THE AMERICAN COLLEGE OF POULTRY VETERINARIANS PRESENTS:

FOOD SAFETY CHALLENGES IN THE POULTRY INDUSTRY:
CURRENT REGULATIONS AND PRACTICAL FIELD EXPERIENCES.

APRIL 1, 2012

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Dear Attendees,

Welcome to the 2012 ACPV workshop.

The topic selected for this year is Food Safety Challenges facing the Poultry Industry. We all recognize the critical role that poultry products play in feeding an exponentially growing population. We also know the importance of food safety in our lives and the current efforts by poultry companies worldwide to provide healthy food to our society. Since food safety will continue to play a very important role in food production, we have selected an outstanding panel of speakers from recognized associations, universities and poultry companies to share their knowledge.

This workshop will be divided in two main sections. During the morning we will be covering the implications of current regulations, recent case reports and the evolving responsibilities of people in poultry production with public health. During the afternoon, practical field experiences in the development and implementation of prevention and control programs in different production types and future challenges will be discussed. Furthermore, a unique round table with exceptional food safety managers and veterinarians representing the poultry industry will be sharing with us their knowledge and practical experiences.

We hope you will find this workshop very practical, allowing you to take some valuable information to be applied in your professional work in our great poultry industry.

Thank you for joining us.

Cordially,

IVAN ALVARADO, Chair
ACPV Continuing Education Committee
The ACPV CE committee would like to acknowledge the following individuals and organizations for their outstanding support and contributions to the workshop:

Dr. Richard Chin, Western Poultry Disease Conference
Janece and Bob Bevans-Kerr, AAAP/ACPV

**Moderators:** Dr. Mariano Salem, Dr. Andres Montoya, Dr. Jaime Ruiz, Dr Tarsicio Vallalobos, and Dr. John McCarty

**Speakers:** Dr. Charles Stephen Roney, Dr. Bruce Stewart-Brown, Joanne Tataryn, Dr. John Maurer, Dr. Sandra Aehle, Dr. Martine Boulianne, Dr. Scott Russell, Dr. Simon Shane, and Dr. Scott Stillwell

**Round table panelists:** Dr. Joseph A. Schultz, Dr. Eric Jensen, Dr. Armando Mirande, and Dr. Helen Wocjncinski


**2012 ACPV Continuing Education Committee**

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Dr. Jaime Ruiz
Phibro Animal Health Corporation
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Food Safety Challenges in the Poultry Industry: Current regulations and practical field experiences.

Agenda

7:00 AM  **Registration and Continental Breakfast**

7:45 – 8:00AM  **Welcome and Introduction**
Dr. Ivan Alvarado, ACPV Continuing Education Committee Chair

*Regulations and scientific background.*

Moderator: Dr. Jaime

8:00 – 8:30AM **Implications of USDA/FDA regulations and the new food safety modernization act (FSMA).**
Dr. Charles Stephen Roney, Director, National Poultry Improvement Plan (NPIP), Conyers, GA.

8:30 – 9:00AM **Evolving Poultry Veterinary Responsibilities as it Relates to Public Health.**
Dr. Bruce Stewart-Brown, Vice-President of Food Safety and Quality, Perdue Farms. Salisbury, MD.

9:00 – 9:30AM **Case reports: public health and economic implications of recent food borne outbreaks.**
Dr. Joanne Tataryn, Senior Epidemiologist, Centre for Food-Borne, Environmental and Zoonotic Infectious Diseases, Infectious Disease Prevention and Control Branch, Public Health Agency of Canada.

9:30 – 10:00AM **Questions and answers.**

10:00 – 10:15AM **Break**

Moderator: Dr. Tarsicio Villalobos

10:15 – 10:45AM **Bacterial pathogenic mechanisms associated with food borne infections (Campylobacter, Salmonella and Listeria).**
Dr. John Maurer, Professor, Poultry Diagnostic and Research Center, Department of Population Health, University of Georgia, Athens, Georgia.

10:45 – 11:15AM **Current advances in immunization of Poultry against food borne pathogens.**
Dr. Sandy Aehle, Technical Manager, Lohmann Integrated Solutions, Lohmann Animal Health International, Waterville, Maine.

11:15 – 12:00PM **Questions and answers**

12:00 – 1:30PM **Lunch break**

*Note that the Workshop CD contains these proceedings and the author’s PPT presentations*
Prevention and control programs: field experiences.

Moderator: Dr. Andres Montoya

1:30 – 2:00PM
**Live production (commercial broilers and turkeys): initiatives and experiences to lower the incidence of food borne pathogens at the farm.**

Dr. Martine Boulianne, Professor, Chair in Poultry Research, Faculty of Veterinary Medicine, University of Montreal, Canada.

2:00 – 2:30PMM
**Post-harvest interventions: initiatives and experiences in the control of food borne pathogens at the processing plant and further processing.**

Dr. Scott Russell, Professor of Poultry Processing and Products Microbiology, Department of Poultry Science, University of Georgia, Athens, Georgia.

Moderator: Dr. Mariano Salem

2:30 – 3:15PM
**Round table: Practical experiences by food safety managers and veterinarians representing primary breeder, layer, broiler and turkey companies.**

Dr. Joseph A. Schultz, Director of Laboratory Services, Cobb-Vantress, Inc., Siloam Springs, Arkansas.
Dr. Eric Jensen, Veterinarian - Grandparent Program, Aviagen, Huntsville, Alabama.
Dr. Armando Mirande, Corporate Veterinarian, Sanderson Farms Laurel, Mississippi.
Dr. Helen Wojcinski, Science and Technology Manager, Hybrid Turkeys – Hendrix Genetics, Ontario, Canada.
Dr. Eric Gingerich, Technical Services Specialist- Poultry, Diamond V, Litchfield, Zionsville, Indiana.

3:15 – 3:30PM  **Break**

Moderator: Dr. John McCarty

3:30 – 4:00PM
**Current Initiatives and Experience in the Control of Salmonella Enteritidis in U.S. Commercial Egg Production**

Dr. Simon Shane, Adjunct Professor, Department of Poultry Science, North Carolina State University, Raleigh, North Carolina.

4:00 – 4:30PM
**Future Food Safety Challenges facing the Poultry Industry.**

Dr. Scott Stillwell, Vice President for Food Safety and Quality Assurance, Tyson Foods.

4:30 – 5:00PM  **Questions and answers**

5:00 – 5:15PM  **Adjourn**
DR. CHARLES STEPHEN RONEY  
DIRECTOR, NATIONAL POULTRY IMPROVEMENT PLAN (NPIP), CONYERS, GA.

Born and raised in the town of Newville in southeast Alabama, Steve earned his Doctor of Veterinary Medicine from Auburn University School of Veterinary Medicine in 1981 and a Master’s of Avian Medicine from the University of Georgia in 1987.

During Dr. Roney’s 24 years in poultry medicine, he has worked in technical services with both vaccine and pharmaceutical allied companies. He has also worked more than 9 years as a production veterinarian with two different broiler integrators where he was in charge of all poultry health programs for the companies.

Dr. Roney is currently the Senior Coordinator of the USDA's National Poultry Improvement Plan in Conyers, Georgia. The National Poultry Improvement Plan is a cooperative Industry-State-Federal Program devoted to elimination and control of specific diseases of poultry breeders as well as administration of the Notifiable Avian Influenza program.

DR. BRUCE STEWART-BROWN  
VP FOOD SAFETY & QUALITY, PURDUE FARMS, SALISBURY, MD.

Senior vice president of food safety and quality for Perdue Farms based at the company’s corporate office in Salisbury, Md. Bruce is responsible for the company’s farm-to-fork food safety programs and oversight of Perdue’s animal health and welfare programs. Bruce has a BS and DVM, both from Iowa State University. He has been a diplomate in the American College of Poultry Veterinarians since 1994.

DR. JOANNE TATARYN  
SENIOR EPIDEMIOLOGISTS, CENTER FOR FOOD-BORNE, ENVIRONMENTAL AND ZOONOTIC INFECTIOUS DISEASES, INFECTIONS DISEASES PREVENTION AND CONTROL BRANCH, PUBLIC HEALTH AGENCY OF CANADA.

Dr. Joanne Tataryn is a senior epidemiologist with the Outbreak Management Division at the Centre for Food-borne, Environmental and Zoonotic Infectious Diseases (CFEZID) with the Public Health Agency of Canada (PHAC).

Joanne received her Doctor of Veterinary Medicine at the Western College of Veterinary Medicine (WCVM) in 1999, and following graduation, worked as a clinical associate at WCVM and a veterinary inspector with the Canadian Food Inspection Agency.

She returned to University in 2005 to do a Master’s of Science in Epidemiology at the University of Saskatchewan, focusing on methods of evaluating and improving surveillance systems for Chronic Wasting Disease in wild cervids.

In 2007, she joined the Canadian Field Epidemiology Program (CFEP) with the Public Health Agency to sharpen her outbreak investigation skills and to diversify her knowledge and experience in public health. While with CFEP, she worked on a variety of public health issues, including West Nile virus, food-borne illness outbreaks and surveillance for congenital anomalies in children.

Since joining the Public Health Agency’s Outbreak Management Division in Nov 2010, Joanne has focused on food-borne outbreak investigation and response and has worked on number of recent national outbreaks. She is based out of the University of Saskatchewan.

DR. JOHN MAURER  
POUlTRY DIAGNOSTIC AND RESEARCH CENTER, DEPARTMENT OF POPULATION HEALTH, UNIVERSITY OF GEORGIA, ATHENS, GA.

Dr. Maurer is a research microbiologist at the Poultry Diagnostic Research Center (PDRC), University of Georgia. He is Professor of Population Health, adjunct professor in the Department of Microbiology and member of the Center for Safety at the University of Georgia. His laboratory works primarily on food safety on a broad range of topics including molecular epidemiology of foodborne pathogens, developing and validating rapid detection methods, and microbial ecology of the intestinal tract.

Dr. Maurer received his PhD degree from the University of Texas Health Science Center at San Antonio. He received three years postdoctoral training in Dr. Roy Curtiss’s III lab at Washington University in St. Louis. In 1996, Dr. Maurer joined the faculty at PDRC. He has over 50 peer-reviewed publications, numerous book chapters, reviews, and Dr. Maurer is the editor and contributor to the book, PCR Methods in Foods. Dr. Maurer has served on several national committees addressing food safety issues including recent review by the Institute of Medicine on proposed changes in food inspections by the USDA.
DR. SANDY AEHLE
LOHMANN INTEGRATED SOLUTIONS, LOHMANN ANIMAL HEALTH INTERNATIONAL, WATERVILLE, ME.

Sandra Kelly-Aehle with Lohmann Animal Health International, a poultry health company. She holds degrees from Western Illinois University and University of Missouri-Columbia specializing in microbiology and agriculture science and has over 20 years working with Salmonella in poultry. After developing live attenuated Salmonella vaccine candidates at Washington University with Dr. Roy Curtiss in the mid-80’s, Sandra led activities toward USDA licensure of the company's swine and poultry vaccines at Megan Health, Inc. Recently, she joined Lohmann Animal Health International and is here today to provide an overview of the latest advances in protecting poultry against foodborne pathogens. So to speak to you this morning on the “Current advances in immunization of poultry against foodborne pathogens”, please welcome Sandra Kelly-Aehle.

DR. MARTINE BOULIANNE
PROFESSOR, CHAIR IN POULTRY RESEARCH, FACULTY OF VETERINARY MEDICINE, UNIVERSITY OF MONTREAL, CANADA.

Dr. Martine Boulianne received her DVM from the Faculty of Veterinary Medicine of the University of Montréal, and her PhD in avian pathology from the University of Guelph. She became a member of American College of Poultry Veterinarians while doing post-doctoral studies at the University of California, Davis.

Dr. Boulianne went back to her alma mater where she is currently a full professor. Over the past years, she has funded a capitalized industry research Chair, the Chair in Poultry Research, as well as a biosecurity level 2 lab facility dedicated to pre-harvest control of pathogens in poultry. Her research interests include the epidemiology, control and characterization of foodborne pathogens affecting poultry products. She has been involved in the development of various preventative programs both at the local and international levels such as the Salmonella Enteritidis control program in Québec and the implementation of HACCP-based Food Safety measures in poultry in Vietnam.

DR. SCOTT RUSSELL,
PROFESSOR OF POULTRY PROCESSING AND PRODUCTS MICROBIOLOGY, DEPARTMENT OF POULTRY SCIENCE, UNIVERSITY OF GEORGIA, ATHENS, GA.

Bachelor of Science in Agriculture, 1986. Microbiology, College of Agriculture, The University of Georgia.

Dr. Russell’s research activities have been primarily directed toward intervention strategies for reducing pathogenic and spoilage bacteria from poultry production and processing operations and developing rapid microbiological methods for identifying and enumerating spoilage, indicator, and pathogenic bacteria from fresh and cooked poultry products. His research has resulted in a total of 44 refereed journal articles, 37 abstracts, 43 proceedings, 1 patent, 7 book chapters, and 71 popular articles for a total of 203 publications. Dr. Russell has been invited to speak 174 times at scientific meetings around the world. Dr. Russell has been featured on Fox News (The Fox Report with Sheperd Smith) and Good Morning America (Interviewed by Dr. Richard Besser, former Director of the CDC). Dr. Russell has published the first full textbook on Salmonella in poultry entitled: “Controlling Salmonella in poultry production and processing” published by Taylor and Francis (CRC Press).

Dr. Russell works closely with the poultry industry throughout the U.S. and Canada, and with countries in Central and South America, Europe, and China. Dr. Russell assists poultry companies with elimination of pathogenic bacterial populations throughout their growout and processing operations. Additionally, Dr. Russell conducts applied research projects to assist in answering a variety of questions related to problems in poultry plants.

DR. JOSEPH A. SCHULTZ,
DIRECTOR OF LABORATORY SERVICES, COBB-VANTRESS, INC., SILOAM SPRINGS, AR.

Animal Veterinary Science BS degree from Univ of Maine at Orono/ MS degree in Pathobiology University of Connecticut.
30 years in the Primary Meat type chicken breeding business…much time working toward Salmonella control / elimination. Currently working with Cobb USA, Brazil and UK lab – Health teams. Instructor at NPIP Salmonella workshops for past several years.
DR. ERIC JENSEN  
GRANDPARENT PROGRAM, AVIAGEN, HUNTSVILLE, AL.

Dr. Jensen earned his Doctor of Veterinary Medicine and Master of Avian Medicine degrees at the University of Georgia, and is a diplomate of the American College of Poultry Veterinarians. He worked 11 years in the poultry biologics industry prior to joining Aviagen in 1995. Dr. Jensen’s current responsibilities include managing the health programs, a veterinary diagnostic laboratory, regulatory and export issues for Aviagen’s grandparent division.

DR. ARMANDO MIRANDE  
CORPORATE VETERINARIAN, SANDERSON FARMS LAUREL, MS.

DR. HELEN WOJCINSKI,  
SCIENCE AND TECHNOLOGY MANAGER, HYBRID TURKEYS – HENDRIX GENETICS, ONTARIO, CANADA.

Dr. Helen Wojcinski is responsible for providing specialized technical services and solutions to Hybrid customers globally. She has been with Hybrid since 1998. Prior to this, she received her DVM from the Ontario Veterinary College (OVC), University of Guelph in 1982. She spent 2 years in private practice before returning to OVC to complete a DVSc degree in Poultry Health Management in 1998. Dr. Wojcinski earned her Board Certification in 1993 through the American College of Poultry Veterinarians.

Helen has been a PAACO certified poultry welfare auditor since 2006 and was one of their poultry foundation auditors. She is also a member of the American Association of Poultry Pathologists Animal Welfare committee and co-chairman of Hybrid Turkeys Turkey Welfare committee.

Dr. Wojcinski is a frequent presenter at industry meetings and symposia both locally and internationally.

DR. ERIC GINGERICH  
TECHNICAL SERVICES SPECIALIST– POULTRY, DIAMOND V, LITCHFIELD, ZIONSVILLE, IN.

Eric Gingerich, DVM, and a diplomate of the American College of Poultry Veterinarians (ACPV), joined Diamond V in May of 2010 as Technical Services Specialist – Poultry. His responsibilities are to provide technical services and information to customers of Diamond V.

Prior to coming to Diamond V, Dr. Gingerich was employed at the University of Pennsylvania School of Veterinary Medicine Laboratory of Avian Medicine and Pathology as staff veterinarian from 2000 to 2010. From 1983 to 2000 he was employed by DEKALB Poultry Research, Inc., a primary breeder of egg-type chickens, as a technical services veterinarian eventually becoming director of Veterinary Services.

Dr. Gingerich is a 1977 graduate of the Purdue University School of Veterinary Medicine. After graduation, he went to work for Central Soya Co., Inc., a feed sales and poultry production company, as a poultry research veterinarian from 1977 to 1982. In 1982, he went to work as a poultry diagnostic lab veterinarian for the Arkansas Livestock and Poultry Commission in Springdale Arkansas before joining DEKALB Poultry in 1983. Dr. Gingerich currently resides in Zionsville IN with his wife and two of four daughters.
DR. SIMON SHANE
ADJUNCT PROFESSOR, DEPARTMENT OF POULTRY SCIENCE, NORTH CAROLINA STATE UNIVERSITY, RALEIGH, NC.

Dr. Simon M. Shane is a retired Professor of the Department of Epidemiology and Community Health, School of Veterinary Medicine, Louisiana State University, where he was involved in teaching, research and service from 1979 through 2001. He currently holds appointments as an Adjunct Professor in the Department of Poultry Science and the Department of Population Health and Pathobiology College of Veterinary Medicine, North Carolina State University.

He obtained his veterinary degree from the University of Pretoria, South Africa, in 1964, and the Ph.D. in Poultry Nutrition from Cornell University in 1969. He subsequently earned a Masters degree in Business Leadership from the University of South Africa in 1975, while serving as a production director for a large integrated broiler producer in the Republic of South Africa.

He was awarded the Diploma of Fellowship of the Royal College of Veterinary Surgeons in 2001, is a 1991 Charter Diplomate of the American College of Poultry Veterinarians and the 2005 recipient of the AAAP Lasher-Botorff Award. Simon is active in aspects of US and international broiler and egg production with special emphasis on biosecurity, economics and food safety, having consulted extensively in North America, Europe the Middle East, Africa and Asia.

He is the editor of EGG-CITE.com which is distributed to 1,700 recipients in the U.S. egg production industry each week.

DR. SCOTT STILLWELL,
VICE PRESIDENT FOR FOOD SAFETY AND QUALITY ASSURANCE, TYSON FOODS.

Scott is Vice-President of Food Safety and Quality Assurance at Tyson Foods, Inc. with responsibility for the Poultry, Food Service, Prepared Foods, Deli and National Accounts divisions’ food safety and quality policies, procedures and staff. This group encompasses approximately 70 meat, poultry, bakery and prepared foods processing facilities and 1500 dedicated food safety and quality assurance team members. Previously, he held the position of Director of Food Safety and Regulatory Compliance at Tyson Foods. Scott has been employed by Tyson Foods for twenty-four years in a number of technical and administrative positions. He holds a Master’s degree In Business Administration from the Edinburgh Business School and is a candidate for a PhD in Poultry Science with emphasis in microbial food safety at the University of Arkansas.
The National Poultry Improvement Plan (NPIP) was established in 1935 as a program for control of vertically transmitted diseases of breeding poultry. The program has been extremely successful in controlling diseases that threatened to limit the growth of the modern poultry industry. For more than 50 years, NPIP has been devoted to control and certification of diseases of poultry which has allowed the development of a primary breeder industry that now supplies well over 50% of the world’s poultry stock. The NPIP continues to play a role in issues facing the poultry industry whether by addressing these issues as part of the Plans’ provisions or by cooperating with other agencies within the federal government.

In July 2010, the Food and Drug Administration (FDA) Egg Safety Rule was implemented in an attempt to control SE infections in commercial layers. The FDA Egg Safety Rule affects 99% of US egg production and requires the facility to register and maintain required records, implement biosecurity and pest control programs, conduct environmental testing for SE at 14-16 weeks and 40-45 weeks, and requires mandatory diversion and egg cultures in the event of an SE positive environmental test. The simultaneous occurrence of the largest egg recall in history in the Midwest for SE contamination served to kick start the enforcement of this rule and prompted interagency cooperation with the bacterial testing demanded by this situation. For environmental testing, the FDA has recognized USDA’s NPIP provision from Title 9 CFR 147.12 “Procedures for collection, isolation, and identification of Salmonella from house environmental samples, cloacal swabs and hatchery samples” as equivalent to FDA methods in accuracy, precision and sensitivity in detecting Salmonella enteritidis infections. This revised provision gained interim approval by the General Conference Committee (GCC) of the NPIP in December 2010 and is currently awaiting publication as a program standard as referenced in the 9 CFR Part 147. Another requirement of the FDA Egg Safety rule is that commercial layer pullets be sourced from breeder flocks certified under the US Salmonella enteritidis Clean Program of the NPIP or an equivalent program. This program requires that breeder flocks be tested for SE through both environmental and serological methods and any positive environmental samples must be followed by bird culture for flock status determination. The willingness of the FDA and the USDA to work together on the issue of Salmonella enteritidis control in table eggs is encouraging in that positive interaction of government agencies could be a method of making our food supply safer.

In 2009, the Food Safety Inspection Service (FSIS) proposed new performance policy aimed at controlling the seemingly increasing incidence of Salmonella enteritidis in processed broilers. As a response to the concerns of FSIS, the delegates to the 40th Biennial Conference of the NPIP voted to adopt the SE Monitored Classification for broiler breeders. This is a program to monitor prevalence of SE in broiler breeders and establish a baseline of SE incidence to compare against the incidence of SE in broilers; another example of inter-agency cooperation to reach a common goal.
On January 4, 2011 President Obama signed into law the Food Safety Modernization Act under the FDA. This is sweeping legislation that will be felt in several agencies and throughout many segments of the poultry industry. The new law is intended to ensure the U.S. food supply is safe by shifting the focus of federal regulators from responding to contamination to preventing it. This law has three major categories which must be followed by all food companies:

1) Improving capacity to prevent food safety problems. This is a proactive approach involving records management, registration of facilities, hazard analysis with risk based preventive measures and protection against intentional adulteration.
2) Improving capacity to detect and respond to food safety problems. This involves laboratory accreditation for analysis of foods, enhanced tracking and tracing of foods and mandatory recall authority.
3) Improving the safety of imported food. Foreign supplier verification requirements and inspection of foreign food facilities are some of the areas covered.

The Food Safety Modernization Act will likely have a profound impact on how we produce and process poultry in the United States. The NPIP will undoubtedly be called on once again to provide assistance in reaching many of the new goals that will be mandated by this legislation.

The “One Health” initiative is a movement to forge co-equal, all inclusive collaborations between both human and veterinary health professionals. This notion is intent on bringing together the many disciplines of animal and human health and encourages interaction among these groups. The federal government has reached a critical budgetary state. Spending must be curtailed to ensure the economic future of our country. Agencies will be asked to do more with fewer resources and less employees. This tight rein on spending will necessitate interagency and intra-agency cooperation in order to accomplish goals which have been set. Recent collaboration between FDA and USDA has established a precedent for this kind of cooperation and will hopefully set the stage for a continuing commitment of all involved agencies to apply those resources necessary to assure the safest and most wholesome food supply in the world.
Introduction:
There are usually just a few things that are the most important things in just about everything we do raising poultry. No matter if it is performance, welfare, biosecurity, food safety, etc. Sometimes we can make it very complicated. The basic concept of a live side best practice programs are to say to each area of the production (breeders, hatchery, feedmill, and growout) the several things they need to do to help control food safety organisms. The company then teaches these, talks about them, measures their compliance to them (honestly) and works to fix those areas that are the least compliant. Ideally, it becomes the training manual for all new employees. It becomes a part of every discussion of performance review. In reality, the result is rarely “100% compliant”. Most times, a new version needs to be written as new information becomes available – just about every year.

The best practice has to be clearly a practice that makes a difference in the production environment. It shouldn’t be just a good idea or something that has been studied only in the laboratory. However, some of them are very hard to absolutely prove the clear value. So, at times they are a measured leap of faith.

Best Practices are NOT critical control points. If they are not in place, it doesn’t mean the flock is “bad”. They are not that kind of thing.

The following live side food safety best practices will be discussed in some detail.

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<td>Nest Box Management</td>
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<td>Egg Room Management</td>
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<td>Vaccination</td>
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<td>Chemical Control Management</td>
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<td>Foreign Material Control Program</td>
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<td>Feed Withdrawal</td>
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<td>Chemical Control Program (with Pesticide Residue Testing)</td>
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<td>&quot;Special&quot; Salmonella Management</td>
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<td>Gut Health</td>
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Summary:

Best Practices are NOT critical control points. If they are not in place, it doesn’t mean the flock is “bad”. They are not that kind of thing.

Some of these cost money, some really don’t. However, they have to become as important to you as air, water, and feed management is to feed conversion.

Some years, compliance might go down from the previous years. Some housing types might be more challenging than others. Some areas of the United States may be more of a struggle than others.

Best Practice programs add clarity to an issue and if done right – simplicity. We can get pretty complicated on a lot of things, so simple is usually better.
Case reports: public health and economic implications of recent food borne outbreaks.

Dr. Joanne Tataryn
Senior Epidemiologist, Centre for Food-Borne, Environmental and Zoonotic Infectious Diseases, Infectious Disease Prevention and Control Branch, Public Health Agency of Canada.

Despite a robust food safety system, food-borne disease continues to cause significant burden of illness in both Canada and the United States. Further, factors such as globalization, concentration of food production and changes in eating patterns and populations are changing the epidemiology of food-borne illness requiring public health agencies to work closely with partners to rapidly respond to large-scale food-borne outbreaks.

An overview of the process for investigating food-borne outbreaks in Canada will be explored and will include a discussion on weight of evidence, partners in food-borne outbreak investigation and response in Canada and surveillance to detect outbreaks. Additionally, a review of Salmonellosis in Canada will focus the discussion on current trends in Canada and challenges in investigating common serovars such as Salmonella Enteritidis and Salmonella Heidelberg.

Finally, a brief overview will be provided of recent outbreaks related to poultry and turkey products.

Note PPT Presentation is not on CD.
If approval is granted it will be available for download at: www.acpv.info/page/2012_acpv_proceedings
Bacterial pathogenic mechanisms associated with food borne infections (Campylobacter, Salmonella and Listeria).

John J. Maurer, PhD
Poultry Diagnostic Research Center
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Cell biology has revolutionized our understanding of pathogenic mechanisms used by Campylobacter, Salmonella enterica, and Listeria monocytogenes to cause disease. Central to Salmonella’s ability to cause disease is its ability to “invade” enterocytes lining the epithelial cells. Salmonellae produce a “needle” complex (Type III secretion system; or T3SS) that literally injects “effectors” that cause reorganization of the cytoskeleton, temporary dissolution of the microvilli and uptake of the bacterial cell via a mechanism that resembles phagocytosis. However, the host cell is not passive in this interaction; producing the chemokines and cytokines involved in inflammation. Similarly, L. monocytogenes can also invade intestinal epithelial cells using a different mechanism. Unlike Salmonella, Listeria escapes its vacuole compartment with its haemolysin that literally dissolves the membrane. Once in the cytoplasm, L. monocytogenes propels itself through the cytoplasm by polymerizing free actin (cytoskeleton building blocks) into a “comet tail” that pushes it into the adjacent cell. This invasion mechanism is believed to be central to its ability to transverse the placenta or the blood-brain barrier. Campylobacter is also capable of invading the epithelium, using a mechanism distinct from Salmonella and Listeria. Like Salmonella, Campylobacter’s interaction with intestinal enterocytes triggers the secretion of chemokines/cytokines that elicits inflammation. Campylobacter also produces a toxin (cytolethal distending toxin; CDT) that arrests the cell cycle resulting in the distension and eventual death of the host cell.
Control of foodborne pathogens remains a major challenge for the poultry industry and of critical importance to public health. Efforts to minimize or eliminate foodborne pathogens, such as *Salmonella*, *Campylobacter* and *Listeria*, must include preharvest and postharvest strategies. Vaccines developed for poultry have shown to be effective in reducing *Salmonella* in the environment and in reducing vertical transmission of infection. *Salmonella* vaccination programs, along with other control measures, have been implemented successfully in providing a last line of defense for the bird against infection by field strains. To date, no other vaccines are commercially available for poultry for the prevention of human bacterial enteropathogens such as *Campylobacter* and *Listeria*.

*Salmonella* sp. and *Campylobacter jejuni* cause the largest number of foodborne illness in the US with poultry and poultry products attributed as the major source of infection. Although *Campylobacter* infections have decreased 27% since 1996-1998, the number of incidences that occurred in 2010 ranks second to *Salmonella* cases at 13.6 per 100,000 (3). *Salmonella* infection was the most common infection reported (17.6 illnesses per 100,000) and was associated with the largest number of hospitalizations and deaths in 2010. The incidence of listeriosis, caused by *Listeria monocytogenes*, has also decreased 38% since 1996-1998 (3). Foods associated with transmission of *Listeria* to humans become contaminated during processing. Although *Listeria* contamination is only infrequently acquired on the farm and carried into the processing plant, equipment and the plant environment become contaminated and serve as reservoirs to cross contaminate carcasses (4, 6).

The USDA FSIS recommends the use of vaccination programs for poultry as one of several interventions to reduce foodborne pathogens (10). Live and inactivated vaccines to reduce colonization of the gut and reproductive organs by *Salmonella* are commercially available and have been demonstrated both by controlled and field studies to effectively reduce vertical transfer of *Salmonella* carriage and to confer protective immunity to progeny of vaccinated breeders through IgY maternal antibody (8, 15, 27). Studies in hens undergoing molt have shown significant protection against challenge with wild-type *S. Enteritidis* after one spray application of a live *Salmonella* vaccine prior to feed withdrawal (16). Hassan and Curtiss (14) demonstrated that vaccination of chickens with a live *S. Typhimurium* vaccine provided significant cross-protection to challenge with several serotypes in the B, D and E *Salmonella* serogroups.

A recent study determined the effectiveness of a vaccination program combining a live *Salmonella* vaccine with an inactivated *S. Enteritidis* vaccine. Two groups of birds were either vaccinated with AviPro® SE-109 SE-4 (Killed Vaccine: KV) at 12- and 16-weeks of age or vaccinated (by coarse spray) with AviPro® Megan® Egg at 9-weeks of age followed by AviPro® SE-109 SE-4 at 12- and 16-weeks of age. Similar groups of birds were held as nonvaccinated controls. After independent groups of vaccinated and nonvaccinated birds were orally challenged with 3 different wild-type *Salmonella* strains at 21-weeks of age,
Internal organs and ceca were obtained a week later and cultured for the respective wild-type *Salmonella* challenge organisms. The level of protection was assessed by determining the difference in the percentage of birds in each vaccination program whose organs were completely cleared of the wild-type challenge strain compared to nonvaccinated birds. Figure 1 shows the synergistic effect of priming young birds with the live *Salmonella* vaccine to enhance protection against challenge with wild-type *S. Typhimurium*, *S. Heidelberg* and *S. Enteritidis* when groups of birds given only the inactivated vaccine were compared to groups of birds given a combination of the live *Salmonella* vaccine and the inactivated vaccine.

**Figure 1.** Protection (%) of birds provided either inactivated SE vaccine alone or in combination with a live *S. Typhimurium* vaccine.

Campylobacter remains a challenge for the broiler industry. Risk factors for the occurrence of *Campylobacter* were identified in broiler flocks as age and flock size (17), animals in the vicinity of the broiler house, livestock other than chickens on the farm, a down period of less than 14 days, dividing the flocks for slaughter (13) and the practice of batch depletion (12). Stern et al (23) reported enhanced on-farm biosecurity practices and freezing of carcasses from *Campylobacter* positive flocks contributed to the significant drop in poultry-associated campylobacteriosis in Iceland. Government regulations and implementation of stringent biosecurity practices in primary production were effective in preventing *Campylobacter* infection of flocks and was directly correlated to a 74% reduction in campylobacteriosis attributed to poultry in New Zealand (21). Several experimental approaches like the reduction of colonization by competitive exclusion, bacteriocins, and application of bacteriophage are currently under investigation for their effectiveness in reducing *Campylobacter* in primary production (11, 22, 24). Although killed whole-cell *Campylobacter* vaccines have had limited success (7), Wyszynska et al (26) reported more than a 6-log reduction of *Campylobacter jejuni* after challenge of birds vaccinated with a live recombinant Δcya Δcrp *Salmonella* vaccine strain synthesizing the highly conserved immunodominant CjaA protein. Buckley and coworkers (2) found that an attenuated ΔaroA *Salmonella Typhimurium* strain synthesizing CjaA fused to TetC reduced the challenge *C. jejuni* organisms in the ceca by 1.4 log in chickens. More recently, Layton et al (19) found that oral vaccination with ΔaroA htrA *S. Enteritidis* synthesizing CjaD, an outer membrane protein, reduced *C. jejuni* colonization in the ileal mucosal samples by 4.8 log to undetectable levels (19).
The Centers for Disease Control demonstrated a direct epidemiological link between human listeriosis and the consumption of undercooked poultry (20). *Listeria* is widely distributed in nature (25) and it would be expected that poultry could be exposed during live production. However, the development of poultry vaccines against *Listeria monocytogenes* would not be economical due to the infrequent and low isolation of the organism from live birds (1, 9). The antimicrobial and protective mechanism of probiotic bacteria against *Listeria* has been investigated. Corr et al (5) demonstrated that bacteriocin-secreting *Lactobacillus salivarius* produced a consistent reduction of 1-2 logs in internal organs of mice challenged with over $10^9$ CFU of *L. monocytogenes*. More interesting was evidence that supported direct antagonism as the mode of action involved in protection against *L. monocytogenes* as early as 30 minutes after administration of the *L. salivarius*. Recent studies by Koo and coworkers (18) showed that *Listeria* adhesion protein (LAP) synthesized by recombinant probiotic *Lactobacillus paracasei* was able to interact and attach to heat shock protein on the surface of intestinal cells just as *Listeria* would. The *L. paracasei* physically crowded out *Listeria* organisms and decreased the number of *Listeria* cells that passed through intestinal cells by 46%. The direct human use of bacteriophage was approved in 2006 by FDA when a phage preparation targeted against *L. monocytogenes* was allowed for spraying meat thus opening the way for other phages to be recognized as having GRAS (generally recognized as safe) status (ListShield, http://www.Intralytix.com).

Extensive research and field trials have identified a wide range of management and intervention measures for the reduction of human enteropathogens from poultry. Vaccination of poultry has been shown to reduce carriage of *Salmonella* into the processing plant. While many strategies for reducing foodborne pathogens have been proven efficacious in laboratory research, the conduct of true field trials under commercial settings requires continued research.

References


Nowadays, one of the most important consumer concerns is safe food. For any government there is tremendous pressure to police the food producers and transformers to ensure that the food supply is safe and wholesome. For those of us in animal production and in research, the impact of human illness in relation to food safety is huge. We work to understand these risks and focus on developing the means to reduce them. Yet, according to the World Health Organization, foodborne diseases are a widespread and growing public health problem, both in developed and developing countries.

Unfortunately, poultry products are among the most frequently incriminated sources of Campylobacter jejuni and Salmonella responsible for human foodborne illness. If Salmonella has long been associated with poultry products, attention has turned in the last decade to Campylobacter as an important cause of foodborne bacterial gastroenteritis in humans. In this presentation, I will focus on these two major causes of foodborne diseases, although Shiga toxin-producing Escherichia coli (mostly of type O157:H7), Listeria monocytogenes and other pathogens may be isolated from poultry products.

**POLICIES**

As a part of the Sanitary and Phytosanitary (SPS) agreement, the World Trade Organization requires that member countries establish SPS measures on the basis of an appropriate risk assessment. Many governmental food inspection agencies are moving away from the traditional single macroscopic carcass examination to develop a food safety system integrating microbiological detection tools, hazard analysis and critical control points (HACCP) principles, with traceability throughout the gate-to-plate continuum.

With the same objective in mind i.e. a safer product, we have seen different approaches implemented by various governments. For example, the Americans have focused on controlling foodborne pathogens from the finished product via carcass treatment and have written policies in that regards with the Mega-Reg, while the European strategy is to act directly on the live commodity via their EU directives.

In some countries, joint industry/government initiatives, often prompted by major food borne outbreaks, have led to the development of comprehensive Salmonella/ Campylobacter control programs. Sweden is certainly a leader with fifty years of experience in controlling Salmonella in livestock while the recent New Zealand Campylobacter control program has received international recognition.

**PRE-HARVEST CONTROL MEASURES**

Historically, the prevention of foodborne illness has mostly depended on safeguarding the microbial integrity of the food products, or their decontamination before consumption. More recently, the scope of food safety efforts for poultry products has been broadened to include pre-harvest control measures. Supporting the importance of pre-harvest control
measures implemented during rearing to reduce contamination of the final product is the finding that Salmonella control was better achieved in countries where control programs targeting animal populations are already in place (EFSA 2011).

**Interventions to prevent the flocks from being infected.** Identification of control measures to prevent transmission requires a good understanding of the epidemiology of bacteria in poultry meat production. While a great deal is known about the mechanism of Salmonella transmission, there are still debates concerning that of the Campylobacter spp.. It is known that both are horizontally transmitted but the vertical transmission of Campylobacter is a contentious issue. Our knowledge of the epidemiology of Salmonella has helped in establishing various and effective preventive measures at every level of production; hatchery, farm, feedmill, Salmonella-free parent and grand-parent flocks, use of vaccination, competitive exclusion, etc..., which finally seem to be succeeding in reducing levels of Salmonella in broilers in countries where implemented (Davies et al., 2001). Unfortunately, similar measures appear to be ineffective against Campylobacter. For example, during the past years, the United Kingdom has successfully put in place various measures to reduce Salmonella, but these measures have failed in controlling Campylobacter as shown by a recent study. Indeed, Meldrum and Wilson (2007) have shown overall contamination rates of 70.2% and 4.0% for Campylobacter and Salmonella respectively, in retail whole chickens in the UK where control measures have been used.

There is no doubt that the application of sound biosecurity measures will decrease the chance of a pathogen becoming established on a farm. If biosecurity has long been proned as a means to decrease the risk of disease transmission, the recent H5N1 threat might have done more to heighten the producers’ awareness to biosecurity than years of education!

Since the external environment is thought to be the most important source of Campylobacter, simple biosecurity measures have been shown to delay flock colonization by Campylobacter (Berndston et al., 1996; Hald et al., 2000; Humphrey et al., 1993), but did not avoid it all the times. Campylobacter control is therefore possible in closed-house poultry production by using strict biosecurity measures to avoid horizontal transmission from the external environment; nearby manure heap and poultry houses (Arsenault et al., 2007c), other animals both domestic and wild (Berndston et al., 1996), insects such as flies (Nichols, 2005), and even professional rodent control crews (Arsenault et al., 2007c)! The slightest breach in biosecurity might ruin all efforts. Drinking water might be another route of infection especially if it is untreated (Arsenault et al., 2007c; Guérin et al., 2007; Kapperud et al., 1993). It is also well known that there are seasonality patterns to Campylobacter positive broiler flocks with the incidence increasing in the summer months in the Northern Hemisphere (Wedderkopp et al., 2001). The reasons behind this seasonal pattern are not fully clear. However, Campylobacter has been isolated from flies (Nichols, 2005) and interestingly the use of fly screens decreased the number of Campylobacter spp.-positive flocks, from 51.4% in control houses to 15.4% in case houses (Hald et al., 2007).
**Intervention to reduce bacterial concentration in the intestines after the flock has been infected.** These interventions may include feed- and water-additives such as organic acids, prebiotics, probiotics, bacteriocins and bacterial phages. At the present time, there is no well-documented method for efficiently reducing the concentration of *Salmonella* or *Campylobacter* in the intestines of broilers in infected flocks. However, some substances tested in small scaled studies have shown some potential. More research is needed to clarify the efficacy of such additives as well as their use under commercial conditions. Bacteriophages can also be considered an attractive alternative to control the presence of enteric pathogens in intestines of birds or on finish products. However, some features of phages such as the narrow range of *Salmonella* serotypes targeted by one phage, the fact that *Campylobacter* is so far much less sensitive to phage infection, the possibility of bacterial resistance, as well as the difficulty to provide a constant and uniform dosage to live animals are likely to reduce the practicality of this solution for the poultry industry.

Vaccination against *Salmonella* Enteritidis and *Salmonella* Typhimurium with either killed or live attenuated vaccines has been shown to reduce the excretion rate of poultry. For a more specific protection, and because part of the immunity conferred by vaccination is transferred to the progeny, many American integrated broiler companies vaccinate their broiler breeders with one or two killed commercial *Salmonella* vaccines and follow with the administration of autogenous bacterins. The latter are often a mix of the most frequently isolated serovars from their slaughterhouses and apparently a decreased prevalence of these serovars can be observed in the following months. Similarly, the implementation of a SE vaccine program for layers in UK has lead to a decrease in human SE intoxication (Cogan and Humphrey, 2003). However neither of these vaccines can consistently and completely prevent organ infection, fecal shedding and egg contamination following experimental *Salmonella* challenge (Gast et al., 1992).

Recent advances in the developments of adjuvants (e.g. microspheres) that can slowly release the antigens and target different parts of the immune system (Barrow, 2007), and the ongoing progress in identifying key *Salmonella* virulence factors could be the origin of a promising next generation of *Salmonella* sub-unit vaccines.

Chickens can develop antibodies to *Campylobacter* infection and high antibody levels have been found in breeder flocks and the yolk of their eggs (Sahin et al., 2001). Although a lot of work is still needed before vaccine commercialization, some experimental sub-unit vaccines are showing promises.

**Preventing contamination prior to processing.** Pre-harvest control measures should not be limited to the farm. For example, an observational study conducted by our research group revealed that significant risk factors (P < 0.05) associated with a higher proportion of positive broiler chicken carcasses within lots were *Salmonella*-positive cecal culture, low rainfall during transportation to the slaughterhouse, temperature of ≥ 0°C during transportation to the slaughterhouse, and a ≥ 4-h waiting period in shipping crates before slaughtering. For *Campylobacter*-positive carcasses, lots containing birds with *Campylobacter*-positive cecal culture results, lots of birds slaughtered at the end of the week, and lots with at least
20% of birds with digestive contents detected in the jejunum at time of slaughtering had a significantly higher proportion (P < 0.05) of contaminated carcasses (Arsenault et al., 2007a).

CONCLUSIONS

The improvement of detection methods and a better understanding of risk factors associated with the presence of Salmonella in poultry farms have led to the implementation of a comprehensive farm to plate approach that gave positive results in countries where such an approach was taken. In order to be as successful in decreasing Campylobacter contamination levels in the final product, there is a dire need to improve our knowledge to develop a meaningful and cost effective approach. In both cases, use of natural strategies in live birds, such as phages and vaccines, could reduce the need of antimicrobial agents at the farm level or chemical treatment at the processing level, helping meet the consumers' expectations for a safe but also a ‘natural’ product. Finally, governmental authorities should support the industry and the producers in the development of on farm food safety initiatives since these programs are developed to the greater benefit of the consumers and ultimately reduce costs of human health care systems.

REFERENCES

Reduction of \textit{Salmonella} and \textit{Campylobacter} on poultry during processing requires a multi-hurdle approach. The following article details interventions that can be used during processing to lower \textit{Salmonella} and \textit{Campylobacter} progressively as the carcass moves through slaughter, evisceration, and chilling.

As the weather begins to warm, a number of poultry companies will begin to experience problems keeping the birds cool in the growout house. As a result, some growers will use foggers to wet the birds and keep them cool. In some cases, these fogging systems wet the birds, allowing litter to attach to feathers. This may result in a serious problem once the birds arrive at the processing plant, because the litter on their feathers and skin is loosened during scalding and comes off of the birds, resulting in excessive organic material in the scald water. Scalding water containing high concentrations of fecal material is a problem because it comes in contact with the external surface of the birds and, during picking, bacteria contained in this dirty water may be massaged into the skin and open feather follicles.

To reduce this problem, some companies have installed a bird brush and washer prior to scalding (See Pre-scald bird brush diagram). Larger brushes and chlorinated water physically remove the feces from the feathers and skin of the birds. One company using this technique decreased the amount of fecal material going into the scalding by approximately $90\%$. This decreases the amount of organic material on the surface of carcasses as they go into the chiller.

The next important step in removing organic material from carcasses is the scalding. The scalding is one of the most important areas in the processing plant in which cross-contamination with \textit{Salmonella} and \textit{Campylobacter} can occur. Most scalders are not set-up to be truly counter-current. The water should move against the carcasses, going from the exit of the scald toward the entrance. This opposing water flow is essential to wash the birds and remove contamination from the birds as they travel through the scalding. Counter-current flow may be accomplished by adding a steel barrier between the lines of chickens going in either direction. By separating these chickens, bacteria that are washed off of the external surface of the chickens entering the scalding are not transferred to those
exiting the scalding chamber. The rate of water flow should be high, so as to dilute the concentration of foreign material and bacteria in the scalding chamber. There is a common adage that goes “dilution is the solution to pollution” and it applies in this case. Plants that are not equipped with multi-stage scalders (scalders with successive, separate tanks) should attempt to make their scalders multi-stage.

An ideal scalding set-up is depicted in Figure 1.

By introducing plenty of fresh water into the scalding chamber (at the exit end), a significant portion of the organic material can be removed from the surfaces of the carcass. If this material is allowed to remain on the carcass, it will be transferred into the chiller. If the chiller contains high levels of organic material, then oxidative sanitizers, such as chlorine, will have little effect on bacterial concentrations. Thus, maintaining proper flow direction and water flow rate should increase the efficacy of chlorine as it is used later on in the process to kill bacteria.

Controlling Salmonella cross-contamination in the scalding chamber

Scalding is one of the most important processing steps with regard to controlling the prevalence of Salmonella and Campylobacter on processed ready-to-cook carcasses. The scalding chamber is the first area in the plant where pathogenic bacteria associated with the surface of one bird can be washed free from that bird and be spread to the surfaces of other birds. This situation may lead to increases in overall prevalence of Salmonella and Campylobacter on carcasses. Interestingly, the actual number of Salmonella and Campylobacter on positive carcasses decrease as bacteria encased in excreta are washed free from the surface of the bird. However, because negative birds may then become contaminated, the overall prevalence increases.

Most older scalders are like a bath (Photo 1), as opposed to having a counter-current flow. This counter-current flow has the effect of washing the chickens, much as a fast moving river would wash dirt from a person better than would a bathtub. However, many poultry companies have difficulty in increasing water flow rate because of municipal water supplier limits.
If the surface of the carcass is contaminated with Salmonella and Campylobacter in the scalder as a result of the bacteria being transferred from bird to bird, another problem may occur in the next processing step. In the picker, feathers are removed and the bacteria in the contaminated water from the scalder may be transferred from bird to bird.

**Testing the scalder efficacy**

By evaluating microbiological counts or Salmonella and Campylobacter prevalence pre- and post-scald, it is possible to determine if the scalder is operating appropriately. Figure 3 below is an excellent example of an improperly operating scalder. Reasons for this problem may be the following: 1) the temperature of the scalder is far too low to prevent Salmonella from growing, 2) not enough fresh make-up water is being added to the scalder, or 3) the water is flowing in the same direction as the carcasses as opposed to a counter-current flow.

![Figure 3: Salmonella prevalence pre- and post-scald](image)

Some suggestions for correction of this problem are as follows:

1. Balance the scalders in terms of fresh water makeup and flow direction (counter-current)
2. Make sure that the temperature is above 123°F in all scald tanks
3. Add a post-bleed brush system to remove any clumps of fecal material from the carcasses prior to scalding
4. Consider introduction of an approved chemical into the scald tanks

In the picker, feathers are removed and the bacteria in the contaminated water from the scalder may be transferred from bird to bird.
Once these corrections have been made, conduct additional microbiological evaluations. Figure 4 shows a more realistic scenario in a plant that is running the scalder correctly.

The scalder should be considered a positive intervention step in controlling Salmonella and Campylobacter. If biomapping of the plant indicates that the scalder is significantly contributing to cross-contamination of Salmonella and Campylobacter between carcasses, then steps should be taken to correct the problem.

Addition of chemicals to the scalder and lowering temperatures

In a survey conducted by the U.S. Poultry and Egg Association at http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf indicated that, of the poultry companies that add anything to the scalder (which very few do), 50% use chlorine and 50% use sodium hypochlorite. Chlorine should not be used in scalders because it is immediately deactivated by the organic load in the scalder and can gas off. Sodium hypochlorite does not significantly impact the bacterial levels on carcasses during scalding.

A benefit to adding acidic disinfectant chemicals to the scalder is that the scalder temperature may then be lowered. This has a tremendous impact on the efficacy and expense of scalding. Figures 5 and 6 indicate APC and E. coli counts on carcasses before and after scalding for controls (scalded in water only) and for carcasses scalded using a strong acid mixture as a carcass disinfectant.
Using a chemical sanitizer in the scalder in these studies had a dramatic impact on Aerobic Plate Counts and *E. coli* counts on chicken carcasses. Using a sanitizer, the scalder may be used to prevent growth of *Salmonella* in the scalder and this allows for the use of lower scalder temperatures that may have the following benefits:

1. Easier pick (acid sanitizers)
2. Less bacterial growth and lower bacterial numbers including *Salmonella*
3. Less overscald striping of breasts
4. Less energy cost to heat the scalder water
5. Less sub-skin fat cook-off leading to higher yields

**Controlling cross-contamination in the pickers**

The pickers present a serious problem for processors when it comes to cross-contamination. Fecal material is removed from a carcass by the mechanical action of the picker fingers. Subsequent carcasses are then exposed to this fecal material as they are rubbed by the contaminated picker fingers. Efforts have been made to control this problem by adding antimicrobial compounds to the rubber picker fingers. However, there has been little evidence indicating the efficacy of this approach. When conducting in-plant trials, we discovered that the chlorinated water coming from the bottom of the pickers contained around $10^6$ (1 million) bacteria per milliliter. This indicates a very high level of contamination within the pickers, even when chlorine was added to the water at 40 ppm.

The USDA-FSIS has conducted biomapping studies on plants throughout the U.S. and found that in most plants, *Salmonella* and *Campylobacter* increase in prevalence as the carcasses traverse the pickers. Thus, there are tremendous opportunities for the use of disinfectants during picking to assist processors in lowering total *Salmonella* prevalence on finished carcasses. Figure 7 shows how *Salmonella* prevalence may be increased during picking.

![Figure 7: Salmonella prevalence pre- and post-pick](image)

**Testing cross-contamination in the pickers**

Figure 8 depicts data from a large in-plant trial in which the scalders, pickers, and New York spray cabinet were using chlorinated water (controls) or treated with Tasker Blue. The combined effects were dramatic. Instead of increasing APC during scalding and picking (combined), the addition of the sanitizer was able to result in a $2.7 \log_{10}$ (greater than 99%) lower level of bacteria on the carcasses as they approached the OLR system.
In subsequent trials, this reduction early on in the process has proved to have an enormous impact on *Salmonella* carcasses as they exit the chiller.

![Figure 8: Aerobic plate counts pre-pick and pre-OLR](image)

Only the effect of a sulfuric acid, ammonium sulfate, and copper sulfate mixture has been presented in here, however, very few other chemicals have been studied as a means of disinfecting the scalder and picker systems. Great caution should be used when attempting to use chemicals in the scalder. Oxidants should not be used in the scalder because they bind readily to organic material and are deactivated before they are able to interact with bacteria. Additionally, oxidants generally gas-off under higher temperatures, causing employee health problems. Acidic chemicals or combinations other than Tasker Blue may prove to be effective, however, their corrosivity to equipment should be determined prior to use and may preclude their use. Use of sodium hydroxide has not significantly improved bacterial levels as bacteria tend to be more resistant to increases in pH as opposed to decreases in pH (acids). Wastewater systems should be monitored closely when using chemicals in these systems as they may impact the ability of the plant to treat the wastestream and, if the chemicals have a long residual effect, they may kill the bacterial populations in the treatment ponds.

One major problem associated with the use of chemicals in the scalder and picker systems is that the poultry industry is not accustomed to paying for chemicals in the front of the plant. Thus, many companies, when presented with the additional cost of treatment, which they currently are not paying, balk at the idea of spending the extra money. With the new *Salmonella* and *Campylobacter* regulations in place, the industry may begin implementing chemical hurdles at the front of the plant, even though they are resistant because of the cost. The cost of treating the scalder and pickers is generally much lower than interventions currently used in the field and it is proving to be far more effective overall.

**Chemical disinfection on the processing line**

There are three main methods by which poultry processors can reduce pathogenic bacteria on the processing line, excluding the scalder, pickers, chilling, and post-chill dip systems. These methods include: 1) equipment sprays, 2) carcass rinses or washes, and 3) the online reprocessing system (OLR). Each of these processes will be discussed.
**Equipment sprayers**

The purpose of equipment sprayers is to disinfect the part of the processing equipment that comes into contact with each carcass to prevent pathogens from coming off of one carcass and being transferred to another carcass, resulting in cross-contamination. Generally, high pressure spray nozzles are used in these applications and by far the most commonly used chemical is chlorine because of its cost. Other chemicals that are being used for these applications include chlorine dioxide, peracetic acid, and Zentox or TOMCO water (acidified hypochlorous acid). While chlorine is an excellent sanitizer, there are some general principles that must be taken into account when using it. The incoming water pH should be less than 6.5 after addition of the sodium hypochlorite bleach in order for the chlorine to do its job. This may be accomplished by the addition of citric acid or carbon dioxide to the water.

The main inhibitor to chlorine being effective as an equipment disinfectant is the buildup of fat or other organic material on the equipment, such that even though chlorinated water is being sprayed onto the built up material, it is not able to penetrate the material and kill the bacteria underneath. These bacteria may then be liberated when the next carcass comes by and be transferred to that carcass. This is a common occurrence on carcass brushes intended to remove feces after evisceration. Often, even though chlorinated sprays are used, these systems end up causing an increase in *Salmonella* prevalence when biomapping is done on carcasses before and after the brush or fecal finger system. The cropper can be especially troublesome in that the ingesta in the crops of birds often contain pathogens such as *Salmonella* and *Campylobacter*.

The pH of the equipment rinse waters should be maintained below 6.5 and checked regularly to ensure that the chlorine is in the appropriate form for optimal activity against bacteria. The spray pressure should also be checked and any clogged nozzles should be replaced. Photo 2 shows a spray bar in which the nozzles are set differently and some of the nozzles are not working.

![Photo 2. An improperly operating spray bar.](image)

Moreover, the nozzles and bars should be positioned so that they spray the part of the equipment that touches the chicken carcass and not other parts. Used properly, these systems can help to reduce cross-contamination.
Carcass sprays and inside/outside bird washers

The water from these sprayers or rinses should be checked frequently to determine chlorine levels or other chemical levels, pH, pressure and distribution. In one processing facility, the IOBW’s had very little water pressure. When confronted, the maintenance manager said, “Oh, do you want this turned up? I had it turned down so that it wouldn’t spray people as they walked by.” This is a case of someone changing the process without understanding the microbiological effect on the carcass. In another instance, a company’s E. coli results became unacceptable within one day and continued that way. The maintenance manager had swapped the nozzles in the IOBW for a different type of low flow nozzle. This had a dramatic influence on bacterial levels.

General suggestions for all washers and rinsers include:

1. Maintain proper nozzle pressure.
2. Maintain proper water pH.
3. Maintain proper chlorine or other chemical level.
4. Maintain proper water distribution on the carcass.

As with equipment rinses, chlorine dioxide, peracetic acid, and Zentox or TOMCO water (acidified hypochlorous acid) are being used in IOBW’s on an experimental basis.

Companies generally use chlorine in IOBW systems; however, a comprehensive research study conducted by Northcutt et al. (2005) of the USDA-ARS clearly demonstrated that adding chlorine to the IOBW has absolutely no impact on aerobic plate counts, Escherichia coli counts, Salmonella prevalence or Campylobacter counts on carcasses. These data correlate well with numerous biomapping studies that show no difference in the microbiological quality of carcasses entering versus those exiting the IOBW systems. This may be explained by the high level of organic material on the carcass at that point in the process. Chlorine is not able to penetrate the organic material and interact with the bacteria. Therefore, little or no effect is observed.

Online reprocessing systems

The purpose of OLR systems is not to reduce Salmonella. The USDA-Food Safety and Inspection Service (FSIS) views the OLR as a process intended to make carcasses that would otherwise have to be reprocessed by hand because they have fecal material or ingesta on them microbiologically equivalent to those carcasses that do not have any fecal material or ingesta on them. This is, in fact, the type of research protocol that companies must run to achieve approval for their chemical as an OLR agent (i.e. they must compare the microbiological quality of fecally contaminated to uncontaminated carcasses). That having been said, most processors expect to achieve at least a 1 log\textsubscript{10} reduction in bacterial levels on carcasses as they traverse the OLR system.
The U.S. Poultry and Egg Association conducted a survey of the poultry industry in February of 2006 and the presentation of those data given by Dr. John Rice may be found at the following web address: http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf.

The following are chemicals that the poultry industry (94 plants responded to the survey out of approximately 247 in the U.S.) is using for OLR purposes and the percentage of companies that use that particular chemistry: 1) acidified sodium chlorite (Sanova® - 33%), trisodium phosphate (Rhodia – 24%), chlorine dioxide (numerous companies – 15%), hypochlorous acid (Zentox and TOMCO – 9%), organic acids (6%), peracetic acid (FMC 323 or Parasafe and Inspexx 100 - 5%), cetylpyridinium chloride (Safefoods Cecure® - 3%), SynerX® (citric acid and HCl – 1%), bromine (Bromitize™ – 1%), sodium metasilicate (AvguardXP® - 1%), and electrolyzed oxidative water (EAU – 1%). Chemicals not mentioned in the survey include Zentox monochloramine and SteriFx (FreshFx) which was included with organic acids, but contains mostly inorganic acid.

**Sanova® (Ecolab) acidulated sodium chlorite**

This product is approved as a poultry spray or dip at 500 to 1200 ppm singly or in combination with other GRAS acids to achieve a pH of 2.3 to 2.9 as an automated reprocessing method. In chiller water, sodium chlorite is limited to 50 to 150 ppm singly or in combination with other GRAS acids to achieve a pH of 2.8 to 3.2. Studies have shown that it can reduce *Salmonella* contamination from 31.6 % prevalence to 10 % prevalence (Kemp et al., 2001). In the survey by the U.S.P.E.A. listed above, the industry mentioned that they had no confidence in Sanova® or Inspexx® as OLR or chiller agents. However, they said that Sanova was an effective post-chill dip solution.

**Trisodium phosphate (TSP)**

Use of trisodium phosphate (TSP) over the years has been encouraged by the USDA as an approved method for automated reprocessing. TSP is costly to use because of the high concentration (10 %) used on carcasses (Photo 3). There are negative aspects to using TSP in poultry processing plants that should be considered. Residual TSP on carcasses causes the chiller water pH to increase dramatically. In plants where TSP is used, the chiller water will generally be in the pH range of 9.7 to 10.5. This is extremely high and prevents chlorine from being converted to its effective form, hypochlorous acid. Hypochlorous acid forms most effectively when water is in the pH range of 6.5 to 7.5. Thus, plants using TSP are wasting their bleach. This is not a desired situation because chlorine is very effective against *Salmonella*. 
Photo 3: Trisodium phosphate system (TSP).

If a poultry company is having trouble with high *Salmonella* prevalence and have an operating TSP system in place, it must make major adjustments to reduce *Salmonella* prevalence. CO$_2$ gas systems have been added to the aeration systems of chillers as a means of reducing the pH of the water so that when chlorine is added, it will form hypochlorous acid. Discharging TSP in areas of the country that have strict phosphorous discharge limitations may be a problem as well. One beneficial effect of using TSP is that companies report that a 1% yield increase may be achieved due to increased water holding capacity.

**Chlorine dioxide**

Chlorine dioxide has had a rocky past within the poultry industry. Early attempts to introduce this chemical were unsuccessful because of the inability to control the levels of ClO$_2$ during use. Gassing off occurred frequently and employees complained. ClO$_2$ is an extremely effective sanitizer. The companies that are most successful with this chemical produce the chemical on site and control it very carefully. Adequate ventilation is necessary to ensure worker safety. In an in-plant trial conducted recently, I found no observable reduction in APC or E. coli on carcasses as they traversed an OLR using ClO$_2$. This may be related to the relatively short contact time used in this plant and should not be used to evaluate all ClO$_2$ used in all OLR applications.

**Hypochlorous acid**

The success of this technology varies greatly as well. Companies have seen excellent to no positive results depending greatly on the organic loading of the carcasses entering the system. In systems that adequately clean the carcasses prior to introduction to the OLR system, the bacteria may be greatly reduced using this approach. However, carcasses that have high organic loading in plants that use very few carcass washes and little water, may not achieve success using HOCl. Another key to this approach is using precise control of the pH of the water. HOCl will not be formed in significant amounts above a pH of 6.5 to 7.0, depending on the temperature.

**Organic or inorganic acids**

Acids definitely kill bacteria, however, they must be closely monitored to ensure that they contact the skin of the carcasses for an appropriate period of time and that they do not create product defects. Acid needs more time to kill bacteria than oxidant based chemicals and if the chiller immediately (within 2 min) follows the OLR system, it can be difficult to achieve good results. Often, bacteria become acid stressed when a carcass is treated with an acid. These organisms become hard to recover when doing efficacy studies. This does not mean that the bacteria were killed and will not be discovered by the USDA. Thus, when using acids, make sure that adequate neutralization and recovery steps are used during microbiological analysis or inaccurate results will be obtained.
Peracetic acid

Peracetic acid is a mixture of an organic acid (acetic acid) and an oxidant (hydrogen peroxide). Therefore, this chemical kills bacteria in two separate ways. Most research indicates that a 1 log$_{10}$ reduction may be achieved using approximately 200 ppm peracetic acid in the OLR system. A precaution when using peracetic acid is that it may react with blood vessels, producing a slightly gray color on the skin of the carcasses in areas that are highly vascularized, such as the neck.

Cetylpyridinium chloride

Cetylpyridinium chloride is a relatively newly approved OLR methodology. It is effective and I have conducted studies that have demonstrated an 83% reduction in Salmonella on carcasses traversing this system. Unfortunately, in another plant, we achieved only a 10% reduction using this method, even though the exact same spray cabinet, pressure, and concentration of chemical were used. A number of considerations must be taken into account when using this product. If the carcass has a biofilm, the biofilm should be disrupted prior to use of this chemical to make it more effective.

Electrolyzed oxidative water (EO)

The machine used to generate EO water is expensive; however, the cost of the raw materials is very low (salt and water). Thus, the total cost is reasonable. Studies have shown that it is very effective and can achieve a 1 log$_{10}$ reduction in bacteria on carcasses while being completely safe to use. EO water is acidified (pH 1.9 to 2.4) oxidative water that contains some hypochlorous acid (50 ppm) and other antimicrobial ions. It is generated on site, stored, and used as generated. It is not diluted. This material is excellent for post-chill dip applications as well.

Monochloramine

Monochloramine (Zentox) has many of the advantages of chlorine without the negative aspects. Monochloramine is used in a similar fashion as chlorine at about 50 ppm. It is generated by mixing bleach and ammonia under controlled conditions. It kills bacteria but is resistant to deactivation by organic material. Thus, it is more stable under high organic loads. Likewise, Axtell et al. (2005) demonstrated that no carcinogenic compounds were formed when monochloramine was used to chill poultry carcasses. This is a major concern in Europe with regard to the use of chlorine.

Unfortunately, there are still no magic bullets for use with OLR systems. The short contact time and methods of application (generally a spray) make it very difficult for chemicals to eliminate Salmonella during this step. We have observed reductions in Salmonella prevalence of 0% to 90% using various chemistries. It is also possible to see this type of variation from plant to plant using an individual chemical. This is because plants and incoming loads vary tremendously from plant to plant. Thus, it is important to select the appropriate type of sanitizer based on an individual plant setup.
Disinfection during chilling

More bacterial reduction (both numbers and prevalence) can be accomplished in a properly balanced chiller than anywhere else in the processing plant. Most studies demonstrate that the chiller can significantly reduce *Salmonella* prevalence (Izat et al., 1989) if operating properly. As with the scalder, the pH, temperature, flow rate, flow direction, chlorine concentration, and concentration of organic material (digesta, fat, blood) is crucial in order for the chlorine in the chiller to do its job. The pH should be 6.5 to 7.5, the temperature should be below 40ºF, the flow rate should be high (at least one gallon per bird), and the flow direction should be counter-current. The most effective methods for controlling the pH of chill water include addition of carbon dioxide gas (90% of the industry uses this method according to the U.S. Poultry and Egg Association survey at [http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf](http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf)) to the tubes normally used for air agitation, the addition of citric acid (10% of the industry uses this according to the survey) or sodium acid sulfate to the water.

The organic material in the chiller is generally determined by the following factors: the flow rate (amount of fresh make-up water), flow direction (should be counter-current), the use of pre-scald bird brushes and the cleanliness of the scalder, the temperature of the scalder, the number of high pressure carcass sprays used on the line prior to the chiller, and the number of chill tanks (more tanks equals less organics). Excessive organic material (blood, digesta, fat, protein) in the chiller will result in less chlorine being available to kill bacteria, as it will be bound up and rendered useless by the organic material.

Experiments conducted at the USDA’s Western Regional Research Center, Agricultural Research Service concluded that a free chlorine residual could not be established in a commercial poultry chiller even by adding up to 400 ppm of free chlorine (Tsai et al., 1992). When chlorine reacts with organic material, it generally loses its microbiocidal properties, and can no longer act as a disinfectant (White, 1992). Therefore, in order to maximize chlorine use in poultry chillers, efforts should be made to reduce the amount of organic material in these systems. Pre-scald bird brushes, effective carcass rinse systems, proper bleedout procedures, counter-current scalders and chillers, proper fresh water make-up in scalders and chillers, all contribute to lowering organic loading of the chillers. Use of monochloramine can avoid these issues. Monochloramine is not bound by organic material, is effective, and does not result in the formation of carcinogenic compounds (Axtell et al., 2006).

Many of the chillers in the industry are more like a bath than a river. The water is stagnant and organic material builds up during the shift (Photo 4). Also, fat builds up on the chiller paddles and sides of the chiller (Photo 5). This allows for *Salmonella* to be encased in the fat, offering it protection from the sanitizers used in the chiller. Suggestions for maintaining a balanced chiller include:

1. Maintain proper water flow direction (counter-current).
2. Maintain proper water pH.
3. Maintain proper chlorine level.

4. Maintain water temperature below 40°F.

Photo 4. Excessive organic loading in the chiller

Photo 5. Fat buildup in the chill system.

A properly operating chiller should have a visible gradient such that the water at the chiller exit is significantly cleaner than the water at the entrance. This is accomplished by adding all of the fresh water input and newly added chlorine directly to the exit end of the chiller as close to the exit paddles as possible. This will result in a “clean space” near the exit end of the chiller. In this space, chlorine will be able to act against bacteria, similar to the way a post-chill dip tank works. The ideal chiller setup is depicted in Figure 9.

Figure 9. Ideal chiller setup.
Based on a survey in February of 2006 by the U.S. Poultry and Egg Association found at http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf, the chemicals used in the U.S. for chiller applications and the percentage of plants that use them include hypochlorous acid (72%), peracetic acid (18%), chlorine dioxide (8%), bromine (1%), and monochloramine (1%). Other chemicals not listed in the survey that have been used in the industry include sodium acid sulfate and electrolyzed oxidative water. These chemicals all have advantages and disadvantages associated with their use and some companies may find that one or the other is most appropriate for their specific plant environment. Overall, the chiller, if operated properly can be the most significant intervention step for controlling Salmonella prevalence on broiler carcasses.

Post-chill dips and sprays

Poultry processors are employing the “hurdle hypothesis” to reduce Salmonella at different locations throughout the plant. The “hurdle hypothesis” is the premise that the more hurdles (i.e. interventions) that are employed against Salmonella or Campylobacter, the less likely it is that Salmonella or Campylobacter cells will be able to survive until the end of the process. As a final intervention and hurdle, companies are now using post-chill dips or sprays.

These systems are advantageous in that the chickens are as clean as they will be throughout the process and the ability of any given chemical to contact bacteria on the surface of the skin without interference from organic material is highest at this point. In general, fecal material, fat, protein, blood, bile, and bacterial biofilms that may be on the surface of the carcass have been removed by the time the carcass exits the chiller. Thus, the bacteria are most susceptible to disinfection at this point.

The chemicals that are being used for this purpose include acidified sodium chlorite (Sanova), hypochlorous acid, peracetic acid (FMC 323 or Parasafe and Inspexx 100), a mixture of hydrochloric, citric, and phosphoric acid (FreshFx), chlorine dioxide (multiple companies), and electrolyzed oxidative acidic water (EAU) to name a few. The U.S. Poultry and Egg Association industry survey found at http://www.fsis.usda.gov/PDF/Slides_022406_EKrushinskie.pdf indicated that of the companies that participated in the survey, 67% of the industry uses sodium chlorite, 25% use chlorine dioxide, and 8% use hypochlorous acid. The dip tanks used for these applications generally vary from small 50 to 100 gallon tanks to much larger (5,000 to 10,000) gallon pre-chiller type tanks. Likewise, the contact time used by these poultry companies varies from 8 seconds to 30 minutes. The spray systems are generally similar to those used for online reprocessing.

Figures 10, 11, and 12 depict Salmonella, aerobic plate count (APC) or E. coli reductions observed at two different poultry processing plants. Figure 10 shows reductions in Salmonella prevalence using Sanova (acidified sodium chlorite) for 8 seconds. Figures 11 and 12 show reductions in APC or E. coli using an acidic sanitizer for 10 seconds.
Because the organic loading is so low on carcasses after chilling, the efficacy of oxidant type chemicals is very high. These chemicals are most effective in situations where they can directly contact bacteria without interference from organic material. Likewise, acid based sanitizers are very effective as well because they are able to have an extended contact time. Whether a spray or dip is used, if the chemical is applied after the chiller, no other water washes are used. Therefore, the contact time may be hours or days. Care should be used when using chemicals that leave a residual. The reason is that, although chemicals that leave a residual may be very effective in post-chill dips or sprays and they may significantly extend the shelf-life of the product because of this residual, the U.S. Food
and Drug Administration (FDA) requires that chemicals that have a “material effect” on the product after packaging, such as extending shelf-life, must be added to the label as an additive (preservative). Thus, the processor would have to add the chemical to the label and this is generally viewed in a negative light in terms of consumer acceptance.

The decision to use a dip or spray system to apply the chemicals post-chill is based on whether the company normally rehangs the carcasses post-chill. For example, for companies that normally process whole ready-to-cook carcasses, these carcasses are packaged after chilling and would not be rehung. Thus, a dip system is more useful in this situation. Whereas, if the company debones most or all of the carcasses, then the carcasses will be rehung on a line and the spray system may be much easier to install and used in this scenario.

Overall, the companies are achieving success using post-chill dips or sprays and are finding that the interventions throughout the plant, combined with a post-chill dip system can be effective for lowering *Salmonella* and other bacteria to acceptable levels.

References


INTRODUCTION

The index outbreak of *Salmonella* Enteritidis (SE) infection among consumers of eggs occurred in New England in 1979. During succeeding years the infection extended to the Mid Atlantic region. Subsequently, incident cases were diagnosis in the Pacific region and in the Midwest in 1992. In 1995 surveillance applying the FoodNet system was initiated which allowed public health authorities to monitor the incidence rate and to initiate traceback investigations. In 2008 the incoming Administration in Washington evaluated possible health initiatives and decreed that FDA should activate a dormant proposed rule to prevent egg-borne SE. In retrospect this action was after-the-effect since isolates of SE had been declining progressively as a result of industry action. In 1995 10,200 cases were identified in contrast to less than 2,500 in 2005. The rate expressed as cases per 100,000 population declined from 9.1 in 1994 to 2.5 in 2007. In New England, the 1994 rate of 7.5 ebbed to 2.5 by 2007. In this year a rate of 1.5/100,000 was recorded in both the Mountain and Pacific regions of the U.S.

The impetus for the Final Rule was the 2007 CDC projection of the incidence rate of SE based on 5,333 cases reported. Applying a multiplication factor of 38 derived from estimates relating to actual illnesses, clinical diagnosis, and laboratory confirmation the CDC published a value of 202,654 cases of SE in the U.S. population with a 64% mid-range estimate attributable to eggs.

INDUSTRY RESPONSE TO THE EMERGENCE OF SE

Based on knowledge of the epidemiology of SE infection through the chain of production, a number of obvious preventive measures were adopted by the U.S. egg production industry. Key to the problem was compliance with newly developed National Poultry Improvement Program regulations which effectively eliminated vertical transmission through successive generations to commercial pullets.

A number of states including Pennsylvania and California adopted Egg Quality Assurance Programs which specified monitoring of the SE status of flocks, recommended biosecurity, rodent and fly control and advised vaccination. The voluntary but widely adopted United Egg Producers “Five-Star program” required monitoring of pullets prior to transfer to laying facilities for the presence of SE followed by a second screen two weeks before final flock depletion.

The Pennsylvania and California programs required more intense sampling at critical stress periods corresponding to post-peak production in the first cycle and after molting. Eggland’s Best Inc. the leading producer of nationally distributed specialty eggs imposed a rigorous program of testing in 2002, requiring samples from day old chick box papers, the
environment of pullets at approximately 14 weeks of age, at post-peak corresponding to 45 weeks, post-molt and two weeks before depletion. Vaccination was mandated, initially requiring two doses of *Salmonella Typhimurium* live attenuated mutant vaccine but with administration of an SE inactivated emulsion from 2003 onwards for at-risk operations and on all flocks in 2008.

**THE FDA FINAL RULE ON PREVENTION OF SE**

The Final Rule required NPIP compliance in sourcing of chicks, intensified rodent and fly control and testing of the environment of pullets prior to transfer at 45 weeks and five weeks post-molt. Flocks which are identified as being SE positive on environmental assay using drag swabs are subjected to confirmatory evaluation using four successive egg pool assays. Refrigeration of eggs at or below 45 F within 36 hours after production was an important component of the Final Rule.

The FDA embarked on a series of audits of egg production enterprises holding more than 50,000 hens. The process was associated with a prolonged start-up and training program for inspectors. Deficiencies in this process resulted in considerable discrepancies in interpretation of regulations and assessing compliance with SE Prevention Plans prepared for each operation. The task of inspecting the requisite number of farms was only accomplished by delegating responsibility for “targeted” (compliance audits) to state officials especially in regions with a high density of egg producing flocks.

The impact of enhanced vaccination, biosecurity and rodent control is evidenced by the experience in Ohio with approximately 10% of the Nation’s 280 million hens. The proportion of individual houses which tested positive using the approved drag swab technique declined from 5.6% of 386 units in 2009 to 2.1% of 473 units in 2011.

**FINANCIAL IMPACT OF THE FDA FINAL RULE**

A series of financial simulations was carried out to quantify the impact of the FDA Final Rule. Calculations were based on a typical 10-house high-rise complex with 1.25 million hens. Compliance with the FDA Final Rule was estimated to amount to $157,500 per annum for a complex including surveillance sampling, maintaining records, rodent suppression, protective clothing and vaccination of replacement pullets at 18 cents per hen. By allocating the cost over 28.9 million dozen produced by the complex each year, compliance was estimated to amount to 0.6 cents per dozen.

Over and above the basic compliance cost, it is possible to project the losses associated with introduction of SE infection onto a complex. If a flock is demonstrated to be environmental-positive at 45 weeks, producers would in all probability elect to deplete the flock of approximately 123,000 hens to prevent lateral transmission to adjoining flocks. Maintaining the flock and diverting eggs to breaking at prevailing costs of production and
realization would in any event be uneconomical. The cost associated with depletion at 45 weeks would amount to $443,500 based on the value of the non-amortized pullets and the loss of future production.

Even if an SE environmental positive is detected at 75 week associated with the mandatory post- molt assay, the cost associated with depletion of a flock would be $203,000. In the event that an FDA audit detects SE at 25 weeks of age, given that the youngest and oldest flocks on a complex are routinely sampled, the loss to a producer would be $567,500.

Losses can accrue as a result of “false positive” environmental assays. In on specific case a flock aged 45 weeks required diversion of eggs and four successive egg pool assays in addition to costs associated with quarantine and biosecurity. In this case the false positive assay resulted in a cost to the producer of $74,500.

In projecting the cost of the FDA Final Rule to the U.S. industry it can be calculated that routine compliance over 225 million hens producing shell eggs for table consumption would be $28.4 million or 0.63 cents per dozen. If it is assumed that 5% of flocks are affected with SE, the cost associated with diversion or depletion would be $4 million representing a total cost to the U.S. shell egg industry of $31.0 million per annum.

The costs used in the projections were based on estimates of SE prevalence, the value of shell eggs and the cost of feed and other production inputs. It is possible to develop models to evaluate the financial impact of SE in the context of the FDA Final Rule based on specific factors relating to an operation.

CONCLUSION

Although the FDA Final Rule has imposed additional costs on the U.S. industry, the ultimate benefits relate to improved acceptance of shell eggs by consumers. The potential cost of negative publicity associated with an extensive outbreak of SE is evidenced by the estimated $150 million loss experienced by the U.S. industry following the August 2010 recall of 0.5 billion eggs. Negative publicity and revelations of unhygienic practices coupled with egregious indifference to safety as reported by the media, based on premature releases by the FDA, depressed consumption resulting in a drastic reduction in revenue.

In retrospect it is doubtful whether the U.S. Egg Industry would have adopted more stringent preventive measures including diligent biosecurity, aggressive rodent control and refrigeration of eggs without the intervention of the Federal government. It is indeed fortunate that the prevalence rate of SE is relatively low, certainly below 5% in 2010. Given upgraded preventive procedures it is conceivable that the infection will be eradicated from commercial flock within three years. The SE situation with regard to backyard and subsistence flocks below 5,000 hens is questionable. Although there has only been one documented outbreak associated with an organic farm to date, the problem of identifying infection from a small unit by trace-back is self evident.
Future Food Safety Challenges facing the Poultry Industry.

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During a period in which food and agriculture businesses face a multitude of challenges to sustainability and profitability: rising input costs; increasing governmental regulations; growth in non-governmental activism; etc.; one of the most significant challenges faced by the poultry industry is the deficit in consumer trust that management members will “do the right thing”. Consumers have a basic expectation that the products they buy will not cause harm to them or their family members -- regardless of how the products are handled or consumed. Food safety is the number one reported concern for consumers and to ensure success and sustainability, management within the poultry processing industry must take steps to reassure the public, lawmakers and regulators that all conceivable means have been employed to reduce microbial pathogen carriage on raw products to the lowest level possible.

Recent outbreaks of human Salmonellosis associated with consumption of poultry products have reinforced a long-standing belief held by many members of the consuming public (and other interested parties):

“A lot of people contract Salmonellosis; and...
Poultry products contain a lot of Salmonella; therefore...
Poultry products cause a lot of Salmonellosis!”

The “other interested parties” include representatives of the nation’s public health community; non-governmental associations; and state and federal food regulatory authorities. While the poultry industry spends large sums of money marketing products and establishing interventions to prevent products from carrying human pathogens into the kitchens of consumers, we have been unable to communicate the results of our technical competencies sufficiently to overcome the beliefs based upon this commonly held syllogism. Thus, there exists an eroding consumer trust in the poultry business model.

Given that: human illnesses reported to be caused by species of the Salmonellae have not declined in recent years; and the goals related to this group of vegetative pathogens contained within the federal “Healthy People 2010” initiative have not been met; there is growing pressure from a variety of sources for food regulators to “do something” to address this concern. Government food safety regulatory policy makers have compared recent reports comparing rates of illnesses and concluded that the success achieved in lowering the human health burden due to the presence of Escherichia coli (E. coli) O157:H7 in red meats provides lessons that can be applied to the poultry industry. Regulators will make a more aggressive attempt to negatively incent poultry processors to lower the human health burden presumed to be caused by the presence of species of Salmonella in raw poultry products and will base policy on the set of lessons contained within a broad policy stance that has come to be called the “Cycle of Pain!”
As reflected in the red meat industry, this policy stance evolved to a point at which the industry had no choice but to identify meaningful and efficacious interventions to reduce the rate of pathogen carriage in the raw products – or face significant disruptions to business, profitability and sustainability. While attribution of human illnesses to the presence of *E. coli* O157:H7 -- in conjunction with the preferred preparation methods (cooking to low end point temperature for consumption) -- differ significantly from the current situation with the Salmonellae in raw poultry products (poorly defined illness attribution and consumer preference for well-cooked poultry products); there is a presumption that the “Cycle of Pain” will incent members of the poultry industry to develop innovative measures to further reduce pathogen carriage on raw products. The hoped for outcome of such a policy stance is a reduction in the number of people contracting Salmonellosis.

While the desired outcome is uncertain, staff members from the USDA’s Food and Safety Inspection Service (FSIS) are establishing policy to be applied within poultry processing that will create the framework in which FSIS inspectors will have the ability to drive change by inflicting on poultry processors substantial costs of nonconformance. These regulatory policy changes include impacts to the in-plant operations that may result in inefficiencies; changes to testing requirements that may result in products becoming associated with otherwise non-attributable outbreaks of human illness; and changes that may make the regulatory span of control extend to poultry live production operations. All of these changes are intended to drive reductions in pathogen carriage with the hoped for reduction in human illness.

To succeed in such a policy environment, poultry processors must accomplish several end results: 1) very low frequency of pathogen-positive product test results; 2) a very comprehensive and effective process control program to prevent visible contamination; and 3) a lack of product associated with human illnesses. The first two objectives are within control of management of a poultry processing company. The last objective is much less certain to be attained as it is predicated upon the poorly understood attribution of cases of Salmonellosis presumed to be caused by raw poultry products. If the presumption proves to be incorrect and further reductions in pathogen carriage do not result in reduced frequency of human illness, the misguided presumption will likely result in future cases of incorrect attribution; suggesting that poultry products remain a significant cause for concern.

Management of the poultry industry must take steps to ensure pathogen levels are as low as possible and work with relevant public health authorities to better understand the etiology of human Salmonellosis. In the event the presumption is proven correct and raw poultry products are clearly demonstrated to cause a significant public health burden due to the presence of vegetative microbial pathogens, structural changes and the associated costs required to reduce pathogen loads to the maximum extent possible will necessarily become an inherent organizational feature of successful, sustainable poultry processors.
The American College of Poultry Veterinarians was formed in 1992 exclusively for charitable, scientific and educational purposes. It is a 501(c) 3 incorporated in the Commonwealth of Pennsylvania.

The American College of Poultry Veterinarians is a veterinary specialty organization recognized by the American Veterinary Medical Association (AVMA) according to the policies and procedures of the American Board of Veterinary Specialties (ABVS). ACPV is the certifying board for veterinarians specializing in poultry medicine, health and management. An Annual exam is conducted by ACPV to award diplomate status to those qualifying by examination.

The American College of Poultry Veterinarians has 302 diplomates. Twenty have Emeritus status and seven members have Honorary status. Last year we added three new members. Two members passed away in 2011.

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