Monday, July 9
SYMPOSIA AND ORAL SESSIONS
Keynote Symposium: Tomorrow’s Poultry: Sustainability and Safety

1 Introduction: Tomorrow’s Poultry: Sustainability and Safety. G. Cherian,* Oregon State University.

The poultry industry in the United States faces numerous challenges that both directly and indirectly impact the sustainability of the nation’s poultry production systems. The intensive selection for fast growth and high feed efficiency in modern-day birds has been accompanied by a weakened immune system, increased disease susceptibility and dependence on in-feed antibiotics. Consumers have voiced a concern about the ways in which birds are fed and the widespread use of in-feed antimicrobials. Such concerns have led to the tremendous increase in organic poultry production in recent years. However, such antibiotic-free production systems also face bacterial disease challenges such as necrotic enteritis resulting in reduced growth rate, poor feed efficiency and increased contamination. It is imperative that today’s poultry industries be proactive in improving the safety of poultry foods. Addressing these challenges requires an increased input of knowledge about production systems and expertise to develop integrative systems that maximize animal health and product safety in a sustainable manner. Such measures include improvement of diet, utilization of biocontrol measures to enhance bird health, and novel processing and packaging strategies to enhance safety of food products. These measures must also be cost-effective for the continued viability of the industry. It is essential to understand these different strategies to successfully plan for the future of poultry production and food security in the US. The objectives of this symposium are to provide a direct interaction and collaboration among food/feed scientists, nutritional immunologists, microbiologists, and veterinarians who are working in the areas of bird health, feed, and food safety. Such a dialog will foster cross-fertilization of ideas, stimulate the development of innovative strategies to enhance food safety and the sustainability of US poultry food systems.

Key Words: poultry, sustainability, safety

2 Role of dietary phytochemicals in modulating local innate immunity and as alternatives to growth promoting antibiotics to reduce inflammation. H. Lillehoj,* D. Kim, and S. Lee, USDA, ARS, BARC, Beltsville, MD.

The global animal industry needs to address the increasing regulatory restrictions on the use of antibiotic growth promoters (AGPs) in animal production. Many AGPs have already been restricted by animal farms in the EU and soon other countries are expected to be under increasing scrutiny as consumers’ concerns about drug resistant superbugs increase. Accordingly, scientific evidence-based publications are supporting the possibility of sustaining intensive modern farming without the use of AGPs, especially in the area of disease control. There has been a great deal of information on new biocontrol approaches for preventing and/or treating bacterial, viral and parasitic pathogens in food animal production. Multiple alternatives, including prebiotics, probiotics, phytonutrients, hyperimmune antibodies, antimicrobial peptides, and toll-like receptor agonists, have already been used by the animal industry for various claims, but it is generally accepted that none of these alternatives are known to be as effective as AGPs in field application. However, a combination of additives or novel feed additives have shown some efficacy to compensate for production loss, in the absence of AGPs, with economic returns. “Phytonutrients” are plant- or fruit-derived chemical compounds possessing health benefits including promoting tumor killing and increased resistance to infectious diseases. While numerous studies have shown disease prevention or immune enhancing effects of phytonutrients, very few reports have examined the underlying mechanisms for their specific immune modulating effects in animal disease models. Many phytochemicals are known for their anti-inflammatory properties and an increasing number of studies have indicated that diets rich in anti-inflammatory phytochemicals may have beneficial effects in ameliorating tissue damages caused by pathogens. This presentation will highlight recent progress in understanding immunomodulatory properties of phytonutrients and developing dietary immune enhancing strategies to mitigate the use of antibiotics.

Key Words: necrotic enteritis, immunomodulation, phytonutrients


Salmonella Enteritidis and Campylobacter jejuni are major foodborne pathogens transmitted through poultry products. Chickens are the reservoir host of S. Enteritidis and C. jejuni, with their intestinal colonization being the most significant factor causing contamination of meat and eggs. Effective pre-harvest strategies for reducing the colonization of birds with these pathogens are critical to improve the microbiological safety of poultry products. An antimicrobial treatment that can be applied through feed represents the most practical and economically viable method for
adoption on farms. Additionally, a natural and safe antimicrobial will be better accepted by the producers without concerns for toxicity. This symposium talk will discuss the potential use of several plant-derived, GRAS-status molecules as a feed supplement for reducing cecal populations of S. Enteritidis and C. jejuni in chickens. Additionally, the effect of plant molecules on Salmonella virulence genes critical for cecal colonization in chickens will be discussed.

Key Words: Salmonella Enteritidis, Campylobacter jejuni, chicken, cecum, plant-derived molecules


Salmonellosis in the United States is one of the more costly foodborne diseases. Given that Salmonella can originate from a wide variety of environments, reduction of this organism at all stages of poultry production is critical. During its life cycle Salmonella species can encounter various environmental stress conditions which can dramatically influence their survival and virulence. Research continues to focus on Salmonella metabolism and genetic regulation of stress responses during a variety of growth conditions and how these overlap with expression of virulence when foodborne Salmonella become pathogenic. Although there is considerable evidence on Salmonella infection, little is known about the mechanism(s) involved when Salmonella are successfully repulsed as well as when they are able to surmount these unknown mechanism(s) and successively colonize the gut. Knowledge of Salmonella species metabolism and physiology is traditionally based on studies conducted primarily with tissue culture and animal infection models. Consequently, while there is some information about environmental signals that control growth and pathogenesis during and after invasion of the intestinal tract much less is known about the biology of Salmonella species in the gastrointestinal tract before attachment and invasion. With new genetic tools and information now available, more is known on how growth and survival conditions influence virulence and pathogenic characteristics of Salmonella in the chicken gastrointestinal tract. This has led to development of novel approaches for limiting Salmonella establishment in all phases of poultry production.

Key Words: Salmonella, control, food safety, poultry, gastrointestinal tract

5 Characterization of bacteriophages virulent for Clostridium perfringens and identification of phage lytic enzymes as alternatives to antibiotics for potential control of the bacterium. B. S. Seal,* Poultry Microbiological Safety Research Unit, ARS, USDA, Athens, GA.

There has been a resurgence in the use of bacteriophages or their gene products to control bacterial pathogens as alternatives to currently utilized antibiotics. Clostridium perfringens is a gram-positive, spore-forming anaerobic bacterium that plays a significant role in human foodborne disease as well as non-food-borne human, animal and poultry diseases. Countries that have complied with the ban on antimicrobial growth promoters (AGP) in feeds have reported increased incidences of C. perfringens-associated necrotic enteritis in poultry. To address these issues, new antimicrobial agents, putative lysins encoded by the genomes of bacteriophages, are being identified in our laboratory. Poultry intestinal material, soil, sewage and poultry processing drainage water were screened for virulent bacteriophages that could lyse the bacterium C. perfringens and produce clear plaques in spot assays. Bacteriophages were isolated that had long non-contractile tails, members of the family Siphoviridae, and with short non-contractile tails, members of the Podoviridae. Several phage genes were identified that encoded N-acetylmuramoyl-l-alanine amidases, lysozyme-endopeptidases and a zinc carboxypeptidase domain that has not been previously reported in viral genomes. Two putative phage lysin genes (ply) were cloned and expressed in Escherichia coli, and the resultant proteins were purified to near homogeneity. The recombinant lysins were amidases capable of lysing both parental phage host strains of C. perfringens as well as other strains of the bacterium in spot and turbidity reduction assays, but did not lyse any clostridia beyond the species. Consequently, bacteriophage gene products may eventually be utilized to target specific bacterial pathogens to control animal and human diseases without having deleterious effects on beneficial bacteria.

Key Words: antibiotic alternative, enzybiotic, bacterial virus, poultry health, food safety

6 Irradiation and additive combinations on the pathogen reduction and quality of poultry meat. D. U. Ahn* and E. J. Lee, Iowa State University, Ames; University of Wisconsin-Stout, Menomonie.

Reduction of food-borne illnesses and deaths by improving the safety of poultry products is one of the priority areas in the US, and developing and implementing effective food processing technologies can be very effective to accomplish the goal. Irradiation is an effective processing technology for eliminating pathogens in poultry meat. Addition of antimicrobial agents during processing can be another approach to control pathogens in poultry products. However, the adoption of irradiation technology by meat industry is limited because of quality and health concerns about irradiated meat products. Irradiation produces a characteristic aroma as well as alters meat flavor and color that significantly impact upon consumer acceptance. The generation of a pink color in cooked poultry and off-odor in poultry by irradiation is a critical issue because consumers associate the presence of a pink color in cooked poultry breast meat as contaminated or undercooked, and off-odor in raw meat and off-flavor in cooked meat with undesirable chemical reactions. As a result, meat industry has difficulties in using irradiation to achieve its food safety benefits. Antimicrobials such as sodium lactate, sodium diacetate, and potassium benzoate are extensively used to extend the shelf-life and ensure the safety of meat products. However, the use of these antimicrobial agents alone cannot guarantee the safety of poultry products. It is known that some of the herbs, spices, and antimicrobials commonly used in meat processing can have synergistic effects with irradiation in controlling pathogens in meat. Also, addition of spices or herbs in irradiated meat improved the quality of irradiated poultry by reducing lipid oxidation and production of off-odor volatiles or masking off-flavor. Therefore, combinations of irradiation with these additives can accomplish better pathogen reduction in meat products than using them alone even at lower levels of antimicrobials/herbs and irradiation doses. Effects of irradiation and additive combinations on the pathogen reduction and quality of poultry meat will be discussed in detail.

Key Words: food-borne illnesses, safety and quality, poultry products, irradiation, additives
Organic poultry farming is one of the fastest growing segments of animal agriculture since the past decade in USA. This is due to a combination of increased consumer demand, environmental awareness among producers, increased antibiotic resistance of human pathogens and regulations. National organic program is being administered by USDA and poultry raised organically should meet animal health and welfare standards, do not use hormones, not use antibiotics unless in an emergency, use organic feed and provide birds with access to the outdoors. In spite of the growing popularity of organic farming, there are limited numbers of scientific papers published related to poultry health especially from USA. This is further hampered by lack of scientific research on raising poultry organically. Health of organically raised poultry are influenced by various factors such as breed, flock size, feed composition, rearing environment, external parasites, predators, free flying and wild birds, insects, rodents, vaccination, biosecurity, disease detection and prevention and lack of basic knowledge. Most common noninfectious disease problems reported with organic farming is increased incidence of feather picking and cannibalism that can lead to increased mortality. Integumentary problems such as foot pad dermatitis, breast blisters, external parasites such as mite infestation have been reported to increase in poultry raised organically. Among the infectious agents the greatest threat to poultry raised outdoors is probably exposure to Avian Influenza by free flying birds. Insects, rodents, and wild birds as well as predators cannot only be a source of diseases but also transmit infectious diseases to poultry. Internal parasites such as *Ascaridia sp.*, *Heterakis gallinarum*, *Capillaria sp.* and tape worms and protozoa such as coccidia and *Histomonas meleagridis* have been reported to be increased in organically raised poultry resulting in increased mortality. Among bacteria *Salmonella sp.*, *E. coli*, *P. multocida*, *Erysipelas*, *Campylobacter spp.*, *Clostridium perfringens*, etc., have also been known to cause disease in poultry raised organically but some of them can also of great public health significance.

**Key Words:** organic, farming, health, diseases