University of Wisconsin-Madison's Food Research Institute 2015 Annual Meeting Highlights

Wendy Bedale

Food Research Institute, University of Wisconsin-Madison, 1550 Linden Dr., Madison, WI 53706, USA

OVERVIEW

The University of Wisconsin's Food Research Institute annual meeting, held in late May of 2015, brought together scientists, regulators, public health representatives, and industry professionals to discuss alternatives to antibiotic use in food animals, the future of microbiome research and its applications, current topics in microbial food safety (norovirus research and the caramel apple listeriosis outbreak), novel antimicrobial technologies, and Food Safety Modernization Act (FSMA) implementation strategies.

MEETING SUMMARY

The Food Research Institute (FRI) of the University of Wisconsin-Madison held its annual meeting May 20–21, 2015. The scientific sessions included presentations by representatives of industry, academia, and public health and regulatory agencies on topics related to antibiotic use in animals, microbiome research, microbial food safety and public health, clean-label technologies, and progress in implementing the Food Safety Modernization Act (FSMA).

The powerful roles that the public and government play in driving the food industry was a strong underlying theme, evident throughout the meeting. Shifts in public perception and government regulatory practices create challenges and drive innovation in the food sector.

While the general public clearly fears microbes (as the proliferation of antimicrobial products such as hand sanitizers demonstrates), it also doesn't want antibiotics to be used in food production. Consumers are willing to pay extra for that preference, with the result that current market prices for antibiotic-free chicken are 70% higher than those for conventionally-raised chicken, according to Mark Cook at the University of Wisconsin-Madison. The FDA's move to halt antibiotic use for growth promotion in feed animals by the end of 2016 is prompting an active search for alternatives.

Originally, in the 1940s and 1950s, the use of antibiotics in otherwise healthy animals reduced feed costs by 20%. This effect has been a powerful incentive to perpetuate the practice, according to Torey Looft of the ARS Animal Disease Center, even if the exact mechanism for antibiotic promotion of growth is not clear. Most scientists agree that antibiotic use in food animals provides selective pressure for development of resistant strains of bacteria. What is less clear is the extent to which antibiotic use in animals leads to antibiotic-resistant infections in humans. Peter Davies of the University of Minnesota illustrated the complexity of the debate with several examples: the addition of zinc to animal feed increases the prevalence of antibiotic resistance genes in pigs, even in the absence of antibiotics, while vancomycin-resistant enterococci-associated bacteremia in Europe actually increased after the 1997 ban of the vancomycin-related antibiotic avoparcin.

Mark Cook described a novel antibiotic replacement strategy for feed animals. Instead of focusing on attacking the microbe, his group's research targets the host's immune response. The researchers found that oral delivery to chicks of an egg-based antibody against the anti-inflammatory cytokine IL-10 reduced gut IL-10 levels and decreased coccidiosis-associated body weight loss, with no adverse systemic effects. Commercial trials of the antibody are under way in chickens, and other applications are likely, as proof-of-concept for controlling helminth infection in lambs and cattle was recently achieved.

The public also fears chemicals with unfamiliar names, even those effective at killing or inhibiting pathogens in food products. Food safety may be taken for granted by a younger generation of consumers, who play a key role in determining which hurdles food companies employ to manage microbes. "Cultured sugar" sounds better than "lactic acid" on a food label to the typical consumer, even if the former employs microbes in its production. Cherry powder (unstandardized and containing unknown but nevertheless "natural" components) is accepted, possibly with some curiosity, in meat products, yet purified ascorbic acid (vitamin C) is rejected as not "natural." Natamycin (an antifungal compound derived from *Streptomyces*) is considered a natural ingredient, but acetic acid is treated with suspicion unless it is called "vinegar." And why are "cultured" products containing unknown and variable amounts of bacteriocins preferred

Corresponding author: Phone: +1 608.263.6934; E-mail: bedale@wisc.edu

FRI Director Chuck Czuprynski presenting the William C. Frazier award to Robert Tauxe, Deputy Director of CDC's Division of Foodborne, Waterborne, and Environmental Diseases.

by the public over irradiation of food to prevent microbial growth? The importance of understanding and responding to the public's changing perceptions cannot be discounted, as highlighted in talks by Jae-Hyuk Yu of the University of Wisconsin-Madison, Amanda King of Kraft Foods, and Alvin Lee of the Institute for Food Safety and Health.

Although microbes generally are feared, consumers have embraced pre- and probiotics, even though evidence for their benefit in otherwise healthy individuals is scanty. Indeed, according to Emma Allen-Vercoe of the University of Guelph, it is difficult to make lasting and significant changes to a healthy gut microbiome after it has been established, at the time of weaning. However, what we eat clearly can affect the bacteria in the gut, as demonstrated in a recent study that found altered gut microbe composition in people consuming artificial sweeteners. Because various lines of evidence suggest that alterations in gut microbe composition could be linked to a variety of disorders, including inflammatory bowel disease and autism, it is important to understand how to maintain (and feed) a healthy gut microbiome. A low-fiber, highly refined diet is digested in the upper gastrointestinal tract, leaving less nutritional value for microbes in the lower GI tract. Dr. Allen-Vercoe suggested that the uniqueness and stability of the gut microbiome (which she dubs one's "poo-print") might someday lead to personalized diets based on one's microbiome.

Other presentations illustrated diverse ways in which an understanding of gut microbiology and microbiome research can be applied. The use of human-derived probiotics for *in situ* delivery of proteins or other products requires development of genetic tools in those strains. Such a system has been elegantly developed in *Lactobacillus reuteri* by J. P. Van Pijkeren of the University of Wisconsin-Madison. Greg Siragusa of DuPont described how his organization and others have begun testing food products at the microbiome level in order to better understand and control food's entire microbial content, including organisms that might not be culturable.

Recent advances in norovirus work, including progress towards an *in vitro* model using human B cells, were described by Stacy Schultz-Cherry of St. Jude Children's Research Hospital. Most healthy patients clear norovirus infections quickly, but the immunocompromised may harbor and shed the virus for months, representing an important, underappreciated reservoir for transmission.

A description of the Canadian approach to food safety oversight, and in particular the microbiological testing of food, was provided by Penelope Kirsch of the Canadian Food Inspection Agency. Within their monitoring program, a combination of monitoring and risk-based sampling plans is used to assess food products and environmental samples to verify industry compliance with Canadian food safety standards. In recent years, the Agency has implemented targeted and enhanced surveys to increase its emphasis on the sampling and testing of fresh produce and has expanded its testing to include viruses and parasites.

The 2014 caramel apple listeriosis outbreak took food safety experts and epidemiologists by surprise, as neither apples nor caramel are associated with listerial growth because of their low pH and low water activity, respectively. Kathy Glass of FRI presented data in which *Listeria monocytogenes* (obtained from the caramel apple outbreak and inoculated in the lab on apples before caramel coating) grew better on caramel apples with sticks than in caramel apples without sticks. Insertion of the stick may promote release of juice and microbe transfer to the interface between the caramel and the apple, creating a microenvironment capable of supporting listerial growth.

Caramel apples and other foods not previously associated with foodborne disease have been implicated increasingly in outbreaks as food distribution networks expand and outbreak investigations become more sophisticated. Without whole genome sequencing (WGS), the role of caramel apples in the outbreak might not have been appreciated for some time, according to Rachel Klos of the Wisconsin Division of Public Health. WGS was essential in linking one of the Wisconsin cases to a different multi-state cluster of cases in that outbreak. This patient was infected with *Listeria monocytogenes* strains representing two case clusters being investigated separately, before either cluster was linked to a food product. WGS helped investigators trace the source of the outbreak to a single apple supplier.

Robert Tauxe of the Centers for Disease Control and Prevention (CDC), presenting the William C. Frazier

(Continued on next page)

lecture, also commented on the increasingly important role WGS is playing in outbreak investigations. A big obstacle in identifying outbreaks occurring across different geographic regions has been the lack of standardized subtyping methods. PulseNet is the CDC's nationwide network of laboratories, which have all adopted standardized subtyping methods based on pulsed-field gel electrophoresis (PFGE). By collecting and monitoring data generated by use of the same subtyping methods, PulseNet has been very successful in identifying outbreaks occurring in geographically disparate locations. PulseNet continues to be adapted to new pathogens (soon to include norovirus) and is being adopted in other countries.

Although PulseNet has greatly improved the ability to link among cases when outbreaks are still small (average outbreak size of 72 cases prior to PulseNet, compared with a current average outbreak size of 35), the overall incidence of illness caused by certain foodborne pathogens has not decreased appreciably. WGS could change this. Tauxe reiterated and expanded on Klos's suggestion that WGS can help identify "polyclonal" disease outbreaks, such as the caramel apple outbreak. WGS can also match pathogen strains that confound PFGE analysis, such as those harboring an integrated bacteriophage. The CDC currently is using WGS for *Listeria monocytogenes*, and will soon apply the technology to Shiga toxin-producing *E. coli* and *Salmonella* investigations. With the use of WGS, "upside-down outbreaks," in which pathogens are first found in food or the environment before clinical cases are linked to them, may become the new norm, and foodborne disease may become more preventable.

The increasing complexity of today's food systems was one of the key drivers towards creation of the Food Safety Modernization Act (FSMA). FSMA represents a huge shift in the way food production is regulated, moving from a reactive stance to a proactive approach to preventing food safety problems. The final session of FRI's annual meeting, featuring Steve Ingham of the Wisconsin Department of Agriculture, Trade, and Consumer Protection; Michael Dutcher of the FDA, and Joseph Shebuski of Cargill, discussed progress in translating the concepts of FSMA into rules, strategies, and new ways of operating for regulators and food producers. Although FSMA was signed into law in 2011, and proposed rules have been published for public comment, the final rules implementing FSMA will begin rolling out in August 2015. Compliance by large food producers is expected within one year after each final rule is published. Michael Dutcher commented that the FDA hopes to provide regulatory incentives for compliance. Joe Shebuski expanded upon this concept, calling for policies that encourage, rather than provide disincentives, for food producers to continue environmental monitoring and address potential contamination issues.

Many challenges exist in the implementation of the new rules. For example, in relation to produce safety, how will inspectors identify and inspect farms not required to register with the FDA? With new regulations related to the transport of food, how will food regulators interact with transportation regulators? The FDA is committed to meeting implementation deadlines and to keeping its processes as transparent as possible. The imminent implementation of FSMA may represent an opportunity for state and federal inspectors to reduce redundancies and streamline processes, including inspections, but it is clear that the FDA, state regulators, and food producers will be very busy as deadlines for FSMA implementation loom.

FRI is the portal to food safety at the University of Wisconsin-Madison. FRI operates its own laboratories and administers its own research and service programs in an effort to fulfill its mission to enhance the safety of the food supply.

In Memory

Dr. Jose M. Rodriguez

We extend our deepest sympathy to the family of Dr. Jose M. Rodriguez who recently passed away. Dr. Rodriguez was a member of the Association since 2008. IAFP will always have sincere gratitude for his contribution to the Association and the profession.