diagnosed morphologically and the results from PCR and morphology were compared. PCR primers used were unique to each species and ran with positive controls for confirmation of desired band size. The primers used were for E. maxima, E. tenella, E. necatrix, E. praecox, E. brunetti, E. mitis and E. acervulina. E. acervulina was seen in 96% of the samples (n=28), E. brunetti 86% (n=25), E. maxima 93% (n=27), E. mitis 48% (n=14), E. necatrix 24% (n=7), E. praecox 86% (n=25) and E. tenella 89% (n=26). Vaccination records were also used to compare the species variation between the farms. With 24% prevalence, pathogenic E. necatrix warrants further investigation as a potential vaccine addition. Future plans include comparison of the species at the same farms over several years and observe any changes over time.

**Key Words:** Coccidia, PCR, Anticoccidial Sensitivity Test

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### Processing & Products

**M31 Ultrasonic for Disinfection**

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The pathogens intervention system is a key part of poultry processing. A disinfection system that can use chemical disinfectants effectively, reduce and/ or eliminate harmful byproducts is in demand more than ever. The goal of this project was to evaluate the effectiveness of sonication (ultrasound) for inactivation of *Salmonella* with and without a disinfection agent (chlorine, peracetic acid) in poultry (chiller) water.

The experiment was designed to investigate the ultrasonic effect of various power intensities, volumes, and exposure times with several repetitions. All ultrasound experiments were conducted in isothermal conditions to eliminate disinfection via indirect heat input from the ultrasonic probe. The data from the *Salmonella* inoculated DI water tests showed a correlation between an increase in ultrasonic energy, increase in exposure time, and decrease in volume that led to better disinfection of *Salmonella*. The data demonstrates that ultrasound can be used to inhibit *Salmonella* growth.

This study also evaluated the effectiveness of ultrasound and chemical disinfection agents (chlorine or peracetic acid (PAA)) in *Salmonella* inoculated water, surrogate chiller water and poultry chiller water. The synergy effect for chlorine (1.66, 3.32 and 4.98ppm) and PAA (0.75, 1.5 and 2.25ppm) in water is evaluated by assessing the disinfection agents with approximately 40kJ of ultrasonic energy (65W for 10 minutes) in *Salmonella* inoculated DI water. When comparing the data of chemical disinfection with the combination of ultrasonic and chemical, the disinfection is greater for the combined system than the disinfection observed with chemicals only. Surrogate chiller water (5g of chicken skin and fat per litter of DI water) was treated with combined chlorine (16.6 ppm) and ultrasound in parallel to chlorine treatment alone. The experiment of surrogate chiller water was also repeated using peracetic acid concentrations of 0.75, 1.5, and 2.25ppm. A similar trend of log reduction was observed for combination ultrasound and chemicals treatment for all concentrations of chlorine and PAA.

The ultrasonic disinfection trend in poultry chiller water was found to be similar to that of DI water experiments. Furthermore, the poultry chiller water with additional chemicals (16.6ppm chlorine and 2.25ppm PAA) and ultrasonic were also tested. The data show the combined system disinfection better than the chemical alone. However, more work is needed to characterize the actual chiller water. In all cases, samples treated with combined ultrasound and chemicals exhibited better disinfection than samples treated with chemical alone.

**Key Words:** sonication, disinfection agents, Salmonella

**M32 Dissolved Air Flotation as superior pre-treatment for poultry waste water**

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Dissolved air flotation (DAF) has been successfully applied as industrial wastewater treatment for many years. Recent technological improvements have expanded the applicability to the pre-treatment of wastewater. Nijhuis Water Technology, known for supplying more than 1700 DAF systems worldwide developed a new ‘Intelligent DAF’ which achieved better COD and TSS removal compared to current DAF systems due to smarter flow pattern, smaller bubble size and intelligent aeration control. Up to 60% of the total suspended solids can be removed by DAF from poultry slaughterhouse wastewater. With chemical additives the removal increases up to 99% removal of suspended solids and up to 85% COD removal.

Extensive research with the Intelligent DAF proved that the energy usage of the recirculation and aeration could be decreased up to 30% in comparison to older DAF installations at similar suspended solids and COD removal. Due to the large contribution of the recirculation and aeration to the total energy demand of a DAF system, a significant energy reduction up to 25% is obtained by the ‘Intelligent DAF’ system. This yields an energy usage of 0.03 kWh/m³ and 0.05 kWh/m³ wastewater for DAF systems with and without chemical additives, respectively. The research and the first full scale Intelligent DAF installations have proven that treatment of industrial wastewaters gives higher removal efficiencies at lower energy use per m³ treated waste water.

**Key Words:** DAF, poultry slaughterhouse wastewater, energy efficiency, flocculation, flotation

**M33 The Aecomix™ system: converting waste and waster in one reactor towards clean water and biogas**

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Food and beverage production plants are major wastewater contributors and often have food waste. Particularly plants with wastewaters with a significant total suspended solids and/or fats, oils and greases like in the dairy, red meat and chicken industry needs to pre-treat their wastewater before high rate anaerobic reactors can be applied. This pre-treatment generally includes undesirable chemical treatment and generates a concentrated side stream which needs to be dealt with. The Aecomix™ reactor is an innovative anaerobic reactor with solids retention, particularly suited to treat such effluents, together with available organic wastes. In this manner two waste streams are dealt with in one system and a high level of conversion to biogas is achieved. The solids retention is achieved by Dissolved Biogas Flotation. A full scale Aecomix™ reactor treated the effluent of a chocolate/candy factory with a COD concentration varying between 10,000 – 60,000 mg/l at an average of 30,000 mg/l. The removal for COD and TSS was more than 95% on average. To meet with local discharge regulations a post aerobic biological treatment may be required. The excess sludge from this aerobic system can be returned to the Aecomix™ reactor, which is another advantage over high rate (UASB type) reactors. The Aecomix™ is approximately 20% lower in operational costs compared to a chemical treatment plant followed by an UASB reactor. The Aecomix™ system provides a single step process solution for different substrates from dairy, red meat and other food industry, with a high removal efficiency (on organic matter). It is proven to be a robust process with advantages such as integrated gas storage.

Frozen pre-stuffed turkeys are convenient and may be cooked either after thawing or direct from solid state. All carcasses (4.35kg) were from 12wk heavy hens of common background. Each was cooked in a raised-wire
shallow Al pan using a standard oven (163°C) to an 85°C internal breast. Prior to freezing, all crop and body cavities had been filled with bread cubes having 50% added water by weight to increase RTW by 20%. Each of 4 treatments involved 7 RTC carcasses: thawed to +5°C when cooking was initiated with frozen repetitions at -5, -15 and -25 to enable regression analysis. Time to attain breast end-point was 44 min when starting temp was +5°C which increased to 63 min when -5°C with similar values at lower starting temperatures (P<**Q). Total cooking loss was similar among all treatments when stuffing was included (20.4%, P>NS), but calculation after its removal indicated a loss from +5°C carcasses of 26.6% while it was greater those that had been frozen with similar values among treatments (28.3%, P<*Q). Total drip of cooking loss from stuffed carcasses was 26.2% when +5°C but lower and similar among frozen treatments 22.9% (P<*Q). Analysis of stuffing removed from a thawed +5°C carcass that was not cooked indicated 64.9% moist and 16.6% fat, 11.8% CP, and 7.0% ash on a DM basis. Cooking led to 10.2% gain in weight for the crop-body cavity composite that was similar among treatments (P>NS); however, their moist content decreased from the level at initiation of cooking, particularly when frozen (crop, 59.4% at +5°C vs 55.8% frozen, P<*Q; Body cavity, 56.9% at +5°C vs 52.8% frozen, P<*Q). Acretion of fat accounted for the reduction in moist with crop being similar to body cavity which was similar among treatments (21% DM, P>NS), while CP increase with crop was greater than body cavity (13.7% DM vs 11.7%, P<*) with each being similar, regardless of starting temperature (P<*Q). Yield of parts as well as breast and thigh meat proportions were not affected nor were their compositions altered by method of cooking. Caloric increase for solid-liquid phase change dominated the increased cooking time when frozen and marginal changes in losses, yields, and compositions of stuffing occurred, regardless of starting carcass temperature.

**Key Words:** Biogas production, COD reduction, Dissolved Biogas Flotation, High Rate Anaerobic treatment, wastewater

M34 Cooking Frozen Turkey Containing Stuffing: Preparation Characteristics Once Thawed and From Progressively Reduced Solid Temperatures Ed Moran1, Laura Bauermeister Auburn University, Auburn, AL, USA

Frozen pre-stuffed turkeys are convenient and may be cooked either after thawing or direct from solid state. All carcasses (4.35kg) were from 12wk heavy hens of common background. Each was cooked in a raised-wire shallow Al pan using a standard oven (163°C) to an 85°C internal breast. Prior to freezing, all crop and body cavities had been filled with bread cubes having 50% added water by weight to increase RTW by 20%. Each of 4 treatments involved 7 RTC carcasses: thawed to +5°C when cooking was initiated with frozen repetitions at -5, -15 and -25 to enable regression analysis. Time to attain breast end-point was 44 min when starting temp was +5°C which increased to 63 min when -5°C with similar values at lower starting temperatures (P<**Q). Total cooking loss was similar among all treatments when stuffing was included (20.4%, P>NS), but calculation after its removal indicated a loss from +5°C carcasses of 26.6% while it was greater those that had been frozen with similar values among treatments (28.3%, P<*Q). Total drip of cooking loss from stuffed carcasses was 26.2% when +5°C but lower and similar among frozen treatments 22.9% (P<*Q). Analysis of stuffing removed from a thawed +5°C carcass that was not cooked indicated 64.9% moist and 16.6% fat, 11.8% CP, and 7.0% ash on a DM basis. Cooking led to 10.2% gain in weight for the crop-body cavity composite that was similar among treatments (P>NS); however, their moist content decreased from the level at initiation of cooking, particularly when frozen (crop, 59.4% at +5°C vs 55.8% frozen, P<*Q; Body cavity, 56.9% at +5°C vs 52.8% frozen, P<*Q). Acretion of fat accounted for the reduction in moist with crop being similar to body cavity which was similar among treatments (21% DM, P>NS), while CP increase with crop was greater than body cavity (13.7% DM vs 11.7%, P<*) with each being similar, regardless of starting temperature (P<*Q). Yield of parts as well as breast and thigh meat proportions were not affected nor were their compositions altered by method of cooking. Caloric increase for solid-liquid phase change dominated the increased cooking time when frozen and marginal changes in losses, yields, and compositions of stuffing occurred, regardless of starting carcass temperature.

**Key Words:** Turkey Cooking, Cooking Temperature, Cooking Loss

M35 Post-mortem pH decline in broiler carcasses subjected to either air or ice chill environments Sara Orlovski1, Audrianna Rogers, Alex Gilley, Fred Pohlman, Nicholas Anthony University of Arkansas, Fayetteville, AR, USA

When muscle is converted to meat, post-mortem pH decline occurs. If this decline occurs too slowly or too rapidly, meat quality suffers. Previous research has shown that cooling rates may have an effect on pH decline. This study characterizes pH change over a 24 h period for divergently selected lines (24 h color L*) and evaluates the response of these lines to different chill methods. The broiler lines used included the random bred control (RBC) as well as the High L* (HMC) and Low L* (LMC) meat color lines. It is hypothesized that the HMC line would have a faster rate of decline and a lower ultimate pH than the LMC line. In addition, a faster chill rate would result in a slower pH decline. The study consisted of three replications of twenty-four male broilers, eight from each line. Broilers were reared on litter floor pens to 8 wk at which time they were processed. Carcasses were equally and randomly assigned by line to either open air or ice-bath chilling. Temperature and pH measurements were collected on the breast and thigh muscles immediately after exsanguination, 15 minutes post-mortem and every hour until deboning at 4 h. Temperature and pH measurements were recorded at 6, 8, 10, 12, 16, 20 and 24 h. Breast meat color was measured at 4, 12 and 24 h. Within the HMC and LMC lines, no treatment differences were observed for pH decline or 24 h breast meat color. When averaged across treatments, the rate of pH decline was greatest with the HMC line and lowest with the LMC line with the RBC line being an intermediate. For all lines, pH decline stopped between 6 and 8 h post mortem indicating the completion of rigor mortis. Differences were observed between lines for 24 hour L* indicating that the divergent lines behaved as expected. Understanding of the interaction of pH and temperature decline for lines known to vary in meat characteristics will allow for management techniques that can be implemented ante and post-mortem to help improve meat quality.

**Key Words:** broiler carcass, chill method, meat color, meat quality, pH

M36 Meat quality of broiler breast fillets with white stripping and woody breast muscle myopathy Vishwesh V. Tijare*, Famous Yang1, Christine Z. Alvarado2, Craig Coon1, Casey M. Owens 1University of Arkansas, Fayetteville, AR, USA; 2Texas A&M University, College Station, TX, USA

The global poultry industry has been faced with emerging broiler breast meat quality issues including conditions known as white stripping (WS) and woody (WD) breast. White stripping is characterized by white stripes on the breast and thigh muscles immediately after exsanguinations, 15 minutes post-mortem and every hour until deboning at 4 h. Temperature and pH measurements were recorded at 6, 8, 10, 12, 16, 20 and 24 h. Meat color was measured at 4, 12 and 24 h. Within the HMC and LMC lines, no treatment differences were observed for pH decline or 24 h breast meat color. When averaged across treatments, the rate of pH decline was greatest with the HMC line and lowest with the LMC line with the RBC line being an intermediate. For all lines, pH decline stopped between 6 and 8 h post mortem indicating the completion of rigor mortis. Differences were observed between lines for 24 hour L* indicating that the divergent lines behaved as expected. Understanding of the interaction of pH and temperature decline for lines known to vary in meat characteristics will allow for management techniques that can be implemented ante and post-mortem to help improve meat quality.

**Key Words:** broiler carcass, chill method, meat color, meat quality, pH
leuenet-Owens razor shear energy values (MORSE) on non-marinated and marinated (vacuum tumbled, 15% marinade addition; targeted 0.75% NaCl and 0.45% phosphate for final concentration) fillets. The incidence of WD in 285 breast fillets was NORM 3.9%, W1 48.1%, W2 28.0%, W3 20.0% and incidence of WS was normal 3.9, moderate 63.8 and severe 32.3%. Interestingly, SL slightly increased (P < 0.05) as the degree of severity of either WS or WD (SEVS, SEVD or SEVboth) increased compared to CONT fillets, and GFI was not impacted (P > 0.05). As severity of WS or WD increased, MU decreased (P < 0.05), and cook loss of non-marinated and marinated fillets both increased with increasing severity of WS or WD (P < 0.05). The MORSE of SEVboth fillets was higher (P < 0.05) compared to other fillets; however, no differences for MORSE of non-marinated fillets were noted. Results of this study suggest that severe degrees of white striping and woody (hardness) together or alone negatively impact meat quality.

Key Words: broiler, myopathy, white striping, woody breast, meat quality

M37 Evaluating breast meat tenderness using a blunt version of the Meullenet-Owens Razor Shear method of broilers raised for small or big bird market programs. Famous L. Yang1, Vishwesh V. Tijare1, Aline Giampietro2, Casey M. Owens1

Broiler breast meat tenderness is an important meat quality attribute and previous research has suggested that older market broilers have tougher meat at times compared to younger broilers (e.g., 8 vs. 6 weeks). The Meullenet-Owens Razor Shear (MORS) method was developed to assess broiler meat tenderness in recent years. A blunt version of MORS has been reported to be a more sensitive method at higher degrees of toughness. An experiment was conducted using standard breast yielding (SY) and high breast yielding (HY) commercial male broilers. Of each strain, 108 birds were commercially processed at 40 d age and 95 birds were commercially processed at 54 d age in 2 replicates per day. Breast fillets were deboned at 2, 4, 6, and 24 h postmortem (PM). Muscle pH, color (L* a* b*), sarcormere length (SL), myofibrillar diameter (MD) were measured. Breast fillets were cooked to 76°C and cook loss, MORS and a blunt version of MORS measuring energy (MORSE, BMORSE) were determined. Birds grown to 40 d had a higher live weight than 54 d (2.7 vs 4.3 kg, P < 0.05). Muscle pH decreased (P < 0.05) over time at both ages. There was little impact of debone, strain or age on color or GFI. SL increased (P < 0.05). At 54 d, fillets deboned at 2, 4 and 6 h were similar (P > 0.05) for MORSE and BMORSE while 6 and 24 h were similar (P < 0.05) to each other and less than those deboned at 2 h (P < 0.05). Using the MORSE, value BMORSE values were higher than MORSE values overall (P < 0.05). Additionally, BMORSE was positively correlated to MORSE (r = 0.74 and 0.65 at 40 and 54 d, respectively; P < 0.0001). Data suggest that BMORS could be used to differentiate shear values, but more research is needed to determine its relationship to sensory at a wide range of shear values resulting from deboning at multiple debone times and/or varying broiler ages.

Key Words: MORS, BMORS, tenderness, broiler breast, shear

M38 Salmonella presence and counts on different skin parts from turkey carcasses. Ye Peng1, Walid Q Alali2, Mark A. Harrison2, Xiangyu Deng2

Turkey skin of drumstick, thigh and wing is currently utilized as a source of fat in ground products. Salmonella contamination in the three parts of skin is thought to be a potential source of this pathogen in ground tur-
of the 4 dietary treatments). On the day of placement, 2 seeder chicks/pen were orally gavaged with $3 \times 10^7$ nalidixic acid resistant *Salmonella Typhimurium*, and returned to the pens to commingle with penmates. The feed treatments were: basal control, 0.3% bamboo charcoal, 0.3% activated bamboo charcoal, and 0.3% pine charcoal that were added to both starter (1 to 14 d) grower (14 to 28 d), and finisher (28 to 42 d) feeds. At wk 1 and 2, ceca from 1 seeder and 1 penmate broiler/penn were sampled and cultured for *Salmonella*. From the penmate broiler the crop and duodenum were exposed to record the luminal pH. Ceca were *Salmonella* positive in all chicks (both seeders and penmates) sampled at wk 1 and 2. By wk 3 *Salmonella* prevalence in ceca detected by direct plating had begun to decrease to 34%, at wk 4 to 24%, at wk 5 to 23%, and by wk 6 to 12%. Following defecating the *Salmonella* prevalence for enriched breast skin samples was significantly higher (P<0.05) at 40% for the control, compared to 10% for bamboo charcoal, 15% for activated bamboo charcoal, and 0% for pine charcoal. The pH of the crop decreased weekly but there were no detected feed treatment differences in pH within any wk. The pH at 1 wk for the crop ranged from 5.84 to 6.44 across treatments and differed compared to wk 2 to 6 (3.83 to 6.12). Duodenal pH varied minimally from 5.8 to 6.1. Overall, the small amount of feed chicks consume in the first wk may contribute to the higher pH of the crop and enable *Salmonella* from the seeders to spread to and colonize penmate chicks. Adding charcoals at 0.3% to broiler starter diets did not prevent *Salmonella* colonization, but charcoals added to grower diets may have hastened *Salmonella* elimination from ceca and resulted in significantly lower *Salmonella* recovery from breast skin samples following defecating.

**Key Words:** charcoal, feed, *Salmonella*, pH crop, broiler

### M41 Effect of Original XPC on prevalence and numbers of *Salmonella (S).* from ceca of turkey hens inoculated at 1 d of age with *S. Typhimurium* and at 56 d with *S. Heidelberg* D. P. Smith1, G. F. Mathis2, C. L. Hofacre3, R. D. Berghaus3, D. R. McIntyre4 'Diamond V, Cedar Rapids, IA, USA; 2SPR Group, Athens, GA, USA; 3University of Georgia, Athens, GA, USA

*Salmonella (S)* contamination of live poultry may occur early or late during the growout period, and may involve different serovars. Pre-harvest interventions must be evaluated for their efficacy against multiple exposures and serovars of *S.* during the life of the flock. This study was conducted to determine the effect of XPC (a broad-spectrum immune modulator) on the prevalence and cecal colonization of commercial turkey hens from early and late exposure to *Salmonella* (Typhimurium and Heidelberg, respectively). One-day-old turkey hen poults (n=60) were placed in each of 24 pens (n=1440). Twenty pens of hens were fed a diet including XPC at a level of 1.25 kg/mT (trt = XPC); the remaining 12 pens were fed the same diet without XPC (Control). On d 1, 20 birds in each pen were orally inoculated with *S. Typhimurium* (log 10 CFU). On d 42, ten (10) hens that had not been inoculated were euthanized and ceca collected aseptically to determine *S.* prevalence. On d 56, 20 additional birds (not previously inoculated) in each pen were orally inoculated with a nalidixic acid-resistant strain of *S. Heidelberg* (log 10 CFU). On d 84, 10 hens from each pen that were not inoculated with either serovar were euthanized and ceca collected aseptically to determine *S.* prevalence and MPN. There was no difference (P>0.05) in cecal *S.* prevalence observed between Control and XPC hens at 42 d (mean of 22% positive), nor was Control and XPC cecal prevalence different at 84 d (mean of 91% positive). Turkey hens fed XPC had significantly lower numbers of *S.* (P>0.05) compared to Control hens (mean MPN of 1.1 vs. 2.9, respectively). XPC was an effective pre-harvest intervention against two inoculations of two different *S.* serovars in turkey hens.

**Key Words:** turkey hens, *Salmonella*, XPC, pre-harvest food safety

### M42 Evaluation of a novel biologic formulation to reduce *Salmonella* in market age broilers Jose Luis Vicente1, Jacob Lum, Matthew Faulkner, Ross Wollfenden Pacific Vet Group USA Inc., Fayetteville, AR, USA

*Salmonella* has long been known to be a common foodborne pathogen. Poultry meat, while not the only source of *Salmonella*, is one of the most commonly implicated sources in outbreaks of human salmonellosis. Poultry companies are currently taking extraordinary efforts within the processing plants to reduce carcass contamination, but since the source of *Salmonella* in poultry meat is from the bird itself, not the plant, it is prudent to begin interventions in the field. Several field interventions have been evaluated in the past with varying levels of success. Presently, a specifically selected bacteriophage cocktail and a specifically selected probiotic formulation were evaluated alone or in combination. Briefly, market age broilers were challenged with *Salmonella Enteritidis* (SE), then later treated with the Probiotic (PRO), bacteriophage (PG), or the combination of the two (COMBO). The crops were aseptically removed and cultured for the presence and quantification of SE. SE was found to be significantly reduced (p<0.05) in all treatment groups as compared to the untreated control (CON). While 3.30Log10 cfu SE/g crop content was enumerated from the CON, 1.74Log10, 1.95Log10 and 1.12Log10 were isolated from the PRO, PG, and COMBO groups respectively. This indicates that all three treatment groups may be potential candidates to reduce SE in commercial broiler flocks.

**Key Words:** *Salmonella*, Bacteriophage, Probiotic, Poultry

### M43 Inhibition of *Salmonella Typhimurium* by Cultures of Cecal Bacteria during Aerobic Incubation Arthur Hinton Jr1, Gary Gamble2, Kimberly Ingram3, Ensa Tah3, Ronald Holser*1 Russell Research Center, Athens, GA, USA; 2Tuskegee University, Tuskegee, AL, Afghanistan

Two trials were conducted to examine the ability of cecal bacterial cultures from broilers to inhibit growth of *Salmonella Typhimurium* during aerobic incubation. Cecal broth media was inoculated with 10 μl of cecal contents from 6 week old broilers taken from 2 separate flocks. Cultures were incubated aerobically at 37°C for 48 h. Supplemented cecal media was prepared by the addition of: #1 0 mM ethanol, lactate, and succinate; #2 104 mM ethanol and 50 mM lactate and succinate; #3 208 mM ethanol and 100 mM lactate and succinate; or #4 312 mM ethanol and 150 mM lactate and succinate. Each medium was inoculated with 0.25 ml of the cecal culture, 10^4 cfu/ml of *Salmonella*, or the cecal culture and *Salmonella*. Inoculated media were incubated aerobically at 37°C for 21 days, and aliquots of media were collected on days 0, 7, 14, and 21 for analysis. Cecal bacteria and *Salmonella* were enumerated, and cecal colonies were selected for identification by the Biolog Bacterial Identification System. Results from Trials 1 and 2 indicated that after 21 days of incubation, between log 6 and 7 cfu/ml of *Salmonella* were recovered from all media inoculated with *Salmonella* only. Conversely, in Trial 1 after 21 days, log 4 to 5 cfu/ml *Salmonella* were recovered from all media inoculated with *Salmonella* and cecal cultures. However in Trial 2, no *Salmonella* were recovered on days 14 or 21 from supplemented medium #4 inoculated with *Salmonella* and cecal cultures. Furthermore, log 0.74, 2.27, and 4.67 more *Salmonella* were recovered from Trial 1 than Trial 2 from supplemented media #2, 3, and 4, respectively, inoculated with *Salmonella* and cecal cultures. Cecal isolates were identified primarily as Enterococcus spp. in addition to Proteus mirabilis, Bacillus lntenus, Paenibacillus wynii, Streptococcus gallolyticus, and several isolates not identified by the Biolog. Findings indicate that cecal cultures incubated aerobically may possess anti-*Salmonella* activity related to the ability to utilize metabolites produced by intestinal bacteria. However, cultures from different flocks may vary in their ability to inhibit the growth of *Salmonella*; therefore, all cecal cultures may not be suitable sources of bacterial isolates required to formulate effective, defined probiotic cultures.

**Key Words:** Broilers, competitive inhibition, cecal bacteria, lactate, succinate
M44 Re-evaluation of broiler carcass scalding protocols on the recovery of Campylobacter from breast skin after defeathering

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This research re-evaluated the impact of scalding protocols on the recovery of Campylobacter from breast skin following defeathering after preliminary processing trials detected Campylobacter from breast skin for 4/8 carcasses that had vents plugged and sutured prior to scalding. Published research indicated that when fecal expulsion during defeathering was prevented carcass breast skin was Campylobacter negative when sampled following immersion scalding at 58.3°C/137°F for 90 s and defeathering. Five days after oral challenge with a gentamycin resistant strain of Campylobacter coli (108 cells), broilers were subjected to a 12 h feed withdrawal and transported (5 broilers per solid bottom coop) to the pilot plant. Batches of 5 broilers (2 batches for each scalding protocol) were stunned at 15 V for 10 s, bled for 2 min, and during bleeding vents were plugged and sutured closed. Carcasses were hard scalded at 60°C/140°F for a total immersion time 90 s in either a single, double, or triple tanks. The picker had been adjusted to achieve acceptable defeathering with minimal over-picking of the hips and elbows. All carcasses were defeathered for 30 s in a single 4 bank picker, and breast skin (including the sternum and pectoral feather tracts) was aseptically excised. The picker was rinsed with 82°C/180°F water between each batch of carcasses and the scalders were drained and rinsed after completion of 1 batch for each scalding protocol.

With direct plating, Campylobacter was not recovered from any carcasses that were single tank scalded (0/10), but was recovered from 2/10 carcasses that were double tank scalded, and from 4/10 that were triple tank scalded. Breast skin from all carcasses was Campylobacter positive when samples were plated after 24 h enrichment. These results agree with the published results, that when the carcasses vents are plugged and sutured and then are single tank scalded for 90 s no Campylobacter was recovered from breast skin sampled by direct plating. However, comparable results are not obtained when scalding immersion time is subdivided in double (45 s each) or triple (30 s each) tanks.

Key Words: Campylobacter, broilers, scalding, defeathering

M45 Detection of Campylobacter on the outer surface of retail broiler meat packages and from the exudate within

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Previous work has suggested that outer surfaces of retail broiler meat packaging may be contaminated with Campylobacter presenting a potential hazard to the consumer through direct transfer or by cross contamination of other products or surfaces. The objectives of this study were to measure the prevalence of Campylobacter detected on the outside of retail broiler meat packages and compare that to the prevalence detected on exudate from inside those same packages. Chicken meat products were purchased at retail, one package individually bagged per store per sample day. Effort was made to exclude packages that showed obvious signs of leaking or exposure to other leaky packages. Samples included: whole carcasses, wings, drum-sticks, bone-in thighs, boneless-skinnless thighs and bone-in breast halves. Ten packages of each type of product were purchased (N=60). The exterior surface of each package was sampled by pre-moistened sponge, the package was sanitized, opened and exudate was collected from within the package. Sponge diluent and exudate were direct plated and enriched for the presence of Campylobacter spp. Overall, 27 of 60 packages (45%) had detectable numbers of Campylobacter in the exudate within. This included some of each type of product. Despite efforts to avoid leaking packages, upon arrival at the lab and further examination three packages were found to be leaking small amounts of exudate. Overall, 1 of 60 packages had detectable numbers of Campylobacter on the outer surfaces. This package was one of the three characterized as leaky. Campylobacter isolates from inside and outside of the positive package were characterized using multi-locus sequence typing and found to be indistinguishable. Although a substantial percentage of retail broiler meat packages may have Campylobacter on the inside, the outer surface of intact, non-leaky packages can be reasonably expected to be free of Campylobacter.

Key Words: Campylobacter, packaged broiler meat, retail, package surface, product exudate

M46 Comparison of Selective Campylobacter Media for Detection and Enumeration of Naturally Occurring Campylobacter spp. on Poultry

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Campylobacter spp. are among the most common cause of bacterial foodborne diarrheal illness; poultry has been linked as a primary source of contamination. Detection and enumeration of low numbers of naturally occurring Campylobacter spp. on poultry is difficult due to the presence of competing microflora that are not eliminated by selective media. This study compared the effectiveness of various combinations of enrichment broths and plating media to detect naturally occurring Campylobacter spp. in broiler carcass rinse samples. Campy-Cefex Agar (CCA) and RF Campylobacter Agar (RFA) were used for enumeration of Campylobacter spp. recovered from 100 mL broiler carcass rinses. These two selective plating media were also used for Campylobacter detection following enrichment in Bolton broth and Bolton broth supplemented with 0.1 µg/mL triclosan (T-Bolton). On average, enumeration of carcass rinsate on RFA resulted in a 2.5-3.5 cfu/mL log recovery of Campylobacter spp. with little contamination by background microflora, while enumeration on Campy-Cefex agar resulted in a 1.5-3.0 cfu/mL log recovery of Campylobacter spp. with a significant amount of contamination by background microflora. When enriching for positive or negative, the combination of Bolton broth and CCA resulted in 0-10% positive, the addition of triclosan to the Bolton broth improved recovery on CCA to 30-40% positive. Enrichment in Bolton and plating on RFA resulted in 90-100% positive samples, and enrichment using T-Bolton paired with RFA plating media was the most effective combination resulting in 95-100% positive samples. When enumerating or enriching for naturally occurring Campylobacter spp. in broiler carcass rinsate, RFA or T-Bolton broth followed by plating on RFA proved to be most effective in the elimination of background microflora, therefore allowing for more accurate enumeration and enrichment procedures.

Key Words: Campylobacter spp., Campy-cefex agar, RF agar, supplemented Bolton broth, Campylobacter methodology

M47 Quantifying moisture content on eggs that have been sweated in various environments

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There are instances where shell eggs may be moved from cold storage into ambient temperature with high humidity such as before wash and before or during transportation. Under these conditions it is of concern that bacteria can grow and migrate through the shell pores into the egg. Objectives of this experiment were to 1) Compare three methods of quantifying condensate on sweated eggs and 2) to quantify moisture content on refrigerated shell eggs sweated at two different temperatures (22 °C and 32 °C) and 60% humidity. For Objective 1, 90 fresh, unwashed eggs were obtained from the Auburn University Poultry Farm. These eggs were individually weighed and placed in plastic flats in a refrigerator at 7 °C stored for four weeks. The eggs were then set out in plastic flats at room temperature (22 °C, 50% RH) for approximately one hour to form maximum condensation. 30 of the eggs that were previously weighed were weighed again. 30 paper towels were weighed, and then the condensate was wiped from the surface of the next 30 eggs. The wet paper towels were re-weighed. Both
tests were repeated three times. A pinless moisture meter was also tested. ANOVA was run on this data. The results indicated that there was no significant difference in quantifying egg sweat by egg weight or weight of moisture absorbed on a paper towel (P≤0.05). For objective 2, a single egg was sweated in two environments (32°C, 60% RH and 32°C, 60% RH) on a tared scientific scale. The egg weight was recorded from beginning of condensation formation to the point where the egg dried. This was repeated three times for each environment. A greater amount of sweat is formed at a faster rate (0.2177 g/min compared to 0.1311 g/min) at 32°C, 60% RH than at 22°C, 60% RH. A greater amount of condensate is formed on eggs sweated in a warmer environment compared to room temperature (0.653 g and 0.393 g). In conclusion, both weighing an egg before and after sweat and wiping the surface moisture off a wet egg and weighing the paper towel are adequate methods to quantify moisture on sweated eggs. The rate of adsorption is greater than the rate of desorption on sweated eggs. A greater amount of condensation is formed on eggs sweated in a warmer environment compared to room environments. Temperature and humidity influence the rate of condensate formation and the total amount of condensate formed on eggs.

**Key Words:** shell eggs, egg sweating, egg safety, food safety, egg processing

**M48** Impact of extended stun duration and voltage on the recovery of consciousness in broilers C.E. Harris1*, Dianna Bourassa1, Kimberly Wilson1, R. Jeff Buhr2 1The University of Georgia, Athens, GA, USA; 2USDA-ARS Russell Research Center, Athens, GA, USA; 3University of Georgia, Athens, GA, USA

Typical electrical stun duration for broilers in the United States is from 5 to 15 s (depending on voltage), but would be considerably longer if and when the kill-line stopped. The welfare and conscious/unconscious status of broilers within the stunner cabinet is a concern while the line is stopped and when the line restarts. Therefore, the effect of stun duration (60, 90, or 120 s) at two voltages (15 or 20 V pulse DC at 550 Hz) was investigated in a pilot processing facility. Two prior broilers were selected by weight between 2.9 to 3.1 Kg and were subjected to a 12 h feed withdrawal. Individual broilers were hung on the shack line, feet wet to maximize ground contact, and line was started. The standard stun duration in this pilot plant stunner is 10 s, so at 5 s when the broilers were at the middle of the stunner cabinet (brine depth 2.5 cm) the line was stopped for an additional 50, 80, or 110 s. The line was then restarted and the broilers stunned for the remaining 5 s. Upon exiting the stunner cabinet the broilers were immediately removed from the shack line and placed on the floor on their side to enable observation of ventilation and/or mandibular movements. Within 120 s, if the broiler did not exhibit any skeletal muscle movements and the comb became pale, they were recorded as not recovered. Recovered broilers initiated movement within 15 s and were able to maintain vertical posture at 120 s when placed on their feet. Broilers were individually stunned in sequential batches of 5 broilers at the same voltage setting and duration before changing parameters. All broilers stunned at 15 V for 60 s recovered (5/5 broilers). However, broilers stunned at 15 V for 90 s did not recover (0/5 broilers) and no broilers stunned at 15 V for 120 s recovered (0/5 broilers). Broilers stunned at 20 V for 60 s only 3/6 broilers recovered, unexpectedly those broilers stunned at 20 V for 90 s and 2/10 recovered, and no broilers were tested at 20 v for 120 s. For stun durations of 60, 90, or 120 s for either 15 or 20 V, recovery of consciousness did not appear to be related to a lower stunning amperage (21 to 49 mA) compared to those that did not recover (23 to 44 mA).

**Key Words:** electrical stunning, stun duration, consciousness, broiler