

ABSTRACTS

Wednesday, August 3, 2005

SYMPOSIA AND ORAL SESSIONS

*Author Presenting Paper

Processing and Products: Eggs and Antibiotic Resistance

177 Impact of strain on environmental and fecal microbial load and *Salmonella* prevalence during a single production cycle. K. E. Anderson*¹, L. K. Kerth², V. Kretzschmar-McCluskey², and P. A. Curtis², ¹North Carolina State University, Raleigh, ²Auburn University, Auburn, Alabama.

Salmonella species have been recognized as major food borne pathogens that appear to be closely related to the consumption of contaminated egg products that were improperly handled and prepared. It has been documented that commercial laying strains have different production characteristics and respond to stressors in the laying house differently due to the genetic selection. The objective of this study was to determine whether the strain of the hen or age influenced the total microbial load or the prevalence of *Salmonella* in the environment or feces. In this study, 2 white egg strains the Hy-Line W-98 and Bovans White were sampled every 4 weeks throughout the production period from 17 to 66 wk of age. Each strain was equally represented and housed at a density of 413 cm². Husbandry practices were the same for each strain and identical to those used in the 35th North Carolina Layer Performance and Management Test. Environmental samples were taken from egg contact surfaces within the cage with a sterile swab from a 25 cm² area located at the center of the cage 10 cm from the feed trough. Composite fecal samples of approximately 75 g were collected from sanitized dropping boards placed under the replicate cages 24 hr prior to collection. Samples were placed in a sterile whirl pack bag and immediately placed in a cooler on ice for transport to the laboratory. The environmental and fecal samples were diluted to 10⁻¹ and 10⁻⁵, respectively then spiral plated on Standard media. A *Salmonella* prevalence procedure selective growth of *Salmonellas* was used. The strain of the laying hen did not affect the environmental (log 2.96 and 2.85) or the fecal microbial load (Log 8.00 and 8.07) for the W-98 and Bovans White, respectively. There were 144 total fecal samples taken and of these there were three suspect positive *Salmonella* samples 2.1%. This indicates that although strain had no impact on total microbial shedding there appears to be an impact on *Salmonella* shedding in the production environment. Within the first production cycle *Salmonella* was present at times in the feces but not on a consistent basis.

Key Words: Chicken, Microbial shedding, *Salmonella*

178 Influence of hen age on shell egg exterior, interior, and contents microflora and *Salmonella* prevalence during a single production cycle. V. Kretzschmar-McCluskey*¹, K. E. Anderson², P. A. Curtis¹, and L. K. Kerth¹, ¹Auburn University, Auburn, Alabama, ²North Carolina State University, Raleigh.

Salmonella Enteritidis (SE), one of the foremost causes of foodborne illness, has been chiefly attributed to the consumption of raw or undercooked eggs or egg products. Research has shown that SE prevalence in the United States is approximately 1 in 20,000 eggs. The objective of this study was to determine if increasing hen age influenced the total microflora counts or the prevalence of *Salmonella* spp. on the egg shell surface, within the shell, or in the contents. Eggs from Hy-Line W-36 and W-98 egg layer strains were sampled approximately every 28 days from 17 to 66 wk of age from the 35th North Carolina Layer Performance and Management Test. The layers were managed under identical husbandry practices. This study utilized 45 eggs per hen population for a total of 90 eggs per period. Pooled sets of 9 eggs were used for each strain. The exterior, interior shell, and contents were spiral plated on PCA to calculate total aerobic counts. After a 24 hour enrichment, 0.01 mL of sample was added to RV broth. After an additional 24 hour enrichment, 1mL of the RV enrichment was plated on BGS agar and evaluated for the presence of *Salmonella* spp.

Hen age significantly (P<0.05) affected the microbial loads on each of the egg components tested. Exterior counts increased in period 4, possibly due to birds being diagnosed with Osteomalacia. However, the birds were treated and returned to normal production by the 5th period. Interior counts were erratic (P<0.05), increasing as much as 2 log units over the 12-month cycle. Contents data was not significantly different (P>0.05) until period 12, when microbial loads increased from 0 to 1 log unit. There were 120 total eggs taken, and of these there were two suspect positive *Salmonella* samples. Exterior and interior shell each had one suspect positive.

Key Words: Laying hen, *Salmonella*, Shell eggs

179 Recovery of *Salmonella* from nest run egg cart shelves. M. T. Musgrove* and D. R. Jones, *USDA-ARS, Russell Research Center, Athens, Georgia.*

A study was conducted to determine if *Salmonella* could be recovered from the shelves of nest run egg carts at commercial shell egg processing facilities. Eggs that are produced by hens not housed in buildings connected to the processing plant are referred to as nest run eggs. Nest run eggs to be processed are transported to the plant on these carts. In a previous survey conducted in our laboratory, data indicated high numbers of *Enterobacteriaceae* could be recovered by swabbing shelves from the nest run egg carts. In the present study, shelves were swabbed by two methods. A 10 cm x 10 cm sterile gauze pad was moistened with 10 mL phosphate buffered saline (PBS) and used to wipe a 12 x 12 cm section of shelf. An adjacent section of shelf of equal size was then swabbed using a sampling sponge that was moistened with 10 mL of PBS. After swabbing, the gauze (G) or sponge (S) was transferred to a Whirl-pak bag, placed on ice, and transported back to the laboratory. Individual samples were pre-enriched in buffered peptone water, selectively enriched in TT and Rappaport-Vassiliadis broths, and selectively plated onto BGS and XLT-4 agar plates. Presumptive colonies from these plates were used to inoculate LIA and TSI agar slants. Typical reactions were confirmed using *Salmonella* sero-grouping antisera. There were 73.3% (11/15) G and 66.7% (10/15) S *Salmonella* positives from nest run cart shelves at the first plant. At the second plant only 4.0% (1/25) of G and 4.0% (1/25) of S samples were confirmed as *Salmonella*. All *Salmonella* isolates were confirmed as serogroup B or C. None of the isolates were identified as being from serogroup D, which includes *S. Enteritidis*. Each of the methods was equally effective at recovering *Salmonella* but gauze pads were easier to prepare and less expensive to use.

Key Words: *Salmonella*, Nest run eggs, Sampling

180 Effects of cool water washing of shell eggs on interior quality. A. B. Caudill*¹, P. A. Curtis¹, D. R. Jones², M. T. Musgrove², K. E. Anderson³, and O. A. Oyarzabal¹, ¹Auburn University, Auburn, Alabama, ²USDA-ARS Russell Research Center, Athens, Georgia, ³North Carolina State University, Raleigh.

Recent identification of several emerging pathogens in the United States has contributed to increased consumer awareness of food safety issues. *Salmonella* Enteritidis (SE) is the most common human pathogen associated with shell eggs and egg products. Reduction of SE in eggs has been a focus of the egg industry, consumer groups, and the federal government for the last decade. Current regulations state that wash water temperature must be at least 90°F or 20°F warmer than the warmest egg. Today's egg washing process increases the internal temperature of the egg 12-14°F. Washing eggs at a cooler temperature could aid in reducing the internal egg temperature, and in turn, possibly reduce potential SE growth and preserve quality factors such as vitelline membrane strength. A pilot study was conducted to determine the feasibility of using cold water to wash eggs. The objective of the pilot study was to rapidly cool eggs to refrigerated temperatures in an effort to decrease SE growth in contaminated eggs by increasing vitelline membrane strength, which would decrease nutrients available for SE growth. Eggs were washed using six different wash water temperature combinations, which included a single warm water temperature (120°F) and two cool water temperatures (60 and 75°F). A ten week storage study followed in which the vitelline membrane strength and microbial levels were monitored weekly. Microbial results will be reported in a separate paper. The force required to break the vitelline membrane was measured using a Texture Technologies TA-XT2i Texture Analyzer. No difference was found between wash water temperature configurations. There was, however, a significant difference ($P < 0.05$) in the force required to break the vitelline membrane as storage time progressed. As expected, the vitelline membrane became weaker over time.

Key Words: Eggs, Egg quality, Egg processing

181 Effect of egg refrigeration on the *in vitro* penetration of *Salmonella enteritidis* through the yolk membrane. R. K. Gast* and P. S. Holt, *USDA-ARS, Russell Research Center, Athens, Georgia.*

Internally contaminated eggs have been implicated as leading sources of transmission of *Salmonella enteritidis* to humans. Although *S. enteritidis* is not of

ten deposited inside the nutrient-rich yolks of naturally contaminated eggs, penetration through the vitelline membrane to reach the yolk contents could result in rapid bacterial multiplication. Previous studies have observed such penetration to occur at a low frequency at warm temperatures using *in vitro* egg contamination models. The present study determined whether egg refrigeration affects the frequency of *in vitro* penetration of *S. enteritidis* across the yolk membrane. After inoculation of approximately 100 cfu of *S. enteritidis* onto the outside of the vitelline membranes of intact yolks in plastic tubes, the albumen was added back into each tube and the samples were either immediately refrigerated at 7° C, held for 2 or 6 hours at 30° C and then refrigerated, or held at 30° C. Twenty-four hours after inoculation of the samples, the numbers of *S. enteritidis* inside the yolks were determined. Refrigeration, especially when applied immediately to contaminated yolk samples, significantly reduced the penetration of *S. enteritidis* into the contents of egg yolks in the *in vitro* contamination model. These results highlight the value of prompt refrigeration for restricting the opportunities for *S. enteritidis* to multiply to high levels inside the yolks of contaminated eggs.

Key Words: *Salmonella enteritidis*, Refrigeration, Vitelline membrane penetration

182 The correlation of eggshell strength and *Salmonella* Enteritidis growth in commercial shell eggs. D. R. Jones* and M. T. Musgrove, *USDA-ARS, Russell Research Center, Athens, Georgia.*

Shell quality has been identified as a heritable trait which can be manipulated by genetic selection. Previous research has concluded that many methods of determining shell quality produce variable results. With the development of newer, more precise measuring technologies, shell strength can now be assessed in a consistent, objective fashion. A research project was conducted to determine what role shell strength might play in affecting external *Salmonella* Enteritidis (SE) contamination of egg contents. Visibly clean eggs were collected from an in-line shell egg processing facility at the accumulator. Eggs were inoculated by dipping in a concentrated suspension of nalidixic acid resistant SE. After storage, eggs were assessed for shell strength and both external and internal SE contamination. Shell strength was subjectively determined utilizing a Texture Analyzer. In the first study, there was a significant difference ($P < 0.05$) in shell strength amongst the three replicates. No differences between treatments were found for shell strength or SE contamination of contents. In the second study, there were no replicate differences for any of the monitored factors. When rinsate and content samples were enriched, 100 % of the rinsates were positive for SE. No content samples were shown to be SE contaminated during direct plating, but 3-5 % of the samples from each replicate were positive after enrichment. Correlation analysis of the results from each study found only weak correlations between shell strength and eggshell surface or contents SE contamination. Within the range of shell strengths recorded in this study, the correlation analysis suggests that shell strength does not play a major role in SE contamination.

Key Words: Shell strength, *Salmonella* Enteritidis, Shell eggs

183 The effect of cooking temperatures on the destruction of *Salmonella* in eggs. A. L. Davis*, P. A. Curtis, and D. E. Conner, *Auburn University, Auburn, Alabama.*

While the numbers of *Salmonella* Enteritidis (SE) outbreaks have declined in the past years, undercooked eggs still remain as a primary source of SE infections in the US. This study is based on previous research which looked at consumer preference and cooking temperatures that would aid in the destruction of *Salmonella*. Based on the previous cooking study, those who find hard-cooked eggs distasteful can minimize their risk by cooking the egg until the white has completely formed and the yolk begins to thicken, but has not hardened. The Food and Drug Administration recommends cooking all parts of the egg to 63°C (145°F) for 15 seconds. However, consumer preferences do not always agree with the recommendation of cooking eggs to complete firmness. This study reassessed the safety of various cooking methods by actually inoculating *Salmonella* into the egg and cooking as recommended. For the most part the results of the study on the eggs which were inoculated and then cooked followed the same pattern as the cooking study.

Key Words: Eggs, *Salmonella*, Egg cooking temperature

184 Impact of white and brown-egg layer strains on egg quality, and size distribution during a single production cycle. K. E. Anderson^{*1}, L. K. Kerth², V. Kretzschmar-McCluskey², and P. A. Curtis², ¹*North Carolina State University, Raleigh*, ²*Auburn University, Auburn, Alabama*.

The production characteristics of commercially available layer strains are different from one another due to the genetic selection of laying hens. In addition, production, quality and egg sizes vary with respect to the specific strain examined, yet few studies continuously document these differences. In this study, there were 9 white egg and 3 brown egg strains represented. Each strain was equally represented and housed at a density of 413 cm². The white and brown egg strains were segregated by the phase feeding program in order to meet the nutritional needs of the two different groups. The remaining husbandry practices were the same for each group and identical to those used in the 35th North Carolina Layer Performance and Management Test. Every 28 day period production, feed intake, and egg samples were collected. The eggs were weighed and graded in accordance with USDA standards for shell eggs. Haugh units and other internal quality measurements were taken on egg samples collected every other period. The percentage of Grade B and Loss eggs differed ($p < 0.05$) between the white egg strains. These differences ranged from 1.80 to 0.93% Grade B for the Bovans White and Hy-Line, W-36, respectively. The range percentage of loss eggs was 0.30 to 0.07 for the Dekalb and Bovans White, respectively. Egg weights and each of the USDA egg sizes were affected by strain. Within the Brown egg strain group there was no effect on the USDA grades, however, the egg size distribution was impacted. The percentage of Medium and Extra Large eggs was different between selected strains. The Hy-Line Brown had the highest percentage of Mediums and the lowest percentage of Extra Large. Strain selection within the production operation can significantly affect the size of the egg produced and the quality of the eggs, which may influence the use of these eggs for further processing in the breaker market.

Key Words: Chicken, Egg quality, Egg size distribution

185 Effect of layer hen strain on egg weights and solids during a single production cycle. L. K. Kerth^{*1}, P. A. Curtis¹, and K. E. Anderson², ¹*Auburn University, Auburn, Alabama*, ²*North Carolina State University, Raleigh*.

In the modern laying industry, breeding layer strains for production of large egg sizes to enhance yield is ongoing. However, the effects of such breeding efforts on egg solids properties have not been studied. Eggs from layer strains bred for optimal albumen production may produce solids percentages that detrimentally affect the yield of albumen. In addition, eggs may be more susceptible to breakage of the yolk membrane and contamination of albumen by yolk lipid. To evaluate those breeding effects on solids, five layer strains were selected based upon their egg weight, availability, and market share and were monitored for a single laying cycle from 17 to 66 wk. Every 28 days eggs from these 5 strains were collected from the 35th North Carolina Layer Performance and Management Test in which the strains were maintained under identical husbandry and environmental conditions throughout the study. The hens were provided nutrients to meet the needs of all the hens based upon compilation of the breeder recommendations. After collection the solids content of the fresh eggs were determined. Hy-Line W-36 had the lowest ($P < 0.05$) whole egg weight, while Hy-Line W-98 and ISA White were higher than Hy-Line CV-20 and Bovans White. This contrasts what was expected from whole egg solids. Hy-Line W-36 and CV-20 had a higher percentage of ($P < 0.05$) whole egg solids compared to all other strains. Bovans White and ISA White had lower ($P < 0.05$) albumen solids compared to other strains. Additionally, percentage of albumen solids in Hy-Line CV-20 was higher than Hy-Line W-36 ($P < 0.05$). On the other hand the percentage of yolk solids were not affected ($P > 0.05$) by layer strain. Yolk solids ranged from 50.30 to 50.85%.

Key Words: Laying hen, Eggs, Egg solids

186 Layer strain impact on functional properties of eggs during a single production cycle. L. K. Kerth^{*1}, P. A. Curtis¹, and K. E. Anderson², ¹*Auburn University, Auburn, Alabama*, ²*North Carolina State University, Raleigh*.

Over the years, genetic selection programs have developed laying hen strains that produce large eggs to enhance yield. However, the effect of such selection

programs on the functional properties of eggs has not been studied. As the selection programs progressed, the egg breaking industry has reported variable whipping performance of egg whites. These problems could be attributed to many factors, including nutrition of the hen, pH, additives, physical treatments, viscosity, and temperature as they all affect the foaming properties of egg whites. In this study, five egg strains (Hy-Line W-36, Hy-Line, W-98, Hy-Line CV-20, Bovans White, and ISA White) selected for their egg weight, availability, and market share. Their eggs were sampled for a single laying cycle 17 to 66 wk. Eggs from these 5 strains were collected every 28 days from the 35th North Carolina Layer Performance and Management Test in which the strains were maintained under identical husbandry and environmental conditions throughout the study. The hens were provided nutrients to meet the needs of all the hens based upon compilation of the breeder recommendations. Once collected, the functional properties of the egg, such as foaming and emulsification, were tested by measuring albumen pH, albumen whipping height, angel food and sponge cake volume, and mayonnaise emulsion strength. Bovans White eggs had higher ($P < 0.05$) albumen whipping heights than all other strains which varied from 74.25 mm to 69.44 mm in height however, albumen pH and angel food cakes were not affected by layer hen strain ($P > 0.05$). Sponge cake volume of Hy-Line W-36 eggs were lower ($P < 0.05$) when compared to all of the other strains. The compression force required to penetrate the mayonnaise was significantly higher ($P < 0.05$) for Hy-Line W-98 than the other strains and Hy-Line W-36 and Hy-Line CV-20 required the least amount of compression force overall. The variability of the functional properties of eggs that were seen in this study was similar to those reported by egg breakers.

Key Words: Laying hen, Eggs, Functionality

187 Impact of strain on egg quality and composition during a single production cycle. P. A. Curtis^{*1}, L. K. Kerth¹, and K. E. Anderson², ¹*Auburn University, Auburn, Alabama*, ²*North Carolina State University, Raleigh*.

Egg quality and composition has been inevitably changed due to genetic selection over the years. However, no comprehensive study has been conducted that evaluates breaker eggs from current commercial stock over a complete laying cycle including a molt. The studies that have been conducted only evaluated a few characteristics. Five layer strains were selected based upon egg weight, market share, and egg size distribution. These strains were monitored from 17 to 66 wk. Eggs from these strains were gathered on a 28 d basis from the 35th North Carolina Layer Performance and Management Test in which strains were managed under identical husbandry practices and environmental conditions. Hens were fed a diet to meet the needs of all the hens based upon collection of the breeder recommendations. Haugh units, vitelline membrane strength, and percentage of component parts of the eggs were measured monthly. Strain significantly ($P < 0.05$) impacted all of the quality measurements taken. Whole egg weights varied ($P < 0.05$) for all strains from 56.56 to 61.13 g. When evaluating the percentage of the components of the egg: shell differed ($P < 0.05$) from 8.85 to 9.8%, albumen differed ($P < 0.05$) from 63.99 to 65.69%, and yolk differed ($P < 0.05$) from 25.12 to 26.63%. Both vitelline membrane and Haugh unit quality measurements varied significantly ($P < 0.05$). It took 1.88 to 1.95 g of force to rupture the vitelline membrane. Haugh units varied ($P < 0.05$) from 74.99 to 83.47. In some cases these differences did affect the functionality of the egg. Specific details about functionality can be found in a companion paper presented at this meeting.

Key Words: Laying hen, Egg quality, Egg composition

188 The impact of layer dietary threonine levels on egg yield, composition, and functionality. P. L. Niemeier^{*}, C. D. Coufal, and J. B. Carey, *Texas A&M University, College Station*.

Ninety 61 week old commercial laying hens were housed in individual cages in an open sided laying facility with groups of 5 hens sharing access to a common feed trough. A typical layer diet, containing 0.56% threonine (Thr) served as control. Two experimental diets containing 0.76% and 0.96% Thr were fed to the hens for sixteen weeks. Egg samples were analyzed for egg weight, shell strength, shell thickness, vitelline membrane strength, and yolk and albumen yield and functionality. Yolk and albumen were separated, pooled by nutritional treatment, homogenized, and analyzed for solids every 14 days throughout the

experiment. Yolk and albumen were separated and pooled by nutritional treatment at weeks 2, 6, 10, 15 to make three replicates each of sponge and angel food cakes. Cake samples were cored, five cores per cake and subjected to double compression on an Instron Universal Testing machine for texture profile analysis. Cakes were measured for hardness and springiness. Yolk and albumen gels for each egg were boiled in 30ml beakers every fourteen days during the duration of the experiment and subjected to the same measures as the cake cores. During weeks 2, 10, 12, 14, 16 egg albumen gels from each egg were subjected to torsion, deriving peak stress and peak strain at fracture for each sample. Whole egg weight was found to be significantly ($p < 0.05$) higher in the diet containing 0.76% Thr compared to all other diets. Significantly stronger and thicker egg shells were found among hens fed the diet containing 0.96% Thr compared to the control diet. Albumen torsion strain at fracture was found to be highest among the diet containing 0.76% Thr. Angel food cakes from the diet containing 0.96% Thr were found to be statistically harder than cakes made from the other diets. Sponge cakes were found to be statistically harder baked from eggs of hens that were fed the control diet. These data clearly indicate a potentially important impact of threonine nutrition of laying hens on egg component functionality and shell characteristics.

Key Words: Threonine, Egg functionality, Shell strength

189 Presence of antibiotic resistant *Salmonella* in commercially raised organic chicken. J. A. deGraft-Hanson*, T. A. Littler, A. Bhumbla, and A. Nakamura, *West Virginia University, Morgantown.*

Over a period of three months fresh organic chicken parts from a commercial integrator were purchased on a weekly basis and analyzed for *Salmonella*. Samples were stomached 1:10 using buffered peptone water as a pre-enrichment at 37 C, and then selectively enriched in tetrathionate Hajna and Rappaport-Vassiliadis broths at 42 C and 37 C respectively. Samples were plated on to XLT-4 and BGN agar plates at 37 C overnight and characteristic colonies screened on TSI agar slants. Presumptive positive isolates were biochemically screened and grouped with individual somatic antisera. For the majority of sampling days, samples were negative for *Salmonella*, but out of a total of 484 samples collected and analyzed, 24 were positive for *Salmonella* with an average of 4.95% and ranges from zero percent to 27.77%. The majority of the isolates belonged to group B and the rest were C2 and D1. All confirmed isolates were tested for sensitivity to a group of 12 antibiotics using the disk diffusion assay of Kirby-Bauer. Twenty-five percent (6 out of 24) of the isolates were resistant only to streptomycin, with one being resistant to both streptomycin and ofloxacin.

Key Words: *Salmonella*, Organic chicken, Antibiotic resistance

190 Prevalence and antibiotic resistant profiles of *Salmonella* from fresh retail chicken. J. A. deGraft-Hanson*, T. A. Littler, A. Bhumbla, and A. Nakamura, *West Virginia University, Morgantown.*

Over a period of one year 1842 samples of fresh retail cut-up chicken from 5 commercial integrators and one generic company were purchased from area grocery stores and analyzed for the presence of *Salmonella*. Ten gram samples were taken from each tray pack and were pre-enriched 1:10 by blending in buffered peptone water and selectively enriched in tetrathionate Hajna and Rappaport-Vassiliadis broths at 42 C and 37 C respectively. Samples were plated onto XLT-4 and BGN agar plates overnight at 37 C and screened on TSI agar slants. Presumptive positive samples were biochemically characterized and serogrouped with individual somatic antisera. All confirmed isolates were tested against 12 antibiotics using the disk diffusion assay of Kirby-Bauer. Overall there were 6.89% (127 samples) positive for *Salmonella* with 2 samples having multiple serogroups. Fifty-four percent of the isolates were periodically resistant to 4 antibiotics, tetracycline, ampicillin, chloramphenicol, and streptomycin. About 60% of the resistant isolates were resistant to more than one antibiotic. Only one isolate was resistant to a fluoroquinolone, ofloxacin. None of the

other isolates showed any resistance to ciprofloxacin, enrofloxacin, or nalidixic acid.

Key Words: *Salmonella*, Fresh chicken, Antibiotic resistance

191 Antibiotic-resistant bacteria on broiler carcasses raised in small flock production systems without routine antibiotics. J. P. Griggs*¹, J. B. Bender², and J. P. Jacob¹, ¹*University of Minnesota, St. Paul,* ²*University of Minnesota, St. Paul.*

A study was conducted to determine the incidence of food-borne pathogens on broiler carcasses from small flocks raised without antibiotics on Minnesota farms. Carcass rinse samples were collected by Minnesota Department of Agriculture inspectors at small processing plants across Minnesota. The sampling was conducted just prior to carcasses being placed into the chill tank. A carcass rinse sampling technique was employed. The two pathogens with which we were primarily concerned were *Salmonella* and *Campylobacter*. Broiler flocks from 11 of the 20 farms (55%) represented in the samples were contaminated with bacteria from the genus *Salmonella* at least once in the course of our sampling. The most common *Salmonella* serotype was Kentucky. Only one flock from one farm was free of *Campylobacter*. The majority of carcasses sampled in other flocks from the other farms were contaminated with *Campylobacter*. Antimicrobial susceptibility tests were conducted on most of the isolates.

Key Words: *Salmonella*, *Campylobacter*, Broilers

192 Integrating food safety and food security into highly effective operating system; theory and practice from poultry operations and mass feeding systems. G. Zeidler*, *University of California, Riverside.*

HACCP system is currently used around the world as the food safety standard. However, HACCP is not fully safe nor user friendly. It is a laborious reactive system, thus responding to failures but not preventing them. Most causes for HACCP failures are equipment breakdown, human errors and force major which are not monitored by the current HACCP system. To overcome these problems a proactive second generation HACCP system was developed where food safety parameters, equipment and accessories operational parameters and possible human error data were automatically monitored and the data was wirelessly transmitted into the facility computer, stored and processed into needed reports by specifically developed software.

A hardware which is composed from various units (Microgates and Picogates) was also developed. These units can connect with the electronic box of every processing equipment or accessory such as refrigeration unit, air condition and analytical instruments. The connecting units can retrieve the food safety and the equipment operation data and wirelessly transmit it to a central unit (Gateway Interface) which wirelessly transmit all the facility data into a near-by computer.

If data starts to deviate from the specifications a warning or alarm are sent inside or outside the plant. Among the recipients are equipment and computer repair services who can rapidly access the system, identifying the problem and repair or help to repair it before it turns into a HACCP or equipment failures. As a result food safety failures, recalls, equipment breakdown, plant downtime, food spoilage and food deterioration are drastically reduced.

As food security is also proactive in nature, desired preventive parameters are easily being integrated and monitored by this system.

The system can be easily expanded by integrating cold storage, transportation, processing and production into one operating mega-system.

The newer system was designed and tested in poultry operations (eggs) and in foodservice. The later was fully commercialized.

Key Words: HACCP, Food safety, Food security