

184 Increased internal radiodensity of humeri in high-producing non-commercial laying hens. W. D. Clark^{*1}, W. R. Cox², and F. G. Silversides¹, ¹*Agriculture and Agri-Food Canada, Agassiz, BC, Canada*, ²*Canadian Animal Health Management Services Ltd., Chilliwack, BC, Canada*.

The humerus is often used to assess skeletal health in laying hens. It usually contains an airsac in the central cavity, but studies have demonstrated that the humeri of some hens do contain medullary bone. This study used radiographs to compare the incidence of increased radiodensity in the central cavity of humeri between lines of high-producing non-commercial laying hens. Hens of six lines (n=71 to 78, 451 total) were euthanized at two ages: 1) 65 wk [Barred Rock (BR), Columbian Rock (CR), Rhode Island Red (RIR), and White Leghorn-Burgundy (WL-BUR)], and 2) 47 wk [WL-Black (WL-BLK), WL-Blue (WL-BLU)]. Hens were euthanized using Euthanyl Forte, stored at -20 C, and thawed prior to being x-rayed. The radiographs were examined for increased radiodensity in the central cavity of the humeri of each hen, the extent of which ranged from a small section

at the distal end of the bone to the entire length. Each humerus was recorded as having or not having increased internal radiodensity. Contingency chi-square analysis was used to compare lines within age groups. Among the older hens, the incidence of birds with at least one humerus with increased radiodensity was highest in the BR and RIR (61.0 and 66.7%, respectively). The incidence in CR (17.8%) and WL-BUR (18.3%) was significantly lower. The incidence in the younger birds did not differ significantly (16.0 and 15.1% for WL-BLK and WL-BLU, respectively). These results demonstrate substantial variation in the occurrence of increased central cavity radiodensity between lines, which can likely be attributed to medullary bone development. This variability, along with the variable amount of the humerus affected, could impact results of humerus bone assessment using methodologies dealing with the whole bone (ash, density, strength) and those such as quantitative computed tomography that use only a small portion of the bone. Caution should be used when using the laying hen humerus to assess skeletal health.

Key Words: humerus, radiograph, medullary bone

Processing, Products, and Food Safety: Processing, Products and Food Safety

185 Effect of combining antimicrobial treatments with in-package pasteurization for control of *Listeria monocytogenes* in ready-to-eat turkey bologna. S. Mangalassary^{*}, I. Y. Han, J. Rieck, and P. L. Dawson, *Clemson University, Clemson, South Carolina*.

Post-cooking contamination of Ready-to-Eat (RTE) meat and poultry products by *Listeria monocytogenes* (LM) is a major food safety problem as well as an economic hardship to the food industry for several years. Various post-processing interventions like in-package pasteurization, high pressure processing, and application of various antimicrobial agents alone or in combination have been tested to eliminate LM from RTE meat surfaces. The objective of this study was to determine the effect of combining nisin and/or lysozyme surface application with in-package pasteurization on the survival of LM on RTE turkey bologna during storage at 4°C. Bologna samples were subjected to surface application of 4 treatments—control (no antimicrobial), nisin (2000IU/ml), lysozyme (10mg/ml), and a combination of nisin and lysozyme (2000IU nisin+10mg lysozyme/ml). Samples were inoculated with 10⁸cfu of the organism and vacuum packaged. A set of 4 treatments were stored without subjecting to in-package pasteurization. Another set of 4 treatments were subjected to in-package pasteurization at 65°C for 1.3 minutes. All treatments were sampled for LM growth at 0day, 1, 2, 3, and 4 weeks of storage. Treatments subjected to in-package pasteurization showed a 3–4 log initial reduction and also a significant reduction over 4 weeks of storage in LM population compared to treatments without pasteurization. Pasteurized control and lysozyme treated samples showed a 2 log reduction over 4 weeks whereas pasteurized nisin and nisin–lysozyme combination treatments showed a 4 log reduction (no viable cells of the organism from 3rdweek). Results of this study indicate that combining nisin and nisin–lysozyme combination treatments with in-package pasteurization is effective in eliminating LM from RTE meat and poultry products. Results would be significant to the industry considering the fact that the reduction in bacterial population was achieved by a relatively short pasteurization time.

Key Words: turkey bologna, antimicrobials, in-package pasteurization

186 Comparison of poultry processing conveyor belts for susceptibility to bacterial attachment and biofilm formation. S. Pitchiah^{*}, C. Z. Alvarado, and M. M. Brashears, *Texas Tech University, Lubbock*.

During processing of poultry products, bacteria from the carcass can attach to wet surfaces which can lead to biofilm formation providing a source for cross contamination for subsequent carcasses. The purpose of this study was to determine susceptibility to bacterial attachment and biofilm formation with and without poultry products of different conveyor belts including polyurethane with mono polyester fabric, acetal (3.2 % open mesh), polypropylene- mesh top (24% open mesh), polypropylene (48% open mesh), stainless steel –single loop (80% open mesh) and stainless steel–balance weave (70% open mesh). Experiment 1 –Surfaces were inoculated with *Salmonella* cocktail (without any poultry product) in BPW to achieve final inoculum level of 5 log CFU/ml. Test surfaces were analyzed by sponge and swab method at 0, 1, 2, 4, 6, 8, 12, 24 and 48 hr. For aerobic plate count, the stainless steel belts (single loop and double loop) showed significant reduction in APC when compared to other belts. Initial attachment (0 hr) of *Salmonella* did not show any significant change in all belt types; however, canvas belts showed a significant attachment over time. Experiment 2 –Attachment of bacteria with poultry products was determined with test chips. Chicken breasts were inoculated with *Salmonella* or *Listeria monocytogenes* culture for one hour and rinsed with PBS. Test chips were immersed in this solution and evaluated (1, 6, 12, 24 and 48 hr). At 1 and 48 hr, attachment of *Salmonella* and *Listeria monocytogenes* was lowest in the stainless steel single loop (0.403 log CFU/cm²), and stainless steel –balance weave (0.364 log CFU/cm²). Experiment 3 –Attachment of *Listeria monocytogenes* to form a biofilm was determined. Initial biofilm formation was very low on the stainless steel belts but by day 4 all belts had biofilm formation. Therefore, stainless steel belts allowed for less growth and attachment of bacteria over time. However, even stainless steel belts must be cleaned and sanitized to prevent biofilm formation over time.

Key Words: poultry processing, biofilm, bacteria

187 Effect of alkaline scald conditions on *Salmonella* or *Campylobacter* recovery during commercial turkey processing. S. M. Stevens*¹, J. A. Byrd², A. P. McElroy³, S. M. Anderson¹, D. J. Nisbet², and D. J. Caldwell¹, ¹Texas A&M University, College Station, ²USDA-ARS-SPARC, College Station, Texas, ³Virginia Tech, Blacksburg.

Despite several published reports performed with broilers, scant attention has been given to the scald environment as a potential area of bacterial reduction in commercial turkey processing. Research conducted in broiler plants has shown that proper operation of scald tanks results in significant log-scale reductions of *Campylobacter* on carcasses. Further, raising the pH of scald water during broiler processing (pH=9.0) has similarly been shown to increase thermal killing of *Salmonella* on broiler carcasses. To determine if similar reductions occur during commercial turkey processing, we compared *Salmonella* or *Campylobacter* incidence and direct recovery from carcasses following alkaline or normal pH scald conditions. Sodium carbonate or sodium hydroxide (Plant 3 only) was used to raise scald tank water pH (pH 9-10). In each of three distinct commercial facilities, sampling consisted of taking 50 pre-scald and 100 post-feather pick carcass rinses (50 normal pH scald and 50 alkaline pH scald) for *Salmonella* or *Campylobacter* recovery from collected rinse fluid. Two of three plants sampled revealed slightly increased *Campylobacter* recovery (1% or 4% whole carcass incidence) following alkaline scald as compared to normal pH scald conditions. All three facilities were associated with increased *Salmonella* recovery from carcasses (20%, 35%, or 40% whole carcass incidence) following alkaline scald conditions when compared to normal pH scald incidence. These findings differ from previous reports using broilers as a model. While alkaline pH scald did not appear to increase thermal killing of *Salmonella* or *Campylobacter* based upon our collected data, increased or facilitated bacterial detachment from carcasses by a pH dependent mechanism at this point in processing could have impacted our observed data.

Key Words: turkey processing, bacterial recovery, scald conditions

188 Effect of a high level chlorine rinse on the recovery of *Salmonella* and enumeration of bacteria from broiler carcasses. L. N. Bartenfeld*¹, D. L. Fletcher¹, and J. K. Northcutt², ¹The University of Georgia, Athens, ²USDA-ARS, Athens, Georgia.

A study was conducted to determine the microbiological impact of exposing broiler carcasses to a high concentration chlorine rinse (500 ppm sodium hypochlorite). During each of five replicate trials, eviscerated pre-chill carcasses were obtained from a commercial processing plant. Test carcasses were subjected to a 1 min rinse in 500 mL of a 500 ppm chlorine solution (HOCl), then removed from the bag and rinsed for an additional 1 min in 500 mL of sterile water. Control carcasses were treated the same way except sterile water was used in place of chlorine. Both chlorine-treated and control carcasses were then subjected to a whole carcass rinse (WCR) in 450 mL of buffered peptone water, with 50 mL of the rinsate removed for immediate enumeration of total aerobic bacteria (APC), *Escherichia coli* (EC), and total coliforms (TC). The entire carcass was then incubated overnight at 37°C in the remaining 400 mL of buffered peptone for recovery of *Salmonella*. Levels of bacteria recovered from WCRs were 1.3, 0.6 and 0.6 log₁₀cfu/mL lower for APC, EC and TC, respectively when carcasses were rinsed with chlorine instead of sterile water. However, there was no significant difference in

prevalence of *Salmonella* between the two treatments (14/38 positive for control; 16/38 positive for HOCl). These results suggest that a high concentration chlorine rinse may significantly reduce the numbers of bacteria recovered from broiler carcasses without lowering the prevalence of *Salmonella*.

Key Words: broiler carcasses, carcass microbiology, chlorine

189 Reduction of *Campylobacter* spp on poultry carcasses using various interventions under simulated industry conditions. T. W. Thompson*, J. R. Blanton, J. E. Mann, M. M. Brashears, and C. Z. Alvarado, Texas Tech University, Lubbock.

A study was conducted to determine the effectiveness of various interventions on the reduction of *Campylobacter* spp in chilled poultry. A total of 6 interventions, 2% lactic acid (LA), 2% acetic acid (AA), 1000 ppm acidified sodium chloride (ASC), 2% Trichloromelamine (TCM), 10% Trisodium Phosphate (TSP) and Hot Water (82 C) (HW), were compared to a rinse with Ambient Water (CONTROL) and to no rinsing (UNTREATED CONTROL). A total of 72 carcasses were assigned to the 8 treatments in three replications. In the pathogen processing area at Texas Tech University, a cocktail mixture of 4 strains of Campy spp. were prepared and added to chicken carcasses by dipping to yield a population of approximately 7.0 log₁₀ cfu/g of rinsate from the carcasses. Bacteria were allowed to attach for 1 h prior to application of interventions or sampling. The USDA poultry rinse method was used to sample the chickens. Standard FDA-BAM methods were used to enumerate *Campylobacter* spp. on the carcasses. Prior to treatments, the average number of *Campylobacter* spp. were 6.95 log₁₀ cfu/ml of rinsate. The CONTROL and UNTREATED CONTROL samples contained 6.78 and 6.95 log₁₀ cfu/ml of *Campylobacter* spp. after treatments. The TSP and ASC treatments gave almost a 99.9% (3 log cycles) reduction of Campy spp. compared to the control samples with numbers of 4.20 and 4.08 log₁₀ cfu/g, respectively. The LA, AA, TCM, and HW treatments all resulted in approximately a one log reduction (90%) of *Campylobacter* spp. on the treated carcasses compared to the controls. Treatment with ambient water did not result in a reduction of *Campylobacter* spp. on the carcasses. No apparent sensory differences were evident after treatment. It is recommended that treatments with TSP and ASC are most effective in reducing *Campylobacter* spp. loads in poultry.

Key Words: *Campylobacter*, postharvest interventions, chicken

190 EU promoted research towards zootechnical feed additives for the safe use in poultry production. V. Klose*¹, R. Plail¹, M. Mohnl², S. Nitsch², and G. Schatzmayr², ¹University of Natural Resources and Applied Life Sciences, Tulln, Austria, ²Biomim GmbH, Herzogenburg, Austria.

Livestock industry in Europe is facing new feed additive regulations banning the use of antibiotic growth promoters by 2006 as these could cause drug resistance in microbes that afflict humans. A multinational project (C-EX QLK-CT-2002-71662) funded by the European Union was initiated and brought together 5 industrial and 3 research partners in order to develop a safe microbial feed additive for poultry. The main aim was to establish a well-defined multi-component product combining various effective strains which should comply with the EU guidelines (Council Directive 87/153/EEC) for evaluation of probiotics for use in feedingstuffs, in terms of identity, efficacy and

safety. Numerous bacteria were isolated out of the gastrointestinal tract of healthy chickens and subjected to microbiological studies in order to obtain optimal strains for a competitive exclusion product. A polyphasic approach was carried out combining morphological, physiological and genotypic methods (e.g. morphology, protein profiling, analysis of metabolic end products, 16S rRNA gene analysis). 121 isolated strains were selected as representatives based on differences in whole cell protein patterns and screened for antagonistic properties against poultry pathogens. By using a co-cultivation assay, a reduced number of 90 strains exhibited the ability to inhibit *Salmonella enteritidis*. The 20 most effective strains were able to inhibit indicator pathogens such as *E. coli* serotypes, *S. choleraesuis*, *C. jejuni* and *C. perfringens*. Finally in regard to technological and functional aspects a multispecies product (Biomim[®] PoultryStar) was established consisting of 5 well-defined strains belonging to the genera *Enterococcus*, *Pediococcus*, *Lactobacillus* and *Bifidobacterium*. According to European safety requirements the candidates were subjected to a critical evaluation of the risks associated with the genetic transfer of antibiotic resistances from animals to humans via the food chain. On basis of a screening according to an opinion from the EU Scientific Committee on Animal Nutrition (SCAN, 2001) the strains were sensitive to the majority of clinically effective antibiotics. Using molecular studies (mating, polymerase chain reaction, plasmid preparation) single resistances were proven to be intrinsic (e.g. *vanA*) and not transferable. Positive effects of Biomim[®] PoultryStar have been shown *in vivo* with an efficacy trial (480 mixed sex Ross 308 broilers randomly allocated to 2 groups, 3 replications each). The control group received a standard diet, the test group received the product in the diet with an inclusion level of 5E+9 cfu/kg finished feed. At the end of the trial chicks receiving Biomim[®] PoultryStar revealed a statistically significant ($P < 0.05$) increase in their average body weight as well as in weight gain (~7.6%). Feed conversion was slightly improved and mortality (1.25% control vs. 0.42%) was reduced in the group receiving the additive. Overall fattening efficiency in this group was improved which was indicated by an increased European Production Efficiency Factor (356 vs. 318).

Key Words: competitive exclusion, European registration, safety assessment

191 Egg yolk antibody efficacy test I: The growth inhibition of *Clostridium perfringens* vegetative cells and spores in vitro. H. Karami¹, W. Cho², M. Song², and H. Sunwoo*¹, ¹University of Alberta, Edmonton, AB, Canada, ²CJ Co., Seoul, Republic of Korea.

Regardless of research aimed toward decreasing growth of food pathogens, *Clostridium perfringens* continues to remain a major cause of foodborne illness. The objective of this study is to test the efficacy of specific egg yolk antibodies (IgY) against the growth of *Clostridium perfringens* vegetative cells and spores in culture medium. *Clostridium perfringens* vegetative cells and spores prepared from ATCC were enumerated and normalized. The tubes were further divided into four groups containing either, *Clostridium perfringens* vegetative cells (1×10^5 CFU) mixed with anti-*Clostridium perfringens* specific IgY (10 µg/ml); *Clostridium perfringens* spores (1×10^5 CFU) mixed with anti-*Clostridium perfringens* specific IgY (10 µg/ml); *Clostridium perfringens* vegetative cells (1×10^5 CFU); or *Clostridium perfringens* spores cells (1×10^5 CFU).

Subsample of each group were incubated at 37° C for either 0, 2, 4, 8 or 24 h. Significant CFU reduction between controls and test groups

against *Clostridium perfringens* vegetative cells ($p < 0.05$) and spores ($p < 0.05$) were observed. During 4 to 8 h of incubation, the number of vegetative cells increased by only 3.18 logs CFU/mL in test group, while cells increased by 3.72 logs CFU/mL in control group. At 24 h of incubation, a 2.1 log CFU/mL increase in the control group and 0.5 log CFU/mL decrease in the number of bacteria in the test group. Cell counts of *Clostridium perfringens* spores increased by 1.4 log CFU/mL and 5.47 log CFU/mL in test and control groups, respectively, during 0 to 8 h of incubation. This indicates a 10,000 fold reduction in number of bacteria in tubes containing specific IgY. At 24 h of incubation, there was over a 10 fold reduction in number of bacteria in tubes containing specific IgY. As a result, the growth of both *Clostridium perfringens* vegetative cells and spores in a culture medium was significantly inhibited by specific IgY. Our findings suggest the use of specific IgY as a natural food preservative to control the growth of *Clostridium perfringens* in food products.

Key Words: IgY, *Clostridium perfringens*, natural preservative

192 Rapid and specific real-time polymerase chain reaction method for detection of viable *Salmonella* species in poultry feed and feedstuff. X. Li*, J. Caldwell, and J. Levine, North Carolina State University, Raleigh.

Traditional culture-based methods used to detect *Salmonella* are laborious and require a minimum of four days before isolates can be obtained and identified. The objective of this study was to develop a real-time polymerase chain reaction assay (qPCR) for routine analysis of viable *Salmonella* species in poultry feed and feedstuffs. Twenty-five grams of each sample obtained from a commercial poultry feed milling company at North Carolina was mixed with 225 ml of buffered peptone water (BPW) in a sterile plastic bag, stomached for 1 min, and incubated at 37°C for 18 to 24 h. The individual bag was thoroughly shaken before 1-ml samples were withdrawn and frozen at -20°C. The frozen samples were thawed and diluted 1:100 prior to conducting the qPCR assay. This method amplified a 119 bp PCR product originating from the *invA* gene of *Salmonella* chromosome DNA. *Salmonella* Heidelberg present at 10000 copies per PCR tube was used as a positive control. The PCR assay was performed in a Smart Cycler II System. Twenty-nine poultry feeds (starter, grower and finisher) and twenty-five feedstuffs (corn meal, soybean meal, and animal by-product) samples were evaluated by the qPCR method and compared to the standard Bacterial Analytical Manual (BAM) culture method for *Salmonella* detection. The qPCR method was rapid (obtained results within 45 min), simple (did not require DNA extraction or cell lysis), specific (only amplified *Salmonella* spp.), sensitive (detected 1 *Salmonella* cell in 25 grams of feed/feedstuff with background microflora 100000000 cfu per gram), accurate (yielded identical detection results as determined by the BAM method). Common PCR interference factors such as lipids, salts, proteins and the presence of a natural background microflora in feed and feedstuffs were circumvented by the use of DNA Hot Start TaqTM polymerase, pre-enrichment and appropriate sample dilution. This method can be used in the routine analysis of *Salmonella* spp. in feed and feedstuff with potential industry applications.

Key Words: real-time PCR, *Salmonella* detection, feed and feedstuff

193 Destruction of *Salmonella enteritidis* and quality of table shell eggs using microwave commercial sterilization. D. Lakins*, A. Echeverry, C. Alvarado, M. Brashears, and L. Thompson, *Texas Tech University, Lubbock.*

Currently, table eggs are the leading cause of foodborne illness caused by *Salmonella enteritidis*. The application of microwave commercial sterilization can cause the destruction of pathogenic microorganisms by both thermal and non-thermal effects. Therefore, the objective of this study was to determine if microwave commercial sterilization could be used to reduce loads of *Salmonella enteritidis* in shell eggs without causing a direct detrimental effect to the overall quality. A total of 414 shell eggs were used to determine the effect of microwave sterilization on quality. Destruction of *Salmonella enteritidis* was also determined by inoculating 12 eggs with a 10^6 *Salmonella enteritidis* cocktail and determining log recovery following the 10 sec microwave treatment. A trained sensory panel was used to evaluate the treated eggs (10 sec microwaved) and control eggs; eggs were observed for both raw and cooked (poached) attributes. The raw attributes that were evaluated included vitelline membrane strength, chalazae attachment, yolk color, and albumen color. There were no significant differences ($P>0.05$) between the microwave 10 sec treatment and the control for any of the raw attributes. The cooked attributes that were evaluated included hardness, egg flavor, yolk color and albumen color. There were no significant differences ($P>0.05$) between the microwaved 10 sec treatment and the control for any of the cooked attributes. For *Salmonella enteritidis* destruction, a 90% reduction was determined following the microwave treated (10 sec) shell eggs. Therefore, use of microwave commercial sterilization can be used on table in shell eggs to reduce *Salmonella enteritidis* within the eggs by up to 90% without causing detrimental effects to the overall quality of the raw and cooked eggs.

Key Words: microwave, in shell eggs, *Salmonella enteritidis*

194 Effects of cool water washing of shell eggs on Haugh unit, vitelline membrane strength, aerobic bacteria, yeast, and mold. A. B. Caudill*¹, P. A. Curtis¹, D. R. Jones², M. T. Musgrove², K. E. Anderson³, and L. K. Kerth¹, ¹*Auburn University, Auburn, Alabama*, ²*USDA Russell Research Center, Athens, Georgia*, ³*North Carolina State University, Raleigh.*

Current egg washing practices utilize wash water temperatures averaging 49C, and have been found to increase internal egg temperature by 7-8C. These high temperatures create a more optimal environment for bacterial growth, including *Salmonella* Enteritidis (SE), if it is present. However, SE, the most common human pathogen associated with shell eggs and egg products, does not grow well at lower temperatures. This study's objective was to determine if commercially washing eggs in cool water would aid in quickly reducing internal egg temperature, creating an environment less beneficial to bacteria and preserving egg quality. During three consecutive days eggs were washed at an off-line (Plant A) and an in-line (Plant B) commercial facility. Four dual tank wash water temperature schemes were used (WW = 49C, 49C; WC = 49C, 24C; CC = 24C, 24C; CW = 24C, 49C). Wash water pH ranged from 10.85 to 11.14 throughout the study. A 10 week storage study followed, in which vitelline membrane strength, Haugh unit, and presence of yeast, mold, and aerobic bacteria were monitored weekly. Haugh unit values and vitelline membrane strength declined over time; however, wash water temperature schemes did not significantly affect egg quality. There were no differences in yeast and mold found in the

contents or on exterior shell surfaces of eggs from either plant. No significant differences in aerobic bacteria present in contents or on exterior shell surfaces of eggs for each temperature scheme from Plant A were found. The amount of aerobic bacteria found in contents and on exterior shell surfaces of eggs from Plant B was significantly lower for the WW temperature scheme; differences were within 1 log cfu/mL for contents (WW = 2.2; WC = 2.7; CC = 2.6; CW = 2.6) and slightly above 1 log cfu/mL for exterior shell surfaces (WW = 1.7; WC = 2.0; CC = 2.8; CW = 2.7). This study's results indicate that commercial cool water washing did not affect interior egg quality or the microbial integrity of interior egg contents.

Key Words: shell eggs, cool wash, egg quality

195 Influence of hen age and molting treatments on shell egg exterior, interior, and contents; microflora and *Salmonella* prevalence during a second production cycle. V. Kretzschmar-McCluskey*¹, P. A. Curtis¹, K. E. Anderson², L. K. Kerth¹, and O. A. Oyarzabal¹, ¹*Auburn University, Auburn, Alabama*, ²*North Carolina State University, Raleigh.*

Salmonella is one of the most frequently reported foodborne illnesses in the world, and *Salmonella* Enteritidis (SE) is the serotype most associated with eggs. The objective of this study was to determine if increasing hen age and three different molting treatments influenced the total microflora counts or the prevalence of *Salmonella* spp. on the exterior egg shell, within the interior shell, or in the contents. Eggs from Hy-Line W-98 and Bovans White layer strains were sampled approximately every 28 days from 70 to 114 wk of age, with the molting treatments enforced from wk 70 to 73. Layers were utilized from the 35th North Carolina Layer Performance and Management Test, and managed under identical husbandry practices. This study consisted of non-fasted, feed restricted, and non-molted treatments with the use of 135 eggs per layer strain, for a total of 270 eggs sampled per period. The exterior, interior shell, and contents were both spiral and spread plated onto Plate Count agar to calculate the total aerobic counts. Additional pre-enrichment, enrichment, conformational, and biochemical procedures were performed to test for the presence of *Salmonella* spp. Hen age and molting treatment significantly ($P<0.05$) affected the microbial loads on all three egg components. Exterior, interior, yolk, and albumen counts increased during the molt period to as much as 1 log unit higher than the highest countable plate (10^5). Exterior, interior, and contents counts rose ($P<0.05$) during period 15, with an increase ($P<0.05$) in the interior also in period 14, and in contents in periods 14 and 17. There were a total of 360 egg pools and of those 7 were suspect positive *Salmonella* samples. All three components, including a separate yolk sample detected in period 13, and the three molting treatments had suspect positive samples.

Key Words: *Salmonella*, eggs, laying hens

196 Impact of white and brown-egg layer strains and molt on size distribution, and egg quality during the second 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 the commercially available layer strains vary, yet few studies continuously document these differences. In this study, 9 white egg (WES) and 3 brown egg strains (BES) were

equally represented and housed at a density of 413 cm². The feeding programs were segregated in order to meet the nutritional needs of the white and brown egg strains. At 66 wk the hens were divided into three groups; non-molted (NM) group; non-fasted molt (NF); and fasted molt (FR) for 4 wk. The remaining husbandry practices were the same for each group as those used in the 35th North Carolina Layer Performance and Management Test. Every 28 day period from 70 through 114 wk egg samples from the previous 24 h were collected from each replicate. 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. Strain had the greatest influence on egg weight with the distribution of eggs from mediums and large to the extra large classification. In the WES the W-98 produced more ($P < 0.05$) 89.1% extra large eggs while the W-36 and B-300 produced 69.4 and 65.1%, respectively. In the BES, egg weights were the heaviest ($P < 0.05$) for the Bovans Brown and Goldline at 67.7 and 67.8 g, respectively while the egg weight for the Hy-Line Brown was 66.5 g. This egg weight shifted the egg size distribution from large to extra large for the Bovans Strains. In both WES and BES, the NM control hens had the highest percentage of medium eggs while the two molt treatments were no different. WES molted by either method resulted in fewer Grade B and Cracked eggs than in the NM control group. In BES percent Grade A eggs for the NM, NF, and FR molt programs were 85.9, 88.3 and 90.5%, respectively. The shift in egg size was inversely related to the percent Grade B for the same molt treatments. There was no effect of molt treatment on cracks or loss eggs. Strain selection within the production operation can significantly affect the size of the egg produced while molting influenced the egg quality.

Key Words: chicken, molt, egg quality

197 Feeding White Leghorn hens yeast beta-glucans to influence egg quality. N. McKillop¹, J. MacIsaac², and B. Rathgeber³, ¹*Nova Scotia Agricultural College, Truro, NS, Canada*, ²*Atlantic Poultry Research Institute, Truro, NS, Canada*, ³*Agriculture & Agri-Food Canada, Truro, NS, Canada*.

Poor egg shell quality remains to be a major source of economic loss to the poultry industry. A deficiency in calcium will adversely affect the egg structure. Partially purified soluble beta-glucan is a potent inhibitor of bone resorption by the inhibition of osteoclast activity. This potential to slow bone loss can allow for better utilization of calcium. In this experiment 480, 18-week-old White Leghorn hens of the Babcock variety were randomly assigned to 80 cages; 40 of these were administered the treatments beginning at 18 wks of age. The remaining 40 cages received the treatments beginning at 50 wks of age. Each of these two groups of birds were randomly assigned to one of four diets supplemented with either 0, 25, 50, or 250 g/tonne of refined yeast beta-glucan. Beginning at 22wks for the first group and at 46 wks for the second group, 8 eggs per unit were collected every four weeks with the last collection at 78 wks of age. Albumen height, egg weight, and specific gravity of the eggs were measured at each collection. Daily egg production was recorded. At 66 wks 4 eggs per cage were collected and stored for 12 days and foaming volume, albumen pH, albumen height, and egg weight, were measured. No

treatments effects were observed on the albumen height, egg weight, and specific gravity measurements or the number of soft shelled eggs. Foaming volume, albumen height, and egg weight were not influenced by dietary treatment. However, albumen pH was lower ($P < 0.05$) for eggs from birds on the 250g/tonne treatment compared to the control and 50g/ton treatments, but not different from 25g/ton. Future studies will attempt to identify potential structural changes that may influence exterior and interior egg quality due to dietary inclusion of yeast beta-glucans.

Key Words: leghorn, yeast beta-glucan, shell quality

198 The relationship between egg storage time and functionality in sponge cakes. J. C. Butler*, P. A. Curtis, and L. K. Kerth, *Auburn University, Auburn, Alabama*.

Functionality of eggs is of great concern to the egg industry. In a study done by Pyke and Johnson (1940) results concluded that the length of egg storage was a factor that might have indicated deterioration in egg quality in regard to cake baking. In this study, research was conducted over a six-week period to determine the storage effects of egg age on sponge cake volume. Eggs were collected from a layer study at Auburn University to test functionality. Eggs were then stored at room temperature for 0, 1, 2, 3, 4, & 5 weeks. On a weekly basis a pooled set of 18 eggs were broken out, homogenized and three replicates of sponge cakes were prepared according to the method of Norris and Cotterill (1986). Over the past four repetitions of the study, statistics have shown that there is a negative trend between the age of the egg and sponge cake volume.

Key Words: sponge cake, egg, functionality

199 The effect of egg storage time on custard functionality. A. Davis*, P. Curtis, and L. Kerth, *Auburn University, Auburn, Alabama*.

Eggs have many proteins that help produce certain characteristics in foods. These proteins include ovalbumin, conalbumin, and globulin which are the proteins used in coagulation. An egg custard is a good way to show the use of these proteins. However as eggs age their proteins degrade, which can lead to a change in the functionality of an egg. In this study storage time was used to determine if a loss of custard functionality occurred. Eggs from an Auburn University facility were stored at room temperature for six weeks (0, 1, 2, 3, 4, and 5). A modified egg custard recipe from the American Egg Board was used to show the interaction between egg storage and custard functionality. Coagulation of the custard was tested by determining the amount of weep produced after cooking. Weep is defined as the amount of moisture lost after cooking as the custards are refrigerated. Gelation of the custard was measured using gel bloom strength on the texture analyzer. In this study storage time provided a variation in the coagulation and gelation of eggs in custards.

Key Words: custard, functionality, storage