(n=70) CIDR for 7 days and CR for 48h. All groups were subject to AI 12h after heat detection. Ovarian structures and pregnancy were evaluated by ultrasound (Aloka SSD-500). BCS and cyclicity (evaluated by two ultrasound examinations 10 days apart) were determined before the beginning of BS. Data were analyzed by GLM, and the parameters included in the model were DPP, treatment, calf gender, BCS, and interactions. Cows bred during the BS were not affected by treatment: G1-53.3%; G2-64.1%; G3-56.5%; G4-64.5%. Number of days and conception to first IA were affected (P<0.01) by treatment: G1-28.5d; 45.7%; G2-13.3d; 29.3%; G3-26.9d; 50.9%; G4-9.6d; 76.6%, respectively. Treatment affected the number of days to conception (G1-34.3d; G2-40.5d; G3-36.4d; G4-13.0d; P<0.01), but not the percentage of cows pregnant at the end of the BS (G1-43.5%; G2-41.1%; G3-38.8% G4-45.5%). Conception at first AI and percentage of pregnant cows at the end of the BS were affected by BCS (2.5-40.2%; 20.4%; 2.75-42.5%; 37.5%; 3.0-41.6%; 40.7%; 3.25-56.8%; 54.1%; 3.5-72.0%; 58.3%; P<0.05), respectively. These data suggest that treatments G2 and G4 decrease the number of days to first AI, comparing with G1 and G3 (13.3d; 9.6d vs. 28.5d; 26.9d) respectively, but G2 had a decrease in conception (29.3%). Thus combining calf removal with CIDR insertion is a good strategy to induce fertile estrous and to enhance early season pregnancy. The responses may be even higher in cows with better body condition score.

Key Words: CIDR, Calf Removal, Short Cycle

M270 Effect of subluteal concentrations of progesterone on an estradiol cypionate induced LH surge in lactating Holstein cows. T. B. Hatler*, D. L. Ray, S. H. Hayes, and W. J. Silvia, *Department of Animal Science, University of Kentucky, Lexington*.

Intermediate circulating concentrations of progesterone (INT P4: 0.1-1.0 ng/ml) are often associated with ovarian follicular cysts in lactating dairy cows. The following experiment was conducted to determine if INT P4 during the follicular phase affected the occurrence of a LH surge induced by estradiol cypionate (ECP). Eazi-Breed CIDRs (1.38 g of progesterone) were preincubated in host cows for either 0, 14 or 28 days (CIDR-0, CIDR-14, CIDR-28, respectively) for subsequent use in this experiment. Ovaries of lactating Holstein cows were examined by transrectal ultrasonography to identify those with a corpus luteum (CL). Luteal function was later verified by RIA for P4 (>3.0 ng/ml). Within 24 hours of CL detection, preincubated CIDRs were inserted into 15 cows (n=5 per preincubation time). The day of CIDR insertion was designated as experimental day -1. Four cows received no CIDRs and served as controls (CONT). CIDRs remained in place for the following 3.5 days. Luteolysis was induced with 2 injections of PGF2α (Lutalyse, 25 mg, i.m.) given at 6 PM on day -1 and at 6 AM on day 0. Plasma samples were collected from day -1 to 2.5 at 12 hour intervals to measure P4. At 6 AM on day 1, an injection of ECP (3 mg, i.m.) was administered. Blood samples were collected via jugular venous catheter every 2 hours for the next 36 hours to detect the LH surge. The average circulating concentration of progesterone in the four samples collected on days 1 and 2 was calculated for each cow. The mean P4 concentrations were 1.20, 0.78, 0.45, and 0.11 ng/ml for cows treated with CIDR-0, CIDR-14, CIDR-28 and CONT, respectively (P<0.01). Treatment altered the occurrence of the ECP-induced LH surge (P<0.01). In all 4 CONT cows, the LH surge was detected an average of 18 hours after ECP injection. LH surges were not detected in any of the 5 CIDR-0 cows. The surge of LH was detected in 2 of 5 CIDR-14 and 4 of 5 CIDR-28 cows, respectively. It was concluded that intermediate progesterone during the follicular phase may contribute to cyst formation by blocking the estradiol-induced LH surge.

Key Words: Progesterone, Ovarian Follicular Cyst, LH Surge

M271 Effect of subluteal concentrations of progesterone on follicular phase events in lactating Holstein cows. T. B. Hatler*, D. L. Ray, S. H. Hayes, and W. J. Silvia, *Department of Animal Sciences, University of Kentucky, Lexington*.

Intermediate circulating concentrations of progesterone (INT P4: 0.1-1.0 ng/ml) are often associated with ovarian follicular cysts in lactating dairy cows. The following experiment was conducted to determine if INT P4 during the follicular phase prevented ovulation. In order to synchronize ovarian events, lactating Holstein cows were administered 2 injections of PGF2α (Lutalyse, 25 mg, i.m.) 14 d apart. An injection of GnRH (Factrel, 100 μg, i.m.) was administered 12 d later (designated experimental d 0). Daily transrectal ultrasonography of ovaries and collection of blood samples (for quantification of P4) began on d 0 and continued for the next 22 d. Eazi-Breed CIDRs (1.38 g of progesterone) were preincubated in host cows for either 0, 14 or 28 d (CIDR-0, CIDR-14, CIDR-28, respectively) for subsequent use in this experiment. On d 7(AM), preincubated CIDRs were inserted (CIDR-0 (n=5), CIDR-14 (n=5), CIDR-28 (n=6)) and left in place until the conclusion of the experiment. Cows without CIDRs served as untreated controls (CONT; n=4). Luteolysis was induced with 2 injections of Lutalyse (25 mg, i.m.) given 12 h apart on d 7 and 8. Jugular venous blood samples were collected every 4 h from 8 AM on d 9 to 8 AM on d 14 to detect the LH surge. Treatment with preincubated CIDRs during the follicular phase altered (P>0.01) the frequency of ovulation. Ovulation occurred in 0/5 and 1/5 cows treated with CIDR-0 and CIDR-14 while ovulation occurred in 3/6 and 4/4 cows treated with CIDR-28 and CONT, respectively. Preovulatory surges of LH were detected in all cows that ovulated and were not detected in any cows that did not ovulate. On average, LH surges were detected on d 11. Follicular phase concentrations of P4 were determined by calculating the average of P4 concentrations on d 9 thru 11. Circulating concentrations of P4 during the follicular phase were 1.25, 0.71, 0.36 and 0.14 ng/ml for CIDR-0, CIDR-14, CIDR-28 and CONT, respectively. Intermediate progesterone during the follicular phase may contribute to the formation of cysts by blocking the LH surge and thus, ovulation.

Key Words: Progesterone, Ovarian Follicular Cyst, LH Surge

PSA-Environment and Management

M272 Comparative study of body characteristics of broiler chickens from different rearing systems. A. O. Best*, W. L. Willis, and C. Murray, *Department of Animal Sciences, North Carolina A&T State University, Greensboro*.

An experiment was conducted to investigate the relationship between certain body characteristics and growth performance of broiler chickens subjected to different systems of rearing. Two hundred forty female day old broiler chicks were obtained from a local commercial hatchery, and divided into groups of 40. Each group was subjected to one of the following rearing systems: 1) battery cage-no heat; 2) battery cage-heat; 3) floor pens-no heat; 4) floor pens-heat; 5) pasture poultry-no heat and 6) floor pens/pasture. At seven weeks of age, whole carcass, bursa, gizzard, liver, spleen, stomach, and heart weights were taken. Abdominal and leg lengths were measured, and intestines lesion scores were observed. Although all birds were of the same age, their body characteristics were variable for each rearing system. Treatment 4, floor pens-heat, had the highest average body carcass weight (2.53 kg) and the lowest came from treatment 1, battery cage-no heat (1.37 kg). The bursa weights which reflect the health status of broilers in most treatments were above average, ranging from 0.20 (trt. 4) to 0.37 gms (trt.1). The mortality rate was highest in the pastured poultry system (trt. 5). The results of this study indicate that different rearing systems influence the body characteristics such as organ weights, carcass weights and abdominal length.

Key Words: Body Characteristics, Broilers, Rearing Systems

M273 *Campylobacter Jejuni* Asssessment in Organic vs. Conventional Reared Broiler Chickens. L. T. Donaldson*, W. L. Willis, and C. Murray, *Department of Animal Sciences, North Carolina A&T State University*.

An experiment was conducted to investigate the prevalence of *Campylobacter jejuni* in broiler chickens that were produced and marketed as organic or conventional. Trials were performed during the summer and winter utilizing three farms, each of which practice, organic or conventional rearing. Ten broilers from each farm were collected in the processing plant and subjected to carcass rinse (serial dilutions), crop swabbing, ceca swabbing and drug sensitivity prior to evisceration and after chilling. The prevalence of *Campylobacter jejuni* in organically

produced broilers vs conventional was very similar (93 vs 97%) respectively during the summer, but the percentage of positive conventional reared broilers was lower during the winter (77 vs 100% in organically reared broilers). The viable count for *Campylobacter jejuni* in conventional broilers showed a reduction during the winter from 27.3 to 15.3 cfus; whereas, the count in organic broilers increased during the winter from 28.3 to 58.9 cfus. The crop and ceca positive isolates were similar for both rearing systems. The drug sensitivity profile comparison did not differ greatly. Salmonella was found in 91% of the broiler fecal samples collected at the organic farms, while 81% of the samples were positive from the conventional reared broilers. The results from this study showed that organically produced poultry maybe highly contaminated with *Campylobacter jejuni* and care in handling should be encouraged to prevent foodborne illness in humans.

Key Words: *Campylobacter jejuni*, Broilers, Organic

M275 Effect of molting on *in vitro* tissue invasion by *Salmonella enteritidis*. R. W. Moore* and P. S. Holt, *United States Deparment of Agriculture, Agricultural Research Service, Southeast Poultry Research Laboratory, Athens, GA*.

A tissue culture was utilized to compare tissue cell invasion by *Salmonella enteritidis* from molted and full feed hens. Three identical trials were performed in which 80 wk- old active laying hens were divided into two groups of 6 birds each. The molted hen group was subjected to a 14 day feed withdrawal and full fed hen group was administered a standard layer ration. After feed treatment, crop, ileum, cecum, and ovary (small and large yellow follicles removed) were collected, rinsed in PBS, and placed into 50 mL of RPMI medium. The ends of intestine and crop tissues were tied to allow attachment of *Salmonella* only to the lumen surface. RPMI medium containing 10^7-10^8 CFU of novobiocin (NO) and nalidixic acid (NA) resistant phage type 13 *Salmonella enteritidis* was injected into the lumen of the intestine and crop tissues. Additionally, ovaries were incubated in 50 mL of RPMI medium containing 10^6-10^7 CFU of the *Salmonella enteritidis*. Tissues were incubated with *Salmonella* at 37°C for 2 hr, after which tissues were placed in 50 mL of fresh RPMI medium containing 500 μg/mL of gentamycin and incubated for 5 hr at 37°C to remove any *Salmonella* which had not penetrated tissues. Tissues were rinsed, stomached in 10 mL of PBS, serially diluted, and plated onto Brilliant Green agar containing 25 μg/mL NO and 20 μg/mL NA for *Salmonella* enumeration. *Salmonella* invasion of ovaries was reduced in tissues from molted hens in trials 1 and 2 as compared to full fed controls (> 1.2 log reduction), but not in trial 3. *Salmonella* invasion of ceca from molted hens was numerically increased in trials 1 and 2 and significantly increased in trial 3 as compared to controls (> 0.8 log increase). No significant differences in *Salmonella* invasion was determined for crops and ileum. These data suggest that molting may effect invasion of tissues by *Salmonella enteritidis*.

Key Words: *Salmonella Enteritidis*, Molt, Invasion

M276 Influence of experimental chlorate product (ECP) in drinking water on environment of the gastrointestinal tract and *Salmonella enteritidis* (SE) in laying hens during an induced molt. L. F. Kubena*[1], J. L. McReynolds[1], J. A. Byrd[1], R. C. Anderson[1], S. C. Ricke[2], and D. J. Nisbet[1], [1]*USDA-ARS,SPARC, Food & Feed Safety Research Unit, College Station, TX,* [2]*Department of Poultry Science, Texas A & M University, College Station*.

The use of feed deprivation to induce molting and stimulate multiple egg-laying cycles in laying hens is a common practice in commercial egg production. Unfortunately, an increased risk of *Salmonella enteritidis* (SE) may result; therefore, alternative methods are needed. Hens over 50 wk of age were placed in individual laying cages, with 3 groups of 11 hens per treatment. Two wk prior to dietary changes, hens received an 8-h light and 16 h-dark photoperiod that continued for the 9-day experiment. All hens were challenged orally with 10^6 cfu of SE on day 4 of the study. Treatments were non-fed hens with distilled water (NFD), non-fed hens with the experimental chlorate product (ECP which provided 15mM chlorate ion concentration water; NFECP), alfalfa diets with distilled water (ALD), and alfalfa diets with ECP water (ALECP). When compared with the NFD hens, no significant changes in the pH of the crop or in the lactic acid concentrations of the crop and ceca for the NFECP or ALD hens occurred; however, the lactic acid concentrations were higher in the ALECP hens. Also, there were increases in the concentrations of propionic acid and total volatile fatty acids of the ceca in the NFECP, ALD, and ALECP hens. When compared with NFD hens, the numbers of SE positive crop and ceca were reduced in the NFECP hens (67%, 35%), ALD hens (9%, 0%), and ALECP hens (84%, 59%). The ECP reduced invasion of the liver, spleen, and ovaries by more than 50%. The intake of alfalfa was low in this study and most likely accounts for the lowered protection against SE. Results suggest that ECP added to the drinking water may be a useful tool to reduce the risk of SE during an induced molt by feed deprivation or the use of alfalfa molting diets. The combination of ECP and the alfalfa molting diet was the most efficacious for several parameters, indicating that an active fermentation during molting is an important factor in maintaining a hostile environment for enteropathogens.

Key Words: Laying Hens, Molting, Experimental Chlorate Product

M277 Impact of the laying hen cycle and molting on the prevalence and populations of *Salmonella*. X. Li*, J. B. Payne, F. B. O. Santos, K. E. Anderson, and B. W. Sheldon, *Department of Poultry Science, North Carolina State University, Raleigh*.

Salmonella species are recognized as major foodborne pathogens that are closely associated with the consumption of contaminated poultry and egg products. The objective of this study was to determine whether the hen's laying cycle and feed withdrawal (molting) influence the prevalence and populations of *Salmonella* in the feces. Composite fecal samples were periodically taken from a commercial layer complex containing multiple houses. Each house contained 90,000 hens housed in 2700 cages arranged across 6 rows. Composite fecal samples across each row were collected from different houses as a function of bird age [18 wks (pullets housed), 25 to 28 wks (1st production cycle), 65 to 74 wks [molting] and 75 to 78 wks (2nd production cycle)]. Populations of *Salmonella* spp. were enumerated using a MPN (most probable number) procedure. House temperatures and ammonia levels were recorded at each sampling time. For 18-week birds, *Salmonella* populations ranged from log 1.81 to 1.97 MPN per g with 55.6% of the samples testing positive (n = 18). For the 25 to 28-week birds, *Salmonella* populations ranged from log 1.34 to 2.73 MPN per g with 41.7% testing positive (n = 24). No *Salmonella* (<1 log) were detected in the feces from 65 to 74-week (n = 12) and 75 to 78-week birds (n = 6). The average ammonia levels were 13.3, 55.0, 20.0 and 20.0 ppm for houses containing the 18, 25 to 28, 65 to 74 and 75 to 78-week old birds, respectively. The 18-week old birds had the highest incidence of *Salmonella*-positive (55.6%) samples but the lowest average ammonia levels whereas the 25 to 28-week old birds had the highest average population of *Salmonella* (log 2.73 MPN per g) and highest ammonia levels. These results indicate that layer age and feed withdrawal (molting) did impact both the incidence and populations of *Salmonella* recovered from layer feces. Moreover, feed withdrawal molting practices did not appear to increase the incidence or shedding of *Salmonella* in the feces.

Key Words: *Salmonella*, Production Cycle, Molting

M278 Late post-molt egg production in laying hens molted with different rations of alfalfa and layer ration. L. M. Donalson*[1], W. K. Kim[1], C. L. Woodward[1], P. Hererra[1], L. F. Kubena[2], D. J. Nisbet[2], and S. C. Ricke[1], [1]*Department of Poultry Science, Texas A&M University, College Station,* [2]*2USDA Agricultural Research Service, College Station, TX*.

A total of 116 White Leghorn laying hens were induced to molt after being acclimated and monitored for pre-molt egg production. The hens were then divided into five treatment groups: full fed (FF), feed withdrawal (FW), 100% alfalfa(A100), 90% alfalfa / 10% layer ration (A90), and 70% alfalfa / 30% layer ration (A70). The hens were put on a lighting program and molted for 9 days. At the end of the molt, 56 birds were euthanized and organ weights were taken while the other 60 were returned to a layer ration and evaluated for post-molt performance. Parameters examined included: egg height, egg weight, albumen height, yolk height, yolk diameter, shell breakage, specific gravity and overall egg production. Overall egg production was significantly lower ($P<0.05$) at week 17 when FF treatment birds were compared to A90, A100 and NF birds. At weeks 21 and 23 FF birds were significantly different than NF birds. At week 26, A100 birds had significantly shorter egg lengths than all other treatments. The yolk diameters from A70 birds were significantly smaller at week 22 than all other treatments. The yolk heights were significantly smaller in NF birds at weeks 24, 35 and 38

when compared to FF birds. FF birds had significantly lower albumen height measurements at weeks 17, 18, 23, 24, 25, 27 and 28 when compared to NF and at weeks 29 and 34 when compared to A70 and A90 respectively. A70 birds showed significantly higher egg weights at weeks 21, 24, 26, 27, 29, 33 and 34 when compared to A100 and at weeks 21, 27, 30, 31 and 33 when compared to FF. When shell breakage strengths were compared, A90 proved to be significantly stronger than A100, FF, and A70 at weeks 22, 24, and 30 respectively. Specific gravity for A90 also proved to be significantly higher than A70 and A100 at weeks 24 and 32.

Key Words: Molting, Egg Quality, Alfalfa

M279 Evaluating bone and eggshell parameters of molted hens at the end of 2nd laying cycle compared to non-molted hens. W. K. Kim*[1], L. M. Donalson[1], P. Herrera[1], C. L. Woodward[1], L. F. Kubena[2], D. J. Nisbet[2], and S. C. Ricke[1], [1]*Texas A & M University, College Station,* [2]*USDA-ARS, Southern Plains Agricultural Research Center, College Station, TX.*

A study was conducted to evaluate bone and eggshell parameters of molted hens at the end of 2nd laying cycle. Osteoporosis in laying hens is important animal welfare issue as well as economic issue for the poultry industry. Osteoporosis in laying hens is defined as a condition that involves the progressive structural bone loss. Osteoporosis is one of the main reasons of subsequent fractures in laying hens. An induced molt using feed withdrawal is a potential factor increasing structural bone loss and the incident of osteoporosis in old laying hens. The objectives of this study were 1) to evaluate bone and eggshell parameters of molted hens at the end of 2nd laying cycle and 2) to evaluate the relationship between eggshell and bone parameters. A total of 60 Single Comb White Leghorn hens were used for this study. There were two controls and four molting treatments: full-fed control 1 (82 wk old) (FF1), full-fed control 2 (122 wk old) (FF2), feed withdrawal (FW), 100% alfalfa (A100), 90% alfalfa/10% layer ration (A90), and 70% alfalfa/30% layer ration (A70). At the end of the 2nd laying cycle (approximately 122 wk of age), eggs were collected, and then hens were euthanized by CO_2 to collect left tibia and femur. The tibia percent ash of the FF1 was significantly higher than the A90. The tibia ash concentration of the FF1 was significantly higher compared to the FW, A100, and A90 ($P<0.05$). The FF1 had a significantly greater femur percent ash than the A90 ($P<0.05$). In the eggshell parameters, the FF1 had significantly higher shell weight, percent shell, and shell thickness compared to the A100 ($P<0.05$). However, the egg weight of the FW was significantly heavier than the FF1 ($P<0.05$). The correlation analysis showed that overall bone parameters were negatively correlated with eggshell parameters. These results suggest that age of hens and molting practice have an impact on bone status of hens at the end of 2nd laying cycle, and eggshell formation is closely related to bone metabolism in laying hens.

Key Words: Molting, Bone Parameters, Eggshell

M280 Reduction of *Salmonella typhimurium* (ST) yeast agglutination and intestinal colonization in broilers by galactose or mannose liberated from guar gum. J. T. Lee*, S. E. Tichy, C. A. Bailey, A. L. Cartwright, and D. J. Caldwell, *Texas A&M Univeristy System.*

Several laboratories have reported on the ability mannose, administered by feed or drinking water, to interfere with Salmonella intestinal colonization in commercial poultry. Guar gum has a mannose backbone with galactose bound to alternating mannose sugars. The mannose:galactose ratio in guar gum is approximately 2:1. Addition of Hemicell® a galactomannanase, hydrolyzes the gum to produce mannose monomers and oligosaccharides as verified by the Matrix Assisted Laser Desorption and Ionization (MALDI) procedure. The objective of the present experiments was to investigate the ability of hydrolyzed guar gum to reduce the ST intestinal colonization in broiler chicks. First, an *in vitro* yeast agglutination test was performed to investigate the ability of hydrolyzed guar gum solution (4.5%) to prevent ST agglutination of yeast cells. Mannose and galactose solutions were used as positive and negative controls, respectively. Hydrolyzed guar gum solutions were as effective as mannose at inhibiting the ability of ST to agglutinate yeast cells while galactose had no inhibitory effect on agglutination. Two duplicate *in vivo* experiments were performed to determine the inhibitory ability of hydrolyzed guar gum, mannose, and galactose on ST cecal colonization (Log_{10} ST cfu/g) in broiler chickens. Experiment 1 indicated galactose (2.18 cfu/g) significantly ($P<0.05$) reduced ST cfu recovered from broilers while mannose (3.88 cfu/g) and hydrolyzed guar gum (2.40 cfu/g) did not differ from control (3.37 cfu/g). In experiment 2, mannose (0.82 cfu/g) and galactose (1.24 cfu/g) fed broilers significantly reduced ST recovered from the ceca while no difference was observed between control (2.23 cfu/g) and hydrolyzed guar gum treatments (2.10 cfu/g). These experiments indicate that both mannose and galactose interfere with the ability of ST to agglutinate yeast cells *in vitro* and colonize the ceca of broilers.

Key Words: Galactose, Guar Gum, Mannose

M281 Attachment of *Salmonella* and *Campylobacter* spp., to chicken spermatozoa viewed by scanning electron microscopy. N. A. Cox[1], J. S. Bailey[1], D. E. Cosby*[1], R. J. Buhr[1], L. J. Richardson[1], J. L. Wilson[2], D. V. Bourassa[2], W. L. Steffans[3], and M. B. Ard[3], [1]*U. S. Department of Agriculture, Russell Research Center, Athens, GA,* [2]*Department of Poultry Science, University of Georgia, Athens,* [3]*Department of Veterinary Pathology, University of Georgia, Athens.*

We previously demonstrated that vertical transmission of *Campylobacter* could occur. The mechanism of this transmission is still unclear. Previously negative broiler breeder flocks have been reported to become positive with the introduction of spike roosters at 45 wk of age. To determine if the rooster semen is a possible source of transmission to hens for colonization, we evaluated the association of both *Campylobacter* and *Salmonella* spp., to segments (head, mid-piece and tail) of individual spermatozoa after artificial inoculation. Three strains of *Salmonella* (Typhimurium, Heidelberg and Montevideo) or one strain of *Campylobacter jejuni* (in 0.85% saline) was added to a freshly collected (by abdominal massage) aliquot of pooled semen from roosters housed in individual cages. The semen-bacteria solutions were incubated 1 hour at room temperature. Samples were fixed in 2% (para)formaldehyde, 2% glutaraldehyde, 0.2% picric acid in 0.1 M Cacodylate-HCl buffer, pH 7.25, for 24 hours prior to centrifuging and rinsing in the 0.1 M Cacodylate-HCl buffer. Individual aliquot samples were placed on coverslips and allowed to settle overnight in a wet chamber. Samples were taken through an ethanol gradient and critical point dried in an Autosamdri-814 Critical Point Dryer. After drying, the coverslips were mounted and sputter coated with 300 angstroms of gold with the SPI-Module Sputter Coater. The samples were then viewed with a JSM-5800 Scanning Electron Microscope. *Salmonella* was found associated to all three segments (head, mid-piece and tail) of the spermatozoa apparently equally distributed. *Campylobacter* was mainly associated with the mid-piece and tail segments, with few located on the head segment. Further work is planned to determine if the adherence is actually attachment.

Key Words: *Salmonella*, *Campylobacter*, Spermatozoa

M282 Efficacy of Sal CURB®brand ASF liquid antimicrobial against various Salmonella species in a meat and bone meal matrix. M. L. Burke*, J. K. Murphy, and V. J. H. Sewalt, *Kemin Americas, Inc., Des Moines, IA.*

Sal CURB®brand ASF liquid antimicrobial (SC ASF) is a formaldehyde-based product that is used to maintain feeds and feed ingredients Salmonella-negative for up to 21 d. Previous work has demonstrated that an application rate of 6.5 lbs/ton of SC ASF is sufficient to eliminate Salmonella from corn/soy feed (Welch et al., 2003). Its efficacy against various Salmonella species in a high protein matrix, such as meat and bone meal, has not been fully explored. The purpose of this experiment was to evaluate the efficacy of SC ASF against *Salmonella typhimurium* ATCC 14028, *Salmonella senftenberg* ATCC 43845, *Salmonella montevideo* ATCC 8387, and *Salmonella enteritidis* ATCC 13076 in a meat and bone meal matrix. These strains, combined in the form of a lyophilized culture, were used to inoculate sterilized meat and bone meal at 1,500 CFU/g. The meat and bone meal was treated with 6.5, 9, 12 and 15 lb/ton of SC ASF. Samples were done in triplicate. A positive control and negative control were included in the study. The efficacy of SC ASF against Salmonella was determined by assaying for Salmonella via the FDA BAM methodology on Day 1 post-treatment, post-inoculation. Testing on Day 1 revealed that 12 and 15 lb/ton of SC ASF were sufficient to eliminate Salmonella in all replicates, and 9 lb/ton killed the Salmonella in two of the three replicates. Further studies are required to confirm if Sal CURB ASF can maintain

meat and bone meal Salmonella-free after re-exposure. Results of this study demonstrate that at least 9 lb/ton of Sal CURB® brand ASF liquid antimicrobial is required to effectively eliminate Salmonella in high protein matrices such as meat and bone meal, contrary to corn/soy feed, in which 6.5 lb/ton is sufficient.

Key Words: Sal CURB ASF, Salmonella, Meat and Bone Meal

M283 Effect of storage time on *Campylobacter jejuni* isolation and drug sensitivity in broiler wings. W. L. Willis*, K. Smith, and C. Murray, *Department of Animal Sciences, North Carolina A&T State University, Greensboro*.

An experiment was conducted to determine the effect of storage time on the isolation and drug sensitivity of *Campylobacter jejuni* (C.j.) from broiler wings subjected to a commercial antimicrobial treatment. In trial one, wings (2 each) were collected from 64 whole carcasses in a commercial processing plant produced as organic or conventional during the summer and winter. They were subjected to an antimicrobial treatment after chilling. The wings were pooled, placed into zip-locked storage bags, stored in the refrigerator for 1, 5, 10, and 15 days, then swabbed. Swabbs were plated on BBL blood Agar and incubated at 42° C for 24-48 hr then tested for C.j. presence and drug sensitivity. Disk-diffusion for drug sensitivity utilized five antimicrobials (enrofloxacin, erythromycin, gentamicin, tetracycline, and naladixic acid). In trial two, 8 non-commercial chicken wings from pastured and 8 conventional reared poultry were processed without an antimicrobial treatment. The wings were stored in a Campy-gas mixture and refrigerated for 1, 5, 10, and 15 days. The results from trial one showed no difference in the isolation of C.j. at 1, 5, or 10 days regardless of how they were raised or the storage time. C.j. could not be isolated from any 15 day samples. Trial 2 results were similar with almost 100 percent isolation, except for day 15. The treated wings showed a greater reduction ($P<0.05$) in positive samples when compared to non-treated. C.j. was more susceptible to tetracycline than other drugs. There was a trend for 10-day C.j. isolates to become more susceptible to erythromycin. The results suggest that extended storage time affects the isolation of C.j. and drug sensitivity. Moreover, it was concluded that the antimicrobial treatment reduced C.j.

M284 Effect of Immustim® and Protimax® on *Campylobacter jejuni* and *Salmonella typhimurium* Populations in Broilers. J. Spruill*, R. Plunske, J. Grimes, P. Ferket, and B. Sheldon, *North Carolina State University, Raleigh*.

The objective of study 1 was to estimate the populations of *S. typhimurium* (S) and *C. jejuni* (C) in the GI tracts of broilers fed a diet containing beta-1,3/1,6-glucan (Immustim®). Study 2 evaluated the effects of a diet containing a spray-dried egg product from immunized hens (Protimax®) on intestinal S and C populations. Both studies consisted of the same experimental design. Chicks (720) were placed 10/pen (12 pens/battery) in 3 rooms (2 batteries/room). C- and S-challenged and non-challenged chicks were housed in separate rooms. Pens were randomly assigned 1 of 3 feed treatments added to a standard starter feed. Dietary Immustim® levels were 0, 20 or 40g/ton. Feed treatments for the second study consisted of a negative control (a standard starter feed), a positive control (a spray-dried egg product without immunoglobulins) and Protimax® (both at 6kg/ton). In study 1, 3-day old chicks were gavaged with 1mL of 10^6 cfu/mL of a nalidixic acid-resistant S strain. The C challenge (1mL of 10^6 cfu/mL) occurred at 14d. Lower GI tract and cecal samples were collected on 7, 14, 17 (C only) and 21d. In study 2, chicks were gavaged with S at 7d and C at 14d. Samples were removed on 14, 21 and 28d. The samples were serially diluted and spiral plated (50μL) onto BHI agar, BHI agar with 800ppm nalidixic acid or Campy Cefex agar. Control plates and those plates estimating S growth were incubated at 37C for 24h, while C plates remained in a 42C incubator for 48h under microaerophilic conditions. Data were analyzed using GLM of SAS with means separated using LS Means ($P\leq0.05$). Neither feed treatment affected broiler GI tract S or C populations. Improved bird performance was observed for non-challenged birds fed Immustim®. S-challenged birds showed improvement in growth and FC at 20g/ton of Immustim®, while birds challenged with C showed improved growth when fed 40g/ton. The addition of Protimax® resulted in reduced growth for C-challenged birds. However, Protimax® improved FC for S-challenged birds, but had no effect on non-challenged birds.

M285 Acidified Sodium Chlorite application in the drinking water to control Salmonella colonization in market age broilers. P. Mohyla*[1], S. F. Bilgili[1], D. E. Conner[1], C. C. Warf[2], and G. K. Kemp[2], [1]*Auburn University, Auburn,* [2]*Alcide Corporation, Redmond, WA*.

Acidified sodium chlorite (ASC; SANOVATM) is approved as a carcass disinfectant in poultry processing. ASC is produced by combining sodium chlorite (SC) and citric acid (CA). Under low pH, SC forms chlorous acid, a bactericidal oxychlorine species. Efficacy of ASC in reducing Salmonella colonization in broilers was determined. ASC was prepared either by adding CA or sodium acid sulfate (SAS). Two hundred and forty broilers (35 days of age) were randomly allocated to four Petersime batteries (5 birds/pen, 12 pens/battery). Study involved 12 treatments: negative control (plain water-no challenge), positive control (plain water-challenged), and five concentrations (0, 150 ppm, 300 ppm, 600 ppm and 1200 ppm) of SC, acidified to pH of 2.6 $\pm$ 0.1 either with CA or SAS. All birds, except for the controls, were fasted for two hours and orally gavaged with 104 CFU/ml of Salmonella typhimurium one hour before the initiation of treatments. Treatments were freshly mixed and replaced every 4 hours. Live performance (body weight, water consumption and weight gain/loss) was measured during the 24 hour experimental period. All 240 birds were then necropsied, digestive tracts were aseptically removed, split into 3 segments of upper (crop to gizzard), middle (duodenum to cecal junction) and lower (ceca to cloaca) for Salmonella enumeration (CFU/g). No significant ($P>0.05$) changes were found in body weight, weight gain and in the appearance/color of the excreta. There was no significant acidifier (CA vs. SAS) effect on water consumption or Salmonella counts. However, a significant ($P<0.05$) concentration effect for ASC was detected, where levels beyond 600 ppm negatively affected water consumption. ASC reduced Salmonella in the upper segment of the digestive tract linearly ($P<0.05$) with increasing concentrations. Levels of ASC to reduce Salmonella in the middle and lower digestive tract segments were >600 and 1200 ppm, respectively. Pre-slaughter inclusion of ASC in the drinking water may be an effective way to reduce foodborne pathogens in poultry.

Key Words: Broilers, Acidified Sodium Chlorite, Salmonella

M286 Changes in intestinal microbiota and ileal susceptibility to pathogen attachment in broilers subjected to 24 hr heat stress. K. B. Selig* and J. A. Patterson, *Purdue University, West Lafayette, IN*.

The intestinal microbiota in chickens can be altered during periods of stress, which may contribute to intestinal susceptibility to pathogen colonization. The objectives of this study were to determine the effect of 24 hr heat stress on the microbial community structure of broilers and the susceptibility of intestinal tissues to colonization by Salmonella enteritidis. Male broilers were raised for six weeks in floor pens, fed standard corn-soybean meal diets and were adapted to normal (74 degrees F) temperatures as part of another study. At six weeks of age, randomly selected birds were subjected to 86 degrees F for 24 hr, then control and heat stressed birds (10 per treatment) were killed by carbon dioxide asphyxiation and intestinal contents and tissues were sampled. Changes in microbial community structure were determined using denaturing gradient gel electrophoresis separation of the V3 region of 16S ribosomal DNA extracted from luminal and mucosal wall associated intestinal bacteria. An in vitro ileal loop assay was used to determine the susceptibility of intestinal tissue to colonization by Salmonella enteriditis. The similarity index of ileal communities from birds within the heat stressed treatment was significantly lower (55% similarity coefficient) than from birds within the control treatment (65% similarity coefficient). The similarity index between heat-stressed and control treatments (41% similarity coefficient) was lower than the similarity indexes within either treatment ($p<0.05$). Salmonella enteritidis attachment to ileal tissues in the in vitro attachment assay was 1.9 fold higher in tissues from heat stressed birds compared to tissues from control birds (8.77 vs. 8.50 log10 cfu/g, respectively; $p<0.05$). The data indicate that stress-induced alterations of the intestinal tract create opportunities for pathogen colonization by altering both the protective microbiota populations and by altering the epithelial susceptibility to attachment.

Key Words: Poultry, Intestinal Microbiota, Salmonella Enteriditis

M287 Case Study: The effect of drinking water treated with KEM SAN^{TM} $_{brand}$ liquid acidifier on the livability of breeder candidates. J. K. Murphy*[1], P. A. Welch[2], and V. J. H. Sewalt[1], [1]*Kemin Americas, Inc., Des Moines, IA,* [2]*Nutritional Services Consulting, LLC, Laurel, MS.*

KEM SAN^{TM}$_{brand}$ liquid acidifier (KEM SAN) is an EPA-registered water sanitizer for the control of bacteria in poultry drinking water. KEM SAN treated drinking water has been demonstrated to improve livability, reduce plant condemnations, and improve feed efficiency in broilers (Welch et al., 2003; 2004). The purpose of this field study was to determine the effect of KEM SAN treated drinking water on the livability of breeder candidates. This study was conducted at a large commercial broiler integrator complex using a Ross 344 male x Cobb 500 slow feathering female strain cross. A 33% stock solution of KEM SAN was administered to the drinking water resulting in a final concentration of 2.58 ml/L of KEM SAN in the treated drinking water. KEM SAN treated drinking water was administered to two houses of pullets and rooster chicks continuously for the first 21 days after placement in the first study and the first 8 days after placement in the subsequent two studies. Mortalities were recorded daily and maintained in an M-Tec flock database. Fourteen-day mortality was calculated for each test flock and results were compared with settlement records of 88 previous and contemporary flocks that were not treated with KEM SAN. Pullet mortality was reduced ($P<0.05$) by 1.10% when chicks were administered KEM SAN treated drinking water for at least the first 8 days following placement when compared to pullets provided untreated drinking water in previous and contemporary flocks. A numerical reduction in mortality was observed in rooster chicks receiving KEM SAN treated drinking water. Results of this study demonstrate that KEM SAN^{TM}$_{brand}$ liquid acidifier administered at a rate of 2.58ml/L to the drinking water of pullets continuously for a period of at least 8 days following placement significantly reduced 14-day pullet mortality.

Key Words: KEM SAN Liquid Acidifier, Pullets, Livability

M288 Comparison of antibiotic resistance frequency of *Salmonella* Typhimurium growth in glucose-limited continuous culture at slow and fast dilution rates. N. Karabasil[1], S. Bulajic[1], W. K. Kim*[2], K. D. Dunkley[2], T. R. Callaway[3], T. L. Poole[3], S. C. Ricke[2], R. C. Anderson[3], and D. J. Nisbet[3], [1]*University of Belgrade, Belgrade, Serbia-Montenegro,* [2]*Texas A & M University, College Station,* [3]*USDA-ARS, FFSRU, College Station, TX.*

The objective of the study was to determine the frequency of spontaneous acquisition of resistance to select antibiotics by *Salmonella* Typhimurium when grown in glucose limited continuous flow culture at slow (D= 0.025 h^{-1}) or fast (D=0.27 h^{-1}) dilution rates. The bacterium was grown in LB minimal medium (pH 6.25) containing no antibiotics. Upon achieving steady state, samples were plated to tryptic soy agar (TSA) alone or supplemented (per ml) with 2 and 16 ug oxytetracycline, 4 and 16 ug tetracycline, 2 and 64 ug kanamycin and 0.25 and 2 ug enrofloxacin. After 24 h incubation at 37C, recovery of *Salmonella* from unsupplemented TSA was 2.3 and 1.6 x 10^9 CFU for slow and fast growing cultures, respectively. Regardless of growth rate, the likelihood of recovering resistant *Salmonella* from the TSA containing the higher antibiotic concentrations was less than 1 in 10^8 for all antibiotics tested. The likelihood of recovering *Salmonella* from TSA containing 2 ug oxytetracline/ml was also less than 1 in 10^8 /ml or 0.25 ug enrofloxacin/ml. Tests of representative isolates from the antibiotic supplemented TSA for their susceptibility to these respective antibiotics, using the NAHMS panel, revealed little if any difference in susceptibilities. Since Salmonella concentrations in the gut rarely exceed 10^6 CFU/g, these results suggest that in recovery of *Salmonella* from TSA supplemented with 4 ug tetracycline/ml was more likely for cells that had been sampled from the faster rather the slower growing culture (1 in 10^6 versus 1 in 10^8, respectively). Recovery of *Salmonella* was much more likely (<1 in 10 regardless of dilution rate) from TSA supplemented with 2 ug kanamycin. These results indicate that alterations in phenotypic expression of resistance appear to not be influenced by flow rate or exposure to lethal or sublethal antibiotic concentrations in this cultivation system.

Key Words: Antibiotic Resistance, *Salmonella* Typhimurium, Continuous Culture

M289 The influence of a fructooligosaccharide (FOS) prebiotic with feed substrates on *in vitro Salmonella typhimurium* growth of laying hen cecal bacteria. L. M. Donalson*[1], W. K. Kim[1], P. Hererra[1], C. L. Woodward[1], L. F. Kubena[2], D. J. Nisbet[2], and S. C. Ricke[1], [1]*Department of Poultry Science Texas A&M University, College Station,* [2]*USDA-ARS, College Station, TX.*

The objective of this study was to investigate the effect of combining a prebiotic with feed substrates on the growth of *Salmonella typhimurium* in an *in vitro* model. Cecal contents from three laying hens were pooled and diluted to a 1:3000 concentration in an anaerobic dilution solution. The cecal dilution was added to sterile test tubes filled with alfalfa and grain with and without FOS. Two controls, inoculum only and no inoculum were used. The samples were processed in the anaerobic hood and incubated at 37°C. Samples were inoculated with *Salmonella* at 0, 6 and 24 hours after *in vitro* fermentation then plated at 0, 6 and 24 hours after inoculation. Plates were incubated for 24 hours then counted. Samples inoculated at 0 hours after *in vitro* fermentation increased in *Salmonella* 64-fold from 0 to 6 hours after inoculation (beginning count 10^7 and 10^9 respectively), however between 6 and 24 hours after inoculation, no further significant increase was observed. *Salmonella* counts for inoculum and no inoculum controls 24 hours after inoculation were significantly lower than other treatments ($P<0.05$). For samples inoculated at 6 hours after *in vitro* fermentation (average initial counts 10^7) *Salmonella* generally grew slowly over time (4.5-fold) with significant differences at 24 hours after inoculation for inoculum and no inoculum when compared to all other treatments. Samples inoculated with *Salmonella* 24 hours after fermentation showed a general decrease of *Salmonella*. At 24 hours after inoculation, grain plus FOS and alfalfa plus FOS samples (average initial counts 10^9) had significantly lower *Salmonella* counts (99.95% and 99.96% respectively). These results show 24 hour *in vitro* cecal fermentation reduced *Salmonella* growth especially when FOS was present.

Key Words: Prebiotic, *In Vitro*, *Salmonella Typhimurium*

M290 Comparison of *Aspergillus* meal or inulin prebiotics as substrates for *Salmonella* or Lactobacilli *in vitro*. G. M. Nava*[1], V. Davila[2], L. Newberry[1], G. Tellez[1], A. M. Donoghue[3], and B. M. Hargis[1], [1]*University of Arkansas, Fayetteville,* [2]*Universidad Nacional Autonoma de Mexico CEIEPA, FMVZ-UNAM. Mexico City 04510,* [3]*PPPSRU/ARS/USDA, Fayetteville, AR.*

The establishment of beneficial microflora, such as Lactobacilli, is believed to be important for intestinal health, possibly promoting immune system development, mucosal development, mucosal integrity, and other functions. Prebiotics, or non-digestible dietary microbial substrates, should hypothetically promote the amplification of beneficial microflora, such as Lactobacilli while not supporting potential pathogens such as *Salmonella*. Presently, we evaluated the specific growth rate (SGR) of *Lactobacillus casei* or *Salmonella enteritidis* (SE) in basal medium supplemented with either 0.2% (w/v) *Aspergillus* meal (AM) or 0.2% (w/v) of inulin. Each medium was inoculated with approximately 1X10 ^{5} cfu/ml of the target bacteria. Two hundred microliters of each inoculated media were transferred to microtiter-plates and incubated for 10 hours at 37 C. Each hour, the SGR of the respective bacterium was evaluated through optical density using a bio-kinetic reader. In experiment 1, AM or inulin supplementation enhanced ($P<0.001$) the propagation of *Lactobacillus* when compared to controls. In Experiment 2, either supplementation with either prebiotic (AM or inulin) significantly ($P<0.001$) reduced SE-SGR when compared to the control without prebiotic. These results suggest that some prebiotic products may specifically enhance the growth of some Lactobacilli believed to be beneficial gastrointestinal microflora while simultaneously reducing the growth of harmful pathogenic bacteria (SE). These results are consistent with several recently published *in vivo* studies with these candidate prebiotics and may suggest a role for *in vitro* screening of other candidates or combinations of putative prebiotics.

Key Words: Prebiotic, *Lactobacillus*, *Salmonella*

M291 Antibiotic, prebiotic and probiotic programs for Salmonella sp. reduction in chicks, pullets, hens and their eggs. A. St. John*[1], B. Love[2], D. Shaw[2], and P. Patterson[1], [1]*Department of Poultry Science, The Pennsylvania State University, University Park,* [2]*Department of Veterinary Science, The Pennsylvania State University, University Park.*

Salmonella sp. can be responsible for food borne illness among people who ingest contaminated poultry meat and eggs. The efficacy of antibiotics, prebiotics and probiotics or products in combination were evaluated by the level of Salmonella reduction in commercial chicks and pullets. Experiment 1 demonstrated that treatment products resulted in a zone of inhibition ranging from 0.0 to 2.5mm on Sensititre plates with Salmonella enteriditis phage type 8 (SePT8). The antibiotic Baytril had the greatest inhibition followed by $CuSO_4$, Gentamycin, Calsporin and four Terpene mixtures ($P<0.05$). Experiment 2 determined the appropriate SePT8 dose for chicks with recovery and titration in liver, spleen, duodenum, ceca and colon. From this study it was determined that a dose of 0.20ml with 2.0 x 10^9CFUs/mL was sufficient for a systemic infection to reach all organs. Experiment 3 evaluated promising prebiotics, probiotics and antibiotics for chicks challenged with SePT8. In four trials, the products demonstrated a range of SePT8 reduction in tissues from 21.1% to 98.0% compared to positive controls. Feed intake was not significantly impacted by any of the dietary or drinking water additives ($P>0.05$). The final experiment evaluated the most promising treatments in 17 and 19 wk old pullets as well as 21 wk old hens. Initial results demonstrated that Baytril, Calsporin, and Terpenes-B and -PL effectively reduced SePT8 in all tissues from 10.3% to 99.8%. In both the 17 and 19 wk studies, all products including the positive and negative controls had no culturable SePT8 in ovarian tissue. In the hen study, tribasic copper chloride and Primalac eliminated SePT8 in all tissues samples, while Terpene-B and Immunomilk reduced SePT8 in tissues from 8.8% to 99.9%. Egg pools from hens during the 7d post inoculation phase were all negative for SePT8. This study identified promising prebiotics, probiotics and antibiotics that reduce the level of SePT8 in commercial Leghorn chicks, pullets, hens and their tissues.

Key Words: Prebiotic, Probiotic, Salmonella Enteritidis

M292 Evaluation of alternative host bacteria as vehicles for oral administration of bacteriophages. L. R. Bielke*, S. E. Higgins, K. L. Guenther, G. I. Tellez, and B. M. Hargis, *University of Arkansas, Fayetteville.*

Survival of bacteriophages (phages) through the upper gastrointestinal tract (GIT) is essential for treatment of enteric infections. Few phages survived the upper GIT of chicks when administered without protection (> 6 log reduction). We selected alternative host bacteria (AHB) that would support amplification of our *Salmonella enteritidis* (SE) phages, and infected these AHB prior to administration by either oral gavage alone or with supplemental administration in the drinking water (DW). Phages (9 log pfu) with AHB (100X dilution of turbid culture) were incubated (10 min) prior to administration. Phages from cecal contents were enumerated using SE overlay plates to determine GIT survival. Wild-type phage isolates WHR8 or WHR10 were individually evaluated in Exp 1. Cecal contents were obtained at 6, 26, or 77 h post-gavage. At 6-h, 7.63 and 7.71 log pfu were recovered when phage was administered via oral gavage only or with supplemental administration in DW, respectively. By 77-h, phage recovery was 2.77 and 1.88 log. Recovery of WHR10 at 6-h was 5.75 log when administered via oral gavage only, additional administration in DW did not increase phage recovery. At 77-h, no detectable phages were recovered in the gavage only group, but 1.97 log were detected when phage and AHB were added in DW. In Exp 2, only WHR10 was evaluated. Phages were administered by gavage alone (G1), combined with AHB and administered by oral gavage only (G2), oral gavage + AHB in DW at 6.35 log/mL (G3) or 5.35 log/mL in DW (G4), or phage + AHB by oral gavage every 12-h (G5). In G1, 4.73 log phages were recovered at 6-h and 1.54 log phages were detected at 72-h. In G2, 5.33 log were recovered at 6-h, and by 72-h, no phages were detected. Addition of phages and AHB in DW (G3 and G4) had no effect on phage recovery when compared to G2. After an initial recovery of 2.36 log in G5, the number of recovered phages remained constant for 72-h. Further selection of AHB and acid-resistant phages may increase the efficacy of phage treatments for *Salmonella* infection.

Key Words: Bacteriophage, Chickens, *Salmonella enteritidis*

M293 Effects of nitrocompounds and feedstuffs on *in vitro* methane production in chicken cecal contents. S. Saengkerdsub*[1], W. K. Kim[1], T. R. Callaway[2], R. C. Anderson[2], D. J. Nisbet[2], and S. C. Ricke[1], [1]*Texas A & M University, College Station,* [2]*USDA, Agricultural Research Service, Southern Plains Agricultural Research Center, College Station, TX.*

The ceca are the primary site for anaerobic microbial fermentation in chicken. One of the end products of this process is methane. The objective of this study was to examine effects of feedstuff and nitrocompounds on methane production in *in vitro* incubation with laying hen cecal contents. Cecal contents from laying hens were diluted to a 1:20 concentration with anaerobic dilution solution. The cecal dilution was added to serum tubes containing alfalfa or layer feed. There were four treatments: control, 12 mM nitroethane, 12 mM nitroethanol, 12 mM 2-nitropropanol. The samples were incubated at 37 C for 24 hours under CO_2 and H_2 (50:50) gas mixture in closed tubes with 120 mM sodium formate. In alfalfa supplementation, methane production was reduced 99.7 ± 0.0, 99.2 ± 1.0, and 46.6 ± 9.9% ($P < 0.05$) when nitroethane, nitroethanol, and 2-nitropropanol were added, respectively, compared to controls (59.1 ± 5.3 μmol/g cecal content). Similar to providing alfalfa, methane was reduced 99.0 ± 0.1% in treatments incubated with added feed plus nitroethane or nitroethanol when compared to controls (19.1 ± 1.6 μmol/g cecal content). However, methane production increased 6 and 2 times ($P < 0.05$) due to alfalfa and feed, respectively. The results indicate that nitroethane and nitroethanol inhibit *in vitro* methane production; conversely, alfalfa and feed promote methane generation in cecal contents of chicken.

Key Words: Methane, Nitrocompound, Microbial Ecology

M294 Incidence of *Clostridium perfringens* in yolk follicles of broiler breeder hens. G. R. Siragusa*[1], N. A. Cox[1], J. S. Bailey[1], L. J. Richardson[1], R. J. Buhr[1], K. L. Hiett[1], D. E. Cosby[1], J. L. Wilson[2], and D. V. Bourassa[2], [1]*USDA-ARS, Russell Research Center,* [2]*Department of Poultry Science, University of Georgia, Athens.*

Subtypes of *Clostridium perfringens* are a major cause of human food borne gastroenteritis as well as the poultry disease necrotic enteritis. The natural presence of C. *perfringens* in individual mature and immature yolk follicles and the homologous ceca from 66 and 60 week old broiler breeder hens were determined from two different commercial facilities. In accordance with humane animal treatment guidelines, hens were transported for overnight holding and processing at the University of Georgia. Using extraordinary measures to reduce external as well as cross contamination, immature/mature yolk follicles and the corresponding ceca were aseptically removed. Samples were placed into individual stomacher bags, and immediately transported to our laboratory for within-the-hour analysis. Analytical determinations were based on non-selective enrichment culture followed by both cultural and PCR based tests. In the first trial, C. *perfringens* was detected and isolated from all ceca (n=8) and from only a single immature follicle (1 of 8) and from none of the mature egg follicles (0 of 8). In the second trial, C. *perfringens* was detected in 11 of 12 ceca, and from none of the immature or mature yolk follicles. At this stage, based on the low follicular-derived isolation rate of C. *perfringens*, observed in this limited sized study, it appears that the ovary section of the reproductive tract is not a particularly major source of C. *perfringens*. However, this evidence does not exclude the potential for the other segments of the hens reproductive tract nor the contribution of rooster semen as a harborage or source of C. *perfringens*. For the extent of the reproductive tract as a reservoir for C. *perfringens* to be more fully understood, trials during overt instances of necrotic enteritis and from drug-free facilities will be performed over different seasons. The genotypic comparison of the cecal-immature follicle paired isolates of C. *perfringens* is ongoing.

Key Words: Clostridium Perfringens, Broiler Breeder Hens, Yolk Follicles

M295 Response of broilers to graded levels of sodium chlorite and citric acid in water. P. Mohyla*[1], S. F. Bilgili[1], C. C. Warf[2], and G. K. Kemp[2], [1]*Aubrun University, Auburn, AL,* [2]*Alcide Corporation, Redmond, WA.*

Acidified sodium chlorite (ASC; SANOVA) is a highly effective sanitizer, currently approved for product-contact use in poultry processing. ASC is formed by combining sodium chlorite (SC) and citric acid (CA). The

in vivo efficacy of ASC against foodborne pathogens has not been assessed. This study was conducted to evaluate the tolerance of birds to graded levels of SC and CA administered in the drinking water. A total of 320 broilers, at 35 days of age, were randomly allocated to 64 pens (5 birds/pen). Water treatments consisted of 8 concentrations of SC (0, 0.012, 0.03, 0.06, 0.12, 0.3, 0.6 and 1.2%) and 8 concentrations of CA (0, 0.003, 0.01, 0.02, 0.04, 0.08, 0.18 and 0.4%). All solutions were prepared and replaced twice a day. Water intake, feed consumption, weight gain, and mortality were monitored during the seven day experimental period. No significant ($P>0.05$) differences were detected in mortality during the experiment. CA levels of up to 0.4% did not affect live performance. Whereas, SC concentrations above 0.12% significantly lowered weight gain and feed consumption. Linear and quadratic response to daily and 7-day water consumption was observed for graded levels of CA and SC in the water. Overall, concentrations of up to 0.02% of CA stimulated water consumption and may actually have a positive effect on feed efficiency ($P<0.05$). SC concentrations beyond 0.06% negatively affected live performance and water intake ($P<0.05$).

Key Words: Citric Acid, Sodium Chlorite, Performance of Broiler

M296 Effect of high flow rate nipple drinkers on the performance of 21 d old male broiler chicks. W. B. Roush*[1], B. D. Lott[2], and S. L. Branton[1], [1]*USDA-ARS Poultry Research Unit, Mississippi State, MS,* [2]*Poultry Science Department, Mississippi State, Mississippi State*.

Two trials were conducted to examine three week production effects of providing water to broiler chicks with bell and two nipple drinker treatments with low (week1: 30ml/min; week 2: 40ml/min and week 3: 50ml/min or continuous high (120 ml/min) flow rates. In each trial, 80 male chicks were placed on litter in each of nine environmental chambers. Each treatment was replicated in three environmental chambers. Temperature was 32 degrees C for the first week and reduced by 2.6 degrees C weekly. Starter diets, provided as crumbles, and water were provided for ad libitum consumption. Light was continuous. Water consumption was recorded at 6 hour intervals. Bird weights, feed consumption and litter moisture for each chamber were determined weekly. Litter samples for moisture determination were collected in a 1 foot radius of the drinkers. Statistical significance was considered at $P = 0.05$. There were no significant differences in the weight gain for the first two weeks. At week 3 the weight gains for broilers on the bell drinker were significantly larger (469 g) than the birds on low (455.7g) or high flow (451.0g) drinker treatments. Feed conversion during the first week was significantly improved for birds drinking from high flow drinkers; however, there were no differences in feed conversion for the second or third weeks. There was no difference for water usage between bell (121.1 ml/bird) and high flow (121.5 ml/bird) drinkers with a significantly lower usage (109.4 ml/bird) for low flow drinkers. There were no treatment differences in litter moisture or percent livability.

Key Words: Broiler, Nipple Drinkers, Bell Drinkers

M297 Turkey strain effects on commercial turkey tom and hen performance. J. L. Grimes*[1], A. N. Crouch[2], P. R. Ferket[1], A. G. Gernat[1], J. L. Godwin[1], and R. Neely[1], [1]*Dept. of Poultry Science, N. C. State University, College of Agriculture & Life Sciences, Raleigh, Dept of Poultry Science, Raleigh, NC,* [2]*B.U.T.A, Lewisburg, WV*.

The effect of strain on turkey performance was examined. Birds of four strains (males and females) from two primary breeders (B3,B2,N88,N85) were reared in a curtain-sided house with 96 pens (6.2 sq m per pen). Fifty tom or 66 hen poults were placed, on day of hatch, in each of 48 pens on one end the house in a randomized complete block design to provide 6 pens per strain and sex for a total of 1200 toms (300 per strain) and 1600 hens (400 per stain). There were 4 rows of pens with 12 pens per row. One row of pens served as a block. Two blocks were used for toms and two for hens. At five weeks of age, each pen of birds was evenly split. One half remained in the original pen while the other half was placed into a pen at the other end of the building. The same experimental designed was used on both ends of the building. Feed was provided by a commercial mill. Feed consumption (by pen) and mortality were monitored. Feed conversion ratios (FC) were calculated. Birds were weighed at 5, 10, and 15 wk. Toms were weighed and processed in a commercial processing plant at 144 d while the hens were weighed and processed at 147 d. Carcass yield was determined for P. major, P. minor & total breast meat for four pens of toms and three pens of hens per strain. The pen was the experimental unit and data were analyzed by regression ($P<0.05$). At market age, B3 toms were heavier than B2 while both were heavier than N88 or N85 (22.1^a, 21.5^b, 20.6^c, and 20.1^c kg, sem=0.20). At 15 wk, B3 hens were significantly heavier than B2, N88 or N85 hens (9.4^a, 9.0^b, 9.0^b, and 8.9^b kg, sem=0.07) At market age, B3 hens were the heaviest followed by B2, N88, and N85 (14.2^a, 13.6^b, 13.2^{bc}, and 13.1^c kg, sem=0.13). Neither Toms (FC=2.60, sem=0.04) nor hens (FC=2.64, sem=0.05) differed in FC at market age. B3 (5.8 kg) and B2 (5.7 kg) toms produced more breast meat than N88 (5.2 kg) or N85 (5.3 kg) toms but had increased relative breast meat yield only when compared to N88 toms. B3 (3.7 kg) and B2 (3.65 kg) hens produced more breast meat than N88 (3.4 kg) or N85 (3.4 kg) hens but only B3 hens had a greater relative breast meat yield. In conclusion, tom and hen turkeys performed differently due to strain under the conditions of this study.

Key Words: Turkey, Performance, Strains

M298 The effect of vitamin C supplementation to breeder hens and light during incubation on embryonic development and hatchability. T. El-Sheikh*[1], N. Makled[2], and A. El-Gammal[2], [1]*Faculty of Agriculture, South Valley University, Sohag, Egypt,* [2]*Faculty of Agriculture, Assuit University, Assuit, Egypt*.

A total number of 500 Dandarawi laying hens were divided randomly into two groups of 250 each, the first was fed basal diet supplemented with 200 grams of vitamin C per ton, while the second was kept as a control. A total of 4200 hatched eggs representing vitamin C supplemented and unsupplemented groups. The eggs from each group were classified into seven treatments as follows: 1- The eggs were subjected after setting to 24 L:0D for 18 days and then darkness during the last three days. 2-The eggs were subjected to 24 L:0D for 12 days of incubation period. 3- The eggs were subjected to 24 L:0D for 6 days. 4-The eggs were subjected to 0L:24 D during all incubation period. 5-The eggs were subjected to 12L:12D for 18 days. 6-The eggs were subjected to 12L:12D for 12 days of incubation. 7-The eggs were subjected to 12L:12D for 6 days of incubation.The relative embryo weight to initial egg weight,chemical composition of embryos, hatchability, embryonic viability and incubation period were measured. Embryos from eggs subjected to different systems of illuminations were heavier than those from eggs which were unilluminated. The eggs incubated under 24L:0D had heavier embryos than those incubated in 0L:24D, while those incubated under 12L:12D had intermediate weighs. The moisture content decreased by age of the embryo and increased by vitamin C supplementation. Also, it decreased by the increase in photoperiod and by the time of exposure. Protein content decreased by age in all treatments and increased by vitamin C addition. Also, it increased by the increase in photoperiod and time of exposure. Fat content increased as the age of embryo increased. Vitamin C addition led to significantly increase in the fat content at all ages. Continuous light caused an increase in embryonic mortality than those of 12L:12D and 0L:24D lighting program.The overall percentage of dead embryos (based on fertile eggs) was 3.23, 2.9 and 1.9 % for 24L:0D, 12L:12D and 0L:24D, respectively. Total embryonic mortality increased as the time of light exposure increased. Eggs incubated in 24L:0D had lower hatchability than that of their control and 12L:12D.

Key Words: Dandarawi Embryo Development, Incubation Light, Vitamin C

M299 Evaluation of different means of feeding corticosterone to broilers to elicit a stress response. W. S. Virden*[1], C. D. Zumwalt[1], J. P. Thaxton[1], S. L. Branton[2], and M. T. Kidd[1], [1]*Mississippi State University, Mississippi State,* [2]*United States Department of Agriculture*.

Glucocorticoid hormones such as corticosterone (CS) are necessary to facilitate the catabolism of protein and fat to produce glucose for energy during stress. If excessive levels of blood CS are maintained, detrimental effects on growth can occur due to excessive turnover of body tissue for gluconeogenesis. Two experiments (Exp) were conducted to determine the effects of feeding CS on broiler performance using two methods at different ages. In Exp 1, Ross 308 male chicks were placed in floor pens and received either a control diet, or a diet containing 5 mg/kg of CS suspended in soybean oil (2 treatments, 24 replications) during the prestarter period (d 1 to 7). From d 8 to 21, chicks received common starter diets containing no CS. A factorial array of diet (high or low

nutrient density (ND) fed from d 1 to 42) and CS (0 or 20 mg/kg of diet in ethanol administered from d 18 to 21) was used to evaluate performance of Ross 308 chicks in Exp 2. In Exp 1, chicks receiving CS had decreased ($P < 0.05$) BW gain, feed intake, and livability from d 0 to 21. In Exp 2, CS and ND interacted ($P < 0.05$) to affect feed intake from d 0 to 34, as broilers fed diets containing high ND and CS had higher feed intake than broilers fed low ND and CS. From d 0 to 21 and d 0 to 42 feed intake was decreased ($P < 0.05$) in broilers fed CS. Dietary ND improved ($P < 0.05$) BW gain in all periods, but only overall feed conversion. Dietary CS decreased and increased ($P < 0.05$) BW gain and feed conversion, respectively, from 0 to 21, 0 to 34, and 0 to 42 d. Subsequent experimentation is underway to evaluate blood profiles and chemistry of broilers to correlate findings to the results presented herein.

Key Words: Broiler, Corticosterone, Stress

M300 The impact of egg weight on hatchability, chick weight, chick length, and chick weight to length ratios. J. J. Lawrence*, A. D. Gehring, A. D. Kanderka, G. M. Fasenko, and F. E. Robinson, *Department of AFNS, University of Alberta, Edmonton, Alberta, Canada*.

The objective of this study was to examine the effects of egg weight on hatchability, and hatched chick and two week old broiler growth parameters. Broiler hatching eggs (n=900) were obtained from a 43 wk old Cobb 500 FF commercial flock. Eggs (n=300) from three weight ranges (Small (S):6063g; Average (A):6065g; Large (L):70-73g) were incubated then candled at 7 and 14 days to remove and break open any eggs with non-viable embryos. Eggs remaining at 18d were weighed and transfered into pedigree hatch baskets. At 21.5d all saleable chicks were neck tagged, weighed, and chick length measured. Eleven groups of 20 chicks for each egg weight range were randomly allocated to one of 33 cages and provided with feed and water ad libitum. At 14 d of age the birds were weighed and body and shank length measured. The data were analyzed using the GLM procedure of SAS® and probability assessed at $P \leq 0.05$. Egg, chick, and two week broiler weights were significantly different between the egg weight groups (Segg=61.8±0.1g; Aegg=66.5±0.1g; Legg=71.3±0.1g; Schick=43.0±0.1g; Achick=46.4±0.1g; Lchick=49.9±0.1g; S2week=264±0.7g; A2week=281±0.7g; L2week296±0.7g). Hatchability of fertile eggs was lowest in the L (81.8±2.0%) compared to the S (92.4±2.0%) and A groups (89.4±2.0%) which did not differ from one another. This was due to a higher incidence of culled chicks from the L (12.2±1.6%) versus the A (5.1±1.6%) or S (2.8±1.6%) groups, which did not differ from eachother. Chick and two week broiler lengths (Schick=185±0.3mm; Achick=188±0.3mm; Lchick=191±0.3mm; S2week=311±0.7mm; A2week=316±0.7mm; L2week=326±0.7mm) and weight to length ratios (Schick=0.233±0.001; Achick=0.247±0.001; Lchick=0.261±0.001; S2week=0.848±0.001; A2week=0.888±0.001; L2week=0.907±0.001) were also significantly different between all three egg weight groups. These data support previous research showing that chick weight is dependent upon egg weight at setting, and also provide new data on the relationship between egg weight and chick length.

Key Words: Egg Weight, Hatchability, Chick Weight to Length Ratios

M301 Detection of early changes in fertile eggs during incubation using a hyperspectral imaging system. D. P. Smith*[1], J. M. Mauldin[2], K. C. Lawrence[1], B. Park[1], and G. W. Heitschmidt[3], [1]*USDA, ARS, Russell Research Center, Athens, GA,* [2]*Department of Poultry Science, University of Georgia, Athens,* [3]*Biological and Agricultural Engineering, University of Georgia, Athens*.

Detection of fertility prior to incubation or the recognition of development during the first 3 days of incubation could benefit hatcheries, as they could remove infertile or non-developing eggs before investing significantly in incubator space and utilities, or risking contamination from "exploding" eggs. This study was conducted to determine the feasibility of using a hyperpsectral imaging system (CCD detector, spectrograph, lens assembly, and software) to detect changes in incubated eggs related to fertility and development. For each of two replicate trials, 48 unincubated SCWL eggs were obtained from a commercial hatchery, incubated, and then 12 eggs were removed and imaged on each of days 0, 1, 2, and 3 (n=96). Hypercube images were collected on each egg (wavelengths from approximately 400 to 900 nm) using tungsten-halogen backlighting with a 30 millisecond exposure time. Eggs were then broken out for confirmation. A ratio of transmittance images at two different wavelengths, (found to optimize detection of blood in eggs during a preliminary experiment) was used to detect blood ring formation. On day 3, 23 of 24 eggs were determined fertile by breakout; the hyperspectral imaging system accurately classified the one infertile egg and 22 of the 23 fertile eggs. The blood ring was not detected on days 0 or 1, and not consistently on day 2. Insufficient light transmission for one fertile egg prevented its classification. The hyperspectral imaging system appears capable of detecting fertile egg development based on blood ring formation on day 3 of incubation.

Key Words: Egg Fertility, Embryo Development, Hyperspectral Imaging

M302 Broiler litter sampling procedures. A. S. Tasistro, C. W. Ritz*, and D. E. Kissel, *University of Georgia, Athens*.

Sampling procedures are critical in broiler litter analysis for appropriate nutrient management planning efforts and to minimize the spatial variability of nutrient concentrations influenced by conditions such as litter moisture content and waste feed. There is a need for practical alternatives that help obtain representative samples and that simultaneously allow enough time to receive and apply the analytical results. Litter from a commercial broiler house was sampled in two ways: 1) Thirty samples were taken based on a grid that incorporated sampling points around the feeders, waterers, and center of the house), and 2) Five samples were taken from trenches dug from the center of the house to the sidewall. The number of sub-samples needed to have mean estimates for each elemental litter component within specified limits of statistical accuracy were estimated using conventional statistical procedures and computer intensive random resampling procedures. The mixing of litter material associated with trench sampling reduced the variability in the concentrations of all elements analyzed, and resulted in a reduction in the number of sub-samples needed to attain comparable levels of statistical accuracy. Specific for nitrogen (N), the Coefficient of Variation of N concentrations in samples from the grid and trenches were 17 and 6 %, respectively. The number of sub-samples needed to estimate the mean N concentration within 15% of the experimental mean 95% of the time when sampling by taking individual floor samples and digging trenches were 6 and 2, respectively.

Key Words: Broiler Litter, Sampling, Composition

M303 Effects of organic acid on control of bacteria growth in drinking water for broilers. G. M. Pesti*[1], R. I. Bakalli[1], P. F. Vendrell[2], and H.-Y. Chen[3], [1]*Department of Poultry Science, University of Georgia, Athens,* [2]*Agricultural and Environmental Services Laboratories, University of Georgia, Athens,* [3]*Kemira Oyj Helsinki, Finland*.

A total of 664 male Cobb birds were used to evaluate the effect of an organic acid product AMMFOR-pH on the control of microbial growth in drinking water. AMMFOR-pH is a formic acid based product, which is partially ammoniated for improving handling characteristics. One-day-old birds with an average body weight of 40 g were randomly assigned to one of four pens. There were two water treatments, control and experimental (with added AMMFOR-pH at 0.01%). Birds in both treatments were fed the same commercial broiler diets. There were 12 bell drinkers in total, three bell drinkers per pen. Water consumption and pH and bird mortality in each pen were recorded daily. Water samples were taken from all drinkers three times a week for five weeks, and were analyzed for pH, *E. coli* and total enterococcus counts. All birds were weighed on days 0 (43 vs. 43 g), 18 (715 vs. 707 g), and 35 (2117 vs. 2146 g for control and AMMFOR-pH treated birds, respectively). Feed consumption was measured on days 18 (928 vs. 932 g) and 35 (3301 vs. 3310g) and feed conversion ratios (FCR) were calculated. From 0 to 18 days and from 0 to 35 days FCR (1.380 vs. 1.405, and 1.592 vs. 1.574 kg feed/kg gain) were very similar. In the AMMFOR-pH treated group, water pH rose from 3.68 to 5.45 after 24 hours, compared to an average of 7.06 in the control group. The changes in water pH resulted from contaminations of feed and litter materials. Water consumption and bird mortality were not significantly different between the control and AMMFOR-pH treated groups. *E. coli* and total enterococcus were reduced by 49% and 56%, respectively, in drinking water treated with AMMFOR-pH, compared with the control. The results of this study suggest that incorporation of AMMFOR-pH in drinking water for broilers improves the hygienic quality of drinking water by inhibiting the

growth of bacteria, and may reduces contamination of bacteria in broiler chickens.

Key Words: AMMFOR-pH, Broiler, Drinking Water

PSA-Extension/Instruction

M304 Development of a quality control laboratory design project for poultry science undergraduate students enrolled in an advanced food microbiology course. R. S Hardin*, M. M. Kundinger, C. L Woodward, L. M Donalson, J. L Golbach, and S. C Ricke, *Department of Poultry Science, Texas A&M University, College Station*.

With the ever-increasing demand for problem solving skills in todays poultry workforce, more emphasis is needed on integrated training at the undergraduate level. An exercise for designing a quality control laboratory was developed as a laboratory group project in a senior level undergraduate advanced food microbiology course taught in the poultry science department at Texas A&M University. The assignment was based on the students designing their own laboratory and implementing testing methods for different types of bacteria known to cause foodborne illness. They were responsible for determining what equipment was needed for their specific pathogen as well as general supplies and materials required for setting up a fully equipped laboratory. Individual research papers were required of each student midway through the semester to gain a sufficient background on the pathogen; including discussion of the importance, detection methods, and the prevention and control of the pathogen assigned to their group. In each of the laboratory sections students were separated into groups of four students who were then responsible for a group project report. At the end of the semester the group report was required to include a lab diagram indicating where equipment would be placed as well as a comprehensive budget including a list of prices needed to set up the laboratory designed by the group. The group project report was also required to contain justification for specific equipment and materials requested, based on the pathogen and scenario given to the groups discussed where samples would be taken from, how often samples would be taken, as well as what isolation methods would be used. Students were also required to develop waste management procedures to handle all possible biohazard materials. Successful completion of the project provided students with problem solving skills essential for the poultry industry.

Key Words: Food Microbiology, Review Paper, Quality Control Laboratory Design

M305 Student understanding of molecular genetics concepts. B. S. Walters* and T. J. Buttles, *University of Wisconsin, River Falls*.

The purpose of this study was to increase student understanding of molecular genetics concepts. Current students in colleges of agriculture will be entering a world shaped by biotechnology. Applications of biotechnology such as genetically modified crops have been adopted at a rate greater than any other technology in the history of agriculture. Animal applications of biotechnology are also on the rise and raise additional ethical questions. DNA transcription, RNA translation, and protein structure development all play a key role in modern applications of biotechnology. An understanding of these processes lays the foundation for understanding the bigger picture of biotechnology applications in agriculture. The goals of this Scholarship of Teaching and Learning project were to first identify students' background knowledge and then to evaluate the effectiveness of different instructional approaches in increasing student understanding. The starting point for the project was to determine the level of understanding students brought to the course. Students were given the opportunity to complete a short questionnaire asking for related course information (completed or in-progress: Introductory Biology, Animal/Plant Genetics, Animal/Plant Breeding, Introduction to Biotechnology) and definitions of 5 terms (messenger RNA, transfer RNA, ribosomal RNA, transcription, translation). Nearly all students had completed Introductory Biology and at least one additional course that included molecular biology concepts. Despite this background, few students could correctly define all 5 terms. Based on these findings, classroom activities were developed where students examined the core molecular genetics concepts from a variety of perspectives.

Key Words: Undergraduate Education, Teaching, Biotechnology

M306 What does the poultry industry want when recruiting undergraduates? - an ongoing perspective survey to evaluate the importance of certain employable skills to the poultry industry. K. M. Downs*[1], J. E. Mehlhorn[2], J. B. Hess[3], and J. L. Wilson[4], [1]*Middle Tennessee State University, Murfreesboro,* [2]*The University of Tennessee at Martin, Martin,* [3]*Auburn University, Auburn, AL,* [4]*The University of Georgia, Athens*.

A survey instrument was developed to assess personality traits and competency levels important to poultry managers for achieving success in the poultry industry. Twenty questions seek to evaluate the importance of personality characteristics and subject matter competencies sought in new employees. Remaining questions evaluate the importance of seven common industry recruitment efforts. A Likert scale (1=unimportant to 5=critically important) is used to quantify responses, and managers in all phases of broiler and table egg production are targeted. Surveys are mailed with an explicative cover letter, self-addressed stamped envelope, and appreciation gift. At present, personnel in TN, AL, and GA have been targeted; however, to strengthen statistical inferences, administration will continue.

Response rate is currently 52.3%. Most managers completing the survey classified themselves as working in the processing (36%), live production (23%), or HR (19%) sector. To date, respondents (n=23) indicate the five most important characteristics for employment success are integrity (4.87), teamwork (4.83), adaptability (4.39), problem-solving (4.39), and oral communication (4.39). Conversely, the five least important parameters were undergraduate major (2.74); knowledge of foreign language (2.83), basic science (2.83), or computer hardware (2.87); and previous work experience (2.91). Respondents evaluated the most effective recruitment tools to be departmental career fairs (3.64) and informal university contacts (3.64). Trade publications (2.48) and on-line job sites (2.40) were considered the least beneficial for recruitment.

Developing aptitude in team building, problem-solving, and oral communication should be priorities in undergraduate education. Furthermore, fostering strong industry ties should be a significant objective of those in academia to more effectively place students in the poultry industry. This collaborative work is ongoing.

Key Words: Undergraduate Education, Recruitment, Poultry Industry

Milk Protein and Enzymes: Dairy Foods

M307 Exploring the structure and dynamics of labeled β-lactoglobulin using high field NMR spectroscopy. P. J. B. Edwards[1], G. B. Jameson[1], G. E. Norris[2], T. S. Loo[2], K. A. N. S. Ariyaratne[1], D. Uhrín[3], P. N. Barlow[3], and L. K. Creamer*[4], [1]*Institute of Fundamental Sciences,* [2]*Institute of Molecular Biosciences,* [3]*Edinburgh Protein Interaction Centre,* [4]*Fonterra Research Centre*.

Bovine β-lactoglobulin (BLG) is the major whey protein and dominates the effects of heat and pressure on the structure and disulfide bonding of this protein. The two common genetic variants, BLG A and BLG B, behave quite differently in their reactions. For example, BLG A is more readily hydrolyzed and easier to heat denature than BLG B. The X-ray crystal structures do not show any features that could explain this behavior and consequently an extensive project was initiated to resolve this question. A polynucleotide was synthesized and expressed to give fusion proteins, corresponding to both the A and B variants. These were subsequently cleaved to obtain synthetic BLG A and BLG B. Addition of 15N and/or 13C nutrients to the growth media allowed labelled proteins to be made and these have been used to confirm the previously