

## REPORT OF THE COMMITTEE ON FOOD AND FEED SAFETY

Chair: Daniel E. Lafontaine, SC  
Vice Chair: Bonnie J. Buntain, AB, CAN

David C. Ailor, DC; Deanna L. Baldwin, MD; Marilyn F. Balmer, MD; Joseph L. Blair, VA; Richard E. Breitmeyer, CA; Deborah L. Brennan, MS; Roy D. Brister, AR; Peggy N. Carter, VA; Tony A. Caver, SC; Max E. Coats, Jr., TX; Kevin G. Custer, IA; Glenda S. Davis, AZ; Ignacio T. dela Cruz, ; Reta K. Dyess, TX; Kathy D. Finnerty, NY; Robert F. Gerlach, AK; L. Wayne Godwin, FL; C. Ross Hamilton, TX; Larry L. Hawkins, MO; Jay Hawley, IN; Jan E. Hershenhouse, CA; Christine N. Hoang, IL; Donald E. Hoenig, ME; Kristin G. Holt, GA; Rex D. Holt, GA; Clyde B. Hoskins, SC; Danny R. Hughes, AR; John P. Huntley, NY; Susan J. Keller, ND; Sung G. Kim, NY; Spangler Klopp, DE; Elizabeth A. Lautner, IA; Laurent O'Gene Lollis, FL; Kelli S. Ludlum, DC; John R. MacMillian, AR; Bret D. Marsh, IN; David T. Marshall, NC; Kris Mazurczak, IL; James D. McKean, IA; Katherine M. McNamara, VT; David L. Meeker, VA; Andrea Mikolon, CA; Nicole Neeser, MN; Carol A. Olmstead, MT; Kenneth E. Olson, IL; Gary D. Osweiler, IA; Bob E. Pitts, GA; Gerardo Quaassdorff, VT; John R. Ragan, MD; James T. Rankin, Jr., PA; Jane F. Robens, MD; Nancy J. Robinson, MO; Leon H. Russell, Jr., TX; John P. Sanders, WV; Harry Snelson, NC; Rosemary A. Speers, VA; Philip Stayer, MS; Bruce N. Stewart-Brown, MD; James E. Stocker, NC; Stanley A. Stromberg, OK; H. Wesley Towers, DE; Liz K. Wagstrom, IA; Gary L. Waters, MT; Larry L. Williams, NE; Rob S. Williams, DC; Nora E. Wineland, CO; John F. Wortman, Jr., NM

The Committee met on October 11, 2009 at the Town and Country Hotel, San Diego, California, from 1:00 to 5:30 p.m. There were 15 members and 42 guests present. Chair Dan Lafontaine presided. Dr. Lafontaine welcomed all attendees and introduced this year's overall theme, *Animal Production Food Safety*. The program consisted of a series of six presentations by animal production experts from the U.S. Department of Agriculture, Food Safety Inspection Service (USDA-FSIS), industry organizations, private industry and academia. The Committee's business meeting followed the scientific presentations.

Dr. Dee Griffin, the Beef Production Management Specialist at the University of Nebraska, Great Plains Veterinary Education Center opened the program with a presentation entitled Beef Quality Assurance ... the Revolution Impacts on Quality. The key mission of Beef Quality Assurance (BQA) is education. BQA grew from its 1980 start as a Beef Safety Assurance Program (residue avoidance) in five states to a national education program. The first Quality Audit in 1991 pointed to injection sites and "Defect Avoidance." Education became a key program. A selling point for the program was that information to producers was applied with common sense, and these early basic BQA points are still sound. Quality Assurance Programs were designed by producers and food industry affiliates to provide production management education. This education targets defect prevention with an emphasis on safety. Specifically targeted is the prevention of chemical, physical and biological safety defects or hazards. Care and husbandry; feeds and additives; health products; and records are still the basis for the National Guideline Best Management Practices (BMPs). They enhance consumer confidence in product quality and safety. An essential point is that BQA Programs are not Government Programs. They are by and for the industry.

In the world of food, consumers want to purchase safe foods. They buy what they trust. So, producers need to know that defects cost money and that their cattle are never too young or too old to create a quality defect. In food animals, quality defects are a life cycle phenomenon and everyone needs to be on board to prevent them. Further, the beef production industry should build on what it knows best. Cattlemen, employees, veterinarians, nutritionists, suppliers and other specialists must take a close look at what could go wrong and where in the continuum of their particular operation. Everyone should develop practices and techniques that allow checking and verifying. It is equally important to design all of the everyday working facilities to minimize hazards.

HACCP can provide a BQA roadmap by targeting specific chemical, physical and biological hazards. A great success story can be seen in physical hazards. For example, from the period March 1992 through March 2000, top sirloin injection site lesions have decreased from about 22% to 2%. Another example is that broken needles are very rare in industry today due to better needle selection, improved injection methods and better animal restrain techniques. However, simple bruising from improper handling continues to cost the industry tens of millions of dollars per year. The picture with microbiological defects is not as clear cut. In 1982, FSIS noted that microbiological defects would be the beef industry's "Achilles' Heel." The industry's position was that this was a pessimistic view until 1993 when *E. coli* O157:H7 came along. Since then, the industry has been jerked through knot holes that were not even known to exist prior to 1993. As a result, industry has been scrambling to catch up ever since then. The consensus is that continuous education programs and ongoing research and development

of new or improved intervention techniques must be vigorously pursued. Some of the pre-harvest 0157:H7 interventions that are effective are:

- Hide cleanliness and pen surface management
- Direct Fed Microbials - (*Prevalence of Escherichia coli O157:H7 and Performance by Beef Feedlot Cattle Given Lactobacillus Direct-Fed Microbials*. Basshears, et. al. JFP 665-748, 2003.)
- Vaccine Development – (*Decreased Shedding of Escherichia coli O157:H7 by Cattle Following Vaccination with Type III Secreted Proteins*. Potter, et.al. Vaccine 22, 3-4, 362-369, 2004.)

Post-harvest interventions include:

- - Minimize hide contamination on the farm
- - Hide cleanliness - washing cattle (pre & post knocking)
- - De-hiding sanitation (decrease cross contamination)
- - Trim, clean & sanitize hide pattern lines (steam vacuum)
- - Carcass washing cabinets (hot water vs organic acids)
- - Test & Hold

On the surface, chemical defects, violative residues, are also a success story. In beef cattle they have gone from about 2% in 1982 to thousandths of a percent in 2007. Residues in cull dairy cows and veal calves are only slightly higher – in the hundredths of a percent range. But there is no reason they should not all be zero. Any residue violation indicates improper drug use, usually intentional, on the farm and there is no reason for this. There are too many choices of highly effective drugs today and information on proper use and withdrawal times is better than ever before. Ceftiofur is one drug that is receiving intensive scrutiny now. It was approved in cattle in 1988 and the industry went for almost twenty years without a single residue violation. However, in 2008 the testing methodology was changed and new withdrawal times were published. Resultantly, in the past year there have been 128 residue violations. This is directly related to dairy operators not respecting new withdrawal times.

A current point of interest is that in October 2008, the USDA Food Safety and Inspection Service (FSIS) awarded Charm Sciences a contract to provide Charm KIS™ Tests to USDA inspectors at slaughter facilities to screen for sulfonamides and other antibiotic drugs under the National Residue Program (NRP). FSIS has begun implementing the Charm KIS™ Test in phases starting with cattle (FSIS notice 50-90, issued 7/15/2009) and will eventually implement it for all livestock.

There are multiple antibiotic residue avoidance strategies that are effective. Operators that follow these strategies scrupulously have no residue violations.

- - Identify all animals treated
- - Record all treatments:
- - Record date for; animal' ID; dose given; route of administration; the person who administered the treatment; withdrawal time (WD).
- - Strictly follow label directions for product use.
- - Use newer technology antibiotics when possible.
- - Select antibiotics with short WD when the choice is equivalent.
- - Never give more than 10 cc per IM injection site.
- - Avoid Extra Label Drug Use (ELDU) of antibiotics.
- - Avoid using multiple antibiotics at the same time.
- - Don't mix antibiotics in the same syringe.
- - Check ALL medication/treatment records before marketing.

Another strategy that can protect beef producers is to use residue screening tests such as the urine adapted PremiTest or PHAST before "high-residue-risk" cattle are sold. These tests will work "pre-harvest"? But it is a microbial inhibition test and must be used with knowledge of the sensitivity and the maximum residue limit in cattle tissue. If urine doesn't inhibit the test it is not likely that tissue juices from the kidney will inhibit the test. There are two potential exceptions, gentamycin and neomycin, which should never be used in market cattle. Too many good alternatives are available. The most important position the beef industry can have is to not send cattle to market with a chemical residue.

BQA has had successes since 1991. Quality audits up through 2007 have shown decreases in injection site damage, fewer bruises and decreased residue violations. But these same issues also offer continued challenges because they can and should be decreased further. USDA-APHIS data indicates that approximately 90-95% of all US feedlots have a formal training program for Quality Assurance. Their programs include antibiotic selection and use, residue avoidance and physical defect management. USDA-FSIS has stated, "Beef has no residues to be concerned about." Further, FSIS HACCP data suggests that beef has the lowest bacterial counts of all meats. However, BQA is still missing a large segment of the beef industry. There needs to be more BQA involvement with operations having less than fifty cattle – "the other half of the beef industry." BQA programs are in almost

every state, but the programs need to be adapted to meet the needs of small beef farmers, the dairy industry, veterinarians and government agencies. The industry's future will be enhanced with increased adoption of BQA.

Dr. Dan Engeljohn, Deputy Assistant Administrator, Office of Policy and Program Development, USDA/FSIS, presented the USDA-FSIS Vision on Animal Production Food Safety. FSIS has not traditionally looked at the animal production side of the meat and poultry industry. But the Agency is currently reevaluating its position on this very critical part of the meat and poultry industry. Traditionally, the mission of FSIS has been, "As the public health regulatory agency in USDA, FSIS is responsible for ensuring that the nation's commercial supply of meat, poultry, and processed egg products is safe, wholesome, correctly labeled and properly packaged. FSIS's primary statutes are the Federal Meat Inspection Act, the Poultry Products Inspection Act and the Egg Products Inspection Act. As background, this is what we accomplished in federal FY 2008:

Mandatory government inspection of product released into commerce:

- ~44 billion pounds of livestock
- ~57 billion pounds of poultry
- ~3.5 billion pounds of liquid egg product
- ~3.8 billion pounds of product re-inspected at borders
- ~8 million inspection procedures

This was accomplished with approximately 7,800 full-time inspectors, food technologists and veterinary medical officers in over 6,200 facilities. Every establishment received daily inspection. Additionally, at every slaughter establishment and egg product plant, every animal or egg was afforded a critical inspection before and/or after slaughter and/or processing. Our limitation in the pre-harvest arena is that our inspection authority begins at slaughter or at the egg plant. All points thereafter, while product is in commerce, are under FSIS authority to ensure product is not adulterated and is truthfully labeled. One exception is that the 2008 Farm Bill directed that FSIS's authority for catfish inspection specifically extend to the ponds (on-farm). That issue is currently in rulemaking.

Prior to the 1990s, the Agency was considered as the responsible party for safe products being produced. The 1990s brought about a change in philosophy, and concurrent change in regulations. Now it is clear that industry is responsible for producing a safe and correctly labeled product. This is accomplished through validated process control procedures that are documented for each production lot. The written procedures address food safety hazards (biological, chemical, physical) through Pathogen Reduction and HACCP systems at control points throughout slaughter and processing of livestock, poultry and regulated products at official establishments. With this change FSIS is now responsible for verifying that established regulatory requirements are met. This is accomplished through setting performance standards and conducting inspection (observation, testing, and review of records). State inspection programs are verified as "equal to," and foreign establishments are verified as "equivalent."

President Obama's new administration brought in a new focus on food safety and resulted in the establishment of the President's Food Safety Working Group (FSWG). It is chaired by the Secretaries of Health and Human Services and USDA and is founded on three principles.

- - Preventing harm to consumers is our first priority.
- - Effective food safety inspections and enforcement depend upon good data and analysis.
- - Outbreaks of foodborne illness should be identified quickly and stopped.

The FSWG is already delivering results. Projects have been initiated in four areas. First, prevent *Salmonella* contamination. Second, reduce the threat of *E. coli* O157:H7. Third, build a national traceback and response system. Fourth, improve the organization of federal food safety responsibilities. In concert with this new focus on food safety, the Agency is developing a pre-harvest vision; "Pre-harvest controls are viewed as essential to an effective food safety system." In supporting this vision, FSIS policies will be designed to encourage slaughter establishments (and egg handling/processing plants) to know, interact with, and limit (as appropriate) qualified suppliers. FSIS will target inspection resources more frequently and intensely in establishments that do not have effective controls to limit incoming food safety hazards. However, the Agency is not looking at trying to expand its inspection authority to farms. Alternatively, FSIS has a specific commitment to issue compliance guidelines to beef and poultry on-farm producers early next year. These will be followed by guidelines to pork producers.

While pre-harvest guidelines are a current initiative, we also continue to improve current inspection programs. One area we are looking at carefully is reducing chemical food safety hazards. Drug residues and environmental contaminants are increasingly becoming issues of public health concern. They will be more effectively verified through HACCP-related inspection activities and supplemented with residue testing through the National Residue Program for domestic and imported product. The Agency maintains a residue violator list which is the basis for a livestock supplier history. Screening tests, such as FAST (Fast Antimicrobial Screen Test), help in determining

the disposition of single animals. The KIS™ (Kidney Inhibition Swab) test will soon replace FAST. STOP (Swab Test on Premises) also helps in the detection of antibiotic residues in animal tissues. There are recurring surveys for specific compounds such as dioxin and, when needed one-time investigative surveys are conducted. The melamine investigation is a recent example. Biological food safety hazards (primary pathogens plus emerging special emphasis organisms) remain as issues of significant public health concern and are verified through expanding verification testing programs. The organisms of primary interest are:

- Campylobacter
- Escherichia coli O157:H7
- Non-O157 shiga-toxin forming E. coli (6 serogroups: O26, O103, O111, O121, O45, O145)
- Listeria monocytogenes
- Salmonella, specifically multi-drug resistant types and Salmonella enteritidis

The Healthy People 2010 initiative is used as the Agency's guideline to direct pathogen reduction efforts. Good progress has been made with all four microorganisms in the raw classes of product that FSIS regulates. However, the agency is targeting *Salmonella* for more work. There is ongoing effort to develop a mechanism to target the scheduling of a *Salmonella* full sample set or a mini-set for the specific purpose of gathering information about producers contributing to prior sample results of public health interest. The goal is to prevent recurrence of introducing certain types of *Salmonella* into commerce. Another project that is underway is end-of-set letters at completion of *Salmonella* full sample sets. *Campylobacter* will be handled with the same approach. The letter identifies percent positive rate and offers comparison to other producers in the same class. There is also information regarding the average number of common human illness serotypes. For the past year, the Agency has been publishing the names of producers that are performing poorly. All current and future initiatives tie back directly to the Agency's mission of ensuring that the nation's commercial supply of meat, poultry, and processed egg products is safe, wholesome, correctly labeled and properly packaged.

Next, Dr. David L. Meeker, Senior Vice President of the National Renderers Association (NRA) discussed renderers' requirements in relation to new Food and Drug Administration (FDA) feed regulations. Renderers process dead cattle, trim, and offal into animal feeds and the industry is closely regulated by FDA. There is a website with detailed information on the process and a directory of renderers: <http://www.nationalrenders.org> The new FDA feed rule places additional requirements on renderers. Cattle materials intended for animal feeds must have prohibited material (Cattle Material Prohibited from Animal Feeds (CMPAF)) removed and separated. The basic raw material requirement is that the brain and spinal cord from cattle 30 months or older must be excluded. Renderers must comply with this requirement. Four possible options are:

- Discontinue dead stock service
- Discontinue cattle pick up
- Only pick up cattle younger than 30 months of age
- Continue service, separate prohibited material

Pickup of raw product from slaughter facilities is working itself out since most slaughter facilities have the ability to remove CMPAF. It is a business decision on their part to do so or find alternative means of disposal. However, the challenge that deadstock presents to renderers is more difficult. Renderers that process cattle materials for animal feed must document that these materials are free of CMPAF. To facilitate this requirement, producers need to call for pickup service immediately after an animal dies. Since age certification is required, producers can keep costs down by furnishing age certification to the renderer. If producers have valid age documentation, they will be asked to sort and mark carcasses over and under 30 months of age. Renderers can provide a form for documenting age. Using this form as a basis, the NRA has developed a recommended age certification program. It is outlined as follows:

- Complete an age certification questionnaire:

- Do you raise, feed or own cattle that are 30 months of age or older? Yes or No
- Do you have records to determine and verify age of cattle in your herd? Yes or No
- If yes, are they records for *some* cattle or records for *all* cattle?

Once the certification process is complete, producers that maintain valid records would have to agree to segregate and mark cattle carcasses as under 30 months of age or 30 months of age and older. To mark carcasses, it is recommended that producers use an orange paint stick or another color that is readily visible on the carcasses. Each carcass 30 months of age or older, would be marked with an "X" on the side. Carcasses less than 30 months of age would be marked with a "U" on the side. If the age is uncertain or unknown, the carcass would not be marked. Renderers must assume the age cannot be documented from records and/or such records are not maintained for at least one year for any cattle carcasses left unmarked. These carcasses may be assessed a higher fee to defray additional labor costs associated with dentition and handling. Producers must be truthful in declaring the age of dead cattle and they must be aware of the legal obligations. Their certification

constitutes a statement that is subject to inspection and verification by the FDA. The certification contains a disclaimer describing the consequences of making false statements as being subject to civil and criminal penalties under 18 U.S.C. Section 1001(a) (2) & (a) (3).

There are other disposal options available to producers such as burial, landfills, composting, incineration or alkaline hydrolysis. However, rendering is the most suitable technology to protect human and animal health and the environment. The rendering system in the U.S. needs to be strengthened, but it is often the best, most economical choice for emergency depopulations in disease control. The best way to strengthen the rendering system for emergencies is to strengthen it for everyday, normal death loss in livestock production. Several things would help. Local jurisdictions could strengthen disposal regulations. Increased research could expand non-feed uses for animal proteins. Financial incentives could be offered to producers who make the right choice. For example, there could be public payments for carcass pick up. Carbon credits could be offered for producers who avoid choices with higher green house gas production such as composting, burying, burning or abandonment.

Dr. Steve Larsen, Director of Pork Safety for the National Pork Board next presented on pre-harvest food safety in the pork industry. Pork quality assurance is a program that is similar to the BQA program discussed earlier. The pork industry looks at the same three overarching categories of microbiological, chemical and physical defects. As with the beef industry, chemical residues and environmental contaminants are the primary chemical defects. Chemical defects are currently not a major problem in the pork industry and, as a result, there is not a great deal of active research in this area. However, the industry remains vigilant in keeping chemical defects under control. Regarding microbiological defects, there are the usual suspects; *Salmonella*, *Campylobacter*, *Yersenia*, *Toxoplasma* and *Tricinella*. *Toxoplasma* and *Tricinella* are actually more international trade issues than true public health issues, but, as such, are still quite important to the pork industry. Current research includes looking for improved enumeration methods for all microorganisms and *Salmonella* serovar identification techniques. The industry also looks for new or improved microbial intervention methodologies that are consistent, cost effective and applicable to the producer. The ultimate goal is to have interventions that make a difference in microbial load at the consumer level. Other active areas of research involve the effect of lairage (holding pens) and stress on microbial load in processed product. Closely related to microbiological defects is antimicrobial resistance. The industry actively researches the impact of various treatments on developing antimicrobial resistance and the mechanisms involved in antimicrobial resistance. Metagenomics, or how bacteria interact with each other and in reaction to external factors is another subject under review. There is active interest in what actually happens in the swine gut when given antibiotics, during genetic transfer, when under stress and in relation to various levels of immune response. The emphasis placed on microbiological defects has paid off. Using FSIS's performance standards, over 83% of swine sent to slaughter are at less than half the baseline allowed and over 99% are below the allowable baseline. Physical defects are primarily attributable to abscesses. They are estimated to cost the industry about \$50 million annually. After comprehensive research on reasons why abscesses occur, recommendations for farm level interventions are currently being developed.

A methodology the Pork Board uses when it is developing industry recommendations is to fund research. One grant conducted a systematic literature review on microbiological defects of *Salmonella* species in the pork production chain from slaughter to the cooler. This study followed the standard systematic process for a comprehensive literature review. First, the specific issue to be reviewed was developed. The task assigned was to assess the points of introduction and amplification of *Salmonella* species from slaughter to the cooler. Thirteen scientific journals and conference proceedings were selected for review. Next, relevance criteria for citations to be included in the review were developed. The primary relevance criteria were that the study had to examine the same cohort of pigs or pigs on the same day of slaughter and the *Salmonella* species level had to be measured at more than one point in the process. During the data extraction phase of the review, all studies were treated as unique. There was no pooled data. Specific plant processing information and culture methodologies were extracted. Next, all outcomes were described as they occurred after a specific processing point. The points identified were stun, bleed, kill, scald, dehair, singe, polish, bung removal, evisceration, split, stamp, final wash, immediately after chill and 18-24 hours after chilling. Data were summarized to provide point-to-point comparisons. Results were reported from fifteen manuscripts covering forty studies. The results obtained demonstrated that, as a carcass works through the slaughter process, *Salmonella* levels decrease after each step. The results provide empirical evidence that *Salmonella* species prevalence on a pork carcass decreases as the carcass moves toward the cooler. In summary, improving pork quality is a team approach that can be impacted at every step in the production chain.

Dr. Eric Gingerich is an Adjunct Professor at the University of Pennsylvania, School of Veterinary Medicine, and the Staff Veterinarian and Laboratory of Avian Medicine and Pathology for the University. His presentation

was entitled *Pre-harvest Food Safety in the US Shell Egg Industry*. Dr. Gingerich provided a narrative to accompany his presentation, included at the end of this report.

**Committee Business:**

After the formal presentations, Chair Lafontaine opened the Committee's business meeting. The floor was opened for suggested topics for next year's Committee on Food and Feed Safety. No resolutions or recommendations were presented by the members for consideration. Possible topics for scientific presentation at the 2010 Committee Meeting were discussed. FDA's expanding role in regulating the feed industry was suggested as a timely, pertinent topic to consider at the next meeting. There being no further business, Dr. Lafontaine adjourned the 2008 meeting of the Committee on Food and Feed Safety.

## Pre-harvest Food Safety in the US Shell Egg Industry

Eric Gingerich  
University of Pennsylvania, School of Veterinary Medicine

### Summary

*Salmonella enteritidis* (SE) in egg layers became a significant issue in 1988 when it was reported by Dr. St. Louis et. al. in the Journal of the American Medical Association that SE was responsible for causing numerous cases of diarrheal disease in humans, and in some cases death, associated with Grade A shell eggs. The SE bacteria had developed the ability to infect laying hens and invade the interior of the egg thus bypassing the normally effective sanitation of egg shells where all other Salmonella organisms had previously been found. In 1992, SE was declared an emergency disease by the Secretary of Agriculture. To illustrate the significance of SE, the number of cases of SE in humans increased from 0.6 per 100,000 persons in 1976 to 3.6 in 1996. In 1992, USDA began the SE Pilot Project in Pennsylvania to study the related factors associated with contamination of eggs with SE. From this study, infected pullets, rodents in houses, and contaminated houses were associated with positive eggs. Even before SE was declared an emergency disease, the National Poultry Improvement Plan (NPIP) developed guidelines to determine if breeder flocks were contaminated with SE in 1989 with the US SE Clean Program. This program found some hatch egg source flocks as positive in the initial years after inception but since has virtually eliminated SE as a source of the bacteria for layer flocks. From the SE Pilot Project and other studies, state and company based egg quality assurance programs (EQAPs) were developed to create an organized, voluntary means of using best management practices to reduce the risk of SE infection in layers and eggs. These programs have greatly helped keep the rate of SE infections in humans to a relatively low level. At present, the rate of infection is estimated to be about 2.2 per 100,000. In September 2004, the Food and Drug Administration (FDA) produced their "Proposed Rule for Prevention of Salmonella Enteritidis in Shell Eggs During Production" due to the lack of a decline in the incidence of SE in humans. Some of the reason for a lack of reduction is that not all major egg producing states or companies adopted an EQAP. In addition, SE has begun to be found in broiler meat as a source of human infection. This proposed rule received over 2000 comments during the comment period. On July 7, 2009, FDA announced the Final Rule for its Egg Safety Plan to become implemented in 2010.

### History of Human SE Infections Due to Table Eggs

Prior to Dr. St. Louis' first report in the literature about egg associated SE, outbreaks were seen to significantly rise in the New England region from about 1 per 100,000 persons in 1976 to 9 per 100,000 by 1982 (CDC outbreak surveillance information). This likely indicates that SE was established in the table egg flocks during this time. The North Atlantic region was the second region to show an increase in SE as the incidence rose from 1 per 100,000 in 1980 to over 10 per 100,000 in 1989. The Pacific region had a slow rise in SE rates from 1 per 100,000 in 1983 to 2 per 100,000 in 1992. It then took a significant rise to 6.5 per 100,000 in 1994. The Mountain region saw its SE case rates increase significantly starting in 1992 from 1 per 100,000 to 4 per 100,000 in 1996. The Midwest and Southeast regions have not seen significant increases in SE over the period of 1970 to 2006. All regions rates of SE have declined significantly since 1995, likely the result of control measures put in place. The overall US rate of infection has increased from 1 per 100,000 in 1980 to 3 per 100,000 in 1990, remained at 3 per 100,000 during the 1990's, declined to 2 per 100,000 in 2006, but has increased to 2.9 per 100,000 in 2008. There is evidence of SE outbreaks from sources other than table eggs, namely broiler meat, the likely reason for the lack of continued reductions since 2002.

### Control Measures – Reducing Exposure

Both breeders and commercial layers have the same set of risk factors for contamination of SE as follows:

- Infected chicks or point-of-lay pullets
- Rodents
- Contamination from outside sources (Biosecurity) – Contaminated housing, moving equipment, people, egg handling materials, etc.

Both breeder prevention program and EQAPs incorporate best management practices to effectively prevent contamination from these 3 sources. Chicks are obtained from breeder flocks that are participants in the US SE Clean Program of NPIP. This program assures that the chicks are negative due to an intensive testing program whereas the breeder flocks are tested every month for evidence of SE infection (manure drag swab tests). In EQAPs, chick box papers are tested for SE contamination. Pullet growing flocks are grown in houses that are cleaned and disinfected prior to placement and use best management practices to prevent rodent infestations. Pullets are tested during growing prior to movement to the layer house in some EQAPs to assure the layer

producer that the pullets are negative. Rodent control programs not only contain baiting as part of the program but also reducing harborage (rodent hiding and nesting sites) and reducing places where rodents can enter houses (doorways, holes in walls, etc.). A rodent indexing system is used in the Pennsylvania Egg Quality Assurance Program (PEQAP) using 12 live traps set throughout the house and counting the number of mice caught one week a month as a means of estimating the effectiveness of the rodent control program. As SE can contaminate a flock carried on footwear, hands, clothing, and equipment, biosecurity is a big part of prevention. Maintaining disinfectant footwear bathes and hand sanitation at the entries to the chicken area can eliminate SE on hands and footwear picked up outside or in the egg processing area. Requiring all visitors to don clean coveralls, boots, and hats is important. Employees need to wear dedicated clothing and footwear. Crew members moving birds, pullets or spent fowl, must wear clean clothing and footwear between jobs. Any equipment brought into the chicken production area must be thoroughly cleaned and disinfected. The procedure used to clean and disinfect houses between flocks depends on the testing status of the flock. Houses where SE negative flocks have been housed need only standard, minimal cleaning and disinfection. If a flock with SE was present, additional steps need to be taken to assure that the next flock will not become contaminated. A thorough wet washing with hot water, detergent, and high pressure followed by a surface-wetting application of an effective disinfectant on all surfaces is done. In addition, many producers follow this with fumigation of the house with formaldehyde gas or fogging.

#### **Control Measures – Egg Refrigeration**

Refrigeration is an important deterrent to growth of SE inside the egg. Hatch eggs are stored at 62F while table eggs prior to processing are stored at 55F and after processing at 45F.

#### **Control Measures – Egg Washing and Sanitation**

Hatch eggs are generally not washed but can be sprayed with sanitizer to reduce the risk of SE contamination. Handling hatch eggs with washed hands is very important to prevent contamination. Table eggs are washed in 105 to 110F, high pH (10+) wash water containing chlorinated detergent in washers using brushes to clean off any fecal material. The eggs are then rinsed in highly chlorinated water

#### **Control Measures – Vaccination**

Using the birds immune system to aid in preventing infection should the bird be exposed is a very powerful tool which has aided many producers both reduce the risk of contaminated eggs reaching the consumer and reduce house contamination levels over time as SE vaccine reduce shed of SE into the feces. The inactivated vaccines, bacterins, appear to be the superior in effectiveness compared to live vaccines. Bacterin is applied by injection usually at 13 to 15 weeks of age to provide a lifetime of immunity. Live vaccines are applied by spray at 2, 6, and 15 weeks for example. Both must be considered as only a part of the SE risk reduction program and cannot be relied on as the total program.

#### **Control Aspects – Verifying Flock Status**

Verification of the status of flocks is essential to the control of SE as knowledge of the flock status allows accurate program planning and adjustment plus action to remove flocks from the egg (hatch egg or table egg) supply. The NPIP US SE Clean Program calls for testing manure drag swab samples of each flock starting during the 1<sup>st</sup> month of life and continuing each month thereafter. In addition, each breeder flock is tested serologically at 16 weeks of age using the Pullorum test, a group D Salmonella test that will detect flocks positive for SE as well. Many EQAPs also require chick box paper testing which, in essence, is another test of the status of breeder flocks. If a breeder flock is found positive when tested by any of the above tests, further tests of bird's tissues are performed to determine if the flock is truly positive. If the flock is determined to be SE positive, it is no longer used for hatch egg production. Table egg flocks are tested to a varying degree depending on the EQAP the company uses. The greatest amount of testing is performed in PEQAP where the pullets are tested by manure drag swab at 10 to 12 weeks then layers are tested at 30 and 45 weeks of age, and if molted, after molt at 50% production. If a layer flock is found manure drag swab positive, eggs are tested to determine if the flock is at a high risk for the consumer. 1000 eggs are tested in pools of 20 at two week intervals for four tests. Thereafter, 1000 eggs are tested every 3 months. If any tests show a single egg pool to be positive, eggs from that flock must be diverted from the shell egg market to hard-cooking or pasteurization. A flock's eggs can return to the shell egg market if it passes one, 1000 egg test but must test 1000 eggs for three more tests at 2 week intervals. In PEQAP, approximately 1/3 of the manure positive flocks have eggs that test positive.

#### **Control Measures – Pasteurization**

Pasteurization of shell eggs has been developed in the US and South Africa. The US method uses progressively increasing temperature water baths to raise the internal temperature of the eggs sufficiently to be capable of the required five log reduction of SE. The South Africa method is less costly and uses microwave ovens initially followed by convection ovens to provide the required heat to bring about the five log reduction of SE bacteria. These methods are slow to be adopted due to the cost of capitalization and operation that adds to the cost of the final product and the perceived lack of risk of using non-pasteurized shell eggs.

#### **Control Measures – Other**

Commercial preparations of beneficial bacteria (probiotics) that seed the intestine with bacteria that produce substances that kill or inhibit SE can be useful when administered to flocks during periods of stress when the intestinal microflora may be upset; moving, hot weather, high production, vaccinations, etc. They also may be very useful when applied to day-old chicks to establish a normal microflora prior to exposure to SE in the pullet house. Prebiotics can also be useful in reducing colonization of SE in the intestinal tract. The commercial preparations are made up of sugars that aid probiotics establish themselves and also reduce the ability of SE to attach to sites on the intestinal cells. Continuous antibiotic use is not advised due to rapid buildup of resistance by the SE bacteria. Treatment with an effective antibiotic can be useful in flocks where SE is causing mortality due to septicemia and peritonitis. Botanical preparations are becoming more available as a natural alternative to antibiotics for long term use. Whether or not SE bacteria will be able to develop resistance to these preparations is not yet known. Feed has not been implicated as a risk factor in contamination of flocks therefore interventions to avoid contamination have not been done. Breeder flocks that choose to use meat byproducts in the feed must obtain these from companies participating in the APPI Salmonella Education Reduction Program and the product must be either treated with a Salmonella-killing additive or palletized.

### **FDA Egg Safety Rule**

The FDA Egg Safety Rule of 2009 uses many of the components of the Pennsylvania Egg Quality Assurance Program (PEQAP) – Chicks from NPIP SE Clean breeders, rodent monitoring and control, cleaning and disinfection of houses between flocks, verification of flock status by manure and egg testing, diversion of eggs from SE egg positive flocks, and refrigeration of eggs at 55F if farm-packed or 45F after washing, grading, and packing. Differences between PEQAP and the FDA Rule are a required fly monitoring and control program, refrigeration of all eggs at 45F within 36 hours after collection, and no early lay (30 week) manure test. Concerns about the FDA Egg Safety Rule are 1) laboratory availability in all states to perform the required tests, 2) increased expenditures by the labs to perform FDA lab test procedures, 3) the increased costs to producers for testing flocks using FDA lab protocols compared to present used methods, 4) possible increased sensitivity of FDA testing protocols yielding high numbers of manure or egg positive flocks, 5) destiny of flocks that test egg positive but the producer has no market in his area that can pasteurize or hard-cook eggs, 6) the thermal crack effect of requiring 45F refrigeration of farm-packed eggs that will be washed in 110F or higher water, 7) training requirements of on-farm persons responsible for the SE program, and 8) egg recall possibilities if eggs test positive for SE.

### **Conclusions**

SE continues to be a serious concern of the egg industry. Each company needs to address issues of potential exposure to SE and implement control measures to reduce the risk of flocks or eggs becoming contaminated.

Dr. Bob O'Connor concluded the afternoon's formal presentations with his discussion on *Effective Salmonella Control – Commercial Poultry Operations*. Dr. O'Connor is Vice President of Technical Services – Food Safety, Quality and Veterinary Services for Foster Farms. Pre-harvest interventions are effective in reducing microbial loads in poultry flocks. The key is to develop a systematic approach to applying interventions that will yield a result that is both effective and economical. Review of an actual case study from a large poultry operation emphasizes this point. In this case study, the problem was significantly increased Salmonella positive samples at one operating unit of a large broiler operation. The approach to solving the problem ("kitchen sink") was to immediately implement every pre-harvest intervention strategy possible as quickly as possible. This included the following:

- Cleaning live-haul modules
- Acidifying water in grow out barns
- Probiotic use in water of grow out barns
- Probiotic gel in chick boxes at hatchery
- Probiotic in feed
- Acidifying litter of grow out barns
- Complete cleanout of litter in grow out barns
- Growth promotant in feed
- Propionic acid in feed
- Antibiotics in the feed
- Vaccinate – hatchery and field
- Breeder vaccination and abtobiotic treatment

A positive result was unquestionably achieved since *Salmonella* levels were significantly reduced. However, the process was expensive and it was unknown which strategies were effective and by how much. It was also unknown if there were some interventions that were ineffective since multiple interventions were implemented almost simultaneously. Consequently, an independent audit firm was contracted to review and stratify the results to the extent possible. One of the first steps by the audit team was that various members of management were

interviewed to capture their perceptions of the sources of *Salmonella* and which interventions had been successful. There was no consistency in the perceptions:

- "everything got better when we put in a new chiller"
- "it is all the things that we did at the grow-out farm that solved the problem"
- "my instinct tells me that it all comes in from the breeders"
- "I don't know what made it better. I hope it stays that way"
- "It must be the vaccine"

This confirmed that, in the absence of empirical data, perceptions are frequently of little value in solving a problem. The audit team then proceeded to conduct a systematic review of available data. The goals were twofold. First, determine the effectiveness of interventions at the grow-out farm level as related to performance measured by *Salmonella* results on carcass wash rinsate. Second, assist in the management of withdrawal of ineffective interventions from this point in the value chain. Post-chiller *Salmonella* test results were then reviewed.

The control chart of *Salmonella* positives week-by-week showed a clear downward trend in the proportion of samples tested positives for *Salmonella* between April 2, 2005 and August 20, 2005. On March 6, 2005, carbon dioxide (CO<sub>2</sub>) was added to the chiller and chlorine (CaClO<sub>2</sub>) was added to the recycled chiller water. From the dramatic drop in *Salmonella* positives on carcasses at this point, it appears that these changes to the interventions were effective. The results were substantiated by the results of a validation study performed at the same facility, with bio-mapping of the process showing the various incidence levels of *Salmonella*. The March 6, 2005 changes to the interventions were noted to be effective albeit not sustainable until the impact of intervention changes made in early April.

There were two dates of statistically sustainable significance, April 12, 2005 and July 18, 2005. In early April, three interventions appeared to have a positive impact on *Salmonella* levels. These interventions were; introduction of vaccinations at the hatchery, field vaccinations at grow-out farms and increased overflow water in the scalders. The drop associated with April 12, 2005 captures the combination of these 3 interventions. The significance of increasing the scalding overflow is related to maintaining a lower microbial load in the scalding. *Salmonella* vaccine was introduced to the grow-out farms on February 9, 2005 as a follow up to the hatchery vaccinations which were started January 26. The impact of this program coincides with the decline in *Salmonella* positive results as seen in the Process Control Chart of *Salmonella* positive drag swabs at the farms. The timing of this intervention corresponds to the improvements seen at the processing plant in April. Later on, a sudden reduction in *Salmonella* positives to 0% (that was persistent for 5 weeks) was noticed at the time of an on-site visit conducted on or about July 18, 2005. This date corresponds directly to the expected 60-day lag time between treatment of breeder birds with antibiotic, and the earliest processing of their progeny. The concept of treating the breeder flocks with an antibiotic was gleaned from control strategies used with table-egg flocks to successfully eradicate *S. enteritidis*. Unfortunately, the antibiotic used, previously licensed for use in poultry, is no longer able to be used in this species as per a subsequent ruling by FDA.

In addition to the statistically significant interventions, there were also interventions with no correlation to reduction of *Salmonella*. A strong correlation related to probiotic use was not found and it is difficult to determine definitively if and when this intervention would produce noticeable results down the value chain. Also, there is not a statistically significant reduction in *Salmonella* counts on carcasses attributed to the implementation of live haul module washing on October 1, 2004. From this, there were several key learning points from the first part on the independent audit:

- Chiller management (CO<sub>2</sub>/Cl<sub>2</sub>) can directly impact final *Salmonella* levels.
- There is a need to consider effectiveness of interventions in combination and alone. Changes should be introduced in a controlled and systematic way.
- Instinct needs to be supported with information.
- Impact of interventions at the breeder level extends throughout the value chain.

Questions remained unanswered after the first phase of the study. A follow up to the data analysis led to a separate, second study to test the impact of eliminating interventions alone or in combination on grow-out farms. Four factors were identified; vaccination (broiler), litter acid treatment (+/-), organic acid (+/-) and probiotic (water: +/-). Carcass rinse samples per house (test/control) were collected pre-chiller and post chiller and analyzed for presence of *Salmonella*. The data was evaluated at the pre-chiller and post-chiller level.

#### **Pre-Chiller:**

- There is a statistically significant reduction in *Salmonella* with the use of litter treatment.
- There is a statistically significant reduction in *Salmonella* if the birds are the progeny of those previously treated with antibiotics.

- The reduction in *Salmonella* positives with the use of either organic acid or probiotics is not statistically significant.
- The effect of vaccination is statistically significant – but in the opposite direction as expected (i.e. the probability of having *Salmonella* decreases when vaccination is not used).

**Post-chiller:**

- At the post chiller location, the probability of having positive *Salmonella* is 0.14 times that of the probability at the pre-chiller location. That is, after processing through the chiller, the probability of having positive *Salmonella* on carcasses drops by 86%.

At the end of the audit, some conclusions were made. First, pre-harvest interventions will work, some better than others. For example, vaccinations do help, but feeding probiotics do not. But the most effective intervention is at the chiller. This is another way of saying that the old, reliable intervention of proper disinfection still works. In a chiller, attention must be given to both pH and free chlorine levels, although there are alternatives to chlorine such as peracetic acid and cetylpyridinium chloride. In closing, food safety is a common goal of all reputable producers whether their product is beef, pork, poultry or others. They learn from one another and practice what they learn.

---