

body weight, feed and water consumption of Japanese quail. Further investigations are underway.

Key Words: Japanese quail, *Coturnix japonica*, table salt (NaCl), health effects, lab animal

428P Blood electrolytes and acid-base balance are affected by F–Strain *Mycoplasma gallisepticum* inoculation in commercial egg-laying hens. H. A. Olanrewaju*, J. L. Purswell, S. D. Collier, and S. L. Branton, *USDA-ARS, Starkville, MS.*

Two trials were conducted concurrently to determine and compare, blood pH, blood gases, hematocrit, and hemoglobin in F–strain *Mycoplasma gallisepticum* (FMG) inoculation layers, and FMG contact–infected broilers. FMG–inoculated layers had the highest partial pressure of O₂ and the lowest partial pressure of CO₂ as compared with the other treatment groups. Blood pH values were unaffected by FMG inoculation. Hematocrit and blood concentrations of hemoglobin were slightly higher and HCO₃[–] levels were lowest in FMG contact–infected broilers in comparison to the other treatments groups. *Mycoplasma gallisepticum* inoculation layers also resulted in a significant increase in blood concentrations of K⁺, a decrease in Na⁺, but no significant effects on blood concentrations of Ca²⁺ and Cl[–]. There were no differences in plasma glucose, cholesterol, triglyceride, and anion gap, but osmolality was significantly reduced in FMG contact–infected broilers. Results indicate that inoculation of layers with FMG vaccine results in changes in plasma acid–base status along with changes in other blood metabolic variables. However, the FMG inoculation did not prevent homeostatic regulation of acid–base balance, as indicated by constant blood pH. There was a significant increase in pO₂, which is generally associated with an oxygen–dependent improvement in tissue oxygenation. Elevated arterial partial pressure of oxygen is beneficial to maximize oxygen transport capacity along with high concentrations of hemoglobin and hematocrit to carry oxygen throughout the body. It was concluded that in addition to protecting birds from MG infection, an FMG vaccine may improve the layer chicken's ability to withstand the harmful effects of stressors on their performance and well–being.

Key Words: *Mycoplasma gallisepticum*, acid–base balance, broiler chickens

429P Real-time PCR measuring gut microflora and its association with body weight selection. C. J. Denbow, P. B. Siegel, and D. M. Denbow*, *Virginia Polytechnic Institute and State University, Blacksburg.*

Obesity is a problem in broiler breeders. Developing strategies to control obesity requires a better understanding of its etiology, and recent evidence suggests that the gut microflora has an effect on body fat content. The aim of this study was to develop a real-time PCR quantification method as a tool to investigate whether gut microflora may contribute to obesity in a chicken model. Real-time PCR was used to monitor and compare *E. coli* and enterococcus populations of bacteria in fecal material from high- (HWS) and low-weight (LWS) selected lines of chickens. The HWS and LWS lines were selected for divergent body weight at 8 weeks-of-age for 50 generations. Samples of fecal material were collected from ten chicks from both high- and low-weight lines at weekly intervals from one to five weeks-of-age. The fecal samples were analyzed with real-time PCR using primers based on conserved genus-specific enterococcus 16S rRNA or *E. coli* malB promoter gene sequences. Fecal material (250 µg) was mixed with water, and the suspension mixed using a stomacher. Then, 100 µl was applied to a CloneSaver Card with FTA technology. The filter was allowed to air dry, and a 2.0 mm punch was removed from the sample using a Harris micro-punch. The CloneSaver punch was transferred to a microcentrifuge tube and DNA eluted as per the manufacturer's specifications. Real-time PCR was performed by fluorescence detection and melting-point analysis. For melting point analysis, the intercalating dye SYBR-Green (BioRad) was used for nonspecific labeling of target DNA. Pure strains of *E. coli* and enterococcus bacteria were used to prepare DNA for standard curves. A melt curve was plotted at the end of each run to verify the specificity of the amplification product. There appears to be no difference in enterococcal DNA between HWS males or females fed either ad libitum or restricted diets. However, enterococcal DNA concentration was increased in LWS birds at 4 weeks-of-age compared to high weight birds.

Key Words: obesity, *E. coli*, enterococcus

Poster Session: Processing, Products, and Food Safety Posters

430P *Campylobacter jejuni*, *C. coli*, and *C. lari* naturally present in Leghorn laying hens and the antibiotic resistance profiles of these organisms. N. A. Cox*¹, L. J. Richardson¹, R. J. Buhr¹, and P. J. Fedorka–Cray², ¹USDA, ARS, PMSRU, Russell Research Center, Athens, GA, ²USDA, ARS, BEAR, Russell Research Center, Athens, GA.

Campylobacter spp. are present in the intestinal tract and internal tissues of broiler breeder and broiler chickens. The objectives were to determine 1) *Campylobacter* spp. presence within internal tissues and organs of commercial Leghorn laying hens, 2) species of *Campylobacter* present, and 3) antimicrobial resistance pattern of *Campylobacter* isolates. In study 1, three flocks ranging from 94–105 wk-of-age were sampled from a commercial laying complex. In study 2, two flocks, 82 and 84 wk-of-age were sampled from a separate complex. Hens (n=30/flock) were euthanized, de-feathered, aseptically necropsied, and the ovarian follicles, spleen, liver/gallbladder, upper (infundibulum, magnum, and isthmus) and lower (shell gland and vagina) reproductive tracts were

aseptically removed prior to the ceca. Samples were packed on ice and transported to the laboratory for evaluation. For speciation, a standard BAX® PCR method was used while susceptibility testing was performed using NCCLS standards and recommended quality control organisms. Isolates were examined for susceptibility using a semi-automated testing system (Sensititre™) to the following nine antimicrobials: azithromycin, clindamycin, ciprofloxacin, erythromycin, florfenicol, gentamicin, nalidixic acid, telithromycin, and tetracycline. In study 1, the isolation rate was 13, 67, 53, 3, 13, and 57% from the ovarian follicles, lower reproductive tract, upper reproductive tract, spleen, liver/gallbladder, and ceca, respectively. In study 2, the isolation rate was 17, 43, 33, 20, 17, and 73% from the ovarian follicles, lower reproductive tract, upper reproductive tract, spleen, liver/gallbladder, and ceca, respectively. Overall, 53% of isolates were *C. coli*, 46% *C. jejuni*, and 1% *C. lari*. In study 1, all of the isolates were pan susceptible. In study 2, 37% of the isolates were resistant to tetracycline. Commercial table egg laying

hens housed in colony cages on wire floors have diverse *Campylobacter* spp. within different tissues and do not display resistance to a broad range of antimicrobials.

Key Words: *Campylobacter*, antimicrobial resistance, laying hens, reproductive tract, ceca

431P Influence of cultural methodology on *Salmonella* serovar detection and serogroup recovery from broiler carcass rinses. N. A. Cox^{*1}, L. J. Richardson¹, P. J. Fedorka-Cray², S. R. Ladely², and R. J. Buhr¹, ¹USDA, ARS, PMSRU, Russell Research Center, Athens, GA, ²USDA, ARS, BEAR, Russell Research Center, Athens, GA.

Salmonella serovars recovered from human patients and poultry carcasses have been compared to determine the relationship of poultry to human illness. The objectives of this study were to evaluate the sensitivity of four methodology procedures for *Salmonella* recovery from broiler carcass rinsates and influence of these procedures on the diversity of *Salmonella* serogroups recovered. Two replications were performed, each with carcasses (n=26) procured directly from a commercial processing plant after defeathering. Carcasses were individually bagged and transported on ice to the laboratory. Each carcass was rinsed with 100 mL of buffered peptone for 1 min and the rinsate collected. Aliquots (1 mL) of rinsate were then inoculated into GN Hajna (GN) and Tetrathionate (TET) broth. Both broths were incubated at 37°C and at 24h a 0.1 mL of GN broth was transferred to Rappaport-Vassiliadis (RV) media. At 48h, 0.1 mL of the TET broth was transferred to RV. RV tubes were incubated at 37°C for 24h then streaked for isolation onto two different selective agar plates, BG Sulfa (BGS) and XLT-4. Following 24h incubation at 37°C, presumptive colonies (a maximum of 3/plate) were selected and standard conformational procedures performed. Of the 52 carcass rinsates, *Salmonella* was recovered from 41, 46, 34, and 45 by the media combinations of GN-BGS, GN-XLT-4, TET-BGS, and TET-XLT-4, respectively. GN detected *Salmonella* in 46/52 of the carcass rinsates and 45/52 by TET. *Salmonella* was recovered from 49/52 carcass rinsates using XLT-4 plating media and 47/52 by BGS plating media. Five serogroups of *Salmonella* were detected by all methods (B, C1, C3, D1, and E). GN broth in combination with either plating media selected for a significantly (P>0.05) greater number of group C3 *Salmonella* but significantly (P>0.05) fewer group E *Salmonella*. These data suggest that the enrichment and plating media used for *Salmonella* detection from chicken carcass rinsates can influence the sensitivity of recovery as well as the serogroup recovered.

Key Words: *Salmonella*, carcass rinse, methodology, serogroup

432P Evaluation of enrichment procedures to recover *C. jejuni* and *C. coli* from a dry-atmospheric-temperature stressful environment. L. J. Richardson^{*1}, N. A. Cox¹, R. J. Buhr¹, and M. A. Harrison², ¹USDA, ARS, PMSRU, Russell Research Center, Athens, GA, ²University of Georgia, Department of Food Science and Technology, Athens.

To accurately assess the ecology of dry-stressed *Campylobacter* spp. in poultry production environments, use of optimal resuscitation procedures is critical. The objective was to evaluate five different enrichment procedures for recovering dry-atmospheric-temperature stressed *C. jejuni* (Cj) and *C. coli* (Cc). In two trials, hatchery trayliner pads and Whatman filter papers (n=1120) were used. Trayliner pad and filter paper were inoculated with either a low (L) 10³ or high (H) 10⁶ CFU/mL inoculum of Cj or Cc. The paper squares (2.5cm²) were left at room

temperature exposed to atmospheric conditions and sampled at 0, 0.5, 1, 2, 4, 6, and 24 h post-inoculation. The water activity of pads (n=5) were recorded at each sampling time. The enrichment procedures were as follows and all were incubated in a microaerobic atmosphere: A) Buffered peptone incubated at 42°C for 48 h, B) Bolton broth without supplement incubated at 42°C for 48 h, C) Tecra broth without supplement incubated at 42°C for 48 h, D) Bolton broth with supplement incubated at 42°C for 48 h, E) Tecra broth without supplement incubated at 37°C for 5 h then supplement added and incubated at 42°C for 43 h. The water activity for the samples incrementally declined over the 24 h period from 0.89 to 0.30. Overall, recovery rate of *Campylobacter* strains decreased gradually from 0 to 2 h, sharply from 2 to 4 h, with some recovery at 6 h, and undetectable at 24 h. Total recovery (for all sample times) for Cj-L papers was 30, 44, 44, 42, and 55% and for Cj-H papers was 40, 57, 54, 52, and 63% from procedures A, B, C, D, and E, respectively. Total recovery for Cc-L papers was 24, 34, 34, 31, and 36% and for Cc-H papers was 33, 40, 34, 41, and 45% from procedures A, B, C, D, and E, respectively. Overall, method E (Tecra with supplement added at 5 h) outperformed the second best procedure by 5.3% for resuscitating dry-atmospheric-temperature stressed *Campylobacter* spp. that can be found in poultry production environments.

Key Words: *C. jejuni*, *C. coli*, methodology, poultry, dry-stressed

433P Modified ecometric technique (four-quadrant sequential streak) to evaluate *Campylobacter* enrichment broth proficiency in suppressing background microflora. L. J. Richardson^{*1}, N. A. Cox¹, R. J. Buhr¹, J. A. Cason², and M. E. Berrang³, ¹USDA, ARS, PMSRU, Russell Research Center, Athens, GA, ²USDA, ARS, PPSP, Russell Research Center, Athens, GA, ³USDA, ARS, BEAR, Russell Research Center, Athens, GA.

Ecometric technique is a semi-quantitative scoring method used for quality control of culture media. The objective was to modify the technique (four-quadrant sequential streak (FQS) procedure) and determine efficacy of procedure to measure broth suppression of background microflora. Acquisition of natural background microflora was achieved using post-pick carcass rinses and separating the rinses into 120 efficacy test samples. Aliquots (2mL) from each sample were transferred into 18 mL of Bolton and Tecra broth and incubated microaerobically at 42°C for 48 h. For the FQS procedure, an aliquot (10µL) from each type of sample was transferred onto campy-cefex agar. The initial aliquot (10µL) was streaked (five passes per quadrant) onto the plating media and designated quadrant 1. Then, from that quadrant streaked into another quadrant and designated quadrant 2 and repeated for quadrants 3 and 4. After incubation, growth of non-*Campylobacter* colonies on campy-cefex was expressed as absolute growth index (AGI). Growth on all four quadrants (1 through 4) was nominated an AGI of 4; growth on quadrants 1-3 was an AGI of 3, and so forth. Standard dilutions (10⁰ to 10⁻⁵) were prepared from each broth and spread plated onto campy-cefex for enumeration of background microflora. Significant (P<0.05) differences in background microflora suppression by the broths was observed using the FQS and enumeration procedure. The mean AGI was 0.17 and 2.84 for Tecra and Bolton broth, respectively. The mean log₁₀ cfu/mL of background microflora was 0.39 and 4.69 for Tecra and Bolton broth, respectively. Relationship of AGI to log₁₀ cfu/mL present within the broths were AGI 4 : 5.9, AGI 3 : 4.9, AGI 2 : 4.1, AGI 1 : 1.9, and AGI 0 : 0.2. A positive correlation between decreasing levels of background microflora within the broths were observed as the AGI declined. The FQS procedure can be used for rapid semi-quantitative

estimation of enrichment broth efficacy in suppressing background microflora without performing enumeration.

Key Words: ecometric technique, enrichment broth, background microflora, *Campylobacter*, absolute growth index

434P WITHDRAWN

435P Influence of dietary fat and packaging on shelf life of ground broiler breast and thigh meat. B. Saenmahayak*, S. F. Bilgili, J. B. Hess, S. R. McKee, and M. Singh, *Auburn University, Auburn, AL.*

This study was conducted to determine the microbial quality and oxidative stability of ground chicken meat stored under refrigerated conditions. A 2 x 2 factorial arrangement of two dietary fat sources [corn oil (CO) vs. lard (LD)] and two inclusion levels (low; 2% and high; 6%) was designed for this study and each of the four dietary treatments was fed to 8 replicate pens of 10 birds (320 birds total) to 49 d of age. Upon processing, boneless-skinless breast and thigh meat (6 birds/pen) were ground separately, pooled, formed into patties and sealed in trays with either oxygen permeable or impermeable film (4 replicate pens dietary treatment/packaging type). Samples were analyzed for lipid oxidation (TBARS) and microbial spoilage (aerobic plate counts, *pseudomonas*, lactic acid bacteria, and Yeast and Molds) following 1, 3, 6, 12 and 18 d of storage at 2°C. TBARS values increased during 18 d of storage and birds fed CO had significantly ($P<0.05$) higher lipid oxidation in thigh meat than those fed LD at 1 and 12 d of storage. TBARS value of breast meat was higher ($P<0.05$) in oxygen permeable packaging (3.27 MDA/kg of meat) as compared to oxygen impermeable packaging (2.77 mg MDA/kg of meat) at 3 d of storage. Interactions between fat sources, inclusion levels and packaging types were observed for thigh meat on day 1 of the storage period. Thigh meat with 6% CO showed higher ($P<0.05$) lipid oxidation than 2% CO packed in permeable film (2.43 vs. 0.89 mg MDA/kg of meat) which was similar to thigh meat from LD treatment. In both packaging types, meat with higher fat level (6%) had higher TBARS values irrespective of the fat source. Microbial profiles among the treatments were not significantly different ($P>0.05$), however, all samples reached 7 log₁₀ CFU/g after day 6 of refrigerated storage. Oxidative rather than microbial changes dominate spoilage during the refrigerated storage of fresh ground chicken meat. These changes can be minimized by alterations in dietary fat source and level, as well as oxygen permeability of the packaging film.

Key Words: shelf life, lipid oxidation, packaging, fat source, broiler

436P Antimicrobial activity of concrete sealant against *Clostridium perfringens* and *Bacillus subtilis*. D. Paiva*, K. Macklin, S. Price, D. Conner, J. Hess, and M. Singh, *Auburn University, Auburn, AL.*

Clostridium and *Bacillus* can survive traditional sanitation and disinfection procedures due to their spore forming ability. They can lead to heavy economic losses due to recalls and food contamination. In this study, antimicrobial efficiency of BioSealed for Concrete™ to prevent bacterial attachment and colonization of *C. perfringens* and *B. subtilis* on concrete blocks was evaluated. Cement blocks were divided into four different treatments: A) No BioSealed application, B) BioSealed applied before inoculation, C) BioSealed applied after inoculation, or D) BioSealed applied before and after inoculation. The cultures were prepared by inoculating *C. perfringens* and *B. subtilis* into brain and heart

infusion broth (BHI) and incubating at 37 °C for 24 h; *C. perfringens* was incubated in anaerobic chamber. Cement blocks were inoculated by immersion in BHI containing one of the cultures and incubated at 37 °C for 24 h (ca. 10⁹ CFU/ml). External surfaces of the blocks were swabbed using sterile swabs and placed in 10 mL of 0.1% peptone water (PW). The blocks were then broken in half and interior surfaces were swabbed to determine viable counts. Samples were serially diluted and spread plated on TSC (*C. perfringens*) and MYP (*B. subtilis*) agar and incubated for 24 h at 37 °C. Experiments were performed in triplicates and results were analyzed using SAS. On external surface of the blocks, significantly lower ($P<0.05$) populations of both microorganisms were observed for treatments C and D when compared to treatments A and B. When comparing treatments A and C; as well as groups B and D; the product was shown to be efficient for biofilm removal on concrete surfaces. No significant difference ($p>0.05$) was found when comparing groups A and B suggesting that the product has minimal residual effect. Results from this study indicated that BioSealed for Concrete™ is a potent antimicrobial and has the potential to be used in combination with other GMP's and sanitation practices to control bacterial colonization on concrete surfaces.

Key Words: *Clostridium*, *Bacillus*, biofilm, concrete sealant, antimicrobial

437P Removed

438P Effect of methylcellulose on quality and shelf-life stability of deep fat fried and oven baked chicken nuggets. N. K. Nguyen*, C. Z. Alvarado, P. S. Takhar, and L. D. Thompson, *Texas Tech University, Lubbock.*

A total of 861 nuggets in each of 2 trials were evaluated to determine the effectiveness of methylcellulose application in coating formulations of deep fat fried and oven baked breaded chicken nuggets to reduce oil

uptake but retain quality and shelf-life stability. Nuggets made from equal portions of breast and thigh chicken were coated in either pre-dust (control) or pre-dust with 5% methylcellulose (MC) prior to batter and breading. After par-frying for 30 sec, chicken nuggets were either deep fat fried at 150 or 190°C for 30 sec, 1, 2, or 4 min or oven baked at 200, 220, or 240°C for 2, 4, or 8 min. Effect of MC on moisture loss and fat uptake (n=408) in both crust and core parts were investigated. Peak force (n=120), pH (n=72), TBARS (n=72), and sensory evaluation (n=1050) were conducted during storage at 0 d, 3 and 6 mo (-18°C). During storage, pH was not significantly different between control and MC nuggets in either deep fat frying or oven baking method ($P \geq 0.05$). TBARS were not significantly different between fried control and MC nuggets at 0 d and 3 mo, but fried MC nuggets had higher TBARS than the controls at 6 mo of storage. Baked MC nuggets had lower TBARS than control nuggets at 0 d, but were not significantly different from the controls at 6 mo. Peak force was not significantly different between control and MC nuggets in both cooking methods at 0 d and 3 mo; however, at 6 mo, the MC nuggets had higher peak force than the controls. For sensory, the deep fat fried MC chicken nuggets were significantly different with control nuggets at 0 d, but not at 3 mo. Therefore, MC can be used in nuggets without significantly altering quality.

Key Words: chicken nuggets, methylcellulose, TBARS, pH, peak force

439P Can vitamin E and organic Se help stabilize omega-3 enriched eggs during cooking and storage? Y. Ren*, J. Wu, R. A. Renema, T. Perez, M. Betti, and M. J. Zuidhof, *University of Alberta, Edmonton, AB, Canada.*

Vitamin E and Se are key components of the antioxidant system to reduce lipid peroxidation. In omega-3 eggs, polyunsaturated fatty acids (PUFAs) are susceptible to oxidative damage during cooking and storage. Furthermore, reactive oxygen species which appear during PUFAs oxidation can trigger the breakdown of cholesterol into cholesterol oxidation products (COPs). This research focussed on the stability of n-3 PUFAs enriched eggs fortified with vitamin E and/or selenomethionine (Sel-Plex) following cooking and storage. Eggs were collected from 120 laying hens (37wk old), which were randomly allocated to one of four n-3 PUFA enriched diets: Control (base diet only), Vitamin E (base + 200 IU/kg), Se (base + 0.3 mg/kg Sel-Plex), and E + Se (base + 200 IU/kg Vit E and 0.3 mg/kg Sel-Plex). Eggs were collected after 4 wk of feeding. Half of the eggs were sampled immediately, and half were stored at 4°C for 4 wk prior to sampling. Vitamin E content, COPs content, and TBARS were measured on raw, boiled and fried eggs.

The content of vitamin E in boiled and fried egg was reduced by 21% and 44%, respectively, compared to that of the raw eggs. Storage for 4 wk reduced vitamin E by 16%. In TBARS test, egg fortified with vitamin E produced less breakdown produced, such as MDA (1.233 ug/kg), than eggs from the low vitamin E treatment (1.446 ug/kg). Se-enriched eggs also reduced the content of MDA (1.305 ug/kg) compared to low Se eggs (1.374 ug/kg). Frying generated more oxidative damage than boiling compared to raw sample (Fried=2.022ug/kg; Boiled=1.435ug/kg; Raw=0.561ug/kg of MDA). Vitamin E and organic Se both protected cholesterol from oxidation. The total COPs were lower in vitamin E enriched eggs (10.32 ug/g) than that of the control eggs (11.51 ug/g). Se-enriched eggs reduced appearance of COPs even more (High=10.23 ug/g; control=11.61 ug/g). Breakdown of PUFAs and cholesterol were related, as results of COPs and TBARS analysis were correlated ($r=0.7171$; $P < 0.0001$). Storage had no effect on COPs and TBARS.

Vitamin E and Se both decreased the oxidative damage of PUFAs and cholesterol during cooking.

Key Words: omega-3 eggs, selenium, vitamin E, cholesterol oxidative products, TBARS

440P Alkaline solubilization process of broiler dark meat: Effect on fat removal and lipid oxidative stability. V. Moayedi Mamaghani*, J. Chan, Y. Xu, and M. Betti, *University of Alberta, Edmonton, AB, Canada.*

Over the past 25 years, emphasis has been placed on improved distribution and marketing of further processed breast meat products which has resulted in excess supplies and depressed returns for broiler dark meat. The major problems with broiler dark meat are dark color, high fat content and lipid oxidation. An approach to increase the utilization of dark meat is to remove fat and pigments to produce a more acceptable resulting product for the production of further processed meat products. The purpose of this experiment was to study the influence of alkaline solubilization on total fat, lipid classes and lipid oxidation of muscle proteins extracted from broiler leg meat. Meat was finely chopped with added water and proteins solubilized by adjusting the pH between 10.5 and 12.0 in 0.5 increments. Following solubilization, the pH was adjusted to the 5.2 to precipitate the myofibrillar proteins which were then centrifuged and recovered to determine total fat, lipid classes (polar and neutral lipids) and lipid oxidation (TBARS). The entire experiment from broiler leg meat through final product was replicated 4 times resulting in 16 extractions. Data were analyzed using analysis of variance and means were separated using Tukey's HSD. The results indicated that approximately 50% of lipids were removed from broiler dark meat by alkaline treatments. pH 11.5 and 12.0 were the most effective (2.93 and 2.96 vs. 6.23 %; $P < 0.0001$). Polar lipids (PL) did not change in response to the treatments, indicating that fat removal was mainly due to neutral fraction. Due to the inefficient removal of PL, extracted meat was more predisposed to lipid oxidation than the raw broiler leg meat, with extracted proteins from pH 10.5 being the most susceptible within the treatments ($P < 0.0001$). According to the results, higher removal of polar lipids is necessary for the efficient application of this technology.

Key Words: broiler leg meat, alkaline solubilization, neutral lipids, polar lipids, TBARS

441P Application of ultraviolet light as an in-process conveyor belt sanitation system. A. Morey*¹, S. R. McKee¹, J. S. Dickson², and M. Singh¹, ¹Auburn University, Department of Poultry Science, Auburn, AL, ²Iowa State University, Department of Animal Science, Ames.

Salmonella is a major foodborne pathogen isolated from poultry and poultry products. Contaminated conveyor belts (CB) can be a potential source of *Salmonella* transmission in processing facilities. Cleaning and sanitation of CB is done generally once in 24 h, hence an online intervention step needs to be introduced to sanitize the CB when plant is in operation. Ultraviolet light (254nm) has been proven as a non-thermal eco-friendly microbicidal method. Sanitation efficiency of UV to kill bacteria depends on the intensities, surface, exposure time, concentration and age of that microbe. This study was conducted to determine the efficacy of UV against *Salmonella* on conveyor belts. *Salmonella* Typhimurium cultures were grown in TSB by incubating at

37°C for 24 h. Pieces (14 sq cm) of CB (Ronanyl DM 8/2 A2+04 Light Blue Thermoplastic polyurethane) were sanitized using 90% ethanol; inoculated with 1 mL of *Salmonella* Typhimurium (~10⁴⁻⁶ cfu/ mL) and dried under a biosafety cabinet for 30 min. These pieces were then exposed to UV (254 nm) for 1s, 3s and 5s at high (8.1 and 7.6 mW/sq.cm), medium (3.78 and 3.48 mW/sq. cm), low (2.73 and 2.52 mW/sq. cm) intensities. Survival populations (log₁₀ cfu/ sq. cm) of *Salmonella* Typhimurium were determined by swabbing the surface of CB and spread plating on TSA and incubating at 35°C for 24 h. Student's T-test was performed to determine the significant difference at $\alpha=0.05$. At high levels of exposure, there was no survival of bacteria after 1s whereas, medium levels significantly ($p<0.05$) reduced the *Salmonella* Typhimurium from 4.18 log₁₀ cfu/ sq. cm to 1.33 log₁₀ cfu/ sq. cm after 5s of exposure. As compared to other two energy levels, there was less reduction in bacterial counts on exposure of CB to 2.73-2.52 mW/sq. cm. Exposure of CB to UV light at specific intensities can eliminate/reduce the load of *Salmonella* Typhimurium. Hence short exposures at high intensities can be used in an online operation.

Key Words: UV treatment, *Salmonella* Typhimurium, conveyor belt, intensity, mW/sq. cm

442P Capability of a yeast cell wall containing product to bind specific *Salmonella* spp. A. Ganner*¹, S. Nitsch², T. Applegate³, and G. Schatzmayr¹, ¹BIOMIN Research Center, Tulln, Austria, ²BIOMIN Holding GmbH, Herzogenburg, Austria, ³Purdue University, Department of Animal Sciences, West Lafayette, IN.

Protection of human and animal health against infectious diseases is of paramount importance. In the European Union, 160,649 confirmed cases of human salmonellosis were reported (EFSA, 2006), while in the U.S., 27% of foodborne illnesses are caused by *Salmonella* spp. (Mead *et al.*, 1999); with the most common serovars being *S. enteritidis* and *S. typhimurium*. Certain yeast products have been hypothesized to protect animals by displaying alternative adhesion sites to enteropathogenic bacteria. This can be used as a prophylactic approach in the control of selective pathogenic bacteria in the gut.

The aim of the present study was to investigate yeast cell wall fractions derived from *Trichosporon mycotoxinivorans* (MTV) for its ability to adhere *Salmonella* spp. *in vitro*. The product was examined with a quantitative microplate-based assay by measuring the optical density as growth parameter of adhering bacteria. The exponential phase of the adhering bacteria was determined and compared with the CFU/ml on the agar plate. A linear regression was compiled and the bacterial number bound to the yeast product was determined.

We investigated five *Salmonella enterica* subsp *enterica*, two *Salmonella typhimurium*, *Salmonella enteritidis* and *Salmonella choleraesuis* for their adherence properties to a MTV yeast cell wall.

Aliquots of MTV cell wall were pipetted in a 96-well plate and incubated for 18 hours. *Salmonella* suspensions were added in the wells of the microplate (triplicates). Bacteria were allowed to adhere for 60 minutes at 37°C and afterwards washed with microplate washer. The wells were filled with nutrient media and incubated for 18 hours at 37°C. Four out of the five *S. enterica* subsp *enterica* as well as both *S. typhimurium* strains and *S. enteritidis* adhered to the MTV cell wall with an amount between 10⁴ and 10⁵ CFU/mg. *S. choleraesuis* adhered with an amount of 10³ CFU/mg.

Our results demonstrate that MTV cell wall fractions are strong binders

of *Salmonella* spp. *in vitro*. The amount of bound salmonella is serovar specific. Thus certain yeast cell wall products could reduce and prevent infections in birds caused by those bacteria.

Key Words: *Salmonella*, adhesion, yeast cell wall, microbiology, infection

443P Viability of *Salmonella* spp. in commercial marinades. A. Pathania*, M. Singh, and S. R. Mckee, Auburn University, Auburn, AL.

Marination of poultry meat is widely being done in the industry not only for value addition but also to enhance the shelf life. In addition to this the combination of spices in marinades has a potential to inhibit microbial growth and increase consumer acceptability of poultry products. A series of experiments were conducted to determine the efficacy of commercial teriyaki and lemon pepper marinades on survivability of multiple strains of nalidixic acid resistant *Salmonella*. Nalidixic acid resistant *Salmonella* (Typhimurium, Heidelberg and Senftenberg) cultures were developed by inoculating BHI broth and incubating for 24h at 37C; subjecting strains to increasing concentrations of nalidixic acid in XLT₄. As a result, *S. Typhimurium* and *S. Heidelberg* resistant to 60 µgm of nalidixic acid and *S. Senftenberg* resistant to 35µgm of nalidixic acid were obtained. These strains were inoculated in 9ml of BHI and incubated for 24h at 37C. This was followed by transferring 100 µl of inoculum into 40ml of BHI and incubating for 20h at 37C. Each strain was individually inoculated (ca. 10⁶⁻⁸ CFU/ ml) into either teriyaki or lemon pepper marinade, maintained at 4 and 25C, and samples were drawn after 0, 4, 8, 16, 24, and 32h. Serial dilutions of inoculated marinade were made and surviving populations (log₁₀ CFU/ ml) of *Salmonella* were enumerated by plating 0.1 mL onto XLT₄ agar. Plates were incubated at 37C for 24h. Teriyaki marinade significantly ($p<0.05$) lowered the counts of *Salmonella* as compared to Lemon pepper irrespective of the time and temperature of storage. *S. Heidelberg* and *Typhimurium* populations were significantly lowered ($p<0.05$) as a result of an interaction effect of marination time and type of marinade used whereas survival populations of *S. Senftenberg* were significantly lowered ($p<0.05$) as a result of a three way interaction between marination time, type of marinade, and temperature at which the marinades were stored. These findings suggest that Teriyaki marinade greatly helped in reduction of *Salmonella* spp. at both 4C and 25C for upto 32h indicating its antimicrobial effects.

Key Words: *Salmonella*, marinade, antibiotic resistance, temperature, poultry

444P Resistance to *Salmonella* colonization by characterized planktonic and biofilm communities from chicken cecal material. C. L. Sheffield*¹, T. L. Crippen¹, K. Andrews¹, R. J. Bongaerts², and D. J. Nisbet¹, ¹Southern Plains Agricultural Research Center, College Station, TX, ²Institute of Food Research, Colney, Norwich, United Kingdom.

Evidence describing bacterial biofilms as contributory in the development of environmental bacterial resistance is increasing. We report on a series of studies that provided a molecular and biochemical based characterization of both the biofilm and planktonic communities from continuous-flow bacterial culture systems, derived from the cecal microflora of chicks of different ages. The ability of these communities to resist invasion by *Salmonella enterica* serovar Typhimurium was tested.

The 5 communities initiated from 1-day old chicks contained 8 species from 6 genera. The planktonic communities were generally more diverse, 3 contained 3-5 species, while only 1 of the biofilm communities contained 3 species, the rest contained only 1-2 species. None of the communities were able to resist colonization by *Salmonella*. Overall, the 6 communities initiated from 7-day old chicks contained 11 species from 8 genera. All of the planktonic communities and 4 of the biofilm communities contained 4-7 species. Of these communities, 3 resisted colonization by *Salmonella*, 2 suppressed growth, and 1 succumbed to colonization. In cultures that resisted colonization, no *Salmonella* could be isolated from the biofilm, while in cultures that suppressed or succumbed to colonization, *Salmonella* was found within the biofilms. Overall, the 3 communities initiated from 14-day old chicks contained 18 species from 10 genera. All of the planktonic communities contained 8-9 species and the biofilm components contained 5-7 species. All of the communities resisted colonization by *Salmonella* and no *Salmonella* could be isolated from the biofilm.

There were many species difference between the cultures, however the common thread relating to successful colonization by *Salmonella* was the presence of *Salmonella* within the biofilm, along with a decreased number of species present and the decreasing age of the chicks from which the culture was started. The capacity to sequester the introduced *Salmonella* into the biofilm appears to be a contributing factor to the inability of these cultures to withstand colonization by the *Salmonella*.

Key Words: chicken, microflora, biofilm, planktonic, ceca

445P Therapeutic supplementation of caprylic acid in feed reduces *Salmonella* Enteritidis colonization in three and six week old commercial broiler chickens. J. Anup Kollanoor*¹, T. Mattson¹, A. B. Sangeetha¹, M. A. R. Amalaradjou¹, B. March¹, S. Valipe¹, S. Babapoor¹, M. J. Darre¹, M. A. Khan¹, T. A. Hoagland¹, D. T. Schreiber¹, A. M. Donoghue², D. J. Donoghue³, and K. Venkitanarayanan¹, ¹University of Connecticut, Storrs, ²Agricultural Research Service, USDA, Fayetteville, AR, ³University of Arkansas, Fayetteville.

Salmonella Enteritidis (SE) is a major food-borne pathogen for which chickens serve as the reservoir host. Reducing the intestinal carriage of SE in chickens would decrease contamination of poultry meat and eggs with this pathogen. We investigated the therapeutic efficacy of feed supplemented with caprylic acid (CA), a natural, GRAS status, 8-carbon fatty acid for reducing SE colonization in chickens. In two separate 3- and 6-week trials, day-old, straight run commercial broiler chicks (N=70 per trial) were assigned to five treatment groups (n=14 per group): a positive control (SE, no CA) and two groups of 0.7% or 1% CA. Water and feed were provided *ad libitum*. On day 1, two birds from each group were sacrificed to ascertain that chicks were initially *Salmonella* negative. In the 3-week trial, birds were inoculated with 7 log CFU of SE on day 5, and 5 days post infection, two birds from each group were sacrificed to ensure SE colonization. CA was supplemented from day 15 to 20 followed by sacrifice for tissue collection. In the 6-week trial, birds were challenged with SE on day 25, confirmed for SE on day 30, and sacrificed for tissue collection after 5 days of CA supplementation. CA at 0.7 and 1% consistently decreased SE populations in treated birds. SE counts in the cecum, small intestine, cloaca, liver, spleen and crop of treated chicks were significantly lower ($P < 0.05$) than controls. Feed intake and body weight were not different between groups. Results suggest that therapeutic supplementation of

CA through feed can effectively reduce SE colonization in chicks and market-age birds.

Key Words: *Salmonella*, caprylic acid, therapeutic, chicken, antimicrobial

446P Effect of bird age and muscle type on levels of carnosine recovered from chicken skeletal muscle. P. S. Manhiani*, P. Dawson, J. K. Northcutt, and I. Han, Clemson University, Clemson, SC.

Carnosine is a water soluble dipeptide composed of β -aniline and histidine. It is found primarily in skeletal muscles of mammals, avian species and other animals, but may also be isolated from other tissues such as brain and skin. It is potent antioxidant, anti-ageing compound and it has a lot of medicinal and therapeutic applications.

The objective of the present study was to compare the recovery of carnosine from broiler and spent fowl breast and thigh tissues and to test the hypothesis if carnosine acts as a stress protein or molecular chaperone like GRP-78.

Grp-78 proteins (Glucose regulated proteins 78kDa) are stress proteins which are normally up regulated during starvation, thigh muscle normally has more muscular activity than breast therefore glucose depletion is faster and hence the expression of the above proteins might be more pronounced in thigh than breast.

Preliminary results have shown that carnosine content of broiler breast was 2.42 mM and thigh was 1.25 mM per 100gm of tissue which shows less carnosine presence under normal conditions while there could be speculated or totally reverse change under acute stress conditions such as starvation.

In future experimentation, breast and thigh meat will be harvested from male and female broilers and spent fowl (hens and roosters). Carnosine will be extracted using a hot water extraction method and will be quantified by spectrophotometric method using diazotized p-bromoaniline. The effects of starvation will be correlated with caspase3/ GRP78 proteins using electrophoresis. And lastly the results will be compared according to breed as well as gender and interpreted using SAS edition 9.2 software.

Key Words: carnosine, skeletal muscle, recovery, GRP78, bird age

447P Effect of white striping on the histological and meat quality characteristics of broiler fillets. V. A. Kuttappan*¹, V. B. Brewer¹, F. D. Clark¹, S. R. McKee², J. F. Meullenet¹, J. L. Emmert¹, and C. M. Owens¹, ¹University of Arkansas, Fayetteville, ²Auburn University, Auburn, AL.

Broiler breast fillets are sometimes characterized grossly by white parallel striations in the direction of the muscle fibers. The present study is intended to evaluate the histological characteristics of this white striping and to assess whether the condition is influencing the meat quality characteristics of the meat. The breast fillets were collected from 1112 birds (59-63d) of different commercial high yielding strains (males and females) processed over 3 days. According to the visual severity of white striping, the breast fillets were separated into three categories: 0 (normal), 1 (moderate striping) and 2 (severe striping). Representative samples were collected from each degree of white striping, immediately after slaughter, to prepare slides for histological

studies. Ready-To-Cook (RTC) carcass weight, pH and color (L*, a*, b*) at 24h postmortem, dimensions of fillets (length-L, width-W, height at the top-H1, bottom-H2 and middle-H3), cook loss, and Meullenet-Owens Razor Shear (MORS) energy values of the fillets were collected. The examination of the histological slides under microscope showed a condition of myopathy with degenerative changes. The percentage of samples showing 0, 1 and 2 degrees of white striping in males were approximately 37, 53 and 10%, respectively, whereas those of females were 53, 42 and 6%, respectively. Within each strain, more than 50% of birds had some degree of striping (1 or 2 category) with the exception of strain D which had 41%. Interestingly, 72% of strain C birds exhibited striping (1 or 2 category); strain C also had the highest RTC weight. RTC weight and most of the fillet dimensions, except the length, were significantly higher for white striping samples compared to the normal ones. Furthermore, the samples with score 2 showed significantly higher values for W, H1, H2, H3, compared to score 0 and 1 samples. Muscle pH, color, cook loss and MORS energy were not significantly affected by the striping condition. The results of this study suggest that the white striping condition is associated with heavier birds, but that meat quality is not affected.

Key Words: meat quality, striping, myopathy, broiler, fillets

448P Development and application of a *Salmonella* serogroup D1-specific lateral flow test strip. M. Muldoon*¹, D. Onisk¹, J. Stave¹, D. Munro², and S. Rankin², ¹*Strategic Diagnostics Inc., Newark, DE*, ²*New Bolton Center, University of Pennsylvania, Kennett Square*.

Monitoring and control of *Salmonella* serogroup D1 serotypes is a primary concern for both the National Poultry Improvement Plan (NPPI) as well as state-sponsored Egg Quality Assurance Programs (EQAP). Both programs involves testing the poultry house environment for *Salmonella* spp., serogroup testing all positives, serotype testing all serogroup D1 isolates, and phage-type testing of all *Salmonella* Enteritidis (SE) isolates. If found in either live birds or egg products, loss of SE-free certification, product, or diversion of product can occur and result in a significant economic loss to the producer.

In order to facilitate the timely classification of NPPI and EQAP samples, a *Salmonella* serogroup D1-specific lateral flow test strip method was developed. Monoclonal antibodies (MAbs) were made against various serovars from *Salmonella* serogroups D1 (O: 1, 9, 12) and D2 (O: 9, 46). These were screened against a panel of both *Salmonella* and potentially crossreactive non-*Salmonella* bacteria. MAbs were isolated that recognized specific somatic O-antigens (factors 9, 12, and 46). Surprisingly, the factor 12-specific MAb did not recognize representative strains from serogroup B (O: 1, 4, [5], 12, 27). Using this MAb on the test strip and coupled to a 24 hr sample enrichment protocol, an expanded panel of 351 *Salmonella* strains was analyzed including 141 from serogroup D1 (primarily SE) and 173 from serogroup B. We found 100% sensitivity and 93% specificity for *Salmonella* serogroup D1 strains. The method was evaluated as an alternative method for the detection of SE in a state-run EQAP program. Initial studies utilizing 50 egg pools from a previously SE-positive shell egg facility indicated results consistent with the established 4-day cultural method. The *Salmonella* serogroup D1-specific lateral flow test strip method should save time and cost for the analysis of SE in NPPI and EQAP applications.

Key Words: *Salmonella* enteritidis, serogroup D1, monoclonal antibodies, immunoassay, egg testing

449P Postmortem cathepsin B activity in the breast muscle of non commercial chicken breeds. R. Currie¹, B. M. Rathgeber², and K. L. Thompson*², ¹*Nova Scotia Agricultural College, Truro, NS, Canada*, ²*Agriculture & Agri-Food Canada, Kentville, NS, Canada*.

The early postmortem role of cathepsin enzymes in chicken breast meat and the contribution to meat quality is largely unknown. Some research indicates that increased proteolytic degradation of myofibrillar proteins may be associated with decreased protein functionality. An objective of this study was to investigate cathepsin B activity in breast muscle of four breeds of chickens subjected to immediate or delay chilling. Four males of each breed, Light Sussex (LS), Rhode Island Red (RIR), Banded Plymouth Rock (BR) and Brown Leghorn (BL), were euthanized by cervical dislocation. Both pectoralis muscles were excised 7 minutes following death and placed in bags. At 15 min postmortem the left breast muscle was chilled in ice water while the right was held at 40°C for 4 hrs, followed by 20 hrs at 4°C. Cathepsin B activity (5 min and 24 hr postmortem) was measured for each breast muscle filet in both the lysosomal extract and the soluble fraction. In the lysosomal extract statistical analysis indicated that the delay chilled treatment decreased the cathepsin B activity (P<0.05) compared to filets placed in ice water. BL (3944 units of activity (UA)/g/ min) had significantly higher cathepsin B activity (P<0.05) than BR (2207 UA/g/ min), RIR (2059 UA/g/ min) and LS (1898 UA/g/ min). A breed x time interaction was found in the soluble fraction where LS cathepsin B activity increased from 5 min (2282 UA/g/min) to 24 hrs (4471 UA/g/ min) with no differences between the other breeds (P>0.05) from 5 min to 24hrs. At 24 hrs post-mortem cathepsin B activity was greater in LS than RIR (P<0.05) with no other breed differences in the soluble fraction. The difference in the level of cathepsin B activity in these birds can serve as a natural source of variation to determine the impact this enzyme has on the quality of breast meat in chickens.

Key Words: cathepsin, chicken, meat quality, carcass chilling, protein degradation

450P Effect of different levels of calcium and vitamin D on egg quality of commercial and heritage breeds from twenty-two to thirty-three weeks of age. R. Kaur*¹, B. M. Rathgeber², K. L. Thompson², M. Jendral¹, and R. Robinson¹, ¹*Nova Scotia Agricultural College, Truro, NS, Canada*, ²*Agriculture & Agri-Food Canada, Kentville, NS, Canada*.

The avian egg shell is a mineralized bioceramic material, containing organic and inorganic constituents. Calcium and vitamin D play a major role in influencing the size of the egg as well as shell thickness. The objective of this study was to examine the effect of three levels of Ca (3.35, 4.10 and 4.85%) and two levels of vitamin D (200 and 2500 IU) on crystalline structure of eggshell in different breeds of chicken. In one trial, two commercial egg laying strains (white and brown egg shell), and two heritage breeds (Fayoumi and Light Sussex) were kept in same cage following a split plot design. The birds were subjected to six combinations of diet from twenty seven to twenty nine weeks of age. Eggshell quality traits were determined and eggshell ultrastructure were examined under scanning electron microscope (SEM). Specific gravity of Light Sussex eggs was significantly (P<0.05) lower than other breeds and shell thickness, shell weight and egg weight were found to vary between breeds. Treatments with the high level of vitamin D (2500 IU) increased shell thickness (0.436 mm) significantly (p<0.05) in commercial and heritage breeds. Round B type bodies known to affect

eggshell quality were observed in the mamillary layer of commercial White Leghorn and Fayoumi breeds under SEM. Mamillary layer thickness was significantly ($P < 0.05$) higher in Fayoumi breed whereas the thickness of palisade layer was higher in commercial hens observed at control diet (4.10% Ca and 200 IU vitamin D). The substitution of 2500 IU vitamin D in a layer's diet can increase the shell thickness and may help avoid shell breakage.

Key Words: egg shell, vitamin D, calcium, heritage chicken, shell ultrastructure

451P Scald tank water and foam as sources of *Salmonella* contamination for poultry carcasses during early processing. K. Liljebjelke*, K. Ingram, A. Hinton, and J. Cason, *USDA-ARS-RRC, Athens, GA.*

Salmonella remains one of the leading causes of bacterial foodborne illness in the United States, and is often associated with poultry consumption. Despite significant reductions in the percentage of *Salmonella*-contaminated carcasses since the implementation of HACCP, continued reductions in *Salmonella* prevalence depend on identifying sources of contamination during poultry processing in order to develop and refine control programs. *Salmonella* was isolated from scald and dip tank water, surface foam, and defeathered carcasses obtained from a commercial poultry processing plant during the second processing shift over nine weeks. A variety of serotypes were isolated from whole carcass rinses, water, and foam samples, including several serotypes that are known human foodborne pathogens, including: Typhimurium, Enteritidis, Heidelberg, Schwartzengrund, Infantis, and Thompson. *Salmonella* was isolated from between 70 - 100% of twelve carcasses sampled at each collection. Both the variety and numbers of serotypes differed from one sampling to another, reflecting the differences in serotypes present in poultry flocks on farms. Multiple serotypes were isolated from individual carcasses, and were isolated against a background of serotype Kentucky, a serotype not in the top 20 causes of human salmonellosis. Despite high temperatures in the scald tanks (50 - 53°C), and dip tank (63°C), *Salmonella* do survive in the water and in surface foam. The thick organic foam layer that builds up on the scald tanks during processing may serve as a source of contamination when carcasses pass through the foam on exit from the scald and dip tanks, as *Salmonella* isolates were obtained from foam samples (40%) more frequently than from water samples (13%). These data will provide valuable information on the prevalence and variety of *Salmonella* serotypes present within

integrated broiler production, in addition to identifying an important source of carcass contamination in early broiler processing.

Key Words: *Salmonella*, processing, broiler

452P Comparison of the statistics of *Salmonella* testing of chilled broiler chicken carcasses in the United States and Europe. J. A. Cason*, N. A. Cox, R. J. Buhr, and L. J. Richardson, *USDA/ARS, Russell Research Center, Athens, GA.*

Whether a required *Salmonella* test series is passed or failed depends not only on the presence of the bacteria, but also on the methods for taking the samples, the methods for culturing the samples, and the statistics associated with the sampling plan. The pass-fail probabilities of the two-class attribute sampling plans used for testing chilled broiler carcasses in the United States and Europe were compared in a Monte Carlo simulation. HACCP tests in the United States use 400-ml whole carcass rinses, with 30 ml cultured for *Salmonella*. Twelve is the maximum number of positives out of 51 samples for passing the sample set and there are milder consequences for as few as seven positives per set. The numbers ($n=51$ samples and $c=12$ positives) were chosen so that a plant operating with a *Salmonella* prevalence of 20%, the national baseline result for broiler carcasses sampled before the introduction of HACCP, would have an approximately 80% probability of passing the test series with 12 or fewer positive results. The European Union (EU) requires taking neck skin samples of approximately 8.3 g each from 150 carcasses, with the necks skins cultured in pools of three and with seven positives as the maximum passing score for a set of 50 composite samples. For each of these sampling plans, 100,000 complete sampling sets were simulated using a random number generator. Under HACCP rules with 20% as the mean prevalence rate, 79.3% of the sample sets passed with 12 or fewer positive carcasses per set of 51, very near the expected 80% rate. A *Salmonella* prevalence of 9.5% on individual carcasses gave a 79.3% probability of passing with six or fewer positive carcasses. Under the EU test conditions, *Salmonella* prevalence of 3.96% in individual neck skin samples yielded a passing rate of 79.1%. Without testing the different sampling methods and cultural procedures using appropriately processed carcasses, it is not possible to determine how a 20% *Salmonella* incidence in whole carcass rinses compares to a 3.96% incidence in neck skin samples.

Key Words: *Salmonella*, chilled carcasses, sampling plans, statistics, simulation