–30 May 2002

Pyle Center
University of Wisconsin–Madison
Madison, WI 53706

*Summary prepared by Ellin Doyle, Ph.D., Food Research Institute
medoyle@facstaff.wisc.edu*

The Food Research Institute (FRI) hosted its annual meeting on May 29–30, 2002, in Madison, Wisconsin, with over 120 scientists from university, industry, and government in attendance. Updates on various food safety issues were presented. Special sessions addressed (a) Bioterrorism/Food Security, (b) Bovine Spongiform Encephalopathy/Animal Diseases that Affect the Food Supply, and (c) Genetically Modified Foods/Food Safety. A brief focus session addressed recent concerns about acrylamide levels in baked and fried foods. Two poster sessions were held: One highlighted the research of FRI faculty and associates; the other presented research results of FRI staff and post-doctoral and graduate students. A summary of the meeting is presented here. Further information can be obtained from our web site or by contacting FRI.

PROGRAM

BIOTERRORISM / FOOD SECURITY

The Food Industry's Response to Ensuring Food Security and Safety, *Rhona Applebaum, NFPA*
Food Safety and Security, *Robert Brackett, FDA, CFSAN*
Biological and Chemical Terrorism: Health Care Implications, *George Mejicano, UW–Madison*

FRI FACULTY AND AFFILIATES PRESENTATIONS

The Infectious Cyst: A Critical Stage in Foodborne Parasitic Disease, *Laura Knoll, UW–Madison*
Characterization and Control of Bacterial Foodborne Parasites, *Eric Johnson, FRI*
Escherichia coli O157:H7 Persistence — Life In and Out of the Intestinal Tract, *Charles Kaspar, FRI*
Regulation of Mycotoxin Biosynthesis and Fungal Sporulation, *Nancy Keller, UW–Madison*
Food Toxicology / Safety Evaluation at FRI, *Michael Pariza, FRI*
Biofilm Formation and Control; *Bacillus cereus* Virulence Factors, *Amy Wong, FRI*
Fungi and Mycotoxins: Understanding the Enemy, *Jaehyuk Yu, FRI*
Immunity in Disease and Physiological Processes, *Mark Cook, UW–Madison*
FRI Briefs: In Progress and Published, *Ellin Doyle, FRI*



BOVINE SPONGIFORM ENCEPHALOPATHY / ANIMAL DISEASES THAT AFFECT THE FOOD SUPPLY

An Update on BSE: Risk Management — Risk Communication, *Gary Weber, National Cattlemen's Beef Association*

BSE — Government Perspective, *Lisa Ferguson, USDA, APHIS*

Evaluation of the Potential for BSE in the United States, *George Gray, Harvard School of Public Health*

Food Safety: Risk Perception, Risk Communication, *Sylvia Rowe, International Food Information Council*

GENETICALLY MODIFIED FOODS / FOOD SAFETY

Plant Biotechnology: Regulatory Perspective, *Rachel Lattimore, Arent Fox*

Plant Genetic Engineering: Future Technologies, *Michael Sussman, UW–Madison*

Biotechnology: Benefits and Bottlenecks, *Linda Thrane, Council for Biotechnology Information*

WINDOW TO THE UNIVERSITY

E. coli O157:H7 Produces an Extracellular Metalloprotease, StcE, Specific for Cleavage of Human C1 Esterase Inhibitor, *Rodney Welch, UW–Madison*

Pathogenesis of Gastrointestinal Listeriosis, *Charles Czuprynski, UW–Madison*

Intellectual Property and the UW, *Bryan Renk, WARF*

Bioterrorism/Food Safety

Terrorists may attack targets in the food industry to cause disease outbreaks but their real goal may be to create chaos by disrupting food production and trade. Responses of the food industry to potential threats to food safety and security were discussed by Rhona Applebaum (NFPA). Food plant and product security require somewhat different expertise than traditional food safety. Personnel is the number one concern, and increased screening and supervision of employees may be necessary. Security of food plants may be improved by the 3 L's: Light It, Lock It, and Limit Access to It. To aid companies in managing and minimizing risks, NFPA has been working closely with FDA to produce guidelines and security checklists and manuals. Various sectors of the food supply system—from farm to table—are working to manage risks and share procedures and best practices by improved communication, coordination, cooperation, consultation, and collaboration. It is important to prevent disease outbreaks and also prevent a loss of confidence in food production and processing systems.

FDA has traditionally focused on detecting and preventing non-intentional contamination of food by science-based inspection, surveillance, and education/training. FDA's new goal is to preserve the safety and security of the U.S. food supply from biological, radiological, and chemical threats—both intentional and unintentional. Robert Brackett (FDA, CFSAN) outlined a sequence of six steps for operational risk management: identification of hazards, assessment of risks, determining and implementing controls, and periodic review of security measures. Laboratory capabilities must be enhanced and plans should be made for emergency response and containment procedures. Some outstanding challenges include the need for improved analytical methods, a mechanism for the sharing of “classified” information, and the possibility that hoaxes can overwhelm analytical and response systems.



Health care implications of biological and chemical terrorism were addressed by George Mejicano (UW Medical School). Contamination of a particular consumable product may not be too difficult, and several small outbreaks of disease have occurred following deliberate tampering or contamination of food. However, a large-scale attack is more complex and difficult. Some extremely toxic agents, such as botulinum toxin, would not survive well in the environment while other less lethal agents, such as smallpox virus, are very infectious. Several potential agents of bioterrorism, including anthrax, smallpox, plague, tularemia, and botulinum toxin, were described. Mortality and morbidity caused by the various agents and their potential for widespread dispersal were also discussed. Food processors and medical personnel should be aware that, when used as bioterrorist weapons, these agents may appear in unexpected places and we should all have an increased index of suspicion when unusual clusters of disease symptoms are observed or reported.

Bovine Spongiform Encephalopathy / Animal Diseases that Affect the Food Supply

BSE in cattle and CWD (chronic wasting disease) in deer and elk (cervids) pose potential food safety risks to consumers of tissues (primarily brain and spinal cord) from affected animals. Although the number of cattle with BSE has greatly diminished since the peak of the epidemic in Great Britain in 1992, affected cattle have been diagnosed in numerous European countries and in Japan. CWD has now been detected in captive cervids in 7 states and 2 Canadian provinces and in wild cervids in 5 states and in Saskatchewan according to Judd Aiken (UW Veterinary School). So far there has been no proven link between CWD and human illness; nor is it known how CWD is naturally spread among cervids.

Measures to manage the real risk of BSE as an animal disease and to address the perceived risk of BSE and other TSEs in food animals by communicating effectively with consumers and international partners were discussed by Gary Weber (NCBA). Disease management in the U.S. has focused on preventing the entry of BSE into the U.S. by a triple firewall: import bans, feed restrictions, and ongoing surveillance. A number of risk assessments have identified key areas of concern. FSIS is considering other policy options for reducing human exposure to central nervous system tissue in meat products. A TSE Working Group, including experts from several federal agencies, has evaluated relevant data and made policy recommendations. Consumers appear confident that U.S. beef is BSE-free.

Since BSE is not naturally spread directly from animal to animal but rather was caused by feeding contaminated meat and bone meal to cattle, restrictions on the feeding of ruminant protein to ruminants have been one important strategy to prevent BSE in the U.S. Lisa Ferguson (USDA, APHIS) also described surveillance strategies and testing methods for analysis of bovine tissues. The government is also coordinating activities with Canada and Mexico and is planning to increase surveillance testing of downer cattle and cattle with symptoms of central nervous system disorders. The APHIS web site (<http://www.aphis.usda.gov/oa/bse>) provides up-to-date information on government activities.

A comprehensive evaluation of the risk for BSE occurring in the U.S. was described by George Gray (Harvard). A quantitative model was developed that analyzed the probable



risk for an outbreak of BSE if a few infected animals were introduced into the U.S. There are many uncertain and variable factors affecting the outcome, and a thousand analyses were run using different values for these parameters. If 10 BSE-infected animals were inadvertently imported into the U.S., the model predicted that the U.S. would be resistant to the introduction of BSE. There might be a small increase in the number of cattle with BSE initially but the disease would die out within 20 years.

Risk communication requires attention to numerous attitudes and concerns of the public. As Sylvia Rowe (IFIC) pointed out, when people are very concerned about food safety issues and don't trust industry and government spokespersons, it is difficult to evaluate and process information. Fortunately, with the BSE issue, consumers appear to have confidence that the meat supply is safe. Communication on risks and preventive measures has been effective in the U.S.

Acrylamide in Fried and Baked Foods

Recent reports of significant amounts of acrylamide in fried and baked foods, particularly in high carbohydrate foods, have aroused concern in producers and consumers of such foods. FRI scientists and colleagues at the UW are investigating possible intervention methods to reduce or eliminate acrylamide production during food processing. Robert Lindsay (UW Food Science) discussed chemical reactions that could form acrylamide at high temperatures. The carbon skeleton of the acrylamide molecule may be supplied by acrolein (which can be formed from lipids), sugars, and certain amino acids. At this point, while the lipid origin seems most likely, there are no supporting experimental data. Conversion of acrolein to acrylamide requires addition of an amine, and there are a number of sources of free ammonia in foods which could participate in this reaction.

Suppression of acrolein production in foods was addressed by Hyuk Yu (UW Chemistry). Lipids can be converted to acrolein by oxidation reactions involving the formation of free radicals at high temperatures. It is not practical to cook foods anaerobically but it may be possible to use a combination of antioxidants (to quench the free radicals) and reduced temperatures to inhibit acrolein production. However, such solutions must be matched with the requirements for producing tasty and safe foods.

Yeonhwa Park (FRI) reported results from initial experiments to verify the presence of acrylamide in potato chips. Using GC/MS with selected ion monitoring, she found that acrylamide in 6 different types of chips varied from 271 to 2468 ppb while raw potatoes contained <30 ppb acrylamide. There was no apparent correlation between the type of oil used for frying and the acrylamide levels in the chips, but the sample size was small. Acrylamide levels in various foods will be investigated further.

Genetically Modified Foods / Food Safety

A perspective on the regulation of genetically modified (GM) foods by FDA, USDA, and EPA was presented by Rachel Lattimore (Arent Fox). EPA's concern is primarily with modifications involving pesticidal substances and PIPs (Plant Incorporated Pesticides). Such GM



organisms, for example those containing Bt genes for insect resistance, require experimental use permits as well as pre-market and post-market review and approval. USDA, through APHIS, is concerned with protection of agriculture and the environment and is involved in clearance for field tests and commercial planting of genetically modified crops. FDA is concerned directly with the safety of food and has adopted a decision-tree approach to determine whether GM crops are substantially equivalent to conventional crops and can therefore be considered GRAS. Regulations on food additives may apply if the GM crop is not substantially equivalent. New rules and regulations have been proposed but have not yet been approved.

Michael Sussman (UW Biotechnology Center) discussed recent technological innovations and the awesome prospects for genetic research and manipulation in the future. Entire genomes of several organisms, including bacteria, plants, and animals, have been sequenced. DNA chips containing 6000 spots of DNA (genes) can be made and used to determine whether gene expression of an organism, such as yeast, is changed under different conditions. These chips are currently expensive but are likely to become cheaper as they are produced in larger quantities. Such chips can be used to determine which genes are important for development and various metabolic processes. Plants may be engineered to produce important products, such as the enzyme phytase, which can be incorporated into animal feed to improve nutritional quality. Better yet, perhaps the phytase gene can be incorporated into farm animals such as pigs. Or, how about a photosynthetic pig, producing its own food! Some of these ideas may seem fantastic, but research in this area is moving fast.

Plant biotechnology remains a controversial issue despite the benefits it may provide farmers and consumers. Linda Thrane (Council for Biotechnology Information) described educational programs to improve awareness and knowledge about biotechnology and thereby increase its acceptance. Educational strategies include advertising, establishing relationships with media outlets, and building relationships among interested groups. Many surveys have demonstrated that the more people know about biotechnology, the more they are likely to support it. GM varieties of potatoes, sweet corn, and sugar beets have been developed but are not being grown because food processors and retailers fear rejection by consumers. An effective educational program may be a way to deal with bottlenecks inhibiting the use of biotechnology in agriculture.

Other Research on Foodborne Pathogens

Parasites are not usually considered a significant cause of foodborne infections in the U.S., but in fact there has been a seven-fold increase in the incidence of coccidian parasitic infections in recent years according to Laura Knoll (UW Medical Microbiology and FRI). Coccidia are single-celled protozoa, all of whom are obligate intracellular parasites and form infective cysts. The most common human pathogens are *Toxoplasma*, *Cryptosporidium*, and *Cyclospora*. Infective stages of *Toxoplasma* can be present in the meat and the feces of infected animals. Thus, common routes of infection include consumption of undercooked or raw meat and exposure to animal wastes, e.g., cat litter. There is a large reservoir of *Cryptosporidium* in animals; infection is passed to humans through water or foods contaminated with animal



wastes. Recent *Cyclospora* outbreaks were traced to fruit which probably had been washed or irrigated with contaminated water. Current research at the UW is aimed at understanding the development of these parasites and defining the factors that control the various stages in their life cycles.

Enterohemorrhagic *E. coli* O157:H7 causes severe bloody diarrhea and hemolytic uremic syndrome leading to kidney failure and death in young children and the immunocompromised. Shiga-like toxins are known to cause some of these effects. Rodney Welch (UW Medical Microbiology and FRI) described another virulence factor, called StcE, that was identified in his lab. This protein is coded on the virulence plasmid and cleaves the human C1 inhibitor. C1 inhibitor normally functions to control inflammatory processes in the body and so its destruction by StcE can result in increased inflammation, edema, and tissue damage in the intestines. These research results suggest that C1 inhibitor replacement could be used to alleviate symptoms of *E. coli* O157:H7 infections. This therapy has proven useful in treating people with a hereditary deficiency in C1 inhibitor activity.

Research on the mechanisms of pathogenesis of *Listeria monocytogenes* in the gastrointestinal tract was discussed by Chuck Czuprynski (UW Veterinary Medicine and FRI). *Listeria monocytogenes* does not compete well with other intestinal flora but does produce several virulence factors, including hemolysin, internalins, and phospholipases, which aid in directly invading intestinal cells. Although several virulent strains of *L. monocytogenes* have been identified, serotype 4b is associated with most large outbreaks. This strain appears to be better able to move out of the intestine and infect the spleen and liver. Experiments are underway to determine whether growth or emulsification of this strain in RTE meats will affect virulence in the gastrointestinal tract. Data on growth in hot dogs and broth under various conditions will be used to develop predictive models.

Intellectual Property and the UW

WARF (Wisconsin Alumni Research Foundation) is the designated intellectual property manager for the UW Madison and is involved in licensing intellectual property to the marketplace. According to Bryan Renk (WARF), WARF receives about 300 invention disclosures and files about 200 patent applications per year. When WARF takes title to intellectual property developed by UW employees, WARF shares a percentage of the royalty income with the inventors and the inventor's department. WARF provides money for university research and is financially supporting the new Biostar building that will house the Food Research Institute and the Departments of Bacteriology and Medical Microbiology.

