

riod and fed a breeders' diet throughout, hens from the 3 other groups were supplemented with 40 ppm T4 for 10 days. Of the 3 treatment groups, 1 was maintained under a 14-h light schedule and fed breeders' diet while the 2 others were subjected to a drop in photoperiod to 6 h during or after supplementation, and were then fed a maintenance diet. Egg production, feed intake, body weight, molt and plasma levels of T4 were measured. All treated hens ceased laying within 20 days; however, several individuals spontaneously returned to lay when left on 14 h light, suggesting incomplete involution of the reproductive tract. T4 supplementation significantly reduced feed consumption ($P < 0.001$) and induced significant rapid body weight loss ($P < 0.001$). However, all hens returned to their initial body weight by experiment's end. Most treated hens initiated molt within 8 days of supplementation and all completed molt by day 37. Plasma T4 levels in treated hens increased significantly by day 3 of supplementation ($P < 0.05$) and remained significantly higher than in controls until day 9 ($P < 0.01$). Levels returned to initial values by day 35. In conclusion, dietary supplementation with 40 ppm T4 was successful in inducing molt in spent turkey breeder hens. However, a drop in photoperiod seems necessary to completely reset the reproductive system.

Key Words: molting, turkey, thyroxin

119 Brain AMP-activated protein kinase and food intake in chickens. D. M. Denbow* and P. B. Siegel, *Virginia Tech, Blacksburg.*

AMP-activated protein kinase (AMPK) is an enzyme which monitors energy levels within cells, and possibly at the whole-body level. We investigated whether genetic selection for growth altered the brain's response to changes in AMPK activity. Using chickens from lines selected from a common founder population for either low (LWS) or high (HWS) 8-week body weight, we investigated whether intracerebroventricularly (ICV) injecting compounds known to affect AMPK had a differential effect on food intake. In mammals, Compound C is reported to inhibit whereas 5-amino-4-imidazole carboxamide riboside (AICA) is reported to stimulate AMPK. ICV injection of AICA decreased food intake in 15-week-old HWS and 9-week-old LWS male chickens. In contrast, the ICV injection of Compound C increased food intake in males from both lines. In addition, the ICV injection of 5-aminoimidazole-4-carboxamide riboside (AICAR), which stimulates AMPK, also decreased food intake in LWS males. In rats, stimulating AMPK increased food intake while inhibiting its activity decreased food intake. These results with chickens are in contrast to those observed in rats. The reason for these disparate results remains to be elucidated. (This project was supported by National Research Initiative Competitive Grant no. 2007-35206-17899 from the USDA Cooperative State Research, Education, and Extension Service).

Key Words: food intake, AMPK, chickens

Processing, Products, and Food Safety

120 Sensory descriptive profiles of air and water chilled broiler breast fillets. H. Zhuang*, E. Savage, D. Smith, and M. Berrang, *ARS-USDA, Athens, GA.*

Air chilled chicken products are gaining popularity in the USA. It has been claimed that air chilling (AC) results in improved tenderness and flavor of broiler meat compared with water chilling (WC). However, there is a lack of published sensory study results to support the claims. The objective of this study was to evaluate the effect of carcass chilling methods on sensory texture and flavor descriptive profiles of broiler breast fillets deboned at 4 h postmortem. In each of 4 replications, 27 eviscerated broiler carcasses (6 weeks of age) were collected from a commercial processing line prior to chilling. After transport to the laboratory, one-third of the carcasses were hot-boned (no chill), 1/3 chilled by water immersion (0.3°C, 50 min) and 1/3 chilled by AC method (0.7°C, 150 min). The WC and AC fillets were removed from the bone at 4 h postmortem. Fillets were cooked to an endpoint temperature of 78–80°C. The sensory properties were measured by 7–9 trained panelists using 0–15 point universal intensity scales (21 attributes). Our study shows that the average intensity scores of the 9 flavor attributes analyzed ranged from 0.9 to 4.0 and there were no significant differences between the 3 treatments. The average intensity scores of the 12 texture attributes ranged from 1.5 to 7.5 and there were no significant differences between the AC and WC fillets. The average intensity scores of the texture attributes, springiness, hardness, cohesiveness of mass, bolus size, rate of breakdown, and chewiness were significantly higher in the hot-boned samples than those of either of the chilled samples, which were not different from each other. These results demonstrate that the AC method did not affect the sensory flavor and texture quality of chicken breast meat deboned 4 h postmortem compared to the WC method.

Key Words: chicken breast, air chilling, sensory

121 Effect of multiple washings in salicylic acid on the bacterial flora of the skin of processed broiler chickens. A. Hinton Jr.* and J. A. Cason, *Russell Research Center, Athens, GA.*

Experiments were conducted to determine changes in the bacterial flora of the skin of processed broilers after each of 5 consecutive washings in solutions of the keratolytic agent, salicylic acid. Skin samples from commercially processed broiler carcasses were divided into 3 groups and washed in distilled water, 10% salicylic acid, or 20% salicylic acid by agitating skin in these solutions in a Stomacher laboratory blender. After each wash, skin was transferred to fresh solutions and washing was repeated to provide samples washed 1 to 5 times in each solution. Washed skin was then stomached in Butterfield's Phosphate Buffer to recover viable bacteria remaining on the skin. Bacterial flora of the rinsates was enumerated on Plate Count Agar, *Staphylococcus* Agar, Levine Eosin Methylene Blue Agar, Lactic Acid Bacteria Agar, and *C. perfringens* Agar. Results indicated that after each of 5 consecutive washes in water, there was no significant difference in the number of bacteria recovered from skin on any of the agar media. Significantly fewer bacteria were recovered on Lactic Acid Bacteria Agar from skin after 5 washes in 10% salicylic acid than after 1 wash, but there was no significant decrease in the number of bacteria recovered on any other media after skin was washed in this solution. However, washing skin 4 or 5 times in 20% salicylic acid significantly reduced the number of bacteria recovered on Plate Count Agar and *Staphylococcus* Agar. Furthermore, no bacteria were recovered on Eosin Methylene Blue or Lactic Acid Bacteria Agars from rinsates of skin washed 4 or 5 times in 20% salicylic acid or on *C. perfringens* Agar from skin washed 3 or more times in the 20% solution. Findings indicate that successive washing of skin in salicylic acid may significantly reduce the number of bacteria recovered from the poultry skin, although bacterial popula-

tions found on poultry skin vary in their resistance to the antibacterial activity of salicylic acid.

Key Words: salicylic acid, broilers, bacteria

122 Dietary gelatin supplementation increases *Salmonella* Typhimurium levels in the ceca of young chicks. Y. O. Fasina*, E. T. Moran, D. E. Conner, and S. R. McKeel, *Auburn University, Auburn, AL.*

The mucus layer and glycocalyx covering the intestinal epithelium act together to limit the level of pathogen penetration, colonization and invasion into the systemic circulation in the chick. Because the intestine of a newly hatched chick is immature at hatch, dietary supplementation of ingredients (or nutrients) that can specifically enhance mucin formation for incorporation into the mucus layer and glycocalyx may be beneficial. Gelatin is an ingredient that is high in crude protein (95%) and rich in mucin-forming amino acids such as glycine, glutamine, proline and serine. Incorporation of gelatin into chick starter diets may modify intestinal levels of different bacteria species. Thus, we designed an experiment to evaluate the effect of dietary gelatin supplementation on *Salmonella* Typhimurium levels in the chick intestine. A 14-day experiment was conducted using 224 day-old broiler chicks. Chicks were randomly allocated to 4 treatments. Treatments 1 (CS) and 2 (CST) consisted of chicks fed corn-soy starter diet and were either challenged with *Salmonella* Typhimurium (ST) or not. Treatments 3 (CSG) and 4 (CSGT) consisted of chicks fed a corn-soy starter diet supplemented with gelatin (at 2% level) and were either challenged with ST or not. At 4 days of age, chicks in the CST and CSGT treatments were challenged with 7.8×10^6 CFU/mL of ST. On days 4 and 9 postchallenge (PC), intestinal and cecal ST levels were enumerated on XLT4 agar. CS and CSG chicks remained ST-free throughout the experiment. At 4 days PC, intestinal ST levels were similar ($P > 0.05$) for CST ($0.93 \log_{10}$ CFU/mL) and CSGT ($1.04 \log_{10}$ CFU) treatments while cecal ST level was higher ($P < 0.05$) for CSGT ($4.46 \log_{10}$ CFU/mL) compared to CST chicks ($3.11 \log_{10}$ CFU/mL). At 9 days PC, no differences were observed in ST levels of all treatments. Gelatin supplementation at 2% level of the diet tended to enhance intestinal ST colonization.

Key Words: mucin, gelatin, *Salmonella*

123 Gas stunning and quality characteristics of broiler chicken breast meat. M. Bianchi*, M. Petracci, and C. Cavani, *Alma Mater Studiorum—University of Bologna, Department of Food Science, Cesena, Italy.*

During poultry processing, gas stunning systems are based on the birds exposure to gases which may induce either anesthesia or anoxia. Research comparing electrical and gas stunning have reported differences in incidence of carcass defects and variation in meat quality traits. However, contradictory results have been reported, especially when different stunning conditions were compared. Three trials were conducted to evaluate breast meat quality of broiler chickens (2.5 kg live wt.) processed using electrical (E) (constant voltage of 120V pulsating DC, 200 Hz, 4.6 s; 60 mA/bird) or gas (G) stunning with carbon dioxide exposure (5.5 min). Birds that were gas stunned remained in crates that were passed through underground chamber with gas concentrations increasing from 10 to 32% (Linco® system). After slaughter and chilling, the incidence of carcasses with blood-engorged wing veins and/or blood

spots on breast meat was evaluated ($n = 144$ /stunning system). Breast (P. major) muscles were deboned immediately after air chilling (commercial deboning time, 2.5 h) or after 6 and 24 h postmortem ($n = 36$ /deboning time/stunning system; $n = 216$). The meat pH was determined immediately after deboning, whereas color ($L^*a^*b^*$), cook yield, and AK-shear of cooked meat were determined after 24 h postmortem. In comparison with electrical stunning, gas stunning produced a noticeably lower incidence of carcasses with blood-engorged wing veins and/or blood spots on breast meat (18.7 vs. 61.8%; $P < 0.01$). The stunning system did not influence breast meat postmortem pH fall, color, and cook yield. Gas stunning resulted in a lower AK-shear values when fillets were deboned after 2.5 h of aging (4.86 vs. 6.89 kg/g; $P < 0.01$); however, shear values were similar for both treatments when fillets were aged for 6 or 24 h postmortem. Using the conditions adopted in the present study, the major advantages of gas stunning over electrical stunning are the lower incidence of breast meat defects and lower AK-shear values of cooked meat for fillets deboned immediately after chilling.

Key Words: broiler chicken, gas stunning, breast meat quality

124 Evaluation of the anti-*Listeria* properties of nisin on ready-to-eat turkey ham. A. Ruiz¹, S. K. Williams*¹, A. Hinton², G. E. Rodrick¹, and N. Djeri¹, ¹*University of Florida, Gainesville,* ²*USDA ARS Richard B. Russell Agricultural Research Center, Athens, GA.*

The incidence of *Listeria monocytogenes* in ready-to-eat meat products has become a major concern for the meat processing industry. The objective of this study was to determine the anti-*Listeria* and general antimicrobial properties of different concentrations of nisin (0.2, 0.3, 0.4, and 0.5%) on ready-to-eat vacuum packaged turkey ham inoculated with a 5-strain inoculum of *Listeria monocytogenes*. All samples were stored at $4 \pm 1^\circ\text{C}$ for up to 63 days and analyzed at 1-week intervals for pH, lactic acid organisms and *Listeria monocytogenes*. Anti-*Listeria* effects of nisin at different concentrations were similar ($P > 0.05$) for the first 2 weeks. The data demonstrated an extended lag phase for the 0.5% nisin treatment through 63 days storage. *Listeria monocytogenes* counts remained less than $1.95 \log$ CFU/g for 0.5% nisin through 63 days. Lactic acid bacteria counts for 0.5% nisin-treated ham were significantly lower ($P < 0.05$) than the positive and negative controls from 28 through 63 days storage. An increase in pH ($P < 0.05$) was observed for the 0.5% nisin-treated hams at days 56 and 63 when compared to the positive and negative controls. Although none of the treatments completely eliminated *L. monocytogenes*, the overall results suggested that the antimicrobial effectiveness of nisin increased as its concentration increased from 0.2 to 0.5%. The methodology used in this study and its results could be used to improve the microbial safety of ready-to-eat meat products.

Key Words: bacteriocins, ready-to-eat products, *listeria monocytogenes*

125 Anti-*Salmonella* properties of PronTech® on commercial poultry broiler meat when inoculated with *Salmonella* Typhimurium. A. Ruiz¹, S. K. Williams*¹, A. Costa², W. Dominguez², and K. C. Sarjeant¹, ¹*University of Florida, Gainesville,* ²*Pan-American School of Agriculture, El Zamorano, Francisco Morazán, Honduras.*

The objective of this research was to determine the anti-*Salmonella* properties of PronTech® (Alkyl Dimethyl Benzyl Ammonium Chloride)

on poultry broiler meat when inoculated with *Salmonella* Typhimurium and stored at $4 \pm 1^\circ\text{C}$ for 7 days. Fresh broiler chicken drumsticks were purchased from a local processor, inoculated with a pure culture of *Salmonella* Typhimurium to yield a final concentration of 4 log CFU/mL on the surface of the drumsticks. The final treatments included drumsticks, no inoculum, no treatment (negative control), drumsticks + inoculum (positive control), drumsticks + inoculum + 100 ppm PronTech®, and drumsticks + Inoculum + 200 ppm PronTech®. Two samples were analyzed for each treatment after 0, 3, 5 and 7 days storage at $4 \pm 1^\circ\text{C}$ for total psychrotrophic counts and *Salmonella* Typhimurium (direct and enrichment methods). Two trials were conducted. Treatment of broiler drumsticks with 100 or 200 ppm PronTech® resulted in 1 log reduction in total psychrotrophic counts and *Salmonella* Typhimurium, when compared to the positive control drumsticks. Total psychrotrophic counts and *Salmonella* Typhimurium were similar ($P > 0.05$) for drumsticks treated with 100 and 200 ppm PronTech®.

Key Words: *Salmonella* Typhimurium, PronTech®, antimicrobial

126 Effects of chlorine or chlorine dioxide during immersion chilling on recovery of bacteria from broiler carcasses and chiller water. J. K. Northcutt^{*1}, D. P. Smith², N. A. Cox², K. D. Ingram², R. J. Buhr², L. J. Richardson², J. A. Cason², and A. Hinton Jr.², ¹Clemson University, Clemson, SC, ²USDA-ARS, Athens, GA.

A study was conducted to determine the impact of immersion chilling broiler carcasses with chlorine or chlorine dioxide. Prechill commercial broiler carcasses were cut into left and right halves along the keel bone, and each half was rinsed (100 mL, 0.1% peptone, 1 min). Halves were inoculated with 0.1 g of cecal material containing 10^7 cells per g of gentamicin-resistant *Campylobacter* (gen-Campy) and 10^7 cells per g of nalidixic acid resistant-*Salmonella* (nal-Sal). Halves were immersion chilled in either 20 ppm chlorine (pH 7.0) or 3 ppm chlorine dioxide. Noninoculated carcasses (NIC) were added to chillers to achieve commercial fill volumes. After 40 min, halves and NIC were removed from chillers and rinsed as mentioned above. Postchill rinses were analyzed for numbers of *E. coli*, coliforms, gen-Campy and nal-Sal. Chiller water samples were evaluated for levels of gen-Campy and *Enterobacteriaceae*. Numbers of *E. coli*, *Campylobacter* and *Salmonella* found in postchill half rinses were similar for both treatments. Coliform levels were slightly different on halves chilled with chlorine ($4.1 \log_{10}$ cfu/mL rinse) compared to halves chilled with chlorine dioxide ($4.4 \log_{10}$ cfu/mL; $P < 0.05$). Bacteria were not recovered from chlorinated chiller water; however, gen-Campy ($2.3 \log_{10}$ cfu/mL) and *Enterobacteriaceae*, ($3.5 \log_{10}$ cfu/mL) were found in chlorine dioxide chiller water. On the NIC, gen-Campy was found on 55% (5/9 positive; $2.0 \log_{10}$ cfu/mL) after chlorine chilling and 33% (3/9 positive; $2.3 \log_{10}$ cfu/mL) after chlorine dioxide chilling. *Salmonella* was not found on NIC after chlorine dioxide chilling, but populations were detected on 22% ($2.6 \log_{10}$ cfu/mL) of NIC chilled in chlorine. The present study shows that immersion chilling with chlorine and chlorine dioxide removed bacteria from carcass surfaces. Data also showed that chlorinated chiller water had reduced bacterial levels but there was greater carcass cross-contamination with *Campylobacter* and *Salmonella* as compared to chlorine dioxide.

Key Words: broilers, immersion chilling, carcass bacteria recovery

127 *Listeria monocytogenes* biofilm formation on silver ion impregnated cutting boards. M. E. Berrang^{*1}, J. F. Frank², and R. J. Meinersmann¹, ¹USDA-ARS-Russell Research Center, Athens, GA, ²University of Georgia, Athens.

Listeria monocytogenes is a human pathogen that can be a member of a biofilm community attached to surfaces in poultry processing plants. When present as a biofilm on product contact surfaces, this organism can effectively cross contaminate fully cooked ready-to-eat meat. Plastic cutting boards can be formulated to include antibacterial agents such as silver ions. In this study we compared the ability of *L. monocytogenes* to attach and form a biofilm on identical plastic cutting boards manufactured with and without silver ions. Cutting boards were cut into 2 by 2 cm squares and inoculated with a poultry plant isolate of *L. monocytogenes* known to effectively form biofilms. Inoculation was conducted by submersion in a cell suspension of approximately 10^8 cells per mL PBS for 2 hours. All pieces were then washed in PBS to remove unattached cells and incubated in dilute (1/10) brain heart infusion broth for 24 hours at 25°C . Unattached cells were again removed by washing in PBS. The surface was sampled using a premoistened sterile cotton swab either immediately after removal of unattached cells or after a 24 hour dry exposure of attached cells to the board formulation at 25°C . Three replications were conducted with 5 cutting board squares for each treatment in each replication ($n = 15$). When sampled immediately after washing, similar numbers were recovered from treated and untreated boards: 6.83 and 6.86 log cfu/cm², respectively. Twenty-four-hour dry time lessened the density of viable attached *L. monocytogenes* on both types of cutting boards to the same degree; silver ion impregnated boards had $3.95 \log$ cfu/cm² while untreated control boards had $3.97 \log$ cfu/cm². Under the conditions of these tests, silver ion impregnation did not lessen the ability of *L. monocytogenes* to form a biofilm on the surface of plastic cutting boards.

Key Words: *Listeria monocytogenes*, silver ion, biofilm

128 Effect of quartering and sampling method on recovery of bacteria from broiler carcasses. D. P. Smith^{*}, USDA, ARS, Athens, GA.

Four eviscerated broiler carcasses were obtained from a commercial processing plant just prior to the final inside-outside bird washer in each of 3 replicate trials. Carcasses were separated into leg quarters and breast quarters ($n = 48$) and weighed. One breast and leg quarter from the same carcass side were assigned to the rinse method; quarters from the other side were assigned to grinding. Right and left sides were alternated for methodology with each carcass. Rinsing was conducted on quarters using 100 mL 0.1% peptone, shaken manually for 1 min, and rinsate was serially diluted. Grinding was conducted using a commercial grinder for 30 s (to produce a paste), then 25 g was weighed and added to 225 mL 0.1% peptone then stomached for 1 min. Rinses and diluted pastes were serially diluted and plated on *E. coli*/coliform Petrifilm. Plates were incubated 24 h at 35°C and colonies representative of *E. coli* and coliforms were counted. Numbers of bacteria are reported as log cfu/mL (rinse) or log cfu/g (grind). Average breast quarter weight was 397 g and leg quarter weight was 321 g. No difference in numbers of bacteria was observed due to side (left or right) or quarter (breast or leg). Significantly ($P < 0.05$) higher numbers of *E. coli* were recovered by rinsing (5.3 log cfu) than by grinding (4.2 log cfu). Coliforms were also recovered in higher numbers by rinsing (5.6 log cfu) than by grind-

ing (4.4 log cfu). Results indicate bacteria may be equally distributed over carcasses with regard to side and quarter, and that rinsing recovers more bacteria than grinding.

Key Words: *E. coli*, coliforms, broiler carcass

129 Effects of postprocessing shell surface sanitizers on egg physical quality. D. R. Jones^{*1}, S. K. Trabue², J. D. Shaw³, and M. T. Musgrove¹, ¹USDA-ARS, Egg Safety and Quality Research Unit, Russell Research Center, Athens, GA, ²Department of Biological Sciences, Tennessee State University, Nashville, ³Department of Food Science, University of Georgia, Athens.

All eggs processed under the voluntary USDA grade shield standards are required to be exposed to a postprocessing sanitizing rinse of 100–200 ppm chlorine (Cl) or equivalents. There has been speculation as to the effectiveness of this sanitizing rinse. The current study was undertaken to determine the effects of the postprocessing sanitizing rinse on the physical quality of shell eggs during 4°C storage. Unwashed, nest run eggs were compared to those exposed for 1 min to 49°C, pH 11 wash water followed by a 52°C sanitizing rinse of either: water, 100 ppm Cl, 200 ppm Cl, 50 ppm electrolyzed water or 200 ppm peracetic acid. The eggs utilized in this study were acquired on 3 consecutive wk from a local processor then processed the following day in the laboratory (replicate). Testing was conducted weekly through 5 wk of storage. The physical quality parameters monitored were: shell strength (SS), vitelline membrane strength (VMS), vitelline membrane elasticity (VME), egg wt, albumen height (AH) and Haugh unit (HU). Throughout the study, no significant differences were noted between treatments for any of the physical quality parameters monitored. There were replicate differences for SS, VMS, VME and egg wt. Replicate 3 had the weakest shells (3,294.54 g force, $P < 0.01$) and greatest egg wt (65.02 g, $P < 0.01$). The greatest ($P < 0.01$) VMS and VME were seen in replicates 1 and 3 (122+ g force and approx. 8 mm deformation). There were highly significant ($P < 0.0001$) replicate*wk interactions for AH and HU. The presence or lack of a variety of postprocessing shell surface sanitizers did not affect the egg physical quality attributes monitored. Replicate differences were seen for many factors which can be attributed, in part, to the variable nature of the egg.

Key Words: egg, shell surface, sanitizer

130 Evaluation of pulse electric fields to reduce *Salmonella* Typhimurium and *Salmonella* Enteritidis levels in scalding water during poultry processing. B. C. Martin^{*} and M. X. Sánchez-Plata, Texas A&M University, College Station.

The use of a common scalding tank during poultry processing increases the likelihood of carcass cross contamination from external contamination and fecal droppings released in the process. Excessive organic material minimizes the activity of common antimicrobials, thus contributing to contamination with foodborne pathogens. A plausible approach to decontaminate carcasses and recycled scalding water is the use of Pulsed Electric Fields (PEF). PEF uses electricity to kill bacteria suspended in liquid media, and could be utilized in the scalding water to reduce patho-

gen contamination on processed carcasses. In addition, the current could exert muscle stimulation that may affect meat tenderness by accelerating rigor mortis completion. A small scale system was assembled with the use of a PEF generator (Model SF-700, Simmons Eng. Co., Dallas, GA). Marker strains of Novobiocin and Nalidixic acid resistant *Salmonella enterica* serovar Typhimurium and *Salmonella enterica* serovar Enteritidis strains were used in challenge studies evaluating the effects of the PEF application on carcasses and scalding water contamination. The system was evaluated with 0, 0.5, and 1% sodium chloride and with 40 volts and 0.54 amps of electric current. Samples were collected at 0, 40, 80 and 160 s of treatment with a 10 s on, 5 s off cyclical pulses. The use of PEF in regular scalding water showed little effect on *Salmonella* reductions. However, with the addition of 0.5% NaCl, the intervention resulted in a 0.20, 0.77, and 2.63 log CFU/mL reduction of *Salmonella* spp. counts within the scalding water after 40, 80, and 160 s, respectively. However, evaluation of PEF directly applied in a commercial scalding tank (Dunkmaster[®], Knase Company Inc, MI), showed minimal reduction on carcass contamination levels and no detectable differences in Allo-Kramer shears of breast muscle harvested after 2, 6, and 24 h postmortem. Pulse Electric Field has great potential as an alternative nonchemical intervention for recycled poultry processing water, thus potentially reducing food-borne pathogens in poultry products.

Key Words: *Salmonella*, pulse electric fields, poultry

131 DOA determination for hanging at processing plant with CAS or LAPS stunning systems. Y. Vizzier-Thaxton^{*1} and K. Christensen², ¹Mississippi State University, Mississippi State, ²OK Industries, Inc., Ft. Smith, AR.

Birds arriving at the processing plant dead on arrival (DOA) are a problem for the poultry processor due to loss of production yield. However, with the advent of controlled atmosphere stunning (CAS) and low atmospheric stunning (LAPS), DOA pose an additional problem. DOA cannot be processed and therefore should not be hung on the processing line. With methods of stun that render birds unconscious before hanging on the line, distinguishing them could be a problem. That is, they must be identified from among a group of as many as 250 birds contained in the typical live haul cage so that they are not hung on the processing line. Previous work by Ritz et al. demonstrated that full rigor can occur in as few as 10 minutes and last for prolonged periods of time. Rigor state along with nominal temperature determinations are the most common method of identifying DOA in the CAS and LAPS systems. The present study combined body temperatures with degree of rigor to determine whether or not DOA can be identified from the dump system at the hanging process at a commercial broiler processing plant. Observers were placed in the hanging area and at the exit from the pickers to monitor removal of DOA. Tests were run on 4 consecutive days. One thousand birds per day were monitored with an average of 0.58% identified as DOA. Only one bird reached the picking area indicating that DOA were easy to identify. The average temperature of the DOA was 33°C with a range of 15–44°C. For experienced hanging line employees, identifying DOA was not a problem. Based on this work, it was determined that simple training will allow poultry hanging line employees to identify DOA birds through rigor rather than temperature.

Key Words: DOA, hanging, processing

132 Dietary conjugated linoleic acid, flaxseed, and menhaden fish oil effect on lipid oxidation stability of *sous vide* chicken meat.

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Lipid oxidation is known to occur rapidly in thermally processed chicken meat. To assess the lipid oxidation stability of *sous vide* chicken meat, 624 broilers were randomly assigned into 6 treatments, 4 replications, with 26 broilers each, and fed diets including 2% of CLA (Luta-CLA 60[®], BASF), flaxseed, or menhaden fish oil, each supplemented with 42 or 200 mg/kg of α -tocopheryl acetate, during 42 days. Skinless and boneless breast and thigh muscle pieces were harvested, individually vacuum-packaged and cooked in a water bath (to an internal temperature of 74°C). Meat packages were stored at 4.4°C for 0, 5, 10, 15, and 30 days. Meat thiobarbituric acid reactive substances, fatty acid methyl esters (FAME), nonheme iron, moisture, and fat analysis were performed. Results showed that dietary CLA induced deposition of *cis9,trans11* and *trans10,cis12* CLA isomers, increased the proportion of SFA (16:0, and 18:0) and decreased the ones from MUFA (16:1, 18:1, 18:1c11) and PUFA's. In contrast, flaxseed oil induced higher deposition of oleic (18:1), linoleic (18:2), linolenic (18:3), and arachidonic (20:4) fatty acids, particularly in thigh muscle; while menhaden fish oil induced higher deposition of EPA (20:5) and DHA (22:6) fatty acids ($P \leq 0.05$). The lipid oxidation stability was affected independently by the interaction of dietary fat or vitamin E level by storage day. Significantly ($P \leq 0.05$) higher malonaldehyde values were found in menhaden and flaxseed oil, compared to the CLA treatment. Higher ($P \leq 0.05$) malonaldehyde values were detected in meat samples from the low than the high level of vitamin E. Neither nonheme iron, fat, nor moisture values affected the lipid oxidation development ($P \geq 0.05$). In conclusion, dietary CLA, flaxseed, and menhaden oil influenced the deposition of fatty acids in chicken muscles. Changes in the composition, amount, and degree of unsaturation of fatty acid in the meat affects the lipid oxidation development in *sous vide* cooked chicken meat. Supranutritional supplementation of vitamin E is more effective in inhibiting the development of lipid oxidation than the commercial levels currently used.

Key Words: CLA, EPA, DHA, *sous vide*, lipid oxidation

133 External and internal bacteria in broiler chickens before and after defeathering.

J. A. Cason^{*}, A. Hinton Jr., J. K. Northcutt, R. J. Buhr, K. D. Ingram, D. P. Smith, and N. A. Cox, *Russell Research Center, Athens, GA.*

Broiler chicken carcasses were removed from the shackle line in a commercial processing plant to determine incidence and counts of coliforms, *Escherichia coli*, *Campylobacter*, and *Salmonella* both before and after picking. Five carcasses were taken from each sampling location on 10 different days (n = 50). External samples included rinses of picked carcasses, feet, and hand-picked feathers from the carcasses before picking. Internal samples included the colon, ceca, crop, and contents of each. Samples were diluted in 0.1% peptone water and bacteria were cultured by standard methods. *Campylobacter* was present at 100% incidence in 3 flocks, but was absent in the other 7 flocks. Numbers of coliforms and *E. coli* were significantly ($P < 0.05$) lower in rinses of carcasses picked in the plant, but numbers of *Campylobacter* were significantly higher in the same samples. All samples from 2 flocks were *Salmonella* negative

before picking, but at least one carcass was *Salmonella* positive in all 10 flocks after picking. *Salmonella* was isolated in external samples from 46% of carcasses before picking versus 74% after picking. *Salmonella* incidence in internal samples was 8% before picking compared to 14% after. Only one cecal sample was *Salmonella* positive at each sampling location, indicating that flocks had a low level of colonization. In most-probable-number (MPN) assays performed on the qualitatively positive samples, approximately half had no *Salmonella*-positive tubes, indicating that many of the *Salmonella*-positive samples probably contained only a few cells. Mean MPNs were lower than in previous sampling of flocks that had greater intestinal colonization by *Salmonella*, indicating that incidence data alone may hide differences in *Salmonella* carriage by carcasses from positive flocks.

Key Words: *Salmonella*, *Campylobacter*, *Escherichia coli*

134 Supplemental vitamin B₆ improves vitelline membrane strength in layer hens fed a flaxseed ration.

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Increased consumption of omega-3 polyunsaturated fatty acids has been suggested to reduce the incidence of heart disease and cancer in humans. Because of these apparent human health benefits, flax seed and fish oil based rations are often fed to layer hens to increase the levels of omega-3 fatty acids in table eggs. However, reductions in egg quality from older hens fed omega-3 rations has been reported. Declines in egg quality may be due to the presence of linatine, which is a vitamin B₆ antagonist found in flax seed. Fish oil and flax seed have also been shown to cause fatty liver syndrome when fed at high concentrations for 4–6 months. The objective of this study was to determine if the addition of vitamin B₆ or the removal of fish oil to an omega-3 diet would improve egg quality. Laying hens were fed 1 of 4 diets: Diet A) a standard omega-3 ration; Diet B) Diet A supplemented with vitamin B₆; Diet C) Diet A without fish oil; and Diet D) a conventional milo based ration. Three separate pools of eggs were stored for 3 weeks in a refrigerator to simulate consumer storage conditions and were later evaluated for egg quality. Measurements were made to determine egg weight, yolk weight, albumen thickness and vitelline membrane strength. Significant differences in eggs weights were observed with Diet B samples in the first pool and Diets B, C, and D in the third pool of eggs. Yolk weights were significantly increased with Diet B samples from the third pool. No differences were observed in albumen thickness in either of the 3 pools of eggs. Numerical increases in vitelline membrane strength were observed in Diets B, C and D in each of the 3 data sets, but only the third pool tested to be significant due to a larger sample size. These data suggest that egg quality is affected by diet. Furthermore, the addition of vitamin B₆ or the reduction of fish oil to a typical omega-3 ration may improve egg quality similar to what is observed with a conventional layer ration.

Key Words: omega-3 fatty acid, egg quality, linatine

135 Efficacy of postwash shell egg sanitizers.

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Chlorine (Cl) solutions of 100–200 ppm are the standard by which postwash shell egg sanitizers are measured. Any facility that packages eggs with the USDA grade shields must use a comparable sanitizer. While Cl solutions are inexpensive, noncorrosive, and safe to handle, they are not very effective after coming into contact with shell egg wash water which has a pH 10–11 and always contains organic material such as feed, shells, and egg meat; all of which decrease the effectiveness of this sanitizer. A study was conducted to determine the efficacy of post-processing sanitizing rinses on microbial populations associated with eggshells immediately after washing and during 5 weeks of 4°C storage. After eggs were washed for 1 min by spraying with wash water of pH 11 and heated to 49°C, eggs were treated with one of the following 52°C sanitizing rinses: water, 100 ppm Cl, 200 ppm Cl, 50 ppm electrolyzed water or 200 ppm peracetic acid. A control group of unwashed nest run eggs was also evaluated. The experiment was replicated 3 times. Eggs from each replicate were evaluated on the day of processing and weekly for 5 weeks of 4°C storage. For each treatment group, 10 eggs

were sampled by crushing shells and membranes in phosphate buffered saline. Microbial populations enumerated were: Aerobic microorganisms (AM), *Enterobacteriaceae* (ENT), and yeasts/molds (YM). Pooled samples (2 sets of 5 eggs) from each of the treatments were culturally enriched for *Salmonella* but the organism was never recovered. Levels for the 3 enumerated populations ranged from 0–2.0, 0–0.8, and 0–2.0 log₁₀ CFU/mL of shell/membrane slurry, respectively. Prevalence (% of eggs contaminated) ranged from 50–100, 0–33, and 17–100, respectively. Control eggs (not washed or sanitized) had the highest counts and the highest prevalence for the 3 populations monitored. None of the sanitizers tested were more effective than rinsing with water ($P < 0.05$). These data indicate that while washing reduced AM, ENT, and AM numbers by 90–99%, the sanitizing rinses tested in this study were unable to elicit a further reduction in the numbers of microorganisms associated with the eggshells and membranes of washed eggs.

Key Words: shell eggs, sanitizers, food safety