

ABSTRACTS
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SYMPOSIA AND ORAL SESSIONS

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Physiology and Pathology
Room: B312

M1 Comparison of delayed type hypersensitivity reaction induced in chickens, turkeys and ducks by killed *Staphylococcus aureus*. O. A. Oladele*, A. A. Owoade, and T. O. Jolaoso, *University of Ibadan, Ibadan, Oyo State, Nigeria*.

Differentials in susceptibility of poultry species to a number of avian pathogens prompted the comparison of innate cellular immune response of chickens, turkeys and ducks via the assessment of delayed type hypersensitivity (DTH) reaction in these species. Delayed footpad reaction (DFR) to killed *Staphylococcus aureus* was adopted for this study.

Twelve broiler chickens, 16 turkeys and 8 ducks were sensitized twice via subcutaneous injection in the neck of *S. aureus* antigen (150µg) mixed 1:1 with Complete Freund Adjuvant (CFA) at 3 and 4 weeks of age. Control birds were injected with CFA only. At 6 weeks of age the birds were challenged intradermally with *S. aureus* antigen (75µg/bird) in Phosphate Buffered Saline (PBS) in the right footpads while the left footpads were injected with PBS only. The thickness of the footpads was measured at 0, 5, 12, 24, 48 and 72 hours (hrs) post challenge (pc) to evaluate DFR. At 72 hrs pc birds were euthanized and both footpads were excised for histopathology. In a second experiment spleens from both sensitized and non-sensitized broilers were separately harvested aseptically; splenic lymphocytes (SL) were prepared and injected intravenously into 2 groups of recipient broilers.

Average DFR values obtained in sensitized birds were generally higher than in non-sensitized birds and was statistically significant ($P \leq 0.05$) between 24 and 72 hrs pc in chickens and at 12 hrs pc in turkeys. While maximum DFR response was at 24 hrs pc in broilers it was at 12 hrs in both turkeys and ducks. At histopathology the killed *S. aureus* injected footpads were characterized by dermal oedema, congestion of blood vessels and perivascular infiltration of lymphocytes and macrophages. Broiler chickens that received sensitized SL had a significantly pronounced DFR following challenge with *S. aureus* antigen in comparison with those that received non-sensitized SL.

This study has shown that while turkeys and ducks have innate ability to elicit faster cellular immune response to *S. aureus* antigen

than chickens, chickens have the innate ability to respond more intensely.

Key Words: Innate cellular immunity, DTH reaction, Chickens, Turkeys, Ducks

M2 Effects of luteinizing hormone, follicle stimulating hormone, 17 β -estradiol or testosterone upon ghrelin receptor mRNA expression in cultured granulosa cells. M. E. Freeman* and A. J. Davis, *University of Georgia, Athens*.

Nutritional status and reproductive function are intricately connected. However, the complex hormonal interactions defining how nutrition effects reproduction have yet to be clarified. Ghrelin is a novel polypeptide hormone produced predominantly in the proventriculus of chickens that effects feed intake and energy metabolism. There is increasing evidence that ghrelin also directly affects reproduction in mammalian species. Previously we reported that ghrelin receptor (GHSR) mRNA was expressed in both the theca and granulosa cells of developing follicles of the ovary and that theca mRNA expression of GHSR increased significantly in fasted hens. In the current research the gonadotropin and steroid hormone regulation of GHSR mRNA expression was examined. For each replicate experiment granulosa cells were isolated from the F₁ and F₃ follicles and small yellow follicles (SYF) from three hens. The isolated and dispersed granulosa cells were then cultured for 24 hours in the absence or presence of 50 ng/mL of LH or FSH (5 replicate experiments) or in the presence or absence of 1 x 10⁻⁶ M of testosterone or 17 β -estradiol (4 replicate experiments). For each experiment, total RNA was extracted from the freshly dispersed granulosa cells and the cultured granulosa cells from each follicle size for two step real-time PCR analysis of GHSR. Untreated, cultured granulosa cells from all follicle sizes had significantly greater expression of GHSR than freshly dispersed granulosa cells. In the cultured granulosa cells isolated from the F₁ and F₃ follicles the addition of LH, FSH and testosterone, but not 17 β -estradiol, significantly decreased the mRNA expression of GHSR. In the granulosa cells isolated from SYF, expression of GHSR was

equal in the untreated control cells and the cells cultured with any of the hormones. The lower expression of GHSR in the presence of gonadotropins and testosterone indicate that these hormones may play a vital role in down-regulating GHSR expression in the granulosa cells of hierarchal preovulatory follicles.

Key Words: Ghrelin receptor, Granulosa, Gonadotropin, Steroid

M3 Compensatory changes to induced anemia in broilers. L. L. Hale-McWilliams*, Z. Williams, M. Putsakum, S. W. Anderson, and J. P. Thaxton, *Mississippi State University, Mississippi State.*

Experiments were conducted to evaluate compensatory changes to induced anemia in broilers in 4 wk-old broilers. Five treatments were used and these were non-bled and bled controls plus bled controls that received iv injections of saline (SAL), chick embryo extract (CEE) or anemic chick serum (ACS). The CEE extract was prepared by pooling 200, 10 d broiler embryos in 10 mL of PBS, homogenizing the embryos using a Stomacher blender, and then filtering the homogenate at 0.4 mmic. The ACS was prepared by collecting serum from 4 wk old chicks that were subjected to severe anemia by multiple bleedings. Additions of 7 mL (iv) of SAL, CEE, and ACS were made immediately after a 10% blood loss (v/BW basis). Thereafter, birds were bled at 5 min, 2 h, 24 h and 72 h to assess pH, pCO₂, pO₂, hematocrit, hemoglobin, electrolytes (Na⁺, K⁺, Ca²⁺, Cl⁻, and HCO₃⁻), anion gap, and plasma corticosterone. The spleen and bone marrow samples were also evaluated for relative weight and hemoglobin levels. Results suggest that homeostatic regulation of acid-base balance were achieved within 72 h; however, physiological compensations of the induced-anemic condition had not been completed within 72 h.

Key Words: Anemia, Broilers, Hematocrit, Hemoglobin, Erythropoietin

M4 Evaluation of novel bacterial species on intestinal development and microflora. B. S. Lumpkins*, Y-J. Cho, A. B. Batal, and M. D. Lee, *University of Georgia, Athens.*

The growing concern of feeding antibiotics to poultry has lead researchers and animal health companies to investigate alternatives. An experiment was conducted to evaluate the effects of an oral inoculation with novel intestinal anaerobes on the development of the intestine. At 0d of age, 500 Cobb male chicks were separated into 4 treatments: a control and 3 test treatments that were orally inoculated with a novel species of *Bacteroidaceae*, *Clostridiaceae*, or a combination of the two. Throughout the experiment all birds were fed a corn-soybean meal diet. At 0, 1, 2, 3, 7, 16, and 42d of age performance parameters were measured and samples were taken for morphological and bacterial community analysis. At 42d of age, birds were randomly selected and processed for carcass yield. For bacterial community analysis, community DNA isolated from small intestinal contents were amplified with universal 16s primers. Diversity and compositional changes were assessed using denaturing gradient gel electrophoresis (DGGE) and terminal restriction fragment length polymorphism (T-RFLP). The performance parameters were similar among all 4 treatments from 0 to 16d of age. At the end of the 42d period the overall weight gain of the birds inoculated with *Clostridiaceae* was significantly lower than the control birds and the *Bacteroidaceae* inoculated birds. The birds inoculated with the combination of *Bacteroidaceae* and *Clostridiaceae*

had increased villi height and goblet cell concentration during the first 3d of age, but after 7d of age there was no overall difference in morphological response between treatments. There was no difference in the carcass yield between treatments. Based on the DGGE analysis, the microbiota populations clustered based on age rather than treatment. Birds inoculated with either *Bacteroides* or *Clostridiaceae* had a higher proportion of lactobacilli in the ileum compared to the control birds, based on T-RFLP analysis at 42d of age. The combination of *Bacteroidaceae* and *Clostridiaceae* improved intestinal development at young ages, but *Clostridiaceae* may have negative effects on weight gain during the latter stages of growth.

Key Words: Microbiota, Morphological, Anaerobes, Bacterial community, DNA

M5 Effect of age on intestinal pH of broiler chickens. J. M. Rynsburger* and H. L. Classen, *University of Saskatchewan, Saskatoon, SK, Canada.*

Protein digestion has been shown to be relatively poor in young birds therefore it is of interest to identify limiting factors. Initial protein digestion involves hydrochloric acid denaturation of protein and conversion of pepsinogen to its active form in the proventriculus and gizzard. If the production of hydrochloric acid is limited in young broilers, protein digestion may be hampered. A one-way ANOVA was used to study the effect of age on intestinal pH of broiler chickens fed a broiler starter diet. Ross x Ross 308 broilers (150 males) were randomly assigned to 10 battery cages. Using one bird per cage per sample age, the pH of the crop, proventriculus, gizzard, duodenum, jejunum and ileum was measured at 2, 3, 4, 5, 6, 7, 8, 9, 10 and 15 days of age. As the birds got older the crop pH increased (2d-5.01, 3d-5.51, 4d-5.64, 5d-5.54, 6d-5.42, 7d-6.13, 8d-5.08, 9d-5.56, 10d-6.29, 15d-6.02) while the pH of the proventricular proventriculus and gizzard decreased (proventriculus: 2d-5.20, 3d-5.12, 4d-4.78, 5d-4.58, 6d-3.33, 7d-4.85, 8d-4.16, 9d-3.48, 10d-3.56, 15d-3.37; gizzard 2d-3.49, 3d-3.47, 4d-3.43, 5d-3.50, 6d-3.24, 7d-3.48, 8d-3.30, 9d-3.42, 10d-3.27, 15d-3.27). The relationship between age and intestinal pH for the duodenum, jejunum and ileum was quadratic (duodenum: 2d-6.57, 3d-6.37, 4d-6.30, 5d-6.45, 6d-6.42, 7d-6.07, 8d-6.23, 9d-6.35, 10d-6.47, 15d-6.40; jejunum: 2d-6.82, 3d-6.66, 4d-6.44, 5d-6.5, 6d-6.38, 7d-6.3, 8d-6.26, 9d-6.34, 10d-6.42, 15d-6.5; ileum: 2d-7.74, 3d-7.07, 4d-7.26, 5d-7.1, 6d-6.74, 7d-7.08, 8d-6.9, 9d-7.05, 10d-7.43, 15d-8.15). In conclusion, during the first week of age the pH of the proventriculus and gizzard decreases indicating that the production of hydrochloric acid may not reach optimal levels until some time after hatch. As a result, protein digestion may be hampered during the first week post-hatch.

Key Words: Intestinal pH, Broiler, Chick, Protein, Digestibility

M6 Gonadotropin and steroid hormone regulation of zona pellucida proteins C and D messenger RNA in chicken granulosa cells. A. P. Benson*, M. E. Freeman, J. B. Hoffman, and A. J. Davis, *University of Georgia, Athens.*

The freshly ovulated ovum in avian species is surrounded by a protein layer called the inner perivitelline layer (IPVL), which is equivalent to the zona pellucida in mammals. For successful fertilization, sperm must attach and penetrate the IPVL. Previous research has established that

two of the IPVL protein components, ZPC and ZPD, are synthesized by the granulosa cells of the hierarchical follicles of the chicken ovary. In the current research, gonadotropin (LH and FSH) and steroid hormone (estrogen and testosterone) regulation of both ZPC and ZPD mRNA expression was investigated in cultured granulosa cells, which were isolated from the F1, F3, or small yellow follicles (SYF) from three broiler breeder hens for each replicate experiment. Isolated and dispersed granulosa cells from each follicular size were cultured for 24 hours in the absence or presence of 50 ng/ml of culture media of LH or FSH (4 replicate experiments), or in the presence or absence of 1×10^{-6} M testosterone or 17β -estradiol (4 replicate experiments). For each experiment, total RNA was extracted from freshly dispersed granulosa cells and the cultured granulosa cells from each follicle size for subsequent Northern blot analysis of ZPC and ZPD. Neither ZPC nor ZPD mRNA were detected in freshly isolated granulosa cells from (SYF), however, both ZPC and ZPD mRNA expression was detected in untreated SYF granulosa cells cultured for 24 hours. ZPC and ZPD mRNA expression was also further up-regulated in SYF granulosa cells cultured in the presence of LH or testosterone. FSH increased ZPD mRNA expression in SYF granulosa cells. F3 granulosa cells cultured with FSH had higher ZPC and ZPD mRNA expression levels than untreated control cells. The mRNA expression of ZPD was higher in F3 granulosa cells cultured with testosterone and estrogen. The addition of LH to F1 granulosa cells lowered the mRNA expression of ZPC but not ZPD. These results indicate that gonadotropins and steroid hormones may play vital roles in regulating the expression of the mRNA for ZPC and ZPD in the granulosa cells of developing preovulatory follicles in the hen.

Key Words: Zona pellucida, Hormones, Granulosa

M7 Hormonal regulation of the activin type IA and IB receptors during follicular development in broiler breeder hens. J. B. Hoffman*, M. E. Freeman, A. P. Benson, and A. J. Davis, *University of Georgia, Athens.*

Increasing research evidence suggests that the activin and inhibin family of proteins have regulatory roles in chicken follicular development. Activin's cell surface receptor complex consists of an activin type I (ActRI) receptor and an activin type II receptor. Previously, we detected and profiled the expression pattern of the mRNA for two forms (ActRIA and ActRIB) of the ActRI receptor in the theca and granulosa cells of preovulatory hen follicles. In the current research, gonadotropin (LH and FSH) and steroid hormone (estrogen and testosterone) regulation of ActRIA and ActRIB mRNA expression was investigated in cultured granulosa cells, which were isolated from the F1, F3, or small yellow (SY) follicles from three broiler breeder hens for each replicate experiment. Isolated and dispersed granulosa cells from each follicular size were cultured for 24 hours in the absence or presence of 50 ng/mL of culture media of LH or FSH (5 replicate experiments), or in the absence or presence of 1×10^{-6} M testosterone or 17β -estradiol (4 replicate experiments). Total RNA was extracted from all the cultured granulosa cell samples for subsequent real-time RT-PCR analyses of ActRIA, ActRIB and GAPDH (endogenous control) mRNA expression using gene specific primer pairs and a Taqman minor groove binding probe for each message. Granulosa cells obtained from F1 or F3 follicles and treated with LH had significantly lower mRNA levels of ActRIA and ActRIB than untreated granulosa cells. Similar results were obtained for FSH, except FSH did not significantly depress the mRNA expression of ActRIA or ActRIB

in F1 granulosa cells. The expression of the mRNA for ActRIA and ActRIB in granulosa cells cultured from SYF was unaffected by the gonadotropins. Estrogen had no effect on the mRNA expression of ActRIA and ActRIB. The addition of testosterone to the granulosa cell cultures decreased the mRNA expression of ActRIA in F1 granulosa cells. The results suggest that the presence of LH and FSH in vivo may decrease the sensitivity of granulosa cells in hierarchical follicles to activin.

Key Words: Activin receptor type I, Broiler breeder hens, Follicular development

M8 Parthenogenesis discovered in unfertilized eggs of *Coturnix chinensis*, the Chinese painted quail. C. D. McDaniel* and H. M. Parker, *Mississippi State University, Mississippi State.*

Parthenogenesis, embryonic development of an unfertilized egg, has been studied for many years in turkeys. In fact, as many as 49% of unfertilized Beltsville Small White turkey eggs develop embryos. However, virtually no research exists on parthenogenesis in quail. The Chinese painted quail is a close relative of the more common Japanese quail and, unlike turkeys or chickens, the small Chinese painted quail reaches sexual maturity rapidly, making it a great candidate for further research on parthenogenesis. Obviously, a better understanding of avian parthenogenesis will increase our knowledge of avian fertilization and early embryonic development. Therefore we determined if unfertilized Chinese painted quail hens produce embryos. Secondly, we explored the possibility that position of the egg within the clutch influenced the rate of parthenogenesis. When initial secondary sexual plumage was apparent at 4 wk of age, male chicks were separated from females to prevent fertilization. Hens were placed in individual cages near sexual maturity, at approximately 8 wk of age. Individual eggs were collected daily and labeled with the hen number and date. Eggs were stored for 0 to 3 days at 20 C prior to incubation at 37.5 C. After 10 days of incubation, approximately 8,000 eggs from 308 laying hens were examined for embryonic development under a magnifying lamp. On average, 4% of the unfertilized eggs contained embryonic development consisting solely of unorganized membranes. About 37% of the laying hens produced at least one parthenogenetic embryo. However, about 9% of the hens exhibited a predisposition for parthenogenesis by producing 4 or more unfertilized eggs with embryos. One hen even produced 8 embryos from 25 unfertilized eggs laid. Additionally, the first egg laid in a clutch was most likely to produce an embryo, with a steady decline in the percentage of eggs developing embryos as position in the clutch increased. In conclusion, the Chinese painted quail does exhibit parthenogenesis and appears to be an excellent animal model for studying parthenogenesis.

Key Words: Chinese painted quail, Parthenogenesis, Fertility, Embryo, Quail

M9 Effects of chronic administration of NOS inhibitors on cardiopulmonary function and ascites parameters in broiler chickens. C. A. Ruiz-Feria*, N. Rougiere, and S. Kawthekar, *McGill University, Ste. Anne de Bellevue, QC, Canada.*

Endothelial dysfunction and inability to produce nitric oxide (NO) has been associated with the development of pulmonary hypertension (PH). Two experiments were conducted to investigate the effects of

chronic administration (14 d) of aminoguanidine (AG, 50 mg / kg BW / day) a specific inhibitor of the inducible form of nitric oxide synthase (NOS); N-Nitro-L-Arginine Methyl Ester (L-NAME, 15mg /kg BW /day), a non-specific NOS inhibitor; and a control (CTL, tap water) on cardiopulmonary function and parameters related to PH. Pulmonary arterial pressure (PAP) and mean systemic arterial pressure (MAP) after an acute challenge of epinephrine (EPI, 0.5mg/kg BW) were evaluated in birds raised in a thermoneutral environment (Experiment 1). Starting at day 28, 8 clinically healthy birds per treatment were anesthetised, cannulated, and after 10 min of equilibration, EPI was injected. The PAP and MAP were continuously recorded. In Experiment 2 we measured hematocrit and electrocardiogram parameters in chickens raised in a cold environment starting at d 14. Basal levels of PAP were highest in the L-NAME group. The PAP increased 30 s after EPI in all groups, but the increase was lower in the CTL group than in the AG and L-NAME group. The increase in PAP after EPI was similar for the AG and L-NAME birds. The basal and peak MAP after challenge was higher in L-NAME group and lowest in the CTL group. Both NOS inhibitors increased the hematocrit percentage and reduced the RS wave amplitude compared with the CTL group, but AG and L-NAME had comparable effects. Those results suggest that iNOS is an important source of NO in chronic pulmonary hypertension

Key Words: Ascites, Nitric oxide, iNOS, eNOS

M10 Effects of pre-lay 6/85 strain *Mycoplasma gallisepticum* inoculation on the internal egg and egg shell characteristics of commercial laying hens when given alone or in conjunction with F-strain *Mycoplasma gallisepticum* inoculations during lay. K. A. Viscione^{*1}, E. D. Peebles¹, S. L. Branton², A. M. Vance², S. K. Whitmarsh¹, R. W. Keirs¹, and P. D. Gerard¹, ¹Mississippi State University, Mississippi State, ²USDA, ARS, Poultry Research Unit, Mississippi State, MS.

Alterations in egg production in commercial layers in response to an F-strain *Mycoplasma gallisepticum* (FMG) infection at 12 wk of age have been shown to be associated with changes in yolk composition. Two trials were conducted to examine the effects of age of inoculation, a pre-lay 6/85 strain of *Mycoplasma gallisepticum* (6/85MG) inoculation, and FMG inoculation overlays during egg production on internal egg and eggshell characteristics of commercial laying hens. Inoculation treatments included: sham inoculation at 10 wk of age, 6/85MG at 10 wk of age, 6/85MG at 10 wk overlaid by a subsequent FMG inoculation at 22 wk, and 6/85MG at 10 wk overlaid by a subsequent FMG inoculation at 45 wk. Parameters assessed in each trial included egg weight; percent yolk, albumen, and eggshell weights; percent yolk moisture and lipid concentrations; yolk fatty acid profiles; eggshell weight per unit of surface area (SWUSA); egg shape index (width/length); and relative eggshell conductance (RG). Determinations of egg shape index, SWUSA, RG, and percent yolk moisture, yolk lipid, eggshell weight, albumen weight, and yolk weight were at various time periods between 24 and 59 wk, egg weight was weekly from 23 through 55 wk, and yolk fatty acid profiles at 59 wk. Parameters investigated before 45 wk were analyzed separately from those investigated after 45 wk. Egg shape index was higher at 49 wk compared to that at 53 wk. FMG overlays at 22 and 45 wk increased yolk moisture content. An FMG overlay at 22 wk increased yolk palmitic acid, and FMG overlays at 22 and 45 wk decreased yolk linolenic acid concentration. However, the 6/85MG inoculation at 10 wk alone increased yolk oleic acid concentration. In conclusion, a pre-

lay inoculation of 6/85MG may increase yolk oleic acid concentration, whereas, FMG inoculations overlaid on a pre-lay 6/85 MG inoculation may further decrease yolk linolenic acid and increase yolk moisture palmitic acid concentrations.

Key Words: Albumen, Egg, *Mycoplasma gallisepticum*, Shell, Yolk

M11 Effects of supplemental dietary phytase and 25-hydroxycholecalciferol on the blood characteristics of commercial layers inoculated before or at the onset of lay with the F-Strain of *Mycoplasma gallisepticum*. E. D. Peebles^{*1}, S. L. Branton², M. R. Burnham¹, S. K. Whitmarsh¹, and P. D. Gerard¹, ¹Mississippi State University, Mississippi State, ²Poultry Research Unit, ARS, USDA, Mississippi State, MS.

In 3 trials, the effects of dietary supplementation with phytase and 25-hydroxycholecalciferol on BW and the blood characteristics of commercial layers that were inoculated pre-lay (12 wk of age) or at the onset of lay (22 wk of age) with F-strain *Mycoplasma gallisepticum* (FMG) were assessed at 34, 50, and 58 wk of age. Experimental layer diets which included either a basal control diet or the same diet supplemented with 0.025 % phytase (600 FTU / kg of diet) and 0.025 % 25-hydroxycholecalciferol (250 ppm) were fed from 20 through 58 wk of age. The supplemented diet decreased blood hematocrit values across bird age, inoculation type (sham versus FMG), and age of inoculation (pre-lay versus onset of lay). Phytase and 25-hydroxycholecalciferol supplemented diets reduced bird BW in sham-inoculated control birds across bird age and age of inoculation. This effect was not observed in FMG-inoculated birds. Across inoculation type and age of inoculation, supplemented diets also reduced serum triglyceride levels in birds that were 34 wk of age. Furthermore, across diet (control versus supplemented) and inoculation type, total plasma protein concentration at 34 wk of age was higher in birds that were inoculated at the onset of lay compared to those inoculated pre-lay. Diet, inoculation type, and inoculation age had no effect on mortality, reproductive organ histopathological lesion scores, or serum cholesterol and calcium concentrations. In conclusion, throughout lay, the supplementation of commercial layer diets with phytase may lower hematocrit, and inoculation with FMG pre-lay or at the onset of lay may ameliorate the depressing effects of dietary phytase and 25-hydroxycholecalciferol supplementation on hen BW.

Key Words: FMG, Inoculation, *Mycoplasma gallisepticum*, Phytase, 25-hydroxycholecalciferol

M12 A comparison of performance of coccidia vaccinated broilers fed RepaXol[®], AciXol[™], or Bacitracin Methylene Disalicylate. G. Mathis^{*1} and N. Scicutella², ¹Southern Poultry Research, Inc., Athens, GA, ²SODA Feed Ingredients, Monaco.

The objective of the study was to determine if RepaXol[®], an homogeneous blend of double coated essential oils, AciXol[™] a blend of organic and inorganic acids (citric, fumaric, malic and ortho-phosphoric) along with the protected essential oils (as in RepaXol[®] encapsulated in the same MICROPEARLS[®], or Bacitracin Methylene Disalicylate (BMD), an antibiotic, in conjunction with a coccidiosis vaccine improves performance of broiler chickens grown to 42 days of age. The experiment consisted of 32 pens of 45 male broiler chickens. Floor space was 0.77 sq. ft. per bird. All chicks were spray vaccinated

with the label recommended dosage of Coccivac-B (coccidial vaccine) on day of hatch. The treatments were replicated in eight blocks, randomized within blocks of four pens each. The test treatments were nonmedicated (NM), RepaXol® 100 ppm, AciXol™ 500 ppm, or BMD 55 ppm, from Day 0 to 42. To confirm Coccivac-B viability and cycling, on Day 21 oocysts per gram litter were determined for all pens. Expected levels of oocysts were detected confirming viability of vaccine. There was a significant improvement in Day 42 feed conversion with all feed additives. The feed conversion of the NM birds was 1.842, RepaXol® 1.785, AciXol™ 1.792, and BMD 1.762. Average live weight gain showed a significant improvement with both RepaXol® and BMD. The weight gains of the NM birds was 2.123 kg, RepaXol® 2.210 kg, AciXol™ 2.165 kg, and BMD 2.230. The feed conversion and weight gain for RepaXol® and BMD were not significantly different. To evaluate the level of coccidiosis immunity, on Day 28, five representative birds were removed from each pen, given nonmedicated feed, and challenged with a mixture of *E. acervulina*, *E. maxima*, and *E. tenella*. Six days post inoculation, all birds were coccidiosis lesion scored. No interference with development of coccidial immunity was shown with any of the feed additives. RepaXol® 100 ppm, AciXol™ 500 ppm, and Bacitracin Methylene Disalicylate 55 ppm, in conjunction with a coccidiosis vaccine improved performance of broiler chickens.

Key Words: Coccidiosis, RepaXol™, AciXol™, BMD, Coccivac B

M13 Selenium sources influence small intestinal characteristics and morphology in reovirus infected broiler chickens. S. Burgos^{*1}, F. W. Edens¹, J. Read-Snyder¹, A. Cantor², and S. A. Burgos³, ¹North Carolina State University, Raleigh, ²University of Kentucky, Lexington, ³University of Guelph, Guelph, ON, Canada.

Avian reovirus (ARV) infections have been associated with malabsorption syndrome causing lower weight gains in broiler chickens. The aim of this investigation was to determine if ARV infection with and without selenium -organic and inorganic- affected small intestinal characteristics and morphology. Eggs were obtained from Cobb breeders that had been maintained on isocaloric Torula yeast diets containing either no supplemental selenium, sodium selenite at 0.3 ppm, or organic selenium (SelPlex, Alltech, Inc., Nicholasville, KY, USA) at 0.3 ppm. Chicks hatched from those eggs were placed on Torula yeast broiler diets containing no supplemental selenium, 0.3

ppm sodium selenite, or 0.3 ppm organic selenium similar to their respective parents' diets. On the day of hatch, 60 chicks per dietary selenium treatment were placed into either control or ARV-infected groups in heated metal-growing batteries in separate isolation rooms. Chicks in the ARV-infected groups were given each an oral gavage of 0.2 mL of ARV-CU98 (10^{4.2} pfu/chick), and control chicks were given the medium only. At 23 d of age, the chicks were weighed, killed by carbon dioxide asphyxiation, and their intestinal tracts were dissected for total and segmental weight and length, with tissue collections for histomorphology. Data from this 2 X 3 factorially arranged completely randomized experimental design were analyzed using the GLM procedure of SAS. The ARV-CU98 challenge caused more than 15% reduction (p<0.0003) in body weight and caused 18.4% mortality compared with 6% in controls. ARV-CU98 infection did not affect intestinal length, but infected chicks had more distended and heavier intestines than did controls. Selenium reduced the average intestinal weight in both control and infected birds (P<0.05). Microscopic analysis revealed longer microvilli in selenium-fed control and infected birds, and goblet cell numbers were increased in selenium-fed birds. It was concluded that selenium is necessary to maintain the integrity of the small intestine of both control and ARV-CU98 infected chickens.

Key Words: Reovirus, Selenium, Broilers, Small intestine, Morphology

M14 Specificity of antibody to detection of reticuloendoteliosis virus in immunohistochemistry and in situ hybridization assay. V. Santos*, S. Williams, C. Brown, and J. Zhang, *University of Georgia, Athens.*

To assist the differential diagnosis of virus induced tumors in poultry, reticuloendoteliosis virus (REV), Marek's™ disease virus (MDV) and avian leukosis virus (ALV), immunohistochemistry and an in situ hybridization assays for REV were developed. A collection of blocks that represent natural and induced cases of REV as well MDV and ALV were tested for specificity and sensitivity of the REV antibody and probe. The REV positive and negative controls were obtained by paraffin-embedded cells extracted from cell culture.

Key Words: Reticuloendoteliosis, Immunohistochemistry, In situ hybridization, Paraffin-embedded tissues, Natural and induced cases

Monday, January 22

Nutrition I

Room: B313

M15 Comparative study on quality of eggs from laying hens fed cocoa podhusk-based and farmers layer's mashes. R. A. Hamzat^{*1}, E. O. Uwagboe¹, M. A. Olumide², and M. T. Adeoti³, ¹Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, ²Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, ³Kolmart Farms, Ibadan, Oyo State, Nigeria, ⁴Quadbis Farms, Ibadan, Oyo State, Nigeria.

Cocoa podhusk (CPH) is a waste, constituting serious disposal problems on all cocoa farms in Nigeria. The use of CPH in feeding poultry, may alleviate the problem of high cost of feed ingredients which has occasioned the reduction in the rate of expansion of the

poultry industry in Nigeria, as revealed by previous station trials. Hence, this study focused on the comparison of the effect of CPH based and farmers layers' mashes on the egg quality of laying hens.

A total of four hundred and ninety five, 3-month-in-lay birds were used for this on-farm trial. The birds were randomly distributed into 5 treatments replicated thrice with each treatment containing 99 layers, in a completely randomized design. These treatments were: 000 (Eggs from Control diet), 00A (Eggs from Farmer's feed 1), 00B (Eggs from Farmer's feed 2), 00C (Eggs from Farmer's feed 3), 00D (Eggs from Farmer's feed 4), 00E (Eggs from Farmer's feed 5). Each feed was fed ad libitum to the laying chickens. This trial lasted eight weeks. The

parameters measured included: egg weight, EW; egg length, EL; shell thickness, ST; shell weight, SW; yolk height, YH; yolk width, YW; albumin weight, AW; yolk colour score, YCS; yolk index, YI; and shell surface area, SSA. Eggs on layers mash OOB, was not significantly different ($p < .05$) from OOA in all parameters studied, whereas significant differences ($p < .05$) occurred in other treatments as compared to the control. The overall ranking of the assessed feeds as revealed by the egg quality parameters studied was: OOA>OOB>OOD>OOF>OOE>OOC. The results revealed that feeding cocoa podhusk-based layer's mash considerably improved egg quality of laying hens.

Key Words: Comparison, Cocoa feed, Farmers' feeds, Egg quality, Laying hens

M16 Hemolytic and antimicrobial activity of guar meal extracts. S. M. Hassan^{*1}, O. Gutierrez¹, A. Haq¹, J. A. Byrd², C. A. Bailey¹, and A. L. Cartwright¹, ¹Texas A&M University, College Station, ²USDA-ARS Food and Feed Safety Research Unit, College Station, TX.

Saponins extracted from guar meal were evaluated for hemolytic and antimicrobial activities. Saponin rich extracts were prepared by refluxing approximately 25 g guar meal with 250 mL ethanol:H₂O (1:1) for 3 hr, filtering and distilling the ethanol using roto-evaporation at 50 C. Resulting aqueous fractions were partitioned three times with equal volumes of n-butanol to yield saponin rich fractions of 4.8±0.6% of the original material. Ethanol extracted n-butanol fractions were further purified by reversed phase flash column chromatography on a C-18 preparatory column eluting 2 fractions with 20, and 1 each with 60, and 100% methanol (MeOH). Fractions were collected, roto-evaporated and freeze-dried with yields averaging 1.72±0.47, 0.88±0.16, 0.91±0.16 and 1.55±0.15 % of the original material, respectively. Freeze dried fractions were dissolved in PBS and filtered using 0.2 micrometer filters before use in two 96-well plate assays for hemolytic and antimicrobial activities. The hemolytic assay measured blood cell lysis of serial dilutions of the extracts (66.66 to 0.52 µgram/mL) using negative and 100% lysis control wells. Antimicrobial activity was measured as minimum inhibitory concentration (MIC) using serial dilution of the extracts (1 mg to 7.8 µgram extract/mL) in 96-well plates with negative and ampicillin or novobycin positive controls. A gram positive bacterium (*Staphylococcus aureus*) and two gram negative bacteria (*E. coli* and *Salmonella Typhimurium*) were surveyed. Hemolytic activity was observed in 100 % MeOH guar fractions ($P < 0.05$) but not in 20 or 60% fractions. Antimicrobial activity was detected upon exposure of 100% MeOH fractions to *Staphylococcus aureus* but not to *E. coli* and *Salmonella Typhimurium*. Positive correlation of hemolytic and antimicrobial activity was only observed with 100% MeOH extracts and *Staphylococcus aureus*.

Key Words: Saponin, Guar meal, Hemolysis, Antimicrobial

M17 Evaluation of pearl millet in combination with different levels of flaxseed and natural pigment in laying hen diets. K. Amini* and C. Ruiz-Feria, *McGill University, Ste-Anne-de-Bellevue, QC, Canada.*

Two experiments were carried out to evaluate the effects of Canadian Pearl Millet (PM) in combination with different levels of flaxseed (FS)

and natural pigment (Oro glo 15) on egg fatty acid (FA) profile and laying performance. In a six week experiment, six treatments were used (8 cage replicates, 3 birds per cage): a control diet (corn-soybean meal based diet) and diets in which corn was totally replaced by PM and supplemented with 0, 2, 4, 8 and 12% FS. In a 12 wk experiment, six diet treatments were used (6 cage replicates, 3 birds per cage) with diets based on PM with three inclusion levels of FS (4%, 6% and 8%) and two levels of natural pigment (0.1% and 0.2%). The diets were formulated to be isocaloric and isonitrogenous and to meet NRC requirements. Three eggs were randomly collected from each cage by the end of each week. Body weight, feed consumption, and egg production were recorded weekly. Yolk pigmentation was determined using the Roche® color fan. At the end of the experiments, all the hens were euthanized to determine liver integrity. Data were analyzed by one-way analyses of variance using the general linear models procedure of SAS. Egg characteristics and flock performance parameters were not different among treatments in both experiments. Yolk pigmentation score was lower for the diets containing PM compared with the control diet, but 0.1% inclusion of pigment was enough to restore pigmentation. No difference was observed among diets in regard to liver hemorrhage. We found that hens fed a diet based on pearl millet and 8% FS produced eggs with an average n-3 FA content of 447 mg, which was higher than n-3 FA content of eggs from hens consuming the control diet, or the PM based diets with lower FS supplementation. Diets based on PM and 8% FS can be used to produce n-3 FA enriched eggs, while maintaining flock productivity and health.

Key Words: Laying hens, Pearl millet, Flaxseed, Natural pigment, Flock performance

M18 Evaluation of Louisiana-produced extruded-expelled soybean meal for chickens. S. Powell¹, V. Naranjo¹, D. Lauzon^{*1}, L. Southern¹, T. Bidner¹, and C. Parsons², ¹Louisiana State University Agricultural Center, Baton Rouge, ²University of Illinois, Urbana.

Soybean meal (SBM) can be produced either by solvent extraction or expeller-extrusion. Expeller-extruded SBM (EE-SBM) contains more oil but less CP than solvent extracted SBM (SE-SBM). The purpose of this research project was to evaluate the energy and protein content of EE-SBM compared with SE-SBM. True digestibility of the amino acids in EE-SBM was determined using the precision-fed cecectomized rooster assay (values are combined samples from 4 roosters). Digestibility values for the amino acids are as follows: Lys 86.8%, Met 87.4%, Cys 81.5%, Arg 92.2%, Thr 83.5%, Val 85.5%, Ile 86.5%, Leu 86.7%, His 86.4%, and Phe 88.9%. A growth experiment was conducted to evaluate the energy and protein content of the SBM. Ross x Ross 708 broilers (0 to 18 d of age) were used in 3 identical trials. Chicks were housed in starter batteries. Each trial had 8 replicates with 6 chicks per pen for a total of 24 replicates per treatment. Dietary treatments were: Diets 1 and 2) Corn-SE-SBM or corn-EE-SBM at 1% total dietary Lys and an ME of 3,300; Diets 3 and 4) Corn-SE-SBM or corn-EE-SBM at 1.3 % total dietary Lys and a ME of 3,000 kcal/kg; and Diets 5 and 6) Corn-SE-SBM or corn-EE-SBM at 1.3% Lys and a ME of 3,300 kcal/kg. The data will be presented and analyzed as 2 x2 factorially arranged sets of treatments (one analysis will evaluate SBM source by Lys level and the second will evaluate SBM source by ME level). In the Lys component, daily gain (ADG), daily feed intake (ADFI), and gain:feed (GF) were decreased ($P < 0.04$) by the reduced Lys level but not affected ($P > 0.10$) by SBM source or the source by Lys level interaction. In the ME component, ADG and GF were

decreased and ADFI increased ($P < 0.01$) by the reduced ME level. Also, ADG and ADFI were decreased ($P < 0.06$) by EE-SBM, but there was no interaction ($P > 0.10$). The results of these experiments indicate that EE-SBM has similar feeding value to SE-SBM when the differences in nutrient values are considered in diet formulation.

Key Words: Broiler, Soybean meal, Extruded

M19 Intestinal enzymes gene expression of late term turkey embryos. J. E. de Oliveira^{*1}, P. R. Ferket¹, C. M. Ashwell¹, and Z. Uni², ¹North Carolina State University, Raleigh, ²Hebrew University of Jerusalem, Rehovot, Israel.

The developing poultry embryo must go through an adaptive process of switching from lipid-based metabolism, associated with fat, absorbed by the yolk sac membrane, to a carbohydrate-based metabolism, associated with intestinal digestion and absorption. The intestine must develop sufficiently to receive exogenous substrates by the time of hatching. However, turkey poults have a limited ability to digest feed containing carbohydrates (CHO) and protein at hatch and they are susceptible to malabsorption problems of early survival. The objective was to study enteric development prior to hatch by measuring the sequence of gene expression of intestinal enzymes and nutrient transporters using microarray technology. Twenty-five Nicholas turkey eggs were sampled at 20, 22, 24, 26 and 28 d of incubation (E) to collect duodenum for RNA extraction. Fluorescent dyes were incorporated to cDNA produced from the extracted RNA and hybridized on array printed with 90 different 70 bp oligonucleotides. The intestinal genes studied were maltase/glucoamylase (MG), sucrase/isomaltase (SI), aminopeptidase (AP), peptide transporter 1 (PepT1) and sodium/glucose transporter 1 (GLUT-1). Cluster analysis revealed MG and SI mRNA was first expressed at E24, while PepT1 gene was expressed only at E28. Gene expression of AP was specifically evident at E22 and again at E26. GLUT-1 gene expression decreased from E20 until E26 and then was up regulated at E28. Enzymes and transporters responded to presence of substrate (ammonia) until E26, but were independently highly expressed at hatch (E28) as in preparation for feeding.

Key Words: Turkey, Turkey embryo, Intestinal enzymes, Microarrays, Gene expression

M20 Effects of vitamin U on broiler performance and intestinal tract integrity. A. L. Shaw^{*}, K. S. Macklin, and J. P. Blake, Auburn University, Auburn, AL.

Vitamin U (DL-methionine methylsulfonium chloride) has been found to modulate the immune system and protect the intestinal membrane in humans and swine. It has also improved weight gain and feed efficiency in cattle and hogs. Two trials were conducted to determine the effects of Vitamin U on growth performance, feed efficiency, and gut integrity of broilers. For each trial, day-old commercial broiler chicks were randomly allotted to one of 6 dietary treatments with 8 replicate pens each. Both trials employed a corn-soy starter diet from 0-28 d (21.5% CP, 3142 kcal/kg) and a grower diet from 28-42 d (19.5% CP, 3153 kcal/kg).

In Trial 1, 480 chicks (10 birds/pen) were fed the basal diet with 0, 200, 400, 600, 800, or 1000 ppm of Vitamin U. Birds were challenged with 1 ml of *Salmonella* Kentucky (10^6 cfu/ml) via oral gavage on day of placement and then re-dosed on day 14. Cecal samples of 4 birds/trt

were collected and enriched weekly from days 7 to 28 to determine presence of *Salmonella*. Bird and feed weights were obtained on days 0, 7, 14, 21, 28, and 42. There was no effect on growth or feed efficiency due to Vitamin U addition. Significant differences ($p < 0.05$) were present among the treatment levels for villi length, villi width, and crypt depth of the duodenum, jejunum, and ileum obtained on day 21.

In Trial 2, 384 chicks (8 birds/pen) were fed the basal diet with Vitamin U substituted for DL-methionine on a molecular weight equivalent at a rate of 0, 20, 40, 60, 80, or 100%. Feed and bird weights were obtained bi-weekly through 42 days of age. Vitamin U caused a slight decrease ($p < 0.05$) in body weight gain between 0 and 14 days, with no differences detected in performance thereafter.

Vitamin U was not effective in improving growth or feed performance when fed to broilers challenged with *Salmonella*, nor did it provide advantages in performance as a substitute for DL-methionine. It did have an effect on duodenal villi characteristics, which may suggest an ability to aid in intestinal integrity improvement.

Key Words: Vitamin U, DL-methionine, *Salmonella* Kentucky, Broilers

M21 Response of broiler chickens to supplementation of xylanase or phytase in wheat-based diet. O. A. Olukosi^{*} and O. Adeola, Purdue University, West Lafayette, IN.

Three-hundred broiler chicks were used for a 21-d study of growth response, bone ash, digestibility and carcass energy retention as influenced by supplementation of phytase or xylanase alone or in combination. Carcass retained energy was determined by comparative-slaughter. At day old, 20 broiler chicks were asphyxiated and frozen for determination of initial body energy content of the chicks. Two-hundred eighty chicks were assigned at 1-d old to 5 dietary treatments in a randomized complete block design. The treatments were: positive control (PC), negative control (NC) diet marginally deficient in ME and P, NC + phytase added at 1,000 FTU/kg, NC + xylanase added at 4,000 U/kg, and NC + phytase and xylanase added at the rates indicated above. Each treatment had 8 replicate cages of 7 birds each. Growth performance and feed intake data were collected weekly. On d 21, 1 bird with body weight closest to the average for the replicate cage was used for final body energy content determination. Excreta were collected at d 18 to 21 for determination of ME and total tract retention. Tibia was defatted and ashed for determination of bone ash. Phytase alone ($P < 0.01$) or in combination with xylanase ($P < 0.05$) improved final body weight of the broiler chicks whereas xylanase alone did. The treatments had no effect on either feed intake or gain:feed. Bone ash was not different between PC and NC; phytase alone or in combination with xylanase improved ($P < 0.01$) bone ash. Xylanase alone improved ileal digestible energy ($P < 0.01$). Combination of phytase and xylanase improved total tract DM retention ($P < 0.01$). Phytase alone or in combination with xylanase improved ($P < 0.01$) ME. Supplementation with phytase alone improved P retention ($P < 0.05$). Body retained energy was improved ($P < 0.01$) in the presence of phytase alone. In conclusion, supplementation of wheat-based diet with combination of phytase and xylanase improved growth performance of broiler chickens up to 21 d, however phytase by itself improved most of the response criteria whereas xylanase when used alone did not.

Key Words: Broilers, Performance, Phytase, Xylanase, Wheat

M22 Effect of dietary organic acids on phytate phosphorus disappearance. A. Liem*, H. M. Edwards, Jr., and G. M. Pesti, *University of Georgia, Athens.*

Supplementation of some organic acids to a phosphorus deficient diet has been shown to improve bone ash content in broilers. Two experiments were conducted from 0 to 16 d in battery pens to determine the effect of various organic acids supplementation on phytate P utilization, indicated by bone ash data, and phytate P disappearance. In both experiments, birds were fed a P deficient, corn and soybean meal based diet. In Expt. 1, citric acid, malic acid, fumaric acid, and ethylenediaminetetraacetic acid (EDTA) were supplemented at 3.23, 2.90, 2.90, and 3.65 % respectively. In Expt. 2, a 2 x 2 factorial design was utilized. Two sources of methionine, 2-hydroxy-4methylthio butanoic acid (HMB), an organic acid, and DL-methionine (DLM) were added at 0.20% to the diets, with or without 500 U of phytase / kg diet. In Expt. 1, the addition of citric, malic and fumaric acid increased percent bone ash, but only the effect of citric acid was significant ($p < 0.05$). The addition of citric acid and malic acid also increased the disappearance of P and phytate P ($p < 0.05$). In Expt. 2, the addition of phytase to the diet significantly increased 16 d body weight gain, feed intake, percent bone ash, mg bone ash, phytate P disappearance, and decreased the incidence of P rickets. Methionine source did not affect 16d body weight gain, feed intake, feed efficiency, mg bone ash, and P rickets incidence. However, the birds fed HMB had higher percent bone ash and phytate P disappearance compared to birds fed DLM. The percent bone ash for the following treatments: DLM, HMB, DLM + phytase, and HMB + phytase were 28.5, 29.0, 31.2, and 33.2 %, respectively. The phytate P disappearance for the treatments above are 36.7, 39.5, 51.0, and 59.9%, respectively. With added phytase, HMB-fed chicks had higher percent bone ash and phytate P disappearance ($p = .005$ and $p = .026$ respectively), but not without added phytase ($p = .390$ and $p = .463$, respectively). In conclusion, some organic acids in our experiment, citric acid, malic acid and HMB, improved phytate P utilization, indicated by bone ash and phytate P disappearance data. HMB and phytase improves phytate P utilization by broiler chicks.

Key Words: Phytate, Phosphorus, Methionine, Broiler, Organic acid

M23 Effect of incremental levels of L-Lysine•HCl in low crude protein corn-soybean meal diets on growth performance of broiler chicks. A. Waguespack*, S. Powell, T. Bidner, and L. Southern, *Louisiana State University Agricultural Center, Baton Rouge.*

Three experiments (Exp.) were conducted to determine the level of L-Lys that can be included in corn-soybean meal (C-SBM) diets for broilers without an amino acid (AA) other than Met, Lys, Thr, or Gly becoming limiting. Ross x Ross 708 broilers (0 to 18 d of age) were used in brooder batteries. Treatments contained 7 or 8 replicates with 6 birds per pen. In all Exp., a control C-SBM diet containing no L-Lys•HCl was used. Also, a similar diet (PC+Gly) with supplemental Gly was fed to provide a total dietary Gly + Ser level of 2.32%, a level which previously has been shown to maximize growth performance of broilers fed AA-supplemented low CP diets. All diets were formulated to contain 1.26% total Lys and to maintain a ratio of TSAA:Lys of 0.72 and Thr:Lys of 0.70. Diets with added L-Lys•HCl contained supplemental Gly to provide a total dietary level of Gly + Ser of 2.32%. Also, when Lys was added, the dietary CP content was decreased by changing the ratio of corn to soybean meal. In Exp. 1, L-Lys•HCl was added to the diets at 0.02% increments from 0.15 to 0.27%. Compared

with the PC+Gly diet, gain (ADG), feed intake (ADFI), and gain:feed (GF) were not affected ($P > 0.10$) by Lys addition to the diet. In Exp. 2, L-Lys•HCl was added to the diets at 0.05% increments from 0.25 to 0.60%. Compared with the PC+Gly diet, ADG and GF were decreased ($P < 0.03$) in diets containing greater than 0.30% L-Lys•HCl, but not ($P > 0.05$) in the diet containing 0.25% L-Lys•HCl. In Exp. 3, L-Lys•HCl was added to the diets at 0.05% increments from 0.20 to 0.30%. Daily gain was decreased ($P < 0.02$) in broilers fed 0.30% L-Lys•HCl but not in those fed 0.20 or 0.25% L-Lys•HCl. Feed intake and GF were not affected by L-Lys•HCl. The results of these Exp. indicate that 0.25% L-Lys•HCl (which results in a dietary CP level of 19.7%) can be added to C-SBM diets supplemented with Met, Thr, and Gly with no negative effects on growth performance, and that at 0.30% added L-Lys•HCl an AA other than these 4 becomes limiting.

Key Words: Broiler, Amino acid, Growth, Low crude protein

M24 Determination of the limiting amino acid other than methionine, threonine, lysine, and glycine in low crude protein corn-soybean meal diets for broiler chicks. A. Waguespack*, S. Powell, T. Bidner, and L. Southern, *Louisiana State University Agricultural Center, Baton Rouge.*

Two experiments (Exp.) were conducted to determine the order of limiting amino acids (AA) in low CP corn-soybean meal (C-SBM) diets for Ross x Ross 708 broilers (0 to 18 d of age) in brooder batteries. Treatments contained 7 or 8 replicates with 6 birds per pen. In both Exp., a control C-SBM diet (PC) and a similar diet (PC+Gly) with added Gly to provide a total dietary Gly + Ser level of 2.32% was fed. All diets in both Exp. were formulated to contain 1.26% total Lys and to maintain a ratio of TSAA:Lys of 0.72 and Thr:Lys of 0.70. In Exp. 1, the order of limiting AA was determined in a C-SBM diet containing 0.45% L-Lys•HCl and 17.8% CP. In addition to the PC and PC+Gly treatments, the treatments consisted of a negative control (NC), NC + 0.247% Ile, NC + 0.484% Arg•HCl, NC + 0.249% Val, and all possible two and three-way combinations of all 3 AA. Diets with added AA and the NC diet contained supplemental Gly to provide a total dietary level of Gly + Ser of 2.32%. Compared to the NC diet, addition of L-Arg•HCl and the combination of L-Arg•HCl and the other AA increased daily gain (ADG) and feed intake (ADFI) but not gain:feed (GF), indicating that Arg was the limiting AA in this diet. It is possible that the order of limiting AA (other than Thr, Lys, Met, and Gly) changes in a diet with different levels of supplemental Lys because of the change in ratio of corn to soybean meal. Therefore, Exp. 2 was conducted in an identical manner to Exp. 1 except the diets with the added AA contained the same ratio of corn to SBM that is found in a diet with 0.25% L-Lys•HCl, which was achieved by dilution with cornstarch. The results of Exp. 2 suggest that Arg and Val are equaling limiting in a diet with 0.25% L-Lys•HCl. In the diet with all 3 AA, ADG and ADFI were different ($P < 0.10$) from the PC and PC+Gly diet but GF was not different ($P > 0.10$). These results suggest that Arg and Val are equaling limiting (after Met, Thr, Lys, and Gly) in a diet containing 0.25% L-Lys•HCl.

Key Words: Broiler, Glycine, Low crude protein

M25 Dietary methionine sources affect intestinal microbial growth in broiler chickens. J. P. Dahiya*¹, D. Hoehler², A. G. Van Kessel¹, and M. D. Drew¹, ¹University of Saskatchewan, Saskatoon SK, Canada, ²Degussa Corporation, Kennesaw, GA.

Previous work in our laboratory showed that methionine hydroxy-analogue (MHA-FA) is more available to gut bacteria than DL-methionine (DL-Met) and may stimulate the growth of intestinal bacterial populations including *C. perfringens*. An experiment was conducted to study the effect of various levels of DL-Met or MHA-FA on *C. perfringens* and other intestinal bacteria in broiler chickens. Two cages of 6 birds (14 d post-hatch) were assigned to one of 7 different diets containing no added Met (control); 2.0, 4.0 or 8.0 g/kg DL-Met or 2.27, 4.54 and 9.08 g/kg MHA-FA, thus providing 3 equimolar levels (0.2, 0.4 and 0.8%) of each methionine source. Birds were challenged with *C. perfringens* type A on d 1 and d 14 to 20, and killed on d 28. Intestinal populations of *C. perfringens*, lactobacilli, *Streptococcus* D and coli forms were enumerated and necrotic enteritis lesions were scored. There were no significant differences in the growth of various bacterial species in intestinal tract of broiler chickens fed two different methionine sources. However, we observed significantly reduced ($P < 0.05$) *C. perfringens* populations in ileum and cecum of birds fed 8 g/kg DL-Met and 9.08 g/kg MHA-FA supplemented diets vs. control. Also there was a significant interaction ($P < 0.05$) between methionine source and level for *C. perfringens* growth. The coli forms and *Streptococcus* D in ileum were significantly lower ($P < 0.05$) whereas lactobacilli in ceca were significantly higher in birds given highest levels of either DL-Met or MHA-FA than the other dietary treatments. There were no significant differences in necrotic enteritis intestinal lesion scores and performance of birds fed different methionine sources or concentrations. The results suggest that the use of low protein diets supplemented with relatively high levels of synthetic amino acids may reduce the risk of clostridial enteritis in broiler chickens.

Key Words: Methionine sources, Necrotic enteritis, Broiler chickens

M26 Standardized ileal amino acid digestibility of plant source ingredients in broiler chicks and turkey poults using a nitrogen-free or casein diet. S. A. Adedokun^{*1}, C. M. Parsons², M. S. Lilburn³, O. Adeola¹, and T. J. Applegate¹, ¹Purdue University, West Lafayette, IN, ²University of Illinois, Urbana/Champaign, ³The Ohio State University/OARDC, Wooster.

The aim of this study was to determine the apparent and standardized ileal amino acid digestibility (SIAAD), total amino acid (TAA), and N digestibility of 5 feed ingredients in 5- and 21-d old broiler chicks and turkey poults. Two methods of endogenous standardization were used, a nitrogen-free diet (NFD) and a completely digestible protein (CDP, 10% casein). The feed ingredients were two samples of corn distillers' dried grains with solubles (light, L and dark, D DDGS), canola meal, corn, and soybean meal. These ingredients were the sole source of amino acids in the diets (20% CP). Each diet was fed to six replicates pens containing 30 and 8 birds which were sampled on d 5 and d 21, respectively. Age had a significant effect on apparent ileal amino acid and N digestibility in broilers. Both standardization methods in chicks resulted in higher values relative to the apparent digestibility values. Standardization using CDP in chicks resulted in higher ($P < 0.05$) standardized ileal digestibility for TAA, N, and some of the amino acids on d 21 for L DDGS, canola meal, corn, and SBM relative to the NFD method. The effect of poult age on ileal amino acid digestibility was significant for L DDGS, corn, and SBM. In poults, both standardization methods resulted in higher SIAAD compared to apparent digestibility, however, there was no significant difference in SIAAD values between the two methods at any particular age except for corn where SIAAD

on d 21 was higher ($P < 0.05$) using a NFD method. Both the apparent and SIAAD values were higher for the L DDGS than the D DDGS in both species. The SIAAD for canola meal, corn, and SBM were higher than for DDGS in both species on d 5. These results show that correcting for ileal endogenous amino acid resulted in higher digestibility values and both methods of standardization produced similar results in poults at d 5 and d 21 whereas SIAAD in broiler chicks was higher on d 21 (3.8% TAA) using a CDP method.

Key Words: Casein, Chick, Ileal endogenous amino acid, Poult, Standardized ileal amino acid digestibility

M27 Utilization of low protein diets by large high yield Ross-708 broilers. J. Small^{*1}, E. O. Oviedo-Rondón¹, P. Tillman³, D. Hoehler⁴, J. Grimes¹, C. M. Ashwell¹, and S. Shah², ¹North Carolina State University, Raleigh, ²North Carolina State University, Raleigh, ³Ajinomoto Heartland Lysine, Chicago, IL, ⁴Degussa Corporation, Kennesaw, GA.

The US broiler industry currently has a tendency to grow large, high yield broilers. Commercial broiler diets are formulated to guarantee that these flocks receive all amino acids (AA) needed for high meat yield. Historically, relatively high protein diets (HP) have been used. In contrast, environmental regulations for nitrogen and ammonia are becoming more stringent. Low protein diets (LP) with AA supplementation are the logical alternative to reduce N waste. This project aimed to evaluate the effects of LP on high yield Ross-708 broilers raised to 56 d on live performance, carcass traits, flock uniformity, body chemical composition and blood metabolites. 240 day-old chicks of each sex were individually tagged and placed in 16 floor pens of 30 birds. Diets were formulated to contain equal amounts of digestible AA by adding crystalline Lys, Met, and Thr. Crude protein levels were 21 or 24% for starter (1-14 d), 20 or 23% for grower (15-34 d), 18 or 21% for finisher (35-56d) for LP and HP diets, respectively. Blood was drawn at 35 d from one male chicken per pen. Three birds of each gender from each pen (24/trt/sex) were processed at 56 d to determine carcass and parts yield. A 2X2 factorial design was used for data analyses. Final average body weights for males were 4292 and 4340 g, and females were 3366 and 3379 g when fed LP and HP diets, respectively. Gender differences were apparent for all variables evaluated. No significant differences ($P > 0.05$) due to diets were observed for body weight, feed intake, or feed conversion in any feeding period or for the entire grow out. Flock uniformity as coefficient of variance was 6.7 and 7.1% for males, and 8.3 and 5.7% for females fed LP and HP diets, respectively. No significant differences ($P > 0.05$) were observed for dressing, individual parts, abdominal fat or organ percentages. Body chemical composition was affected ($P < 0.01$) by diet treatment in males only. Blood level of Val, Leu, Ile, and HyPro were lower in male chickens fed LP. In conclusion, LP diets supplemented with crystalline AA did not affect performance or meat yield of large broilers while N efficiency was increased.

Key Words: Large broilers, Low protein diets, Amino acids, Meat yield, Body composition

M28 Reducing dietary crude protein while maintaining performance and improving economics in Ross 708 broilers. E. A. Guaiume^{*1}, J. D. Firman¹, D. Hoehler², P. B. Tillman³, D.

Burnham⁴, J. Parcell¹, L. B. Linares¹, and P. Butkeraitis¹, ¹University of Missouri, Columbia, ²Degussa Corporation, Kennesaw, GA, ³Ajinomoto Heartland LLC, Chicago, IL, ⁴Aviagen Inc., Huntsville, AL.

A study was conducted to determine the effects of reduced dietary crude protein (CP) on performance and economics of Ross708 broilers from hatch to week 8. 1440 straight-run broiler chicks were randomly assigned to 4 treatments with 12 replicate pens containing 30 birds each. Diets were formulated to be isocaloric and to have the minimum digestible level for lysine, and the same minimum ideal amino acid ratios to lysine for Met+Cys, threonine, valine, isoleucine, arginine, and tryptophan across the four phases [starter (0-2wks), grower (2-4wks), finisher (4-6½wks), and withdraw (6½-8wks)]. An industry standard diet served as the control (A) and the benchmark for performance. The remainder of the treatments (A-0.5%, A-1.0%, and A-1.5%) had CP reduced in 0.5% increments. Birds were weighed at 2, 4, 6½, and 8 weeks of age for feed to gain calculation. At week 8, 4 birds per pen (48/trt) were sacrificed and had fat pad and carcass weighed, and carcass and meat yield determined. Feed cost savings (FCS) per metric ton (MT) of live body weight (BW), FCS/MT carcass, FCS/MT breast meat, income over feed cost/MT carcass, and income over feed cost/MT breast meat, were calculated. Treatments had no effect ($P>.05$) on performance throughout the 8-week period. At week 8, birds fed A-1.5% had a higher ($P<.05$) percentage of fat pad when compared to A (3.11% versus 2.77%, respectively for A-1.5% and A). The remainder of the treatments did not differ from the control. In addition, treatments had no effect ($P>.05$) on carcass and breast meat yield at 8 weeks of age (A: 33.82%; A-0.5%: 33.37%; A-1.0%: 33.13%; A-1.5%: 33.08%). For BW, relative to A, FCS were \$3.90/MT when A-1.5% was fed; for carcass, \$5.46/MT; and for breast meat, \$16.37. Therefore, birds fed A-1.5% CP resulted in an increased income over feed costs of \$5.46/MT carcass and \$16.37/MT breast when compared to A. Overall, these results suggest that a decrease of CP by 1.5%, as compared with industry standards, did not affect performance, carcass, and meat yield, and resulted in significantly higher revenues.

Key Words: Low crude protein, Broilers, Performance, Meat yield, Economics

Monday, January 22 Environment and Management I Room: B314

M30 Utilization of cocoa pod husk (CPH) as substitute for maize in layers mash and poultry farmers' perception in Nigeria. E. O. Uwagboe^{*1}, R. A. Hamzat¹, and M. Olumide², ¹Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, ²Kolmart Farms, Ibadan, Oyo State, Nigeria.

Developing processing technique for efficient use of crop by-products such as cocoa pod husk (CPH) is very important in order to promote poultry feeding in the rural communities in Nigeria. Oluyole and Egbeda Local Government Areas (LGAs) of Oyo state, Nigeria were purposively selected out of the nineteen L.G.As producing cocoa in the state while one hundred and twenty respondents were selected from the list of eight hundred registered poultry farmers with simple random sampling technique. The farmers used the Cocoa Pod Husk (CPH) for a period of eight weeks January through February 2006 after which they were interviewed with interview guide. The data were presented using frequencies, percentages and charts while chi-square was used for the analysis.

The result revealed that 85 percent of the farmers are educated and 95 percent were willing to use CPH in feed production for layers. The

M29 Nutritional value of yeast extract Nupro[®] in male broiler chicks and turkey poults. R. L. Nanney^{*1}, P. R. Ferket¹, A. A. Santos Jr.¹, E. O. Oviedo¹, J. L. Grimes¹, and C. Parsons², ¹North Carolina State University, Raleigh, ²University of Illinois, Champaign.

Yeast extract is a potentially valuable nutrient source of amino acids, peptides, nucleotides, vitamins, minerals and inositol for neonatal poultry, but feeding value must be estimated to facilitate least-cost feed formulation. Our objective was to determine metabolizable energy (ME) and true amino acid digestibility (TAAD) of the yeast extract Nupro[®] (NP, Alltech, KY). In experiment 1, true Me (TME) and TAAD of NP were determined in cecectomized roosters by precision feeding method. In experiments 2 and 3, 6 replicate groups of 15 male chicks and poults were fed diets containing 0, 5, 10 and 15% NP at the expense of a corn-soy diet that met NRC recommendations for 1-21d. Body weight (BW) and feed/gain (FCR) was determined at 7, 14, 21d and AMEn was determined from fecal collections from 12-14 and 19-21d. Average TAAD and TME of NP were determined to be 86.79% and 3,611 kcal/kg DM, respectively, which agree with the AME values determined for both trials. The chicks fed the 5 and 15% NP in the diet had heavier BW than those fed 0 and 10% NP throughout the trial (21d BW: 938, 932 vs 900, 891g, respectively, $P<.05$). Likewise, 1-21d FCR of chicks fed 5 and 15% NP was better than those fed 0 and 10% NP (1.264 and 1.262 vs 1.306 and 1.326, respectively, $P<.05$). Poults fed 10 and 15% NP had significantly greater 21d BW than those fed 0 and 5% NP (634 and 609 vs 498 and 567g, respectively, $P<.05$). However, 1-21d FCR was better for poults fed 0 and 5% NP than those fed 10 and 15% NP (1.160 and 1.199 vs 1.257 and 1.255, respectively, $P<.05$). Mortality rate was not significantly affected by dietary treatment in either experiment. The effect of dietary NP supplementation on the performance appears to be dependent upon the dose and species. Nupro[®] can be fed as high as 15% of the diet without adverse effects on feed intake and BW; however the benefit of NP may differ in chicks and poults.

Key Words: Nucleotide, Chicks, Poults, Performance, TME

result also revealed that there is a significant relationship between constraints of inadequate energy source of ingredients ($X^2=6\bullet242$, $p\le0\bullet05$) method of processing ($X^2=5\bullet895$, $p\le0\bullet05$), inadequate labour ($X^2=9\bullet196$, $p\le0\bullet05$) and perception of poultry farmers towards use of Cocoa pod husk as substitute for maize in layers mash. Five Points Likert Scale result revealed that 85 percent of the respondents had positive perception towards the use of CPH as substitute for maize in layers mash and 75 percent had negative perception towards the processing method of CPH.

In conclusion, poultry farmers are willing to use CPH as a substitute for maize in layers mash if there is an improved method of processing. Hence, there is need for modern processing technique of CPH using hygienic method and at commercial level to enhance increase in the use of waste cocoa by-products and reduction in feed production cost in Nigeria.

Key Words: Cocoa pod husk, Processing, Utilization, Farmers, Perception

M31 Isolation and evaluation of *Salmonella*-lytic bacteriophages from commercial broiler houses. J. P. Higgins^{*1}, R. L. Andreatti Filho², S. E. Higgins¹, G. Gaona¹, S. N. Henderson¹, A. D. Wolfenden¹, G. Tellez¹, W.G. Bottje¹, and B. M. Hargis¹, ¹University of Arkansas, Fayetteville, ²College of Veterinary Medicine and Animal Science (FMVZ) Sao Paulo State University (UNESP), Botucatu, SP, Brazil.

Bacteriophages (\emptyset) represent a group of viruses that specifically infect and replicate in bacteria, and could potentially be used to reduce recovery of *Salmonella* (*S*) from poultry. For experiments 1 – 3 environmental drag swab samples were collected from 5 – 6 broiler houses, each located on different farms for isolation of *S* and \emptyset . In experiment 1, *S* was isolated from 3 of the 6 houses. Six drag swab samples were individually screened against a panel of 9 endemic *S* isolates of 5 serotypes and no \emptyset was isolated. In experiment 2, *S* was isolated from all 6 houses. Six drag swab samples were individually screened as above and \emptyset were isolated from 4 out of 6. Interestingly, none of the \emptyset isolated were able to initially lyse the *S* isolated from that same house. However, once the \emptyset were amplified in a different *S* host these \emptyset were then able to lyse the *S* that was isolated from the original source environment. In experiment 3, *S* was isolated from 3 of the 5 houses. Five drag swabs were individually screened against a panel of 12 endemic *S* isolates and \emptyset were isolated from 2 out of 5 houses. Again, none of the \emptyset isolated were able to initially infect the *S* isolated from the same environment. However, in experiment 3, none of the \emptyset were able to infect the *S* from the same house following amplification in an alternate *S* host. Based upon unique \emptyset host susceptibility profiles and plaque morphologies, at least 9 unique \emptyset isolates against *S* were identified. In all cases \emptyset were only isolated from houses positive for *S* with one exception in experiment 3. In summary, *S* \emptyset isolations were successful almost exclusively from poultry environments where *S* was also isolated. Interestingly, \emptyset from given environments were not able to lyse *S* recovered from those environments. Based upon these observations, the presence of \emptyset against *S* does not immediately explain the absence of *S* in some poultry environments.

Key Words: *Salmonella*, Bacteriophage, Poultry, Environment, Drag Swab

M32 Effect of broiler litter on growth of campylobacter. Z. T. Williams^{*1}, K. Christensen², M. Putsakum¹, Y. Vizzier-Thaxton¹, and S. W. Anderson¹, ¹Mississippi State University, Mississippi State, ²OK Foods, Inc., Ft. Smith, AR.

Campylobacter is one of the leading causes of food born illness in the United States with poultry frequently sited as a reservoir of the organism. While there are many possible sources of broiler flock contamination, litter has been implicated numerous times as not only a primary source of infection but as a mode of transmission between consecutive flocks.

This experiment was conducted to determine if the type of litter or specific characteristic of the litter such as pH or moisture content, could influence whether or not Campylobacter was able to colonize the litter and subsequently the birds .

Litter Samples were taken using a zig-zag pattern throughout the broiler house. The pattern insured that samples from under or near feeders and waterers as well as areas approaching the sides and ends of

the house were represented. In addition to measuring pH and moisture content, each sample was cultured in Campylobacter enrichment broth and then inoculated onto 10 Campylobacter Cefex plates. After 48-hour incubation plates were examined for the presence of generic Campylobacter. The data indicates that litter condition and type does influence the colonization of Campylobacter.

Key Words: Litter, Campylobacter, Broilers

M33 Effect of organic acids and probiotics on *Salmonella enteritidis* (SE) infection in broiler chicks. A. D. Wolfenden^{*1}, R. L. Andreatti Filho², J. P. Higgins¹, S. E. Higgins¹, G. Goana¹, G. Tellez¹, and B. M. Hargis¹, ¹University of Arkansas, Fayetteville, ²Sao Paulo State University, Botucatu, SP, Brazil.

A commercially-available (IVESCO LLC) water treatment PerforMax Optimizer II (PMO) and probiotic (FM-B11) have independently been reported to have anti-*Salmonella* effects. In exp. 1, 80 day-of-hatch chicks were challenged by oral gavage with 2.8×10^4 cfu SE, held in chick boxes for 2 h, and randomly assigned to either untreated control or continuous PMO treatment in the drinking water(dw; 1:128 product dilution for all exps.) in brooder batteries. Crop and cecal tonsils were cultured at 48 h and 5 d post-challenge for recovery of SE after enrichment. SE recovery in the crop and cecal tonsils at 48 h was significantly ($p < 0.05$) lower in the PMO treated group as compared to control (crop: 75% vs 100%; cecal tonsil: 55% vs 100%, respectively) but not different at 5 d. In exps.2 and 3, 160 day-of-hatch chicks were SE challenged (2.4×10^4 cfu), held in chick boxes for 2 h, and randomly assigned to either untreated control, FM-B11 (1.8×10^7 cfu by oral gavage 1 h prior to placement), PMO, or FM-B11+PMO ($n=40$ per group). After 24 or 48 h in the brooder battery, crop and cecal tonsils were cultured for the presence or absence of SE recovery after enrichment. After 24 h, FM-B11 or FM-B11+PMO significantly ($p < 0.05$) reduced SE recovery from the crop as compared to controls (75, 40 and 100%, respectively). All treatments reduced ($p < 0.05$) SE recovery from the cecal tonsils at 24 h (control: 60%, FM-B11: 25%, PMO: 45%, FM-B11+PMO: 13%). While no significant differences were observed in SE recovery from crop at 48 h, SE recovery from FM-B11 and FM-B11+PMO groups was significantly lower than the controls in the cecal tonsils (20, 20 and 100%, respectively). In exp. 3, FM-B11 or FM-B11+PMO caused reduced cecal tonsil SE recovery as compared to controls at 24 h (5, 15 and 75%, respectively), and at 48 h (40, 21 and 100%, respectively) and FM-B11+PMO again reduced SE recovery incidence in crops at 48 h as compared to controls (42% vs 100%, respectively). These data suggest that combination treatment with FM-B11 and PMO are more effective than individual treatment for *Salmonella* reduction in chicks.

Key Words: *Salmonella*, Organic acids, Probiotic

M34 The effect of feed additive antimicrobials on antibiotic resistance activity of gram negative microbes indigenous to poultry. D. Cork¹, A. Gupta^{*1}, and J. Mathers², ¹Illinois Institute of Technology, Chicago, IL, ²Alpharma Animal Health, Chicago Heights, IL.

Bacitracin, monesin, salinomycin, lasalocid and bambermycin are important feed additives used in the poultry industry due to their

antimicrobial activities and use as dietary production enhancers. The antimicrobial activity is generally limited to gram-positive, with minimal inhibition of gram-negative microorganisms. Initial studies have suggested resistance or plasmid loss effects in some bacterial classes. Six selected gram-negative poultry strains (3 *E. coli* & 3 *Salmonella typhimurium*) with phenotypic resistance to tetracycline and ampicillin (determined by antibiotic susceptibility testing) were screened for the presence of plasmid-borne tetR and ampR genes. Plasmid DNA profiling on agarose gel electrophoresis indicated sizes ranging from 3 to 50 kilobases in the selected strains. The plasmids were further evaluated for curing or decrease in copy number following *in vitro* exposure to various concentrations of the aforementioned feed additives. The compounds sodium dodecyl sulfate and acridine orange were additionally applied as known curing agents. Effective levels of some of these feed additive antimicrobials were found to affect losses or reductions of plasmids in certain strains. Plasmid band reductions in liquid test cultures were correlated with the percentage of isolates in the test system demonstrating phenotypic sensitivity to tetracycline and ampicillin. Such data may be important inputs in setting prudent standards for the use of feed additive antimicrobials in the poultry industry.

Key Words: Antimicrobials, Plasmids, Poultry, Microorganisms, Feed

M35 Performance comparison between the use and non-use of an enteric health antibiotic program in commercial broiler flocks. J. Bray^{*1,2}, T. Cherry¹, J. Carey², and C. Smith^{1,2}, ¹Stephen F. Austin State University, Nacogdoches, TX, ²Texas A&M University, College Station.

In the US, current trends show that enteric health antibiotics are being removed from broiler diets. The use of these antibiotics in broiler production is a contentious issue. An experiment was conducted to compare the differences in performance parameters between broilers that were fed enteric health antibiotics in the diets and broilers that were not fed enteric health antibiotics in the diets. This is the preliminary report from three flocks of a five flock trial. Broilers were reared under commercial settings in solid-side wall, tunnel ventilated broilers houses. The four-house farm was divided into two separate farms with two houses being fed the enteric antibiotic program and the other two were fed a naïve feed. Initially, 27,600 broilers were placed per house and reared for 49 days. All birds were fed commercially produced starter, grower and withdrawal rations. Individual body weights of 100 birds per house were collected at 18, 35, and 49 days of age. Feed conversion and adjusted feed conversion were calculated for each of these days. Coccidiosis lesion scores using the Johnson and Reid Method were collected at 14, 21, 28, 35, and 42 days of age. At the conclusion of each flock 140 birds from both treatments were selected and processed in a yield study. The nature of the differences in bird performance between the treatments varied from flock to flock. In general the data indicates a slight improvement in performance and gut health among flocks receiving antibiotics.

Key Words: Broilers, Antibiotics, Performance, Enteric

M36 Effects of water treatment products on broiler performance. J. G. Hughes*, J. M. Cornelison, A. G. Hancock, L. B. Davis, and S. E. Watkins, *University of Arkansas, Fayetteville.*

The poultry industry continues to search for ways to improve bird performance with water additives. Two water acidifiers Kem San[®], a propionic acid blend and SYNTRx, a proprietary acid blend and one sanitizer, PronTech[™], a cationic salt, were evaluated for their impact on broiler performance. Each product was added to the water according to manufacturer's recommendations and given to 6 pens of 55 birds on a continuous basis. Plain tap water served as the control. Average pH for each treatment was 4.49, 2.73, and 7.65 respectively, with the control pH averaging 7.98. Birds were group weighed by pen at days 14, 28, 42, and individually weighed at day 49. Feed consumption was measured for each period. There were no significant differences in body weights, feed conversion or mortality throughout the trial. Average weights, in grams, for the control, Kem San[®], SYNTRx and PronTech[™] for days 14 and 49 were 358, 357, 367 and 379 and 3508, 3488, 3493, and 3556. The feed conversion for the control, Kem San[®], SYNTRx and PronTech[™] for day 14 were 1.219, 1.189, 1.180, and 1.224. Feed conversions for day 49 were 1.684, 1.675, 1.702, and 1.688.

Key Words: Water acidifiers, Water treatments, Broiler performance, pH

M37 Evaluation of different products used for cleaning drinking water systems. A. G. Hancock*, J. G. Hughes, and S. E. Watkins, *University of Arkansas, Fayetteville.*

Clean water systems are essential for providing good water quality to poultry. Several products were evaluated for their effectiveness as water sanitizers in water that had an abundance of algae growth. The different products evaluated were: Proxy-Clean[™], CID 2000[®], Pro-Clean which are all concentrated stabilized hydrogen peroxide products; 35 % hydrogen peroxide, Citric Acid, 6% Sodium hypochlorite or household bleach, and Poultry PronTech[™] which is a cationic salt. Each product was added to 2- 50 ml aliquots of water and untreated water served as the control. The Proxy-Clean[™] and 35 % hydrogen peroxide were added at a rate of three percent. The CID 2000[®] was added at a rate of 2 %. The citric acid was prepared in a stock solution of two packets per one gallon of water, and the stock solution then used at a rate of 1:128. The household bleach was added at a rate of one ounce of bleach per gallon of water or 0.78% concentration. Also a stock solution was prepared using twelve ounces of bleach per gallon of water; the stock was then metered at 1:128. The product Pro-Clean was added at the standard medicator rate of one ounce per gallon and also at a rate of three percent. Poultry PronTech[™] was added at a rate of one gram per liter or 400 ppm, and also at a rate of one gram per four liters or a rate of 100 ppm. The aerobic bacteria loads along with yeast and mold counts were tested initially and four hours and twenty-four hours after treatment. The ORP and pH for each sample was tested.

Microbial loads prior to treatment were within a six log range. Four hours after treatment the product CID 2000[®] had the greatest reduction in microbial presence, with the household bleach at .78%, Proxy-Clean[™], and Pro-Clean products at the 3% rate had the next lowest levels of microbial presence. The remainder of the products only showed a one log reduction in microbial presence.

Key Words: Water sanitation, Chlorine, Hydrogen peroxide

M38 Effect of ventilation, basket capacity, and machine temperature during the last 5 days of incubation on broiler hatching egg temperature and embryonic development. J. T. Brake, P. W. Plumstead, K. E. Brannon*, N. Leksrisonpong, J. H. Small, and E. O. Oviedo, *North Carolina State University, Raleigh.*

It was hypothesized that altering hatching basket ventilation and capacity would ameliorate the adverse effects of high egg temperatures on embryonic development and broiler performance. Ross 344 x 708 SF broiler eggs were incubated at an egg temperature of 37.2-37.8°C until E17 when eggs were distributed into four combinations of basket ventilation and basket capacity in either a "Hot" machine (38.2°C) or a "Cool" machine (36.1°C). The normal ventilation treatment (CN) utilized standard hatching baskets. The top-taped (TT) treatment did not permit air to flow through the top of each basket. Low and high basket capacity comprised either 95 or 190 eggs per basket, respectively. There were two replicate baskets per combination per machine. Egg temperatures and basket exit air velocities were measured daily from E17 to hatching. At hatching, BW and relative weights of the yolk, heart, liver, proventriculus, gizzard, and small intestines were determined. In the Cool machine, a significantly larger BW, and yolk and heart weights were observed in the CN-190 interaction, as well as a significantly smaller liver. In the same Cool machine, the TT-190 interaction displayed a significantly reduced BW, and yolk and heart weights in addition to a significantly larger liver. However, in the Hot machine, significant differences between the interactions were apparently obscured by increased egg temperature. Chicks were grown to 21 d and BW, adjusted FCR, and mortality were determined. At 7, 14, and 21 d of age the largest BW was observed in the CN-Hot interaction while the lowest was observed in the TT-Hot interaction with no major differences observed for adjusted FCR. The most notable difference in mortality was for the main effect of capacity, where the 95 treatment gave 0% mortality while the 190 treatment gave 3.13%.

Key Words: Ventilation, Capacity, Machine temperature, Egg temperature, Embryonic development

M39 Embryonic development when eggs are turned different angles during incubation. H. R. Cutchin*, S. L. Funderburk, M. J. Wineland, V. L. Christensen, and K. M. Mann, *North Carolina State University, Raleigh.*

Failure to turn eggs during incubation has been demonstrated to cause improper development of extra embryonic components necessary for embryonic growth. These include reduced development of the area vasculosa (AV), chorioallantoic membrane (CAM), an increased amount of residual albumen (RA) and reduced volume of sub embryonic fluid (SEF). The purpose of this trial was to evaluate the effects of different turning angles upon development. Eggs stored for 1 day from 48 week old broiler breeder hens were used in three incubators set at 15°, 30° and 45° turning angles with 720 eggs per treatment. The profiles for each incubator were kept the same. At days 3, 6, 8, 13, 18 and 20 samples were collected and evaluated for various aspects of embryonic growth such as: size of AV, amount of SEF, embryo size (ES), CAM development and amount of RA. Eggs were weighed, volume was determined, and moisture loss was calculated at designated sampling times. Hatch of fertile was significantly different (45°>30°>15°). 15° angle demonstrated significantly reduced 6d SEF volume but not CAM or AV. At hatch the residual yolk sac was

removed from 20 chicks per treatment and all dried down at 70°C for determination of moisture content. Hatched chicks from eggs turned 45° weighed significantly more and had less dry matter in the residual yolk. Examination of hatch residue demonstrated significantly greater pipped chicks as well as embryonic dead 4-10d and 17-21d in the group turned 15°. Additionally, these embryos exhibited increased malpositions, hemorrhages and residual albumen. Turning eggs 15° causes multiple embryonic maladies while reduced hatch was noted in eggs turned 15° and 30°.

Key Words: Turning, Incubation, Malposition, Sub embryonic fluid, Chorioallantoic membrane

M40 Influence of a twice a day versus once a day feeding program after photostimulation on the reproductive performance of broiler breeder hens. J. M. Spradley*, M. E. Freeman, J. L. Wilson, and A. J. Davis, *University of Georgia, Athens.*

Previously we reported that extending skip-a-day feeding past photostimulation until five percent egg production decreased total egg production by more than 15 eggs per broiler breeder hen through 65 weeks of age. Those results suggested that broiler breeder hens' reproductive performance was very sensitive to periods of food deprivation. Therefore in the current research the effect of feeding hens twice a day versus once a day after photostimulation on egg production was investigated. Pullets were reared using a skip a day feeding program from 2-21 weeks of age. All pullets were weighed at 20 weeks of age and then segregated into 30 laying pens (35 hens and 4 roosters per pen) such that each pen had a similar distribution of body weights. At 21 weeks of age 15 laying pens were placed on once a day feeding while the other 15 pens were placed on twice a day feeding. The total amount of feed provided per day to the laying pens was the same for both treatments, however, the once a day birds received all of their feed at 6:30AM, while the twice a day birds received 60% of their total feed allotment at 6:30 AM and the other 40% at 3:00PM. Although egg production commenced for both treatments at the end of 23 weeks of age, total egg production through 29 weeks of age is significantly greater for the birds provided feed twice a day. Weekly hen-day egg production was significantly greater for the hens fed twice a day for the entire period from 24 – 29 weeks of age. In addition, although the body weight profile for the two treatments was equal at the start of the experiment, the coefficient of variation for body weight was also significantly smaller for the twice a day fed hens at 29 weeks of age. The results provide further support that once pullets are photostimulated it is essential to limit fasting periods with regard to dietary intake for maximum egg production in broiler breeder hens.

Key Words: Broiler breeder hen, Twice a day feeding, Egg production

M41 Broiler breeder feeding program during rearing and early lay affects reproductive and progeny performance. N. Leksrisonpong*, P. W. Plumstead, H. Romero-Sanchez, K. E. Brannon, and J. Brake, *North Carolina State University, Raleigh.*

Twelve replicate pens of 190 females each were randomly assigned to two rearing feeding program treatments (sigmoid or line) from 1

to 21 wk of age and two feed increase treatments (slow or fast) from photostimulation to peak egg production in a 2 x 2 factorial design with three replicate pens each. The flock was photostimulated at 21 wk of age when Ross 344 males and Ross 308SF females were housed and mixed in the production facility. Females from the sigmoid rearing program weighed more at 4, 6, 8, 10, and 12 wk but less at 18, 40, 48, and 56 wk. There were no differences in rate of lay but females that had been reared on the sigmoid feeding program exhibited reduced mortality during the laying period that resulted in an increased number of eggs per hen housed. Fertility was not affected but fertile hatchability was improved by the sigmoid rearing program as well. No differences due to the two different feed increase programs were found other than that the slow program produced a heavier egg weight at 28 wk. Eggs produced by these hens at 28 wk were incubated under standard conditions and the carryover effects on the broiler progeny evaluated. Fifteen male and 15 female broiler chicks were randomly assigned across 72 pens to create a 2 x 2 x 2 design with 9 replicates per interaction cell with sex added as the third main effect. Body weight, feed consumption, adjusted feed conversion ratio, and mortality were measured to 42 d. Male broilers were heavier and exhibited higher mortality than females, as expected. Mortality was significantly affected by the broiler sex by breeder feed increase rate from photostimulation to peak egg production interaction in that male broilers from the slow feed increase program exhibited the highest mortality. This was thought to be due to an increased egg temperature in the larger eggs of the slow feed increase group that adversely affected embryonic development, specifically the heart.

Key Words: Broiler breeder, Broiler progeny, Feeding program

M42 Measurements of growth and sexual maturity of commercial broiler-breeder pullets fed on varying growth curves. R. S. Harper^{*1}, B. Harvey¹, D. E. Yoho¹, J. R. Moyle¹, P. Sbanotto², and R. K. Bramwell¹, ¹*University of Arkansas, Fayetteville*, ²*Cobb-Vantress, Inc., Siloam Springs, AR*.

Finding ways to measure pullet development and maturity is an important concept in the commercial broiler-breeder industry. Measurements are routinely taken to gather a sense of the uniformity of the flock. Body weight has long been the main measuring tool to check this uniformity. This study examines some new techniques in order to gauge pullet growth and sexual development. Cobb 500FF pullets were reared in four treatment groups, consisting of two separate growth curves. Two of the curves were a standard pullet growth curve and the other two a modified curve. The modified curve held the birds' growth back early in the rearing stage and then accelerated the growth towards lighting. Each curve had a high calorie feed treatment and low calorie feed treatment. Thirty birds from each treatment group were randomly selected for this trial. Measurements taken include: pelvic bone spread, body weight, fat pad score, fleshing score, comb and wattle development, and primary wing feather molt. Each bird was banded and measured to obtain the appropriate data previously mentioned. Birds were evaluated every two wks beginning at 12 wks and ending at 24 wks of age. At 20 wks the birds were moved from the pullet house into a production hen house. Data indicates that pullets that were gaining weight the fastest before being lit (modified curve) had the largest response to lighting. These birds had the largest increases in pelvic width and comb and wattle development. This data indicates that birds gaining aggressively before lighting at 21 wks are the most ready to become sexually mature and respond to light

stimulation. Additionally, results of this experiment indicate that there are other factors besides body weight that can be utilized to assess a pullets readiness for their response to light stimulation.

Key Words: Pullet management,, Pullet sexual maturation,, Pullet development

M43 Evaluating external physical characteristics of commercial broiler breeder males and testes weight and volume. A. D. Swaffar^{*}, D. E. Yoho, J. R. Moyle, R. S. Harper, and R. K. Bramwell, *University of Arkansas, Fayetteville*.

Commercial breeder managers often attempt to assess the reproductive potential of broiler breeder males by their physical characteristics. When evaluating the physical characteristics of commercially reared broiler breeder males the assumption is often that the more predominate the physical characteristics of the male, the larger the testes. This study was designed to determine if several physical characteristics had an effect on testicular weight and volume. Commercially raised broiler breeder males varying in age from 16-65 weeks of age were obtained from commercial broiler breeder farms and were brought to the University of Arkansas for evaluation. Males were weighed live, shank and spur length measured, the comb length, height and circumference determined, and wattle length was measured. Males were euthanized and the comb and wattles removed to obtain weights for each. The testes of each male were harvested and weighed in pairs with the weight and volume recorded for each male. Data were analyzed using JMP statistical software package. Paired testes weight ranged from 4 g to 63 g with live weight ranging from 3.443 kg to 6.485 kg. Analysis of the data indicated no significant correlation between physical characteristics and testes weight or volume. In summary, data from this research indicates that selecting or culling males based upon external physical characteristics is not an effective method for evaluating broiler breeder males for physiologically reproductive traits.

Key Words: Testes,, Sexual maturation,, Male management

M44 Effects of age on nitrogen mass balance of broilers. C. Smith^{*1,2}, J. Carey², J. Bray^{1,2}, and T. Cherry¹, ¹*Stephen F. Austin State University, Nacogdoches, TX*, ²*Texas A&M University, College Station*.

A current important issue facing broiler producers involves the amount of nitrogen produced and subsequently released into the atmosphere from broiler production facilities. At the end of each growout caked litter must be removed from broiler facilities. A large percentage of broiler growers utilize pine shavings as litter in broiler houses and recycle litter from flock to flock. Thus, a study was conducted under simulated commercial broiler production conditions to more accurately measure litter and caked litter production, as well as perform a nitrogen mass balance for different ages during normal broiler production. Broiler chicks and feed were obtained from a commercial integrator and one flock was reared on recycled litter upon which two flocks had previously been reared. Birds were housed in twenty-four 10' X 10' pens with 134 broilers placed per pen, such that at 49 days of age 0.75 square foot per bird was allowed. Broilers were feed a commercially produced starter, finisher, withdrawl-1, withdrawl-2, and withdrawl-3.

To determine the nitrogen mass balance at varying flock age, all incoming and outgoing sources of nitrogen were sampled. Incoming sources of nitrogen include broiler chicks and feed. Outgoing sources of nitrogen include litter, cake, carcasses, mortality, and loss in the form of dust and ammonia. Samples and broiler weights were taken at Day 0, 21, 35, and 49 of age. All samples were analyzed for moisture

and total nitrogen content and mass balance was calculated on a dry matter basis. Litter production, nitrogen content of the litter, and nitrogen loss was greater among older birds. This experiment aids in determining the impact of age on litter characteristics and nitrogen loss.

Key Words: Broiler, Nitrogen mass balance, Moisture, Litter, Age

Monday, January 22 Processing and Products Room: B315

M45 Effects of low refrigeration temperature storage on quality characteristics of shell eggs. M. A. Sartor*¹, J. Regenstein², and M. X. Sánchez-Plata¹, ¹Texas A&M University, College Station, ²Cornell University, Ithaca, NY.

The egg processing industry reports that storage of shell eggs at low refrigeration temperatures (close to 0°C (32°F)) during retail display may be associated with quality deterioration. Typical problems reported include "running whites" and "flaccid yolks". Standard quality parameters and functional properties of shell-eggs stored at -1.1, 0.6, 2.2, 3.9, 5.6 and 7.2°C were evaluated at days 0, 2, 7, 14, 21 and 28 under simulated retail conditions. Quality parameters evaluated included yolk and white color (Minolta), yolk index, Haugh units, pH and vitelline membrane strength. Additionally, foaming properties (cake density) and coagulation properties of the egg products (yolks and whites) were also determined. As expected, the pH of the albumen increased over the time of storage at all storage temperatures tested. The vitelline membrane strength was the lowest when the eggs were stored at -1.1°C. No significant differences associated with the temperature of storage were observed. However, significant differences in pH, Haugh units and yolk index were evident when comparing samples tested at the beginning of the experiment (day 0 and day 2, compared to day 28). Storage of shell eggs at temperatures below 1°C may affect some of the quality parameters and functionality of egg products, especially the albumen. Shell eggs need to be maintained at temperatures below 7 °C as recommended by the USDA guidelines; however, storage temperatures should be kept above 1°C to minimize these changes.

Key Words: Egg storage, Vitelline membrane strength, White color, Yolk index, Haugh units

M46 Effect of immersion or dry air chilling on bacteria recovery from broiler carcasses. R. Huezos*¹, J. K. Northcutt², D. P. Smith¹, D. L. Fletcher³, and R. J. Buhr¹, ¹University of Georgia, Athens, ²USDA-ARS, Athens, Georgia, ³University of Connecticut, Storrs.

A study was conducted to investigate the effect of chilling method (air and immersion) on *Escherichia coli*, coliforms, *Campylobacter*, and *Salmonella* counts and prevalence recovered from broiler carcasses. During each of four replications, 60 broilers were inoculated orally and intra-cloacally with 1 mL of a suspension containing approximately 10⁸ cells/mL of *Campylobacter*. After one day, broilers were inoculated with 1 mL of a suspension containing approximately 10⁸ cells/mL of *Salmonella*. Broilers were processed and carcasses were cooled by

dry air (3.5 m/s, -1.1 C, 150 min) or immersion chilling in ice water (0.6 C, 50 min). Pre-chill counts recovered from carcasses averaged 3.5, 3.7, 3.4, and 1.4 log₁₀ cfu/mL of rinse for *E. coli*, coliforms, *Campylobacter*, and *Salmonella*, respectively. Overall, both chilling methods significantly reduced bacteria levels on the carcasses, and no difference in the bacteria counts was observed between the two chilling methods ($P < 0.05$). Both chilling methods reduced *E. coli* and coliforms levels by 0.9 to 1.0 log units. Chilling reduced *Campylobacter* levels by 1.4 log (air) and 1.0 log (immersion), while *Salmonella* reductions were 1.0 log and 0.6 log units for air and immersion chilling, respectively. Chilling method had no effect on the prevalence of *Campylobacter* and *Salmonella* recovered from carcasses. These results demonstrate that air and immersion chilled carcasses, without any chemical intervention, are microbiologically comparable, and a 90% reduction in counts of *E. coli*, coliforms, and *Campylobacter* can be obtained after chilling.

Key Words: Broilers, Immersion chilling, Air chilling, Cross contamination, Carcass microbiology

M47 Enterobacteriaceae isolated from packer head brushes in commercial shell egg processing plants. J. D. Shaw*¹, M. T. Musgrove², and D. R. Jones², ¹University of Georgia, Athens, ²Egg Safety and Quality Research Unit, ARS, USDA, Athens, GA.

Plant sanitation is an integral component of process control and is crucial to ensuring a wholesome product. This study is an extension of previous work designed to evaluate the status of egg contact surface sanitation in commercial shell egg processing plants. Packer head brushes are placed after the washers and are one of the last pieces of equipment to come in contact with the egg, and therefore may have an important effect on egg cleanliness. In the current study, two egg processing plants were sampled three times each: an offline plant (OL) and a mixed operation plant (MO). While in operation, one packer head brush at each packer head lane was sampled by running a moistened sterile gauze pad across the length of the brush. The gauze pads were then aseptically packaged and transported to the laboratory at refrigerated temperature. *Enterobacteriaceae* were enumerated by plating 1 ml of diluent on violet red bile glucose agar with overlay and incubated at 37 C for 24h. A larger number of *Enterobacteriaceae* were recovered from the MO plant packer head brushes than from those sampled at the OL plant (1.7 log cfu/ml and 0.069 log cfu/ml, respectively). From each positive plate, up to five typical colonies were picked at random, streaked for purity, and subjected to biochemical testing for identification to genus or species. A total of 121 isolates were

identified: 13 from OL and 108 from MO. Genera recovered included *Citrobacter*, *Enterobacter*, *Escherichia*, *Klebsiella*, *Moellerella*, and *Providencia*. At the OL plant, 84.6% of the isolates were identified as *Enterobacter*; of the isolates identified from the MO plant, 68% were *Escherichia*. These genera are the two most commonly isolated from the shells of washed eggs. Five non-*Enterobacteriaceae* genera were found: *Acinetobacter*, *Burkholderia*, *Comomonas*, *Pasteurella*, and *Sphingobacterium*. Identifying bacteria from packer head brushes can assist researchers in developing more effective sanitation practices for the shell egg industry. This is the first report to describe genera associated with packer head brushes in commercial shell egg processing plants.

Key Words: Sanitation, Packer head brush, Enterobacteriaceae, Shell egg

M48 Effect of chilling method and post-mortem aging time on broiler breast fillet quality. R. Huezco^{*1}, J. K. Northcutt², D. P. Smith², and D. L. Fletcher³, ¹University of Georgia, Athens, ²USDA-ARS, Athens, GA, ³University Connecticut, Storrs.

A study was conducted to determine the effects of chilling method (dry air or immersion) and post-mortem aging time on broiler breast fillet quality (raw fillet color, raw fillet pH, cook yield and Allo-Kramer shear). One hundred fifty eviscerated broiler carcasses were removed from a commercial processing line prior to chilling and transported to the laboratory. Half of the carcasses were chilled by dry air (3.5 m/s, -1.1 C, 150 min), while the other half were chilled by water immersion (0.6 C, 50 min). Immersion chilled (IC) carcasses were divided into 3 groups (0, 1.67 and 24 h) that corresponded to post-mortem fillet aging time on the carcass after chilling. Air chilled (AC) carcasses were divided into two groups (0 and 24 h). Because AC requires more time, AC fillets deboned immediately after chilling were aged for the same length of time as the 1.67 h IC fillets. One fillet from each carcass was used for raw pH and color (L*, a* and b*), while the other fillet was cooked (steam cooker, 95 C, 15 min) and used to determine yield and texture. The pH of IC and AC fillets was similar when fillets were aged for the same length of time post-mortem. Method of chilling has no effect on raw breast fillet color ($P < 0.05$); however, post-mortem aging time had a significant, but slight affect on lightness. Tenderness of IC fillets removed 0 and 1.67 h after chilling was similar and corresponded to the texture previously designated as slightly tough to tough by sensory panels (Allo-Kramer shear > 8 kg/g). Force to shear AC fillets deboned immediately after chilling (8.4 kg/g) was significantly lower than IC fillets (10.3 kg/g) aged for the same length of time (1.67 h). After 24 h aging, shear values for IC and AC fillets were < 8 kg/g and values were in the range considered to be tender to very tender by sensory panels. Cook yield of AC fillets was significantly higher than IC fillets for all deboning times. Results show that rigor may develop at a faster rate during AC as compared to IC; however, post mortem aging is still required to maximize tenderness.

Key Words: Poultry chilling, Air chilling, Immersion chilling, Poultry texture

M49 Effect of immersion or dry air chilling on broiler carcass moisture retention and breast fillet functionality. R Huezco^{*1},

D. P. Smith², J. K. Northcutt², and D. L. Fletcher³, ¹University of Georgia, Athens, ²USDA, ARS, Russell Research Center, Athens, GA, ³University of Connecticut, Storrs.

A study was conducted to investigate the effect of chilling method on broiler carcass skin color, carcass moisture retention, and breast fillet quality and functionality. One hundred fifty eviscerated broiler carcasses were removed from a commercial processing line prior to chilling, transported to the laboratory, weighed and chilled by dry air (3.5 m/s, -1.1 C, 150 min) or immersion in ice water (0.6 C, 50 min). Post-chill carcasses were weighed for moisture uptake, individually bagged and held at 4 C for 24 h. Fillets were deboned, marinated (20% wt:wt, 20 min, 3% salt: 2% STTP) and cooked (steam cooker, 95 C, 15 min), with weights taken at each step. Carcass skin color was measured immediately after chilling and after 24 h. Fillet color was measured on the medial surface before marination and after cooking. Cooked fillets shear values were determined using an Allo-Kramer multiple blade. After 150 min of air chilling, carcasses lost 2.5% of pre-chill weight, and weight loss ranged from 3.5% to 2.2%. Water absorption during immersion averaged 9.3% of the pre-chill weight, but varied widely with a range of 3.4% to 14.7%. Immediately after chilling, Immersion chilled (IC) carcasses were significantly lighter (higher L*), less red (lower a*), and less yellow (lower b*) than air chilled (AC) carcasses. Storage time improved appearance of AC carcasses, but skin color after 24 h of storage was still significantly different for the two chilling methods ($P < 0.05$). Raw and cooked fillet color, fillet marination pick-up, and cooked fillet tenderness were not affected by chilling method. Cook yield for fillets deboned from IC carcasses was significantly lower than fillets deboned from AC carcasses. Results suggest that immersion chilling is better for whole birds and skin-on parts; however, air chilling is acceptable for deboned and further processed items as fillet color, marination yield and tenderness is not affected, while cook yield is improved.

Key Words: Broilers, Immersion chilling, Air chilling, Marination, Poultry meat color

M50 Validation of a chlorine dioxide product applied pre- and post- chilling to reduce bacterial levels in broilers. V. Molina*, M. Davis, and M. Sánchez-Plata, Texas A&M University, College Station.

Selectocide™, a chlorine dioxide (CD) generating product, was validated as an antimicrobial intervention applied before and/ or after chilling in a commercial broiler processing facility. Five different scenarios were simulated during each of three independent plant visits. A control plant scenario consisted in sampling 10 different carcasses at each of three different stages including after evisceration, after a chlorine rinse (50ppm), and after a 1h static chilling in icy-water (2ppm chlorine). Interventions tested in this experiment created 4 additional plant scenarios. The second scenario featured pre-chill carcasses sprayed with an acidified sodium chlorite (ASC), Sanova™, solution (1,200ppm) with samples taken after the intervention and after chilling. The third scenario featured pre-chill samples submerged for up to 30s in a 10ppm CD solution and sampled 1 minute after treatment application, and after chilling. A fourth scenario consisted of samples subjected to the intervention post-chill; while the fifth scenario featured post-chill samples subjected to the CD intervention before and after chilling. Standard sampling methods were used to evaluate aerobic plate, coliform, generic *E. coli* and psychrotrophic

counts, as well as the incidence of *Salmonella* spp. Significant variability in *Salmonella* spp. incidence was observed between replications. In general, similar bacterial reductions were achieved by the pre-chill application of acidified sodium chlorite and the chlorine dioxide product. Coliform counts in final carcasses for each of the five scenarios were 3.38, 2.58, 2.04, 2.10 and 2.19 log CFU coliforms/ ml of rinse, respectively. Generic *E. coli* levels in final carcasses for each plant scenario were 2.50, 2.10, 2.00, 1.65, 1.57 log CFU/ ml of rinse, respectively. Final psychrotrophic counts for each scenario were 3.42, 3.52, 3.51, 2.66, 2.27 log CFU/ ml of rinse, respectively. Post-chill application (last two scenarios) of the chlorine dioxide product significantly reduces bacterial populations, especially generic *E. coli* and spoilage organisms.

Key Words: Chlorine dioxide, Pre-chill, Post-chill intervention, Acidified sodium chlorite, *Salmonella*

M51 Ultra-violet light treatment lowers numbers of *Listeria monocytogenes* on raw chicken fillets without changing antibiotic resistance or meat color. S. A. Lyon*¹, M. E. Berrang¹, D. L. Fletcher², and P. J. Fedorka-Cray¹, ¹USDA-ARS-Russell Research Center, Athens, GA, ²University of Connecticut, Storrs.

Listeria monocytogenes is an important foodborne pathogen and raw poultry meat has been shown to be a vector for its entrance into a poultry further-processing plant. Reduction of *L. monocytogenes* in these plants is a high priority for the industry. Ultra-violet (UV) light at a wavelength of 254 nm is called germicidal UV and can kill bacteria. This study was designed to test germicidal UV light as a means to lower *L. monocytogenes* counts on raw chicken meat prior to shipment from a slaughter plant to a further processing plant. Raw chicken breast fillets were inoculated with one of four subtypes of *L. monocytogenes* each with a different antibiotic resistance profile. Inoculated fillets were exposed to UV irradiation at 1,000 $\mu\text{W}/\text{cm}^2$ for 5 min. Untreated control samples were maintained for comparison. All fillets were rinsed in PBS and *L. monocytogenes* were enumerated by plating serial dilutions on modified oxford medium. UV treatment resulted in a 2 Log reduction in viable *L. monocytogenes* recovered from fillets. Antibiotic resistance profiles were determined using the broth micro-dilution method. UV irradiation did not alter the antibiotic resistance profiles of any of the 4 *L. monocytogenes* strains as compared to those isolated from non irradiated fillets. Likewise, UV treatment had no effect on meat color (lightness, redness, and yellowness) on the day of treatment or after 7 days of storage at 4°C. This study suggests that UV irradiation of raw breast fillets at a slaughter plant can significantly reduce *L. monocytogenes* without negatively affecting meat color or changing antibiotic resistance among the surviving population. UV treatment may be useful to reduce the negative impact of *L. monocytogenes* introduction into a poultry further-processing plant on raw poultry meat.

Key Words: Ultraviolet irradiation, Poultry processing, *L. monocytogenes*, Antibiotic resistance, Meat color

M52 The effects of paraffin wax and a wax antimicrobial product to reduce microbial levels in processed chicken broilers. M. X. Sánchez-Plata*, Texas A&M University, College Station.

The suspension of approved antimicrobial treatments into a molten paraffin wax matrix was evaluated as a potential intervention in commercially processed broilers. Bacterial reductions on carcass surfaces were expected after submersion in a hot coating wax product, followed by physical removal of attached bacteria to the solidified residue, and the antimicrobial effects of a chemical intervention suspended in the wax matrix. A total of 420 market age broilers, were processed in a pilot plant research facility and were subjected to four different processing scenarios. Control samples were humanely slaughtered, scalded in a water tank at 58°C, picked using a pilot scale picker, manually eviscerated and chilled in a static icy-water tank (2ppm chlorine). For treatment 1, a separate set of carcasses were submerged in a molten paraffin wax product kept at 60°C for 1 second, followed with immediate submersion in icy water to allow the manual removal of the solidified wax coating. For treatment 2, carcasses were submerged in molten wax for 15 seconds, followed with immediate submersion in ice water. For treatment 3, carcasses were treated with molten wax that had a suspended chlorine dioxide (CD) generating product. Samples taken after bleeding, scalding, picking, waxing, evisceration, and chilling were tested for total aerobic, coliform and generic *E. coli* counts as well as *Salmonella* spp. incidence using standard methodologies. The immediate submersion in the wax product was responsible for a 0.3 to 0.5 log CFU/ ml of rinse reduction in total aerobic, coliform and generic *E. coli* counts. No significant reductions in the incidence of *Salmonella* spp. were observed. Reductions of 0.5 to 0.9 CFU/ ml of rinse in all the parameters tested were observed by the 15 s submersion in the wax product and the submersion in the wax product suspended with the CD product. Results indicate that the thermal, physical and chemical potential of paraffin wax as an antimicrobial intervention could assist processors in reducing overall bacterial levels in processed broilers.

Key Words: Paraffin wax, Intervention, Antimicrobial, Microbial levels, *Salmonella*

M53 The effect of tasker blue applied at various intervention steps on aerobic plate counts and *Escherichia coli* counts on fresh broiler chicken carcasses. S. M. Russell*, University of Georgia, Athens.

A study was conducted to evaluate the effect of Tasker Blue (TB-sulfuric acid, ammonium sulfate, and copper sulfate) applied at various locations in a commercial processing facility on aerobic plate counts (APC) and *Escherichia coli* (*E. coli*) counts on fresh broiler chicken carcasses. TB was applied in the scald (pH 2, Cu 3 ppm), as a New York Dressed (NYD) spray, as an online reprocessing (OLR) treatment (10 second dip was used offline to mimic a 10 second spray treatment), and as a post-chill dip (TB treated offline at pH 3.5, Cu 3 ppm) for 10 s. Ten carcasses were sampled after scalding (PS), after NYD spraying (PNYD), pre-online reprocessing (Pre-OLR), post-online reprocessing (Post-OLR), and post-chill (PC) for controls or PC dip (PCD) for TB carcasses at each of these locations using the whole carcass rinse procedure. Likewise, 10 carcasses were selected from the adjacent processing line and sampled as controls. After collecting from the lines or dip tanks, the carcasses were allowed to drip for 1 min, individually placed into sterile bags, packed on ice in coolers, transported to the laboratory, and evaluated for APC and *E. coli* counts. Log₁₀ APC results for the control line were 5.44, 4.18, 5.50, 4.60, and 3.43 for PS, PNYD, Pre-OLR, Post-OLR, and PC, respectively. Log₁₀ APC results for the TB treated line were 2.95, 3.29, 3.76, 0.97, and 0.00 for

PS, PNYD, Pre-OLR, Post-OLR, and PCD, respectively. \log_{10} *E. coli* results for the control line were 3.20, 2.65, 4.66, 3.73, and 0.43 for PS, PNYD, Pre-OLR, Post-OLR, and PC, respectively. \log_{10} *E. coli* results for the TB treated line were 2.27, 1.50, 2.60, 0.00, and 0.00 for PS, PNYD, Pre-OLR, Post-OLR, and PCD, respectively. Tasker Blue, applied at various locations throughout the processing operation, dramatically and significantly ($P \leq 0.05$) lowered APC and *E. coli* on broiler carcasses when compared to a commercial poultry processing line.

Key Words: APC, *E. coli* count, Tasker Blue, Chicken

M54 Effect of washing broiler carcasses in potassium hydroxide and lauric acid on native bacterial flora. A. Hinton Jr*, J. K. Northcutt, J. Cason, D. P. Smith, and K. D. Ingram, *Russell Research Center, Athens, GA.*

Experiments were conducted to examine the bactericidal effect of potassium hydroxide (KOH) and lauric acid (LA) on the native microflora of broiler carcasses. Eviscerated carcasses were placed in solutions of 1.0% KOH and 2.0% LA or in distilled water (control) and washed by shaking for 1 min on a mechanical shaker. Whole-carcass-rinses (WCR) were performed to recover bacteria from the carcasses following each of 3 successive washes in KOH-LA or water. Bacterial populations of WCR rinsates were enumerated by plating serial dilutions of rinsates on bacteriological media. Total plate count bacteria (TPC), *Campylobacter*, and *Escherichia coli* in the native bacterial flora were enumerated by culturing rinsates on Plate Count Agar, *Campylobacter* Agar, and Petrifilm, respectively. Results indicated that significantly fewer TPC bacteria were recovered from carcasses washed in KOH-LA than from carcasses washed in water; however, there was no significant difference in the number of TPC bacteria recovered from carcasses washed 1, 2, or 3 times in KOH-LA. Additionally, significantly fewer TPC bacteria were recovered from carcasses washed once in water than from carcasses washed 3 times in water. No *Campylobacter* or *E. coli* were recovered from carcasses following the first KOH-LA wash, although \log_{10} 2.71 *Campylobacter*/ml and \log_{10} 0.95 *E. coli*/ml were recovered from carcasses following the first wash in water. Repeated washing in water did not significantly reduce the number of *Campylobacter* recovered from the carcasses, but no *E. coli* were recovered from carcasses after the third wash in water. Findings indicate that the antibacterial activity of KOH-LA can significantly reduce populations of native bacterial flora of broiler carcasses washed in the mixture. Reduction of the number of pathogenic and spoilage bacteria on processed carcasses washed in KOH-LA might reduce the number of foodborne illnesses associated with processed poultry products and extend the shelf life of fresh poultry.

Key Words: Lauric acid, Potassium hydroxide, Antimicrobial, Broilers, Carcasses

M55 Assessment of wing damage during catching and processing as a measure of animal welfare performance. K. N. Opengart*, R. Williams, W. Hammack, and A. Atencio, *Keystone Foods, Huntsville, AL.*

Meeting current animal welfare standards for wing disarticulation and breakage during catching and processing has proven to be one of

the most difficult parameters to consistently achieve. In most audit systems, an acceptable level of wing damage is 1% for broilers <4.5 pounds, 3% for broilers 4.5 to 7 pounds and 5% for broilers greater than 7 pounds when measured prior to defeathering. These arbitrarily assigned targets are sometimes difficult to attain. Therefore, systematic and scheduled evaluation of the process is necessary to quickly identify when and where deficiencies may be occurring that will ultimately lead to damaged wings which may put a plant out of tolerance. Evaluation of wing breakage measured in the cage once the birds arrived at the plant (a measure of catching and hauling) has shown catch crew related wing damage to be 1.0-1.5%. An additional 1-4.5% wing damage was associated with unloading, conveying and shackling when measured prior to defeathering. Areas of opportunity that have been identified as potential causes of excessive wing damage include human:animal interfaces (catching, unloading, shackling), shackling systems (height, shackle spacing), stunning systems, conveyance systems (turns, drops) and factors which may increase bird activity.

Key Words: Wing, Breakage, Disarticulation, Welfare

M56 Non-feed withdrawal broiler processing. Y. Vizzier-Thaxton*¹, A. Corzo¹, M. Putsakum¹, Z. Williams¹, S. W. Anderson¹, K. Christensen², and J. P. Thaxton¹, ¹Mississippi State University, Mississippi State, ²OK Foods, Inc., Ft. Smith, AR.

To minimize fecal contamination in the processing plant, a feed withdrawal period has been considered necessary. With the modern high meat yield broiler there have been reports of excessive yard shrink as a result of holding time and feed withdrawal. At the same time, feed withdrawal has been singled out as a time when broilers are most likely to eat litter and thus arrive at the processing plant with *Salmonella* in the crop. The feeding of organic acids in the water has been practiced in an effort to control the pH of the crop and thus inhibit *Salmonella* attachment or colonization. This study was designed to determine if a feed could be formulated that would allow birds to eat until immediately prior to catching to minimize shrink and at the same time acidify the crop. A total of 600 birds were divided into 2 treatment groups and placed in mini-pens with 10 birds per pen. Twelve hours prior to catching, one group received the experimental diet while feed was removed from the other group. At catching birds were bled for plasma corticosterone analysis. Birds were immediately euthanized. The crops were aseptically removed for pH and coliform counts. The intestinal content and condition was observed and photographed. Shrink was reduced by 44% with no apparent difference in fecal content between treatments. Crop pH was lowered. This work indicates that it may be possible to keep birds on feed up to catching time.

Key Words: Feed withdrawal, Shrink, Crop acidification, *Salmonella*

M57 Tylosin applied at a sub-therapeutic level in broiler feed affects *Campylobacter* recovered from carcasses during processing. M. E. Berrang*, S. R. Ladely, R. J. Meinersmann, and P. J. Fedorka-Cray, *USDA-ARS-Russell Research Center, Athens, GA.*

Tylosin is an antimicrobial drug approved for use in broiler feed at sub-therapeutic levels for purposes of growth promotion. There is controversy about whether such use of antimicrobials could lead to the development of drug resistant pathogenic bacteria. Erythromycin is

often the drug of choice for treating humans with campylobacteriosis. Both tylosin and erythromycin are classified as macrolide drugs and cross resistance between these antimicrobials may occur if either is used. Commercial broiler chicks were placed in isolation grow-out chambers and colonized with *Campylobacter jejuni*. At 14 days of age broilers began to receive a diet including 20 g tylosin phosphate per ton which was continued ad libitum for the rest of grow-out. Control broilers received the same diet with no added drugs. At 42 days of age, broilers were processed in a pilot plant with equipment which very closely models commercial conditions. Carcass rinses were collected after feather removal, after inside/outside washing and after immersion chilling. *Campylobacter* numbers after feather removal were not different according to feed type (3.53 log cfu per ml rinse for control carcasses and 3.60 for those fed medicated feed). Likewise, medicated

feed did not affect *Campylobacter* numbers on carcasses after inside/outside washing (3.11 and 3.07 log cfu per ml rinse). Carcasses of broilers fed medicated feed had lower numbers of *Campylobacter* after chilling (1.45 log cfu/ml rinse) compared to control carcasses (2.31 log cfu/ml rinse). No *Campylobacter* isolated from control carcasses were resistant to erythromycin. However, all *Campylobacter* recovered from carcasses fed medicated feed were resistant to erythromycin (minimum inhibitory concentration of greater than 8 $\hat{1}$ /₄g/ml). Application of tylosin in feed can act to promote growth and results in lower *Campylobacter* numbers on chilled carcasses; however, the *Campylobacter* that do remain are resistant to erythromycin.

Key Words: *Campylobacter*, Tylosin, Processing, Feed, Antimicrobial

Monday, January 22 SCAD I (Avian Diseases) Room: B312

M58 Animal rights and eoterrorism - Current and emerging threats to animal researchers and commercial poultry. R. A. Norton*, G. S. Weaver, and N. R. Morrow, *Auburn University, Auburn, AL.*

Animal Rights extremism is one of the top domestic terrorist issues for the FBI. Originally confined to targeting animal research laboratories, some groups have developed extensive campaigns aimed at animal agribusiness and retail food operations. Legal challenges have also been mounted to dramatically alter animal production systems. The U.S. has experienced an escalation in direct action violence and calls for further violence. Recently a number of splinter groups have openly called for violence against people they feel harm animals.

Currently, there is no open source intelligence indicating animal rights groups are attempting to develop biological or chemical weapons to use against animal agriculture. Although counterintuitive, several activist leaders have openly wished U.S. animal production systems would experience foreign animal diseases (FAD). Potential threats that could cause catastrophic impacts include Highly Pathogenic Avian Influenza or Velogenic Newcastle Disease. Since many animal rights organizations have world-wide reach, infectious materials could be diverted from endemic disease areas and introduced into susceptible animal populations.

Significant changes are needed to harden poultry production facilities. Locked gates are not the answer. Growers need to be trained to recognize when animal rights groups or "lone wolves" are active in the community or conducting surveillance. Veterinarians and animal scientists also need to be trained to distinguish between naturally occurring diseases and those which are intentionally introduced. Combined, better defenses can lessen the probability of attack and better assure the continuation of a safe and secure food supply.

Key Words: Animal rights extremism, Current and emerging threats

M59 Performance improvement with feed additives RepaXol[®], AciXol[™], and Virginiamycin in broilers challenged

with clostridium perfringens. G. Mathis*¹, C. Hofacre², and N. Scicutella³, ¹*Southern Poultry Research, Inc., Athens, GA*, ²*University of Georgia, Athens*, ³*SODA Feed Ingredients, Monaco.*

The objective was to evaluate the anticlostridial efficacy of feed additives RepaXol[®], an homogeneous blend of double coated essential oils, AciXol[™], a blend of organic and inorganic acids (citric, fumaric, malic and ortho-phosphoric) along with the protected essential oils (as in RepaXol[®], encapsulated in the same MICROPEARLS[®], and Virginiamycin, an antibiotic. Groups of 10 birds were weighed and placed into cages on day of hatch. The treatments were nonmedicated, non-challenged (NMNC), nonmedicated, challenged (NMC), RepaXol[®] 100 ppm, challenged, AciXol[™] 500 ppm, challenged, and Virginiamycin (VIR) 20 ppm, challenged. Birds were challenged at 14 days of age with *E. acervulina* and *E. maxima* and on Days 19, 20, and 21 with *Clostridium perfringens*. Each treatment consisted of 6 replications in a complete randomized block design. Feed in mash form was fed ad libitum throughout the test period. The parameters measured were feed conversion and weight gain (Days 0 to 28 and Day 14 to 28), Necrotic Enteritis (NE) mortality and NE lesion scores. On Day 22, five birds per pen were NE lesion scored. There was a significant improvement of feed conversions and weight gains for both measurement periods with all feed additives compared to the NMC birds. The feed conversions (Day 0-28) of the NMNC was 1.461g, NMC, 1.726, RepaXol[®] 1.586, AciXol[™] 1.577g, and VIR 1.519. The average live weight gains (Day 0-28) of the NMNC was 0.963 kg, NMC 0.774 kg, RepaXol[®] 0.915 kg, AciXol[™] 0.901 kg, and VIR 0.935 kg. Percent NE mortality was significantly less for the VIR 12 % compared to NMC 33 %. There was no significant difference in percent NE mortality between RepaXol[®] 23 %, AciXol[™] 22 % and VIR. All feed additive treatments had significantly lower NE lesion scores compared to NMC. This study demonstrated the benefits of adding RepaXol[®] 100 ppm, AciXol[™] 500 ppm, or Virginiamycin 20 ppm into the feeds of broiler chickens exposed to *Clostridium perfringens*.

Key Words: *Clostridium perfringens*, RepaXol, AciXol, Virginiamycin, Necrotic Enteritis

M60 Understanding *Salmonella* transmission on chicken pullet, broiler-breeder, and broiler farms in Georgia. K. Zamperini^{*1}, D. Cole³, C. Hofacre¹, and J. Maurer^{1,2}, ¹*University of Georgia, Athens*, ²*University of Georgia, Griffin*, ³*Georgia Division of Public Health, Atlanta, GA*.

The prevalence of *Salmonella* within the various levels of the integrated poultry production system has not been fully elucidated, but vertical transmission is believed to be a significant contributor to carcass contamination by *Salmonella*. To investigate vertical transmission of *Salmonella*, we sampled two levels of poultry production for *Salmonella*: 1) select, paired pullet and broiler-breeder farms, and 2) broiler farms supplied with chicks from said broiler-breeder farms. Chick box liners were collected at the time of placement of the pullets and broilers in order to detect *Salmonella* strains present in the birds at placement. Of pullet farms surveyed, 26% of environmental samples were positive for *Salmonella*. Chick box liners were sporadically positive for *Salmonella*. Pullet farm houses have also been sporadically positive when sampled the day of placement. *Salmonella* prevalence varied within pullet farms, where *Salmonella* isolation rates ranged between 5 to 42%, for houses sampled on at least one-half of the pullet farms surveyed. While the initial *Salmonella* isolation rate from pullet farms was low at 2%, the number of houses and environmental samples positive for *Salmonella* increased with the age of the birds (chi-squared test, $p < 0.05$). There was also a statistically significant difference between poultry integrators when comparing peak in prevalence with pullets' age (chi-squared test, $p < 0.05$). No statistically significant differences were observed in *Salmonella* prevalence between poultry integrators (chi-squared test, $p = 0.608063$) or pullet farms (chi-squared test, $p = 0.780716$ and 0.155915 for companies A and C, respectively) despite differences in farm management practices evident with these the two integrators. Pulsed-field gel electrophoresis was used to identify strain types. Using this molecular typing tool, we were able to observe introduction and spread of *Salmonella* strains on poultry farms. Both vertical and horizon transmission appears to be involved in the spread of *Salmonella* within poultry integrator.

Key Words: *Salmonella*, Poultry, Vertical transmission

M61 Cationic peptides decrease susceptibility of young chickens to *Salmonella enterica* serovar enteritidis infection by up-regulation of the innate immune response. M. H. Kogut^{*1}, K. J. Genovese¹, H. He¹, and Y. W. Jiang², ¹*USDA-ARS, College Station, TX*, ²*USDA-ARS, College Station, TX*, ³*USDA-ARS, College Station, TX*, ⁴*Texas A&M University, College Station*.

The TAMUS cationic peptides are a group of related cationic peptides produced by a Gram-positive bacterium. Cationic amphiphilic peptides have been found to stimulate or prime the innate immune responses in mammals. The innate immune system of poultry is functionally inefficient during the first week posthatch enabling pathogens such as *Salmonella enterica* serovar Enteritidis (SE) to invade and colonize the visceral organs of these immature birds. The objective of the present study was to evaluate the effect of TAMUS as an immunostimulator of the innate immune response of young chickens. TAMUS was provided as a feed additive at three different concentrations (12, 24, or 48 ppm) for 4 days post-hatch significantly increased protection against SE organ invasion in a concentration-dependent manner. The functional efficiency of heterophils isolated from chickens fed the TAMUS rations at the three concentrations was significantly up-regulated when

compared to heterophils isolated from chickens fed a control starter ration as determined with an array of functional assays. Phagocytosis, oxidative burst, and degranulation were all significantly increased in a concentration-dependent manner in heterophils isolated from chickens fed the TAMUS diets. This is the first report of bacterial cationic peptides inducing the up-regulation of the avian innate immune response that provides protection against extraintestinal *Salmonella* infections. The significance of these data is that the orally delivered cationic peptides stimulate the innate response at a time of immunologic inefficiency and increased susceptibility to bacterial infections (first week posthatch). Because of the non-specific nature of the innate response, we speculate that TAMUS given as a feed additive during the first week posthatch could provide increased protection against a variety of bacterial pathogens.

Key Words: Cationic peptides, *Salmonella*, Innate immunity, Heterophils

M62 Herbal products for control of histomoniasis (blackhead disease) in turkeys. R. Hauck^{*}, P. L. Armstrong, L. Fuller, and L. R. McDougald, *University of Georgia, Athens*.

In the absence of approved products for treatment of blackhead disease there is increased interest in the evaluation or use of natural products. Such products are used for other purposes in the feed industry and have good acceptance by producers and consumers. In this study we evaluated the effects of 3 such products which are used for odor management in feed. These products are extracts or essential oils from commonly used herbs. Tests of the products *in vitro* showed positive results against *Histomonas* and other protozoa. The test model in turkeys consisted of directly and indirectly exposed birds in battery cages. The products offered little protection against the severe direct infections. However, product 2 alone or in a combination with product 3 had beneficial effects on lesions in the liver and ceca. These results suggest that these products could have benefit in helping birds to resist the spread of histomoniasis within a flock.

Key Words: Histomoniasis, Turkeys, Treatment, Essential oils

M63 Comparison of *Mycoplasma gallisepticum* vaccine strain 6/85 dosage rates in layers subsequently challenged with virulent *Mycoplasma gallisepticum*: Serological response, vaccine persistence, and egg production. J. D. Evans^{*}, S. A. Leigh, S. D. Collier, and S. L. Branton, *USDA-ARS South Central Poultry Research Unit, Mississippi State, MS*.

Commercially available attenuated strains of *Mycoplasma gallisepticum* (MG) are commonly used within the layer industry to control MG-induced mycoplasmosis. MG strain 6/85 is a commonly utilized vaccine strain which has been demonstrated to be safe due to reduced pathogenicity and transmissibility. Research has indicated that increased dosage rates or vaccination loads corresponded with an enhanced serological response and increased vaccine strain persistence within the host. In an effort to maximize protection associated with MG live vaccines and to further examine the effects of enhanced 6/85 dosage rates, Hyline W36 layers (n=160) were housed in biological isolations units (10 birds per unit) through 55 wks of age. The layers

were divided among 6 treatment groups: (1) subjects vaccinated with 6/85 at the recommended dosage (1X); (2) subjects vaccinated with 6/85 at 1X and challenged with virulent MG at 22 wks; (3) subjects vaccinated with 6/85 at 1X and challenged with virulent MG at 45 wks; (4) subjects vaccinated with 6/85 at the recommended dosage (15X); (5) subjects vaccinated with 6/85 at 15X and challenged with virulent MG at 22 wks; and (6) subjects vaccinated with 6/85 at 15X and challenged with virulent MG at 45 wks. Vaccinations occurred at 10 wks of age and were applied via fine spray. Throughout the study, eggs were collected and weekly hen production was determined. The *in vivo* persistence of 6/85 was determined via choanal cleft swabs/strain-specific PCR and the serological response was determined via serum plate agglutination (SPA). Preliminary results indicate that the seroconversion rates (measured at 50 wks) were not impacted by differing dosage rates of 6/85. Following virulent MG challenge at 45 wks, however, the 15X 6/85 treatment negated production losses readily evident with the similarly challenged 1X treatment group.

Key Words: Poultry, *Mycoplasma gallisepticum*, Attenuated vaccine, Mycoplasmosis

M64 The effects of stress and concurrent *Escherichia coli* infection on the isolation of *Listeria monocytogenes* from synovial tissue of turkey poult. V. Dutta¹, G. R. Huff², W. E. Huff², N. C. Rath², M. G. Johnson³, and R. Nannapaneni³, ¹University of Arkansas, Fayetteville, ²USDA, ARS, PPPSRU, Fayetteville, AR, USA, ³University of Arkansas, Fayetteville.

The objective of this study was to determine if *Listeria monocytogenes* (Lm) infection of stressed turkey poult would result in colonization of synovial tissues. Male turkey poult, housed in floor pens, were subjected to cold stress from d 4 through 12 and were exposed to an aerosol challenge of either the Scott A strain of Lm, *Escherichia coli* (Ec), or the combination (Lm+Ec). All challenged birds were housed in the same building, while non-challenged controls were housed in a separate, biosecure building. At seven wks, poult were given an immunosuppressive dose of dexamethasone (Dex) and the same bacterial challenges were added to their drinking water. One wk post-challenge 4-6 birds per group were weighed, necropsied, and knee synovial tissues were cultured for Lm using pre-enrichment in University of Vermont medium (UVM) and Fraser broth, isolation of Lm on *Listeria* selective agar plates, and confirmation using biochemical tests. LM was isolated from knee synovial tissue of 75% of cold stressed poult challenged with Dex+Ec+Lm, 43% of cold-stressed poult challenged with Dex+Ec alone, and 20% of cold stressed poult challenged with Dex+Lm alone. Lm was not isolated from non-cold stressed birds challenged with either Dex+Lm or Dex+Ec+Lm, but was isolated from 25% of non-cold stressed birds

challenged with Dex+Ec. Lm was not isolated from synovial tissues of any of the non-challenged controls. There were no differences in body weight due to early cold stress, however Dex treatment itself and Dex + all bacterial challenges significantly decreased body weight at 8 wks. These data suggest that Lm colonization of turkey synovial tissue can be enhanced by early cold stress and by concurrent infection of Dex-treated poult with Ec.

Key Words: Turkeys, Cold stress, *Listeria monocytogenes*, *Escherichia coli*

M65 Effects of vaccine stabilizer Spray-Vac™ on *Mycoplasma gallisepticum* vaccines FVAX-MG™ and Mycovac-L™ survival in solution. S. A. Leigh*, J. D. Evans, S. L. Branton, and S. D. Collier, USDA-ARS South Central Poultry Research Unit, Mississippi State, MS.

Infection of layer chickens with *Mycoplasma gallisepticum* (MG) can result in decreased egg production compared to uninfected hens. Live MG vaccines are available; however, the methods used to administer these vaccines by the end user vary, resulting in the potential for marked differences in vaccine efficacy. In order to help poultry growers obtain uniform results using the live vaccines, various conditions for vaccine delivery are being investigated. One area of investigation is the ability to use tap water for rehydration of lyophilized vaccines. However, the presence of chlorine or other oxidizing compounds in the water rapidly decreases vaccine viability. The use of a vaccine stabilizer (Spray-Vac™) that removes chlorine and other oxidizing compounds was investigated. Tap water for this experiment was simulated by adding chlorine (sodium hypochlorite) to distilled water to a final concentration of 4ppm. MG vaccines FVAX-MG™ and Mycovac-L™ were rehydrated with 10 ml distilled water and then diluted to a usable concentration in either tap water, or tap water containing vaccine stabilizer, or stabilizer with 0.1X or 1.0X PBS from concentrate added. 1.0X PBS concentrate in distilled water was used as a control. Samples were removed at 15, 30, and 60 min., and numbers of viable mycoplasmas were determined by measuring color-change units (CCU₅₀) per milliliter. The results show that chlorine rapidly decreases vaccine survival. The addition of the vaccine stabilizer removes the effects of the chlorine, yielding vaccine survival results similar to that obtained previously for distilled water. The best results were obtained when PBS concentrate was added to a concentration of 1.0X (physiological). These results show that vaccine stabilizer has no detrimental effects on vaccine survival, and can be used to remove the deleterious effects of chlorine from tap water.

Key Words: *Mycoplasma gallisepticum*, Mycoplasmosis, Poultry, Attenuated vaccines, Chlorine

Monday, January 22
Nutrition II
Room: B313

M66 Effects of arginine, vitamin E and vitamin C on cardiopulmonary function and ascites parameters in broilers exposed to cold temperature. S. B. Kawthekar*, N. Rougiere, and C. Ruiz-Feria, *McGill University, Montreal, QC, Canada.*

One experiment was conducted to evaluate the combined effects of Arginine (AR), Vitamin E and Vitamin C on cardiopulmonary performance and ascites parameters of broilers reared under cold environmental temperature starting on d 16. One d old male broilers were fed with corn-soybean meal diet (CTL, 1.2 % AR and 40 IU vitamin E). The birds were assigned to four dietary treatments: CTL, control supplemented with 1% AR and either 200 IU vitamin E (AE), or 500 mg of vitamin C (AC), or a combination of vitamin E and C at the same levels (AEC) per kg of feed. Pulmonary Arterial Pressure (PAP) and Mean Arterial Pressure (MAP) were measured in anesthetized birds (n = 7 per group). Birds were challenged with epinephrine (EPI, 0.5 mg/kg BW i.v.), 20 min later with Amino- guanidine hemisulphate (AG, 100 mg / kg BW i.v.) and 20 min later with L-NAME (50 mg / kg BW, i.v.). PAP and MAP were recorded continuously after each challenge. Data were analyzed with the repeated measures ANOVA and the Student Newman-Keuls test was used to separate means within groups. The PAP values were lower (P <0.05) in the AEC group as compared to all other groups after 30 s of EPI challenge. Within 120 s of EPI challenge, PAP were significantly decreased (P < 0.05) in the AEC birds compared to the CTL birds. The PAP returned to pre-EPI challenge levels within 300 s in all groups. The PAP increased (P < 0.05) 60 s after the AG and L_NAME challenge in all groups, but no differences were found among groups. The right to total ventricular weight was lower (P < 0.05) in the AEC birds as compare to the other groups. Hematocrit values (P < 0.05) were lower in the AEC group as compared to all other groups at 5 and 6 wks. EPI had a less severe effect on the cardio-pulmonary function of AEC birds, probably due to a better endothelial integrity and higher capacity to generate nitric oxide. In general AEC birds appeared to have a better pulmonary vasculature, and this may be explained by the extracellular and intracellular protection against oxidative stress provided by the combination of lipid and water soluble antioxidants.

Key Words: Arginine, Vitamin E, Vitamin C, Ascites, Nitric oxide

M67 Estimation of the relative bioavailability of copper sources for broiler chicks. P. Butkeraitis*¹, D. R. Ledoux¹, L. B. Linares¹, A. J. Bermudez¹, A. Dakovic², S. Matijasevic², and Z. Sekulic², ¹*University of Missouri, Columbia,* ²*Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia.*

An experiment was conducted with 250 day-old male broiler chicks to estimate the biological availability of two sources of Cu, Cu-montmorillonite (Cu-MONT) and Mintrex[®]Cu. Copper sulfate (CuSO₄) was used as the standard source in the bioavailability assay. Chicks were allotted randomly to dietary treatments that included an unsupplemented basal corn-soybean meal, or the basal supplemented with 75, 150 or 225 mg Cu/kg diet as either CuSO₄ (25.1% Cu), Cu-MONT (2.65% Cu), or Mintrex[®]Cu (15% Cu). Chicks were housed in stainless steel chick batteries and allowed access to feed and water

ad libitum for 21 d. Dietary Cu level or source had no effect (P > 0.05) on feed intake, body weight gain or feed conversion of chicks, which averaged 847 g, 696 g, and 1.22 g:g, respectively. A source x level interaction (P < 0.05) was observed for liver Cu. Liver Cu of chicks fed CuSO₄ and Mintrex[®]Cu increased with increasing Cu concentrations, whereas liver Cu in chicks fed Cu-MONT only increased at 225 mg Cu/kg diet. Bile Cu increased (P < 0.0001) with increasing dietary Cu and was higher (P < 0.05) for Mintrex[®] Cu (24.6 mg/L) compared with Cu-MONT (18.4 mg/L) and CuSO₄ (20.0 mg/L). Using the slope-ratio technique from regression of bile Cu on Cu intake with Cu from CuSO₄ set at 100%, the relative biological availability values and associated confidence intervals (CI) were estimated to be 93.8% (CI: 77.6 - 113.3%) and 115.5% (CI: 97.3 - 139.3%) for Cu-MONT and Mintrex[®]Cu, respectively. Data indicate that Cu from Mintrex[®]Cu was more available to broiler chicks than Cu from Cu-MONT.

Key Words: Copper, Bioavailability, Bile, Mintrex[®] Cu, Cu-MONT

M68 Effects of lignin and Bio-Mos on broiler performance and gut microbiology after *E. coli* and *Salmonella* challenge. B. Baurhoo*, C. A. Ruiz-Feria, and L. Phillip, *McGill University, Ste Anne de Bellevue, QC, Canada.*

Three experiments were conducted to evaluate the effects of virginiamycin, Bio-Mos and Alcell lignin using antibiotic-free diets on growth performance, feed efficiency, and cecal loads of Lactobacilli and Bifidobacteria (Exp. 1); cecal *E. coli* load after gavage (O2 and O88, Exp. 2); *Salmonella* internalization into jejunum after an in vivo challenge with *S. enteritidis* (PT4, Exp. 3). Dietary treatments for the 3 studies were: 1) antibiotic free (CTL-), 2) positive control (CTL+, 11 mg/kg virginiamycin), 3) MOS (diet 1 + 0.1% Bio-Mos), 4) LL (diet 1 + 1.25% Alcell lignin), and 5) HL (diet 1 + 2.5% Alcell lignin). 1040 day-old male Cobb 500 broilers were randomly assigned to the treatments (4 pen replicates). BW and feed intake did not differ among treatments. However, at d 35, feed conversion ratio was higher (P < 0.05) in birds fed CTL+ than CTL- fed birds. The cecal Lactobacilli load was highest (P < 0.05) in birds fed MOS or CTL- at d 28, and, at d 38, in MOS fed birds. At d 28 and 38, cecal Bifidobacteria loads were highest (P < 0.05) in birds fed MOS or CTL-, whereas Lactobacilli and Bifidobacteria loads were lowest (P < 0.05) in birds fed CTL+ or HL. At d 21, birds were transferred to cages for the *E. coli* challenge. At d 3 and 9 after *E. coli* challenge (n = 12), birds fed HL had lower (P < 0.05) cecal *E. coli* loads than CTL- or CTL+ fed birds. At d 9 after challenge, MOS fed birds had lower (P < 0.05) *E. coli* load than birds fed CTL- or CTL+. The *E. coli* loads did not differ in birds fed MOS, LL or HL. In *Salmonella* challenge study, at d 31, birds fed MOS or HL had lower (P < 0.05) internalized *Salmonella* in the jejunum than CTL- fed birds. Moreover, *Salmonella* load was lower (P < 0.05) in HL fed birds than those fed CTL+; but not different in birds fed CTL+, CTL- or LL. Therefore, as compared to birds fed CTL+, birds fed MOS and lignin had increased cecal Lactobacilli and Bifidobacteria loads, and, in the challenge studies, lower cecal *E. coli* and internalized *Salmonella* loads. MOS and lignin could potentially replace antibiotic growth promoters in poultry production.

Key Words: Broilers, Gut health, Antibiotic, Bio-Mos, Lignin

M69 Bioefficacy of an exogenous protease from *Bacillus amyloliquefaciens* in corn/soy-based diets for broilers. A. J. Cowieson¹, E. E. M. Pierson*³, and J. M. McNab², ¹Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom, ²Roslin Nutrition, Roslin, Midlothian, United Kingdom, ³Danisco Animal Nutrition, St Louis, MO.

The efficacy of an exogenous protease was examined using a total of 200 male Ross broiler chickens in a 5 treatment and 8 replicate 21d growth study. A maize/soy-based control diet was formulated to contain adequate concentrations of digestible P, Ca and energy (0.40%, 0.90% and 3070kcal/kg respectively) but to be marginal in Lys and TSAA (approx 85% NRC). This control diet was then supplemented with a bacterial protease at 3,000-40,000 U/kg. Weight gain was improved ($P < 0.05$) by around 10% and FCR by around 3 points by supplementation of the diet with protease. Furthermore, the ileal digestibility of energy was improved ($P < 0.05$) by around 90kcal/kg. Most of the beneficial responses were noted at 3,000-6,000 U/kg, with little additional benefit of supra-doses (up to 40,000 U/kg). Interestingly the ileal digestibility of N was not significantly improved with protease. The effect of protease on performance was assumed to be associated with an improvement in the retention of the limiting nutrients in this study (lys and SAA), however the measured responses were more apparent for energy than for amino acids. It is possible that the presence of exogenous protease in the GIT was detected via the CCK feedback mechanism, reducing pancreatic protease secretion and so lowering amino acid requirements of the animal. These net effects are interesting and require further elucidation. It can be concluded that protease is effective in improving performance of broilers fed corn/soy-based diets but the mechanisms are not fully understood.

Key Words: Enzymes, Protease, Corn, Soybean meal, Broiler

M70 Rapid and dramatic improvement in color intensity of brown egg shells from caged laying hens fed dietary CALSPORIN® (*Bacillus subtilis* C-3102 spores) in a commercial field trial in China. H. Miyazaki¹, S. Chou², M. Kato³, and D. M. Hooge*⁴, ¹Calpis Co. Ltd, Tokyo, Japan, ²Shanghai Naseco Ltd, Shanghai, China, ³Calpis USA, Inc., Elgin, IL, ⁴Hooge Consulting Service, Inc., Eagle Mountain, UT.

China has a population of over 1.3 billion people with about 1.3 billion laying hens of which ~80% are brown egg strains. Uniformity and intensity of brown egg color are important marketing considerations because excellent brown egg color (and shell quality, as reported previously) can extend production, bring a premium price (Japan and Korea), or enhance marketing of natural and organic eggs (U.S.). Brown egg color becomes lighter as hens age. An investigation was conducted using dietary CALSPORIN®, a commercial direct-fed microbial product containing *Bacillus subtilis* C-3102 spores, to demonstrate the brown egg color enhancing effect of CALSPORIN® already observed in other situations. Lohmann brown hens, 65 wk 4 d (459 d), at Xiazhuang Egg Farm, Beijing, China and caged in 10 houses of 9,000 birds each, were fed CALSPORIN® for 13 d. Inclusion levels were 1×10^6 CFU/g feed (3.33x) for 7 d (459 to 465 d) and 6×10^5 CFU/g feed for 6 d (466 to 471 d). Shell color was determined daily before and during CALSPORIN® feeding, except 1 d (446 d), from 63 wk 3 d (444 d) to 67 wk 1 d (471 d) from ~150 hens designated for the trial (84-125 eggs/d; collection d=26, 13 before and 13 during) using an egg color fan (1=light to 10=dark brown; Ghen Corp.). Daily

weighted mean egg shell color scores were: before -- 6.02, 5.46, 5.15, 5.72, 5.68, 5.78, 5.83, 5.75, 5.56, 5.82, 5.60, 6.30, 5.92 (5.74, 13 d, n=1,393 eggs); during -- 6.12, 5.75, 5.87, 6.20, 6.10, 6.46, 6.60, 6.35, 6.50, 6.22, 6.47, 6.33, 6.84 (6.29, 13 d, n=1,321 eggs, vs 5.74 $P < 0.001$ by 1-way ANOVA). Compared to the period before, CALSPORIN® feeding increased egg counts in fan color score categories #7 (23.60% vs 14.11%, $P < 0.001$) and #8 (22.78% vs 17.98%, $P < 0.001$), and this shift was associated with a decreased egg count in #3 (5.03% vs 13.16%, $P < 0.001$). Dietary CALSPORIN® rapidly and significantly ($P < 0.001$) improved brown egg shell color.

Key Words: *Bacillus subtilis* C-3102, Brown egg, CALSPORIN, Color fan, Shell color

M71 Dose titration and safety margin of fumaric acid in broiler. A Schumacher¹, K Bafundo², K. M. S Islam*³, H Aupperle⁴, and J. M Gropp¹, ¹Leipzig University, Leipzig, Germany, ²Phibro Animal Health, Ridgefield Park, Ridgefield Park, NJ, ³Bangladesh Agricultural University, Mymensingh, Bangladesh, ⁴Leipzig University, Leipzig, Germany.

Six isonitrogenous (22.8 % CP) and isocaloric diets (13 MJ ME kg-1) containing 0, 1.25, 2.50, 3.75, 5.0, and 7.5 % fumaric acid (FA), respectively, were fed for 26 days to 12 (replicates) x 8 (chicks per replicate) Lohmann-Hybrid newly hatched male chicks (48 g body weight) per treatment. The diets consisted mainly of wheat and soybean meal. Mortality ranged between 0 and 4 %. Final body weight (feed efficiency) amounted to 1,506 (756), 1,597 (767), 1,532 (754), 1,485 (759), 1,342 (738), and 1,378 g (747 g gain kg-1 feed) for the groups with 0, 1.25, 2.50, 3.75, 5.0, and 7.5 % FA, respectively. The 1.25 % FA group showed significantly ($p < 0.05$) better weight gain than all other groups and better feed efficiency than the groups with 5.0 and 7.5 % FA. Higher gain was associated with higher feed intake. It is concluded that 1.25 % FA may promote growth of broilers, but the effect disappears with further increasing doses. Body weight of the 5.0 and 7.5 % FA groups was significantly lower than that of all other groups. The relative weight of heart, liver and spleen was not affected by the treatment. Pathological findings summarized to 5/10 in the 7.5 % FA group, to 1/10 in the control and to 2-3/10 in the other groups. The 7.5 % FA grouped showed also the highest incidence of kidney alterations. From the findings the margin of safety is concluded to be about 3 (3.75/1.25) considering 1.25 % FA in the diet as the optimally effective concentration.

Key Words: Fumaric acid, Performance, Safety, Broiler

M72 Effect of plane of rearing nutrition of broiler breeder females on body weight, egg production, fertility, and progeny performance. H Romero-Sanchez*¹, P. W. Plumstead², N. Leksrisompong², K. E. Brannan², and J. Brake², ¹Universidad de Antioquia, Medellin, Colombia, ²North Carolina State University, Raleigh.

An experiment was conducted to evaluate the effects of two levels of cumulative nutrient intake during the rearing period to 21 wk of age on female broiler breeder performance. A total of 1,120 day old Ross 308 female broiler breeders were reared in 16 floor pens in a blackout facility. From 0-2 wk all birds received a starter feed after which four

pens of pullets were randomly assigned to each of the experimental diets. Two diets were formulated and a single feeding program was used to achieve either a high or a low cumulative nutrient intake. The high cumulative nutrition program (HiDiet; 16.7% CP, 3.25 kcal ME/g) supplied 26.6 Mcal ME and 1,370 g CP, while the low cumulative nutrition program (LoDiet; 14% CP, 2.85 kcal ME/g) supplied 23.5 Mcal ME and 1,160 g CP to photostimulation at 21 wk of age. From 22 to 24 wk the two diets were blended to provide a gradual transition to a single common breeder diet (2,925 kcal/kg ME and 15% CP) that was then amended with calcium and fed throughout the production period. The HiDiet plane of nutrition increased female BW during the rearing period and the differences were maintained until 58 wk of age. The LoDiet plane group exhibited better egg production but no significant differences were observed for fertility, hatchability, or broiler progeny performance. The data showed that a cumulative nutrient intake during the rearing period of 23.5 Mcal ME and 1,160 g CP resulted in a bird of adequate BW at 21 wk of age that produced more eggs and was able to maintain good fertility without significant effects on progeny performance.

Key Words: Broiler breeder, Rearing nutrition, Growth, Fertility, Broiler performance

M73 Performance and health of broiler due to dietary humic acid. K. M. S Islam^{*1}, A Schuhmacher², C Ellenberger³, H. -A

Schoon³, and J. M Gropp², ¹Bangladesh Agricultural University, Mymensingh, Bangladesh, ²University of Leipzig, Leipzig, Germany, ³University of Leipzig, Leipzig, Germany.

Six diets containing 0, 0.3, 0.6, 1.2, 2.4, and 4.8 g Huminfeed[®] (74 % humic acid in DM) /kg were offered to 480 (6 treatments X 10 replicates X 8 birds/replicate) Lohmann-Hybrid newly hatched male chicks to know the performance and health status. The diets formulated based on wheat and soybean meal (25.3 % CP, 12.8 MJ ME /kg). After 35 days feeding trial 60 birds (1 per replicate) were killed for necropsy. Initially HA depressed weight gain, but recovery started in the third week, so that at the end no significant differences could be observed (2,408, 2,369, 2,335, 2,355, 2,310 and 2,301 g for the groups with 0, 0.3, 0.6, 1.2, 2.4, and 4.8 g Huminfeed[®]/kg respectively). Feed intake was not affected by the treatment. Feed efficiency of the 4.8 g Huminfeed[®]/kg group was significantly lower (689) than control (723 g gain /kg feed) at the end of trial. Mortality ranged between 1.25 and 8.75 %, being highest in the control. The relative weight of liver, spleen, Bursa Fabricii and thyroid gland did not differ among the groups. Morphometric parameters (number and diameter of follicle, epithelial height, length and width of nucleus, number of hyperplasia and follicular epithelial index) of thyroid gland demonstrated absence of any dose related response of HA. So, the inclusion of HA at the level of 8 % (2.4/0.3) is possible without hampering performance and without causing any clinical condition in broiler.

Key Words: Humic acid, Broiler, Performance, Health

Monday, January 22 Environment and Management II Room B314

M74 Effect of a hatchery nutrition supplement on broiler placement body weight and growth rate. S. Henderson*, J. Vicente-Salvador, C. Pixley, G. Tellez, and B. Hargis, *University of Arkansas, Fayetteville.*

Previously we have reported that administration of the perinatal nutrition supplement EarlyBird[™] (EB; Ivesco, LLC) at a dose of 2 g/chick in chick boxes reduced body weight loss during 24-h simulated shipping conditions. Recently, we observed higher body weights at placement ($p < 0.05$) in leghorn chicks (4.5%; 1.52 g) and broiler chicks (2.1%; 0.78 g) when chicks were weighed and treated (3 g EB/chick) prior to leaving the commercial hatchery and re-weighed upon arrival at the farm. To examine the effect of this conservation of weight on broiler chick performance, three experiments were conducted comparing the use of EB to no supplementation (NS). For each experiment, broiler chicks from a commercial hatchery were neck-tagged, individually weighed, and randomly placed in chick boxes ($n = 100/\text{box}$). In all experiments, treated chicks received 2 g EB/chick in plastic chick boxes, covered boxes were immediately stacked, and held under ambient light (~42 FC). Following the 24-h simulated shipping period, chicks were individually weighed and randomly assigned to replicate pens. Body weights (BW) and BW gain (BWG) were determined at placement, 7, and 21 d (exps. 1-3), as well as 28 and 42 d (exp. 3 only). Weight loss prior to placement was reduced ($p < 0.05$) by EB treatment in exp. 1 (1.86 g), exp. 2 (0.92 g), and exp. 3 (1.63 g). EB treatment caused increased ($p < 0.05$) BWG at 7 d in exp. 1 (11 %; 9.0 g), and exp. 3 (4.0 %; 3.6 g) and at 21 d in exp. 1 (2.7%; 16.1 g) and exp.

3 (2.1%; 14 g), with no difference in exp. 2. Chicks in exp. 2 were unusually large at placement (49 g), but were 14% or 23% smaller at 7 d as compared to control chicks in exp. 1 and 3, respectively, suggesting suboptimal conditions for exp. 2. In exp. 3, EB-treatment increased ($p < 0.05$) BWG at 28 d (3.1%; 34.7 g) and at 42 d (2.7%; 57.7 g). Hatchery application of EB reduced weight loss during chick transportation prior to placement in all experiments. Furthermore, in 2 of 3 experiments, hatchery treatment with EB resulted in continued segregation of BW and BWG during growth.

Key Words: Perinatal nutrition, Chick supplement, Performance, Early bird, Holding

M75 Brooding light intensity effects on broiler performance. A. J. Brown^{*1}, B. D. Fairchild¹, R. J. Buhr², and A. B. Webster¹, ¹University of Georgia, Athens, ²Russell Research Center, USDA-ARS, Athens, GA.

Light intensity is an environmental factor which is used with a high degree of variation throughout the US Broiler Industry. Light intensity influences bird activity, immune response, growth rate and has been used to alleviate mortality issues related to metabolic disease (spiking mortality). The objective of the current study was to determine the effect of light intensity during the 10 days of brooding on bird performance. Two trials were conducted utilizing three light intensities

(15, 25, 45 lux). Each light intensity treatment was applied to chicks from day 1 through day 10. After day 10, the light intensity was reduced to 5 lux in each room. Each light treatment was applied to two rooms with six pens in each room. A bird density of 0.7 ft² was used resulting in 40 birds per pen. Water and a standard broiler diet were provided ad libitum. Broiler management protocols followed the breeder company recommended guidelines.

In Trial 1, 25 lux resulted in significantly greater BW gain and gain to feed ratio but lower feed consumption at 7 days while 45 lux resulted in significantly greater BW gain at 21d. In Trial 2, BW gain and gain to feed were significantly greater for 25 and 45 lux when compared to 15 lux. No significant differences were noted among the treatments at 42 days of age in either trial. While there were differences in the results between the two trials, similar trends were apparent with the broilers provided 15 lux having the poorest performance. The results of the current study suggest that having light intensity too low (15 lux) during the brooding period will have negative results on broiler performance. The data from Trial 2 suggests that higher intensity light may be beneficial to broiler performance, but due to differences between the two trials the effects of intensities above 25 lux are inconclusive at this time.

Key Words: Broiler, Light intensity, Feed conversion, Lighting programs

M76 Effect of varying brooding management practices on broiler performance parameters and processing yield. A. H. Nilipour*¹, E. Robles¹, C. Rosales¹, F. Mora², and G. D. Butcher³, ¹*Empresas Melo, S.A., Panama City, Rep of Panama*, ²*Universidad de Panamá, Panama City, Rep of Panama*, ³*University of Florida, Gainesville*.

With the advancing of genetics, health care and nutrition, the time period allotted for broilers to achieve optimal market body weight and meat characteristics is decreasing. The first two weeks of life comprise more than 30% of the broiler lifespan. A broiler from setting lives about 1500 hours (500 hrs incubating, 336 brooding, and 700 hrs growing). Management during the first 336 hrs (2 wks) affects final performance. A study was conducted at the Empresas Melo Experimental station where a total of 1692 Cobb X Cobb female and male broilers were sexed and randomly allocated into 36 pens of 47 chicks each. Feed and water were provided ad libitum, and commercial feeds were utilized. Two brooding management treatments were utilized each containing 18 replicates of 9 female and 9 male pens with total of 846 birds. Treatments were 1- Normal Management (NM) and 2- Modified Management (MM). Both trts had 23 hrs light for 7 days, MM had 20 hrs light till 14 days. Heat brooding extended from 9 to 14 days and chicks had access to an extra feed tray. Birds were individually weighed on arrival at DOA and weekly, thereafter. Feed consumption per pen was weighed to calculate the weekly and accumulative feed conversions (FC). Percent mortality and culls were calculated. At 43 DOA a total of 56 birds (14 per sex and trt) were randomly selected and eviscerated, and all parts collected and weighed. Weekly body weights and index were in favor of MM. However, at 42 DOA, weights were equal. Throughout the study MM % uniformity was consistently higher (3-6%), conversions (-2-3 points). Total carcass yield were 68.93, 67.48%, respectively, in favor of MM. Front halves were 37.47, 36.93, with % breast being 31.46, and 30.55%. When all meats (breast, thigh and muscle) were considered, 35.10 vs. 34.28% of

the chicken is meat. MM improved total production costs by 0.25 cents per pound. Applying MM improved broiler performance parameters such as FC, uniformity while at the same time improved the salable part of the chickens, especially of breast meat.

Key Words: Broilers, Yield, Management, Chicks, Brooding

M77 Evaluation of drinking water or post-pelleting probiotic administration alone or in combination with a phytogetic product on broiler performance. D. J. Caldwell*¹, N. H. Eckert¹, J. T. Lee¹, S. M. Stevens¹, R. Beltran², M. Mohnl², and G. Schatzmayr², ¹*Texas A&M University, College Station*, ²*Biomim GmbH, Herzogenburg, Austria*.

The present trial was conducted to evaluate the effects of either drinking water or post-pelleting feed application of a commercially available probiotic, Biomim[®] PoultryStar, alone or in combination with a phytogetic product, Biomim[®] P.E.P. 125 Poultry, on broiler performance during a 48 day pen study. Probiotic was administered to broilers either through the drinking water or by post-pelleting feed application. Phytogetic product was administered by inclusion within the starter and grower diets during grow-out. Experimental groups included a non-treated control group, a probiotic group with intermittent drinking water administration, a post-crumble or post-pelleting probiotic application by feed group, and a phytogetic product administration by feed group. On day of placement, 1,880 straight-run broiler chicks were randomly distributed to 40 pens allowing for 10 replicate pens per group. Broilers were reared on litter consisting of half used litter from a commercial broiler house and half fresh pine shavings. Feed and water were provided to all broilers ad libitum. The ration fed to broilers in both trials was a standard corn-soy ration fed in a four diet feeding program (starter, grower, finisher, and withdrawal). Drinking water application of probiotic was by a medicator system in place within the grow-out house. Across experimental groups, broilers receiving intermittent administration of probiotic by the drinking water performed better in terms of body weight gain and feed conversion. Specifically, body weights were higher (P<.05) on days 15, 30, and 40 of grow-out in broilers in the drinking water probiotic group. Similarly, feed conversion was improved (P<.05) in broilers receiving probiotic by drinking water application between days 1 and 40 of grow-out. Phytogetic product administration within the starter and grower phases of grow-out was not associated with increased body weight gain but was associated with improved (P<.05) feed conversion between days 1 and 40 of this trial.

Key Words: Probiotic, Phytogetic product, Drinking water, Post-pelleting, Broiler performance

M78 Drinking and eating as related to type of drinking fountain in broilers. J. P. Thaxton* and Z. T. Williams, *Mississippi State University, Mississippi State*.

Two separate trials were conducted, one during spring and the other during summer. In both trials 5 wk-old broilers were reared in pens (1.84 x 3.68 M) possessing fresh pine shavings litter in a curtain-sided grow-out facility. This facility was power ventilated and natural lighting prevailed. Ten chicks were maintained in each pen and each

bird was marked with paint so that individuals could be identified. Each pen possessed a centrally located hanging-type feeder and either a single Plasson drinking fountain or a nipple fountain that consisted of six nipples each of which was calibrated to deliver between 35 and 40 mL/min. In both trials, on d 36 through 40 two pens of birds were observed for 60 min starting at 0800 h. The observer recorded numbers of drinking and eating actions, as well as the time duration of each action on an individual bird basis. Results show that incidences of drinking and eating actions, as well as the durations of these actions, were not different among individual birds. However, seasonal differences in numbers of drinking and eating actions were found. Specifically, in spring birds averaged 2.46 drinks/h and 2.36 eating actions/h and in summer these averages increased to 6.58 drinks/h and 4.36 eating actions/h. Durations of drinking and eating times were also influenced by season. Average duration of a drink in spring was 45.6 sec and 73.1 sec in summer, while average eating time in spring was 169.6 sec and 113 sec in summer. The type of drinking fountain also influenced both numbers of drinking actions, as well as average duration of each drink. The number of drinks for birds over both seasons with nipple drinkers was 6.08 and 2.96 for those with a Plasson fountain. The average drinking time over both seasons from nipple drinkers was 80.3 sec and 38.5 for the Plasson drinker. Average eating time for birds drinking from nipples was 125.9 sec and those drinking from a Plasson fountain were 156.8 sec.

Key Words: Drinking, Season, Eating, Broiler

M79 Water consumption as a broiler management tool.

B. D. Fairchild*¹ and M. Czarick², ¹*University of Georgia, Athens,* ²*University of Georgia, Athens.*

Many broiler farms have water meters to monitor bird water consumption and most modern house environmental controllers are able to accept inputs from water meters and log the daily consumption. Water consumption is a parameter that while monitored is not utilized extensively in broiler house management however, it is a useful tool that when utilized, can provide timely information about bird performance and health status. The recent models of many of the computer controllers common in broiler houses are now accepting multiple digital inputs that allow several water meters to be used per house. So in theory a water meter could be used to monitor water in the front of the house, the back of the house, the evaporative cooling system, etc. A field evaluation of bird water consumption on several commercial broiler farms has been conducted utilizing two water meters per house for several years. Monitoring bird density in the front and back of houses has proven to be effective in determining the effects uneven bird distribution has in broiler houses. Observations have been made when bird distribution in houses differed as much

as 40% between the front and back. Using digital photographs of the birds allowed estimates of bird density to be made in different areas of the houses. Comparing water consumption within the house and using those comparisons to determine flock distribution between front and back of the house has resulted in bird distributions within 1 to 2 percent on subsequent flocks.

Individual water lines in the houses have also been monitored for the last six months with the objective of examining water use among the different lines in the house as well as various management factors that might influence water consumption. Most houses have four to five drinker lines in each end of the house. These studies have shown the inner water lines are used 25% more than the outer water lines. The difference in water consumption between the inner and outer lines appeared to decline as the birds get older. The results of this evaluation indicate that water consumption can be a useful tool in day to day broiler house management.

Key Words: Broiler, Drinking water, Management

M80 Growth performance of Rock Partridge (*Alectoris graeca*) under intensive conditions. S. Dikmen*, F. Alpay, and M. Petek, *University of Uludag, Bursa, Turkey.*

Partridge's are game birds in the wild and there are four major markets: hunting preserves, gourmet food markets (mostly restaurants), individuals who buy live birds for custom slaughter and individuals who want to restock birds in the wild. And also recently it has been shown that partridge, especially the rock partridge, can also be raised for meat production. A trial was conducted to determine the growth performance and survival rate of rock partridge under intensive conditions. Seventy eight 1-day-old chicks were used. Chicks were weighed at hatching and fortnightly and recorded. Feed consumption was determined at the same time and the feed conversion ratio (kg feed / kg gain) was calculated. The experimental period was 16 weeks with the first 8 weeks as the starter period and the last 8 weeks as the grower period. Liveweight of partridge's (g) at hatching, 1 mo, 2 mo, 3 mo and 4 mo of age were found 14.64±0.19, 73.27±1.94, 251.66±3.99, 390.72±7.23 and 457.82±8.33, respectively. Cumulative feed consumption (g) and feed conversion ratio (kg feed / kg gain) were found 2883 and 6.51, respectively, at the end of the study. Survival rate at 1 mo, 2 mo, 3 mo and 4 mo of age were found 84.2, 82.4, 70.1 and 63.1% respectively. In conclusion, under intensive conditions partridge's perform a good growth performance but survival rate is low for mature age. According to the results of this study, further studies can be done for improving partridge performance and survival rate.

Key Words: Rock partridge, Growth performance, Survival rate

Monday, January 22
Environment and Management III
Room: B315

M81 Evaluate performance parameters and evisceration yield when incorporating two US Corn (before and after Katrina) vs. Argentinean corn. A. H. Nilipour*¹, R. Fabrega¹, E. Robles¹, F. Mora², and G. D. Butcher³, ¹*Empresas Melo, S.A., Panama City, Rep of Panama*, ²*Universidad de Panama, Panama City, Rep of Panama*, ³*University of Florida, Gainesville*.

Corn is a major imported grain used in poultry feed in Panama. Its quality can greatly influence production parameters and intestinal health. Due to hurricane Katrina, imports from the US were halted, thus Argentinean corn and fresh US corn, when imports were reestablished, were utilized. A study was conducted at the Empresas Melo Experimental station where a total of 1692 Cobb X Cobb female and male broilers were sexed and randomly allocated into 36 pens of 47 chicks each. Standard management practices were applied and commercial feeds with different corns utilized. Three treatments were utilized each containing 12 replicates of 6 female and 6 male pens with total of 564 birds. Treatments were 1- Control. US corn A (USCA), 2- Corn B (USCB), and 3- Argentine Corn (ARGC). Birds were individually weighed on placement, at DOA, and weekly, thereafter. Feed consumption per pen was weighed to calculate the weekly and accumulative feed conversions. Percent mortality and culls were also calculated. At 50 DOA a total of 18 birds (9 per sex) per treatment were randomly selected and eviscerated. The final body weights USCA vs. ARGC (+74 grams), conversions (-2 points) and performance index (6 points) were improved when CARG was used. There was 0.42 cents reduction in production cost utilizing Katrina corn. Total carcass yields were 71.31, 70.60 and 71.01%, respectively. Front halves of the breast % being 31.71, 31.06 and 31.25%. When all meats (breast, thigh and muscle) added, 37.48, 37.46, and 38.48% of the chicken is meat. ARGC inclusion improved total meat yield 1%, over US corn diets. Older US corn consistently had lower performance parameters, while ARGC improved body weight, feed conversion, and saleable part of the chickens, especially of breast meat.

Key Words: US corn, Argentinean Corn, Broilers, Yield

M82 The impact of two incubator systems upon moisture content in eggs and chicks. S. L. Funderburk*¹, M. J. Wineland¹, J. Beavers², J. Shepard², H. R. Cutchin¹, K. M. Mann¹, V. L. Christensen¹, and E. O. Oviedo-Rondon¹, ¹*North Carolina State University, Raleigh*, ²*Mountaire Farms, Siler City, NC*.

Understanding how the environment within both single stage (SS) and multi-stage (MS) systems affects chick quality is needed by the industry in order to produce optimal quality chicks. Once an understanding of each system type is established, management of the systems can be done in order to have a significant impact on the economic return to both the integrator and the grower. The objective of this project is to compare the effects of SS and MS systems on chicks at hatching. Experiments were conducted to evaluate egg and chick characteristics between the incubator systems. Eggs of prime Ross 708 flocks were weighed and incubated, using SS and MS systems. At D18 eggs were reweighed and moisture loss was calculated. At hatch chicks were randomly sampled from each treatment. Sampling was done by carefully separating the chick and residual yolk and weighing

to the nearest 0.01g. Yolk and chick samples were dried down in a 70°C oven in order to remove all moisture. Moisture content of the chick and residual yolk were calculated. SS and MS incubation systems affected the moisture loss among eggs and chicks differently. MS systems consistently lead to approximately a 2% higher moisture loss among eggs throughout incubation. Among chicks more moisture was found in the yolk of chicks hatching from SS systems, while the amount of dry yolk matter was less compared to the MS system. Yolk weights of chicks hatching from MS systems were higher, where chick weights were lower compared to the SS systems. Therefore, a higher percentage of chick to initial egg weight was found among SS systems. The incubation environment can affect the amount of moisture that is lost from the eggs and the moisture present in the chick at hatching. Additionally, the incubation system may have an effect on the ability of the embryo to utilize nutrients during incubation and impact the quality of the chick at hatching.

Key Words: Single stage, Multi-stage, Moisture loss

M83 Turkey embryo muscle growth and physiology is affected by incubator temperature and oxygen concentrations. V. L. Chrisensen*, M. J. Wineland, J. L. Grimes, D. Ort, S. Funderburk, P. E. Mozdziaik, E. de Oviedo, and K. M. Mann, *North Carolina State University, Raleigh, NC*.

Incubator temperature and oxygen concentration may affect embryonic muscle development. Randomly selected turkey eggs were set in the same incubator for the initial 24 days of incubation. At that time, the eggs containing viable embryos were randomly divided into groups and placed in four experimental cabinets until hatching. Each cabinet was operated at temperatures (T) and oxygen concentrations (Ox) in a 2 T (36° and 39°C) x 2 Ox (17 and 23%) factorial arrangement. At 27 and 28 days of incubation, 10 embryos or poults were sampled from each cabinet. Blood was obtained following decapitation. The pipping (musculus complexus), breast (pectoralis thoracicus) and thigh muscles (gastrocnemus) were collected from each embryo, and each muscle was placed in cold 7% perchloric acid (5 mL/g of muscle) for glycogen and lactate analysis. An additional 5 embryos were sampled for histological analyses of muscle fibers. Blood plasma creatine kinase (CK) and lactate dehydrogenase (LDH) activities were measured. T and Ox affected muscle growth differently. Pipping muscle weights at day 27 were higher (P<0.05) for 23% Ox compared to 17% Ox, and T and Ox exhibited a significant interaction at hatching to affect the pipping muscle weight. Breast muscle weights increased at 27 days for 39°C compared to 36°C but the reverse was noted at hatching. The thigh muscle weight was affected only at hatching as 23% Ox weights were higher compared to 17% and 36°C weights were higher compared to 39°C, but the two factors did not interact. The CK and LDH activities were also affected at 27 days because 39°C incubation was associated with elevated CK and LDH activities, compared to 36°C. At 28 days, only CK was affected as 39°C elevated CK activity in the 23% oxygen environment, but not in the 17% environment. Thus, incubator conditions affect muscle development and function in poults.

Key Words: Embryo, Muscle grow and function, Incubation

M84 A new technique for measuring core temperatures of commercial broilers. K. D. Christensen^{*1,2} and J. P. Thaxton¹, ¹Mississippi State University, Mississippi State, ²O.K. Industries, Inc., Fort Smith, AR.

Understanding core temperatures of commercial broilers should allow the identification of exact temperature profiles to maximize performance and bird welfare. Three trials were conducted to determine the feasibility of using Radio Frequency Identification microchips (RFID) with temperature-sensing capability to monitor deep core temperatures of broilers compared to rectal temperatures taken with a digital thermometer. In Trial 1, Day-old commercial broiler chicks were implanted with an RFID subcutaneously in the area between the wings or gavaged with an RFID. Temperatures collected from the RFIDs were compared to rectal temperatures. Implanted RFIDs provided temperatures throughout the 49 day trial period. RFIDs in the gizzard remained in the gizzard for up to 10 days but were either damaged by the muscular contractions of the gizzard or expelled. In Trial 2, commercial broilers were implanted with an RFID, or gavaged with an RFID. An antenna and microprocessor installed in the pen was used to collect and store the temperature data over time. In addition, rectal temperatures were taken and compared to RFID temperatures recorded at the same time. In Trial 3, an RFID was attached to the probe of a digital thermometer. Rectal temperatures of random birds were taken daily until Day 10 and then weekly through Day 49 from two commercial houses with two temperature profiles. Rectal temperatures and RFID temperatures were taken simultaneously using the modified probe. Results of these trials indicate that RFID can be a useful tool to monitor body temperature of commercial broilers. Using this information to improve the growing environment of commercial broilers should result in improvements in performance. Many advances in bird welfare can be made with a thorough understanding of the response of deep core temperatures to management practices.

Key Words: Body temperature, Commercial broilers, Microchip, Welfare, New technique

M85 Dietary calcium, phytate, and phytase control water soluble P excretion from broilers. A. B. Leytem^{*1}, P. W. Plumstead², R. O. Maguire³, P. Kwanyuen⁴, and J. Brake², ¹USDA-ARS, Kimberly, ID, ²North Carolina State University, Raleigh, ³Virginia Tech, Blacksburg, ⁴USDA-ARS, Raleigh, NC.

Soluble phosphorus (P) in broiler litter and manure is important from an environmental perspective as it is related to potential off site P losses following land application. The effects of altering dietary P, calcium (Ca), phytate P, and the addition of phytase on litter and manure P excretion in broilers were investigated. Study I consisted of a 3 x 3 x 2 factorial treatment structure that was applied from 14 to 42 d of age with 3 levels of available P (AvP) of 0.35%, 0.30%, and 0.25% combined with 3 levels of Ca of 0.80%, 0.69%, and 0.57% with phytase applied at either 0 or 600 FTU/kg. Study II consisted of a 3 x 4 factorial treatment structure that was applied from 16 to 20 d of age with 3 levels of dietary phytate P (0.10%, 0.23%, and 0.27%) combined with 4 levels of dietary Ca (0.47%, 0.70%, 0.93%, 1.16%). To assess treatment effects on P excretion, fresh litter was collected when the broilers were 41 d of age in Study I, and fresh manure was collected when broilers were 20 d of age in Study II. Litter and manure were analyzed for total P, soluble P, and phytate P. Results indicated that the inclusion of phytase at the expense of inorganic P, reductions

in AvP, or reductions in dietary phytate P decreased total P excretion. The ratio of Ca:AvP in the diets was negatively correlated with the solubility of P in the litter and manure. The effect of Ca on decreasing soluble P was greater in diets having a greater phytate P concentration. The ratio of litter soluble P:total P increased with phytase additions at all ratios of Ca:AvP. These data indicated that a decrease in litter or manure total P could be obtained by feeding diets with reduced AvP and phytase or by reducing phytate P in diets. However, the ratio of Ca:AvP in the diet was primarily responsible for effects on soluble P and was more pronounced in diets containing higher levels of phytate P.

Key Words: Broiler, Phosphorus, Soybean meal, Phytate, Environment

M86 Influence of early light intensity on broiler performance and yield. J. B. Hess^{*1}, S. F. Bilgili¹, and E. R. Miller², ¹Auburn University, Auburn, AL, ²Mountaire Farms, Siler City, NC.

Broiler strain responses to lighting programs continue to evolve as commercial strains change over time. The current trial examines the effects of light intensity during the first 9 d on Aviagen 708 broilers. Light intensities of 1, 2, 4 or 8 footcandles (fc) (23 h light; 1 h dark) were used on mixed-sex broilers (25 male and 25 females placed/pen) fed diets suggested by Aviagen (4 treatments, 4 light-controlled chambers/trt). At 9 d, all pens were switched to 20 h light and 0.25 fc. Light duration was returned to 23 h (0.25 fc) from 50 to 55 d. Body wt, uniformity and adjusted feed conversion ratio (FCR) were measured at 9 and 54 d. Mortality was monitored weekly and was summarized at 54 d. All birds were processed at 55 d to assess chilled carcass, abdominal fat, front half and parts yields.

Body wt were similar for 1, 2 and 4 foot candles at 9 d (236, 231, 234g respectively), while wt for birds given 8 fc was significantly ($p < 0.05$) lower (226g). No differences were seen in CV at 9 d, 54 d wt (although birds started on 8 fc had the lowest body wt numerically, 3839 vs 3870, 3859 and 3864g), FCR or mortality. Carcass yield of birds given 8 fc to 9 d was lower than that of birds given 4 fc (74.6 vs 75.7 %). Lean carcass yield showed similar results. No differences were seen in abdominal fat, front half yield or leg quarter yield. Fillet yield was lower in birds given 8 fc to 9 d than in those given 1 or 4 fc (19.5 vs 19.8 and 19.7% respectively). No differences in wing, tender or total breast yield were recorded. Early light intensity appeared to influence growth in Aviagen 708 broilers, with intensities up to 4 fc showing no growth reduction.

Key Words: Light intensity, Broiler, Yield

M87 Effects of three lighting programs during grow on performance of commercial egg laying varieties. 1. Growing period. N. P. O'Sullivan^{*}, P. Settar, J. Arango, S. Saxena, and J. Arthur, Hy-Line International, Dallas Center, IA.

An experiment was set to compare the effect of slow (SL), moderate (ML) and rapid (RL) step down light programs (LP) during the growing period of commercial layers. Experiments were carried out in two phases: PH1 (Spring 2005) compared W36 and W98, and PH2 (Fall

2005) included one white (W98) and one brown (HYB) egg variety. A total of 500 pullets per variety were individually wing banded at hatching, and moved to the grow house by variety with 20 h of light during the first week. Three replicates were kept in separate pens by variety-LP during the rest of the growing period. The LP differed in the rate of step down duration of artificial light exposure. All groups started with 20 h light at week one; thereafter, the light exposure decreased 1h/2wk (SL), 1h/wk (ML) and 4h/wk (RL), to 13, 9 and 12 h at weeks 15, 12 and 3 for SL, ML and RL, respectively. Thereafter, SL plateaued at 13 h of light ML and RL plateaued at 9 h till week 17 when all treatments received 10 h of light. Weekly individual body weights (BW) were collected in the grow house up to 17 weeks of age, when the birds were transferred to the layer house. Body weight records were analyzed by variety using least square means procedures. Model included the effect of LP and pen within LP, age (wk) and its interaction with LP and residual. The models' R-squares were over 0.93 for both lines and phases. There were significant differences in growth due to LP. In general, BW was highest for SL and smallest for RL, being intermediate for ML. In PH1 SL birds were, relative to ML and RL, respectively, +18 and +52 g for W36, and -4 and +20 g for W98. In PH2 these figures were +23 and +36 g for W98, and +24 and +45 g for HYB. The SL treatment resulted in heaviest pullets. Final conclusions are pending results of the residual effect of LP during laying on production and egg quality.

Key Words: Laying hens, Growing, Body weight, Light programs, Lighting

M88 Effects of three lighting programs during grow on performance of commercial egg laying varieties. 2. Laying period egg production. J. Arango*, P. Settar, S. Saxena, J. Arthur, and N. P. O'Sullivan, *Hy-Line International, Dallas Center, IA.*

An experiment was set to compare laying period effects of slow (SL), moderate (ML) and rapid (RL) growing light programs (LP). The experiments were carried out in two phases: PH1 compared W36 and W98, while PH2 included one white (W98) and one brown (HYB) egg variety. A total of 500 pullets per variety were wing banded, and grown by variety with 20 h of light during the first week. Three replicates were kept in separate pens by variety-LP during the rest of the growing period. All groups started with 20 h light at week one; thereafter, the light exposure decreased 1h/2wk (SL), 1h/wk (ML) and 4h/wk (RL), to 13, 9 and 12 h at weeks 15, 12 and 3 for SL, ML and RL, respectively. Thereafter, SL plateaued at 13 h of light and ML and RL plateaued at 9 h till week 17 when all treatments received 10 h of light. Afterwards, 2h/wk light increase was applied to 16 h, and then kept constant during the whole laying period. Data were collected on sexual maturity (SM), daily production (PD), and individual weekly body weights (BW). Production records were analyzed by variety using least square means procedures. Model included the effects of LP, week of production and their interaction. Data were analyzed as daily hen housed production pooled by week of production. Additional models treated week of production as a regressor variable at different degree polynomial. Significant PD differences occurred among LP, especially during the pre-peak period. The RL excelled in PH1 due to an earlier SM and higher peak of production. On average, SL birds were 44 and 87 g heavier than ML and RL for W36 and 38 and 83 g for W98. In PH2, LP was not significant for PD in HYB but SL birds were 24 and 45 g heavier than ML and RL. For W98, PD trend was similar to that in PH1, and SL birds were 12 and 51 g heavier than ML and RL. Final conclusions are pending analysis of egg quality and bone density traits.

Key Words: Laying hens, Sexual maturity, Production, Body weight, Light programs

Tuesday, January 23, 2007

**SCAD II (Avian Diseases)
Room: B312**

T89 Development and initial evaluation of a candidate M2e-based avian influenza vaccine utilizing recombinant *Salmonella* as a vaccine vector. S. L. Layton*¹, K. Cole¹, M. M. Cox¹, J. L. Gallagher¹, T. Jiang¹, Y. M. Kwon¹, L. R. Berghman², W. J. Bottje¹, and B. M. Hargis¹, ¹University of Arkansas, Fayetteville, ²Texas A&M University, College Station.

The M2 ion transport protein extracellular domain (M2e) is highly conserved among influenza A viruses. Antibodies against M2e have conferred protection against influenza challenge in previously-reported research. We have recently developed several novel attenuated Δ aroA *Salmonella enteritidis* strains (Δ SE) that express a protective epitope of M2e with or without linkage to a potential immune-enhancing 10 aa CD154 sequence (CD154). These avirulent *Salmonella* mutants

were evaluated as live vaccine candidates ($\sim 10^5$ or 10^7 cfu/chick by oral gavage at day-of-hatch) for invasiveness and M2e seroconversion. Constructs evaluated included Δ SE, Δ SE containing M2e (Δ SEM2e), Δ SEM2e linked to CD154 (Δ SEM2eCD154), or Δ SE containing multiple copies of M2e linked to CD154 (Δ SEHM). At 7 d, liver+spleen and ceca tonsils were aseptically removed for detection of Δ SE mutant recovery (enrichment), and blood samples were obtained for M2e-specific IgG antibody response against M2e at 10 and 20 d. Within doses, no significant ($p > .05$) differences were observed in Δ SE construct recovery from cecal tonsils at d 7. However, marked differences in organ invasion were observed (Δ SE: 7/10, Δ SEM2e(10^5): 1/10, Δ SEM2e(10^7): 10/10, Δ SEM2eCD154(10^5): 4/10, Δ SEM2eCD154(10^7): 9/10, Δ SEHM(10^5): 1/10, Δ SEHM(10^7): 5/10, $p < .05$). M2e-containing Δ SE constructs elicited M2e seroconversion

(S/P-ratio; $p < .05$) with higher responses from higher vaccination doses at d 20. Δ SEM2e produced higher M2e seroconversion at d 20 than the Δ SEHM, but seroconversion was not detectable in any group at d 10. When SP-ratios 2 STD higher than Δ SE-only controls were considered as positive responses, 70% (14/20) Δ SEM2e and 85% (17/20) Δ SEM2eCD154 responded by d 20. Ongoing experiments are focused on duration of response and effect of booster vaccination. These early data suggest that effective M2e seroconversion is possible with this *Salmonella*-vectored vaccine. Such a vaccine could offer advantages relating to stability of epitope and cost of amplification and administration.

Key Words: Avian Influenza, *Salmonella*, Vaccine Vector, M2e, Chicken

T90 Development and initial evaluation of a biosensor for in field screening of avian influenza virus. Y. Li^{*1,2}, R. Wang^{1,2}, L. Lassiter^{1,2}, B. Hargis¹, S. Tung², L. Berghman¹, and W. Bottje¹, ¹University of Arkansas, Fayetteville, ²Texas A&M University, College Station.

An important step in controlling the spread of avian influenza is rapid and sensitive detection of the virus in the field. Thus, a biosensor, originally developed for microbial detection, has recently been modified to enable detection of avian influenza virus. The biosensor consists of a sampler, a microfluidic chip, and impedance detector attached to a microprocessor. In preliminary studies, magnetic nanobeads were coated with specific antibodies to targeted H5N1 (killed) avian influenza virus and used in the automatic sampler to separate target viruses from a poultry swab sample. Red blood cells were mixed with the captured target viruses to form an antibody coated nanobead-virus-red blood cell complex as a result of hemagglutination with the H5N1 virus. The complexes were then sent to a microfluidic chip that was designed and fabricated as a flow-through device with an embedded interdigitated array microelectrode for impedance measurement. The change in impedances of the antibody coated nanobead-virus-red cell complex was correlated to the concentration of avian influenza virus H5N1 in a poultry sample. Results of these studies indicate that the biosensor was very sensitive (102 EID₅₀/ml) in detection of killed H5N1 virus in buffer and when the virus was added to cloacal and tracheal swab samples. No false positives were observed when unknowns were tested with various combinations of killed viruses consisting of H5N1, infectious bronchitis, and exotic Newcastle disease. The total amount of time required for in-field detection would be 20 to 30 min. Thus, the biosensor could be potentially used both in detection of H5N1 in commercial poultry, but also in wild bird populations and backyard chickens or village chickens found throughout the world.

Key Words: Biosensor, Avian influenza, In-Field detection, H5N1 virus, Swab sample

T91 Molecular and antigenic characterization of recent H5N1 avian influenza isolates from Vietnam. J. Pfeiffer^{*} and D. L. Suarez, Southeast Poultry Research Laboratory, Athens, GA.

A recent sequence comparison of the hemagglutinin (HA) gene of Asian H5N1 avian influenza viruses isolated over the past 10 years

demonstrated separation into three clades with recent isolates separating into two clades. Most reported viruses from Vietnam from 2001-2005 clustered in Clade 1, but 19 viruses isolated from the northern part of Vietnam from December 2005 all were clade 2 viruses. These viruses clustered into two sublineages, with no apparent clustering based on origin of the viruses. Genetic relatedness for the other genes also showed two unique clusters that correlated with the HA gene. Additionally, we evaluated the antigenic relatedness between these Vietnamese viruses by cross hemagglutination inhibition (HI) tests using antisera generated with DNA vaccines in chickens. Hemagglutinin-specific sera collected was to be used against either homologous antigen or antigen from the other Asian viruses against which antibodies to their HA genes were produced. We also wanted to evaluate the effectiveness of various vaccines using two Vietnamese challenge viruses that represented each genetic sublineage. Two-week old white leghorn chickens were vaccinated with one of five oil emulsion vaccines, two of which are currently used in Vietnam. Three weeks later, these birds were challenged with 10⁶ EID₅₀ virus. Clinical protection was seen with four of the vaccines, and real-time RT-PCR was used to evaluate levels of shedding among the groups. By compiling the data from these various analyses of the recently isolated Vietnam highly pathogenic H5N1 viruses, we will gain knowledge which can be applied to selecting vaccine seed strain viruses in the future.

Key Words: Hemagglutinin, Vaccines, Avian influenza, HI test, Shedding

T92 Isolation and characterization of an avian influenza virus from a wild waterfowl. T. Dormitorio^{*}, J. Giambrone, K. Guo, and G. Hepp, Auburn University, Auburn, AL.

Wild aquatic birds form the natural reservoir of avian influenza viruses, and have been implicated as a continuous source of virus for domestic birds as well as other animal species including humans. Through surveillance of wild birds, prevalence of avian influenza viruses (AIVs) can be monitored and the pathogenic and antigenic properties of the circulating viruses can be determined. Cloacal swabs were obtained from various species of wild, hunter killed or trap nested waterfowl on the Eufaula Wild Life Refuge in Southern Alabama. The samples were brought to the laboratory where they were processed for embryonated egg inoculation, hemagglutination, DirectigenTM AC-ELISA, and real-time RT-PCR (RRT-PCR) tests. Samples positive for AIV, using all tests, were submitted to NVSL, Ames, Iowa for subtyping. Only one sample, S10706-26, which came from a Northern shoveler was positive for presence of AIV by all tests. It had an HA titer of 64 and allantoic fluid from a second, but not the first, egg passage produced a positive result by DirectigenTM test. RRT-PCR showed that allantoic fluid from the inoculated egg was positive (Cp=24) for the matrix gene of AIV, but negative for the H5 and H7 genes. Allantoic fluid containing the positive AIV was sent to the NVSL and was determined to be of the H10N7 subtype. Additional molecular characterization of this H10N7 isolate is being conducted using cloning and sequencing of the H10 gene.

Key Words: Avian influenza, Waterfowl, Real-time RTPCR, AC-ELISA, Hemagglutination

T93 Protection against exotic Newcastle Disease virus (NDV) challenge of chickens vaccinated with NDV vaccines made from different genetic lineages. P. J. Miller*, C. Estevez, Q. Yu, D. L. Suarez, and D. J. King, *Southeast Poultry Research Laboratory, Athens, GA.*

Vaccines for control of Newcastle Disease (ND) have been used for over fifty years in the United States. The available ND vaccines, both live and killed have been shown to prevent mortality and symptoms of disease. However, they typically do not prevent vaccinated birds from becoming infected and shedding virus that may infect susceptible birds. The purpose of this study was to determine if vaccination with Newcastle Disease virus (NDV) strains that are genetically more similar to the challenge strain reduce the shedding of challenge virus. Two experiments were conducted using four-week-old specific pathogen-free Leghorn chickens. In the first experiment chickens were subcutaneously vaccinated with inactivated vaccines utilizing strains B1, Ulster, CA 2002, Pigeon 84, Alaska 196, or uninfected allantoic fluid as control. In the second experiment chickens were vaccinated with either live or inactivated vaccines using a recombinant Anhinga 1993 NDV with either its own hemagglutinin neuraminidase (HN) gene or with a HN substitution from CA 2002, a live B1 commercial vaccine, an inactivated challenge virus (CA 2002) vaccine, or appropriate control vaccines. Three weeks post-vaccination seroconversion was assessed by ELISA and hemagglutination inhibition (HI) assays performed against each of the vaccine antigens. After challenge with virulent CA2002, birds were examined daily and monitored at selected intervals for virus shedding. All treatments except for the sham vaccinated controls induced greater than 83% protection from clinical disease and mortality. More importantly, the vaccines homologous with the challenge virus reduced oral shedding significantly more than the antigenically heterologous vaccines. Consequently, vaccines formulated to be antigenically closer to circulating virulent viruses can provide better Newcastle Disease control by reducing virus transmission from vaccinated birds.

Key Words: Exotic Newcastle Disease, NDV, Inactivated vaccine, Live vaccine, Viral shed

T94 Infectious bursal disease viruses identified in Colombia, South America. L. Purvis*, P. Villegas, and F. Perozo, *University of Georgia, Athens.*

During 2005-2006, inactivated bursal imprints in FTA cards were obtained from Colombia for molecular identification of infectious

bursal disease virus (IBDV) using RT-PCR and sequencing. Molecular analysis of the hypervariable region of VP2 containing amino acids 206 through 310 was conducted in order to determine the strain of IBDV. The samples were submitted from farms in Colombia experiencing problems with IBDV. Over half of the samples analyzed were classified as very virulent IBDV (vvIBDV), and the second largest group of samples corresponded to variant strains. The finding of the presence of vvIBDV and variant strains in Colombia is important to establish procedures to control these field strains.

Key Words: Infectious Bursal Disease, South America

T95 Characterization of infectious bursal disease virus RNA-dependent RNA-polymerase leads to higher viral titres in cell culture. T. Letzel¹, A. E. Gorbalyena², and E. Mundt^{*3}, ¹*Institute of Molecular Biology, Insel Riems, Germany,* ²*Leiden University Medical Center, RC Leiden, The Netherlands,* ³*University of Georgia, PDR, Athens.*

Infectious bursal disease virus (IBDV) as a member of the family Birnaviridae contains a bisegmented genome of double-stranded RNA. The larger segment A encodes a polyprotein [viral proteins (VP) 2-4-3] and the viral protein VP 5. The smaller segment B encodes VP1 which represents the RNA-dependent RNA-polymerase (RdRp) of IBDV. VP1 was expressed fused to a His-tag employing a baculovirus system for investigation of the functionality of this protein. After purification by affinity chromatography VP1 was used in an in vitro RdRp assay using a mutated VP1 as control. VP1 showed in vitro RdRp activity whereas the mutant did not indicating that the RdRp activity was indeed caused by the presence of VP1. Further investigations using different divalent cations were performed to characterize the reaction conditions in vitro. It was observed that in presence of 5 mM Co²⁺ the efficiency of the reaction was 20-fold higher than in the presence of 5 mM Mg²⁺. To apply this finding to the improvement of virus production in cell culture appropriate experiments were performed. After optimization of the cell culturing conditions IBDV infection experiments were performed. The obtained results showed a significant increase of IBDV titres in the presence of 50 µM Co²⁺. This phenotype was observed independent from the used cell culture since in further experiments using a different bird cell line a significant increase of the viral titre was detected. This effect was observed to be IBDV specific since for the avian reovirus strain 1133 no significant differences were detected. This finding could help establishing a more efficient vaccine production of IBDV in cell culture.

Key Words: IBDV, RdRp, Replication, Titer, Vaccine

Tuesday, January 23, 2007
SCAD III (Avian Diseases)
Room B312

T96 Efficacy study of a live attenuated reovirus vaccine given by the *in ovo* route to SPF and commercial broilers. K. C. Cookson*¹ and J. J. Giambrone², ¹Fort Dodge Animal Health, Overland Park, KS, ²Auburn University, Auburn, AL.

The efficacy of an attenuated reovirus vaccine was measured using a previously established reovirus challenge model. **Study design:** Broilers from a commercial flock (COM, breed A) and an SPF flock (breed B) were vaccinated *in ovo* with a full dose of HVT/SB-1 with or without a 1/5 dose of V.A. ChickVac (VACHVac). 20 chicks per flock were bled for reovirus Idexx ELISA. 120 chicks per flock were then housed 20 per Horsfall isolator. At 3 days of age (D3) a set of birds were challenged intratracheally (IT) with 4.0 logs₁₀ (chick ID50) of malabsorption strain 2408. Another set were challenged at 5 days of age. At 16 days of age all groups were weighed. **Results:** Non-vaccinated COM broilers (NoVax rows, table below) were significantly lighter from challenge at 3 days (8.5%) and 5 days (25.7%). SPF-NoVax were lighter only after D3 challenge. V.A. ChickVac caused no weight suppression (NC columns). V.A. ChickVac completely protected both SPF challenge groups against weight suppression (D3 and D5 columns). The commercial flock was fully protected from the D3 challenge but there was only partial, but significant protection from D5 challenge. **Discussion:** The commercial flock was selected for its marginal levels of reovirus maternal antibodies (MAB). Previous challenge studies using this model have shown flocks near 1,800 geometric mean titer (GMT) are susceptible to D3 reovirus challenge. In this study, the D5 challenge resulted in even greater weight suppression, perhaps because there was less MAB protection at the time of challenge. The SPF flock had a similar level of weight suppression from D3 challenge; however, it was resistant to the D5 challenge. The MAB-negative SPF flock was expected to be more susceptible to early reovirus challenge. Perhaps the breed difference is responsible for the discrepancy seen here. **Summary:** The live attenuated reovirus vaccine was safely given *in ovo*, resulting in full protection in 3 of the 4 challenge groups and partial protection in the 4th, most heavily stunted group.

Table 1. 16-day body weights of broilers intratracheally challenged with reovirus strain 2408

| Flock description | Hatch GMT | No-Reo BW | Challenge | | at 3D | | at 5D | |
|-------------------|-----------|-----------|-----------|---------------|----------|---------------|----------|---------------|
| | | | sup-pres | Chal-lenge BW | sup-pres | Chal-lenge BW | sup-pres | Chal-lenge BW |
| COM-NoVax | 1,793 | 561a | NA | 513b | 8.5% | 417d | 25.7% | |
| COM-VACHVac | | 588a | | 560a | | 474c | 15.5% | |
| SPF-NoVax | 192 | 462b | NA | 432c | 6.5% | 452b | 02.2% | |
| SPF-VACHVac | | 498b | | 470b | | 530a | | |

Challenge groups within a flock (i.e., COM) having a different letter are significantly different, based on Tukey's multiple range test (P<0.05).

Key Words: Reovirus, Vaccine, Protection, *In ovo*, Broilers

T97 Multiplex RT-PCR for the detection of astroviruses and rotaviruses in poultry. C. Stephens*, M. J. Pantin-Jackwood, and E. Spackman, University of Georgia, Athens.

Viral enteric diseases cause substantial economic loss to the US poultry industry because they lead to decreased weight gain, increased morbidity, increased mortality, and increased production costs from poor feed conversions and increased use of therapeutic anti-microbial treatments. Astroviruses and rotaviruses are among the most commonly detected viruses found in chicken and turkey intestinal samples. Two multiplex RT-PCR tests for the simultaneous detection and differentiation of four avian astrovirus types and avian rotaviruses from feces and intestinal samples from poultry were developed and validated. The multiplex RT-PCR for chicken samples detects Avian Nephritis Virus (ANV), Chicken Astrovirus (CAstV) and Rotavirus. The multiplex RT-PCR for turkey samples detects Turkey Astrovirus 1 (TAsTV-1), Turkey Astrovirus 2 (TAsTV-2), Avian Nephritis Virus (ANV) and Rotavirus. Assay detection limits for each virus were determined. An evaluation of different sampling times and types for each virus was performed with experimentally infected chickens and poults. The multiplex RT-PCR's developed were successfully used in a survey on enteric viruses circulating in poultry in the United States.

Key Words: Astrovirus, Rotavirus, Chicken, Turkey, Multiplex RT-PCR

T98 Ecology of reticuloendotheliosis virus (REV) in a closed population of captive endangered prairie chickens. T. M. C. Barbosa*, G. Zavala, and S. Cheng, University of Georgia, Athens.

Reticuloendotheliosis (RE) is a neoplastic and immunosuppressive disease of poultry. RE virus (REV) can be a contaminant of vaccines. Attwater's Prairie Chicken (APC) is an endangered avian species, partly due to enzootic REV infection. REV's were isolated from APCs housed at the Fossil Rim Wildlife Center (TX). In a previous study, one isolate (REV APC-566) experimentally induced delayed growth, mortality, and decreased egg production and hatchability in Japanese quail. It also caused tumors at early ages and the majority of tumors were classified as CD3+ Lymphosarcomas. Nucleotide and amino acid alignments of full genome showed that REV APC-566 is closely related to REV inserted into Fowlpox virus. In this study we examined the nucleotide and amino acid sequences of several APC REV isolates. REV's were isolated and propagated in DF-1 cells from whole blood or tumors from APCs. The proviral DNA was amplified with specific primers for the *env* gene and the LTR. These regions were aligned with REV sequences available at GenBank and other REV sequences also resolved in our laboratory. All APC REV LTR sequences showed highly conserved deletions and insertions in the U3 region. All known promoters and enhancers are also highly conserved. The *env* gene is well conserved, in contrast with other avian retroviruses. Similar to REV APC-566, other APC isolates from the same APC colony display high similarity with REV inserted into Fowlpox virus. An immunosuppressive peptide coding region within the transmembrane

region of env is highly conserved in all REV sequences examined. This immunosuppressive peptide is well described in mammalian in vitro systems and has been detected in mouse, feline, monkey and other retroviruses. Thus, REV's circulating in a closed colony of APCs are genetically stable. REV APC-566 caused impairment of immune responses in experimentally inoculated SPF turkeys. Functional assays are still needed to confirm the immunosuppressive properties of the putative REV immunosuppressive peptide.

Key Words: Reticuloendotheliosis virus, Attwater's Prairie chicken, Sequencing, Immunosuppressive peptide, Fowlpox

T99 Effects of chicken anemia virus (CAV), infectious bursal disease virus (IBDV) and reovirus on cellulitis development in chickens. K. S. Macklin^{*1}, J. J. Giambrone¹, K. Cookson², and H. Toro¹, ¹Auburn University, Auburn, AL, ²Fort Dodge Animal Health, Lawrence, GA.

E. coli derived cellulitis is a major problem in the broiler industry that costs the industry millions of dollars annually. In this experiment 72 broiler chickens were obtained from a commercial hatchery and randomly assigned into 6 Horsfall isolator units. Six treatments were used with no replication per pen. All birds had maternal antibody against all 3 viruses used in this study. The treatment 1 was the negative control (CON). In treatment 2 (VIR), the birds were administered CAV and reovirus at 3 days of age, and IBDV at 7 days of age. Treatment 3 (VHI) consisted of the 3 viruses mentioned in VIR and 0.1 ml of 4.7x10⁸ *E. coli* administered subcutaneously in the breast at 25 days of age. Treatment 4 (VLO) was similar to treatment 3, except *E. coli* was administered at 4.7x10⁵. Treatments 5 (LO) and 6 (HI) were not given a viral challenge, but were challenged at 25 days of age with *E. coli* at 4.7x10⁵ and 4.7x10⁸, respectively.

Of the 3 groups that received CAV, histopathology showed that there was atrophy of the thymus in 18% of VLO, 25% of VHO, but no signs of the virus were detected in VIR. CAV-PCR results show that the virus was present in some of the birds from all three viral challenge groups. All birds that were administered reovirus showed a 9% suppression in body weight compared to the non-reovirus challenged birds. All 3 of the IBDV challenged treatments had approximately 90% bursal atrophy. None of the non-viral challenged treatments showed thymic or bursal atrophy and their body weights were similar to CON. Among the *E. coli* challenged treatments, the 2 high dose groups had 91% and 75% incidence of cellulitis in the HI and VHI groups, respectively. Of the two low dose groups only VLO had positives at 36%. As was observed with the viruses, there were no cellulitis lesions in non-*E. coli* challenged birds. The addition of immunosuppressive viruses did not effect the development of cellulitis lesions in the high dosed birds; however in the low dosed birds the addition of the viruses increased the likelihood of cellulitis development.

Key Words: Cellulitis, *E. coli*, CAV, IBDV, Reovirus

T100 Evaluation of the tissue tropism and transmission of the tissue culture origin (TCO) live-attenuated vaccine of infectious laryngotracheitis virus. A. Rodriguez^{*} and M. Garcia, University of Georgia, Athens.

The protection ability and safety of the ILTV TCO live-attenuated vaccine has been widely studied, however the tropism and transmission of the TCO vaccine has not been well documented. The aim of this study was to determine the target organs where the vaccine replicates, and the ability of the vaccine to transmit to unvaccinated birds in close proximity. Four weeks old specific pathogen free (SPF) chickens were vaccinated by eyedrop with the TCO vaccine. Unvaccinated SPF chickens were housed in direct contact to vaccinated chickens since first day of vaccination. Virus isolation and real time PCR were used to detect the presence of live virus and viral DNA, respectively, in the trachea, trigeminal ganglia, eyelids swabs, cecal tonsils, and cloacal swabs at interval days postvaccination (2, 4, 5, 6, 7, 8, 9, 10, 14, 18, 21, 24, and 28) from vaccinated and contact-exposed birds. The virus was isolated from trachea at day 9 post vaccination from both vaccinated and unvaccinated birds, and from eyelid swabs at 4, 6, 7, and 9 from vaccinated birds, and at 7 and 9 days from unvaccinated birds. Virus was not isolated from the trigeminal ganglia, cloacal swabs, and/or cecal tonsils at any of the time points. Viral DNA was detected from eyelid swabs from day 2 to 14, from trachea at days 4, 5, 6, 9, and 10, and from trigeminal ganglia at days 5, 6, 7, and 9. Real time PCR analysis of cecal tonsils, cloacal swabs and other samples collected at 18, 21, 24, and 28 days post vaccination is ongoing. Replication of the TCO vaccine in the eyelid and the trachea, as well as the transmission from vaccinated to unvaccinated birds was demonstrated.

Key Words: Infectious laryngotracheitis, Tropism, Transmission, Real time PCR, Virus isolation

T101 A natural challenge model for ILTV laboratory studies. J. Giambrone^{*}, S. Fagbohun, and K. Macklin, Auburn University, Auburn, AL.

Infectious laryngotracheitis virus (ILTV) is an economic problem in broilers reared in concentrated areas. A natural exposure (challenge) model was needed to test the efficacy of commercial litter treatments, which are used to reduce ILTV exposure. The ILTV challenge model was developed by seeding pine shavings with commercial ILTV vaccine. This was done by serial back passage of vaccine virus in SPF chickens. The back passage was started by vaccination of four, 3-week-old broilers with 10 doses each of live vaccine by eye and nasal instillation. Birds were placed on litter in Horsfall-Bauer units. At 1 week later birds showed slight respiratory signs (sneezing and conjunctivitis) typical of silent or vaccine induced ILTV. Three more 4-week-old sentinel birds were added to the same units. At 1 week later contact exposed birds showed minor respiratory signs. At this time the initially vaccinated birds were killed and examined post-mortem. Their trachea were taken for microscopic observation and tested for ITLV DNA using a newly developed nested PCR. Another group of 3, 3-week-old sentinel birds were added to the contaminated unit, containing the remaining infected birds. At a week later, these birds also developed minor clinical respiratory signs. At this time all birds were killed and examined. All birds had slight congestion in the trachea or conjunctivitis, and mild microscopic lesions in the trachea suggestive of respiratory distress. A piece of each trachea was pooled from all groups and all were positive for ILTV DNA by the nested PCR test. This contaminated litter was taken to an isolated block house, to be exposed to various litter treatments for 5 days. After this treatment, the litter was returned to the units and 9, day-old birds were again placed on the litter to see if they became infected with ILTV at 3, 4 or 5 weeks of age. Three, SPF birds placed on the positive non-treated

litter were negative for ILTV DNA at 3 weeks of age. However, the additional birds placed in the same unit at day of age, which were tested at 4 or 5 weeks of age, were positive for ILTV DNA. This

ILTV challenge model has proved useful for testing the efficacy of litter treatments.

Key Words: ILTV, Challenge, Litter, Treatments

Tuesday, January 23, 2007
Nutrition III
Room: 313

T102 Effect of a new coating on the thermotolerance and bioefficacy of a phytase product in broilers fed corn-soybean meal-based diets. A. Owusu-Asiedu¹, J. C. Remus*¹, P. H. Simmins¹, and R. Croxall⁴, ¹Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom, ²Danisco Animal Nutrition, St. Louis, MO, ³Danisco Animal Nutrition, Marlborough, Marlborough, Wiltshire, United Kingdom, ⁴ADAS, Gleadthorpe, Mansfield, Nottinghamshire, United Kingdom.

A study evaluated the effects of a new coating (C) on thermal tolerance and bioefficacy of a bacterially-derived, phytase product (Phyzyme XP, 6-phytase, EC 3.1.3.26) in broilers fed corn-soybean meal-based diets. 1440 male Ross 308 chicks were assigned to six dietary treatments (1-6) with eight replicates pens each (30 chicks/pen). The treatments were: 1. Positive control (PC), 2. Negative control (NC), 3. NC + 500 U/kg phytase, 4. NC + 500 U/kg C phytase, 5. NC + 500 U/kg C phytase pelleted at 80°C, and 6. NC + 500 U/kg C phytase pelleted at 90°C. All the diets were formulated to be isocaloric and isonitrogenous. The Ca and available P levels were 0.90% and 0.37% in PC and 0.78% and 0.26% in NC diets, respectively. Birds were weighed on days 0 and 21, and two birds from each pen were randomly selected and sacrificed on day 21. The left tibia was removed and dry defatted ash determined. Birds fed PC diet and diets supplemented with phytase were heavier ($P < 0.05$) at day 21 than birds fed NC diet. Birds fed C phytase supplemented diets and pelleted at 80°C and 90°C were heavier ($P < 0.05$) at day 21 and had a better FCR ($P < 0.05$) than birds fed the PC diet. Birds fed the NC diet consumed less ($P < 0.05$) feed than birds fed the PC or phytase supplemented diets. Tibia ash was lower ($P < 0.05$) for birds fed the NC diet compared to all other treatments. In conclusion, a new coating applied to the phytase achieved thermostability up to 90°C while demonstrating similar bioefficacy to the uncoated phytase.

Key Words: Enzymes, Phytase, Pelleting, Broiler, Thermostability

T103 Coating for pellet stability does not adversely affect the phosphorus-releasing efficacy of an *E. coli*-derived phytase in young chickens. N. R. Augspurger¹, S. D. Frankenbach*¹, T. J. Applegate², J. S. Moritz³, F. Ruch¹, and D. M. Weibel¹, ¹JBS United, Inc., Sheridan, IN, ²Purdue University, West Lafayette, IN, ³West Virginia University, Morgantown.

The phytase enzyme is highly susceptible to inactivation by heat and moisture, conditions encountered during pelleting. Alternatively, phytase can be applied as a liquid to the pellet, by-passing the high heat and moisture, or the dry phytase can be stabilized to retain a high proportion of activity and added prior to pelleting. A series of trials was done with an *E. coli*-derived phytase (OptiPhos™, JBS United, Inc.)

to determine the effect of adding a lipid coating to the phytase particle on the pellet-stability, as well as its *in vivo* phosphorus (P)-releasing efficacy in chickens. For each of the pelleting trials, corn-SBM diets containing 1,000 FTU/kg phytase, from either uncoated or coated preparations, were pelleted at 85°C following 60 s of mixing with steam. Samples of feed were taken pre- and post-pelleting and analyzed for phytase activity; retention values were then calculated. Three chick assays utilized standard-curve methodology to compare the P-releasing efficacy of both uncoated and coated phytase. In each assay, four pens of four or six male broilers were fed P-deficient experimental diets supplemented with inorganic P or phytase from either uncoated or coated preparations for 11-14 d, after which tibia were collected for determination of bone ash (mg and %). The first chick assay showed no effect ($P > 0.10$) of the coating on the P-releasing efficacy of an *E. coli*-derived phytase at 500 FTU/kg (0.14% P); the coated phytase retained 76 ± 6 (SD)% of its activity after pelleting at 85°C ($32 \pm 10\%$ for uncoated). The addition of the coating to the phytase in the second chick trial did not affect ($P > 0.10$) the P-releasing efficacy, and resulted in a phytase retention value of $82 \pm 13\%$ after pelleting at 85°C. The third assay revealed P-releasing efficacy estimates of 0.128 and 0.133% for 500 FTU/kg of the uncoated and coated phytases, respectively ($P > 0.09$). These data show that adding a lipid-based coating to phytase is efficacious for stabilizing the phytase in the pelleting process at 85°C, and does not adversely affect the quantitative efficacy in chickens.

Key Words: Phytase, Phosphorus, Broilers, Pelleting, Stability

T104 Quantum™ phytase exhibits high specific activity and high substrate affinity over the full gastric pH range. A. Nelson*^{1,2}, S. S. Basu^{1,2}, and S. Betts^{1,2}, ¹Syngenta Biotechnology, Inc., Research Triangle Park, NC, ²Syngenta Animal Nutrition, Research Triangle Park, NC.

Phytin in bird feed is solubilized in the acidic environment of the upper gastrointestinal tract, releasing phytate and mineral cations. However the release of phytate is reversible such that as the pH increases, for example as feed digesta move from the gizzard into the small intestine, phytate can again chelate soluble cations to form insoluble phytin. For this reason phytases used to supplement bird feed must be active in the acidic pH range where phytate is soluble and biologically available. The region of highest phytate solubility - and hence susceptibility to enzymatic hydrolysis - is therefore the upper digestive tract from the crop to the duodenum.

In this *in vitro* study the catalytic properties of an *Escherichia coli*-derived phytase, Quantum™ phytase, were examined side-by-side with two commercially available fungal phytases at a series of

physiologically relevant pH conditions. The plot of specific activities (μ mol phosphate released/min/mg protein measured at 37°C) vs. reaction pH showed that compared to fungal phytases Quantum phytase catalyzes phytate hydrolysis at a very fast rate over a broad range of acidic pH-conditions (as low as pH 1.5). By contrast, the fungal phytases exhibited much lower specific activities and were more sensitive to acidic pH conditions. The substrate affinity (apparent K_m values) of each phytase was also determined from double-reciprocal plots of the reaction rate at varying phytate-substrate concentrations. Quantum phytase was found to have comparable K_m values at all physiologically relevant pH conditions tested (pH 2.5, 4.5 & 5.5). These results demonstrate that Quantum phytase is a highly efficient catalyst for phytate-phosphate hydrolysis and an attractive candidate for use as a feed additive enzyme.

Key Words: Phytate, Phytase, Kinetics, pH-profile, Acidic

T105 Effects of buffer types and concentrations on phytase product analysis. S. Dalsgaard^{*1}, C. Gilbert², and R. Lorentsen¹, ¹Danisco Innovations, Brabrand, Denmark, ²Danisco Animal Nutrition, Marlborough, Wiltshire, United Kingdom.

Phytase is used in feed to improve phytate phosphorus digestibility. Commercial phytases are either fungal or bacterial in origin. The feed industry needs a robust assay to measure phytase in products, in premixes and in feed. Ideally, this assay needs to be appropriate for all commercial phytases. To get a better understanding of phytase functionality, a study of two commercially available bacterial origin phytases was carried out to assess how each phytase reacted under different assay buffer conditions. Phytase is described based on the phytase unit (FTU) wherein 1 unit is defined as the amount of enzyme needed to liberate 1 micromole of inorganic phosphate from sodium phytate per minute at pH 5.5 and 37°C. The buffer system used to achieve this pH can vary and potentially could influence the number of phytase units measured. This study used different molarities of acetate and citrate buffers, both of which have been used in published assay methods for phytase. Also, two different colour reagents used in phytase assays were compared to assess their impact on the activity measured. Phytase activity was measured at pH 5.5 and 37°C as per the standard definition of a phytase unit (FTU). The colour reagents did not affect measured activity in the phytases. Changing the buffer from a 0.25M acetate buffer to a 0.2M citrate buffer reduced the assayed activity by approximately 50%. Use of a 0.1M citrate buffer increased the activity measured compared to the 0.2M citrate buffer, but the activity was still 15-20% less than with acetate buffer. Measured activity (FTU) is therefore significantly influenced by assay buffer within the same unit definition. In conclusion, this study shows that it is incorrect to assume that products containing a specified number of phytase units (FTU) are directly equivalent without seeing detail of the assay methodology. For this reason it is always necessary to standardise phytase units using one method before running, or interpreting, comparative bioefficacy studies.

Key Words: Enzymes, Phytase, Assay, Buffers, Activity

T106 Kinetics of phytase-catalyzed sequential hydrolysis of inositol phosphates: Can this be a criterion to differentiate among

phytases used in poultry diet? R. Prata^{*1,2}, C. Batie^{1,2}, S. Betts^{1,2}, and S. S. Basu^{1,2}, ¹Syngenta Biotechnology, Inc., Research Triangle Park, NC, ²Syngenta Animal Nutrition, Research Triangle Park, NC.

Supplementation of poultry feed with exogenous phytase is viewed as essential to liberate trapped phosphate from phytate (inositol hexakisphosphate; IP₆). In addition, phytases have indirect nutritional benefits. Phytate is an anti-nutrient: its metal chelating activity decreases the bioavailability of minerals as well as the digestibility of starch and protein. Thus, phytase also reduces the anti-nutritive effects of phytate. It has also been proposed that the chelating power and capacity of phytate markedly decreases upon removal of two phosphates to form inositol tetrakisphosphate (IP₄).

Studies were conducted to investigate the kinetics of the phytase-catalyzed sequential conversion of IP₆ to inositol phosphate reaction intermediates, IP₅ and IP₄, using the E. coli derived QuantumTM phytase (a 6-phytase) and two commercial fungal phytases (one 6-phytase & one 3-phytase). The objective of these experiments was to identify possible differences in the rates of IP₆ and IP₅ depletion by these phytases. Experiment set 1, all phytase reactions were performed using equal doses of enzyme activity measured in standard unit (FTU, assayed at pH 5.5 & 37°C). The concentrations of IP₆, IP₅ and IP₄ were measured over time in reactions carried out at pH 2.5 and 3.5 with 100% IP₆ as the substrate. Under these conditions Quantum phytase depleted the anti-nutrients IP₆ & IP₅ at a significantly faster rate than the two fungal phytases. In experiment set 2 similar reactions were performed but using equal phytase activity, this time measured at the pH of the reaction (pH 2.5 & 3.5). Development of kinetic models and comparison of the rate constants of IP₆, IP₅ and IP₄ hydrolysis catalyzed by these phytases show that Quantum phytase is more efficient in converting IP₆ to IP₄ over the full range of physiologically relevant pH conditions. Based on the above described catalytic properties of phytases, it may be predicted that Quantum phytase can be highly effective in neutralizing the anti-nutritive properties of phytate in poultry diet.

Key Words: 6-phytase, 3-phytase, Reaction mechanism, Inositol phosphate, Reaction intermediates

T107 The effect of exogenous phytase on performance, dietary energy, mineral metabolism and endogenous losses when different protein sources are fed to chicks. V. Pirgozliev^{*1}, T. Acamovic¹, S. Sarwar¹, M. Allymehr^{1,2}, and M. R. Bedford³, ¹Scottish Agricultural College, ASRC, Edinburgh, United Kingdom, ²Urmia University, FVM, Urmia, Iran, ³Syngenta Animal Nutrition Inc., Marlborough, Wiltshire, United Kingdom.

An experiment (5*3 factorial) was designed to investigate the effects of different concentrations of an evolved E. coli derived phytase (Quantum, Syngenta Animal Nutrition) and three different protein sources on performance, dietary energy, N and mineral metabolism when fed to young chickens (from 7 to 21d of age). Four hundred and fifty male Ross 308 chicks were allocated in a randomised block design to one of the six replicate cages (5 birds per cage) and fifteen experimental diets (positive control (PC), negative control (NC), NC + 250, + 500, + 12500 FTU (phytase units/kg feed). The diets included rapeseed meal (RSM), soybean meal (SBM) or sunflower meal (SM) as the main protein source. Birds fed enzyme supplemented diets

had improved performance ($P < 0.05$) compared to those fed negative control diets. Chicks had higher feed intake, gain and gain:feed ratio ($P < 0.001$) when the protein source in the diet was either SBM or SM, compared to the RSE. Although phytase did not affect ($P > 0.05$) dietary metabolisable energy (ME) and dry matter digestibility (DMD), SBM supplemented diets had higher ME ($P = 0.042$), metabolisability of gross energy and DMD coefficients ($P < 0.001$) compared to the two other protein sources. Birds fed RSM had higher ($P < 0.001$) endogenous losses, measured as sialic acid. Birds fed RSM also had lower Ca, P ($P < 0.001$) and Mg ($P < 0.05$) metabolisability coefficients compared to SBM and AM. The lower coefficient ($P < 0.001$) of S metabolisability of RSM indicates that the S-containing amino acids were also less available compared to those from SBM and SM. The data from the present study suggests that the phytate in rapeseed may be less susceptible to phytase degradation compared to phytate in the other two sources and indicates that phytase supplementation of diets needs to be adjusted depending on the ingredients used in the diets.

Key Words: Phytase, Rapeseed solvent extract, Soybean, Sunflower, Chicks performance

T108 Assessment of the efficacy of quantum phytase and a fungal phytase on the performance of broilers fed a maize-based diet deficient in available phosphorus. T. C. Murphy* and M. R. Bedford, *Syngenta Animal Nutrition, Research Triangle Park, NC.*

A 42d pen trial consisting of 8 replicates of 30 male Ross broilers, randomly assigned to 1 of 9 dietary treatments, was conducted to study the effects of various levels of a bacterial phytase, Quantum™ 2500D (QP) on the performance of broilers compared to a constant level of a fungal phytase (FP). The treatments were: a corn/soybean meal positive control (PC) formulated to meet or exceed NRC requirements, a negative control (NC) with 0.12% and 0.16% less non-phytate phosphorus in the starter (0-21d) and finisher (21-42d) respectively, NC plus QP added at a rate of 125, 250, 500, 750, 1000 or 2000U/kg and NC plus FP added at a rate of 500U/kg. Gain, intake and FCR were analysed by ANOVA with mean separation using the LSD method at the 5% level. The reduction in dietary phosphorus significantly depressed gain and intake at both 21 and 42d but did not alter FCR. All doses of QP significantly improved gain at 21 and 42d. During the 0-21d period the 2000U/kg dose of QP was the only inclusion rate that was capable of increasing gain to levels not significantly different from the PC. By 42d birds fed diets supplemented with QP doses of 750U/kg and above had weight gains equivalent to that of the PC. The FP failed to show any positive effect on gain during either period, in fact it appeared to suppress gain from 0-21d. Supplementation of the NC with 250U/kg or above of QP increased intake. Whilst the lowest dose of QP was unable to offer any benefit upon addition to the NC in terms of intake, it still resulted in birds consuming significantly more than that observed for the 500U/kg of FP. No dose of QP restored intakes to that of the PC; however, since weight gain achieved parity at 750U/kg this meant that FCR was better for treatments having at least 750U/kg, relative to the PC. No difference was noted between 500U/kg of QP and the same dose of FP for FCR. This study further validates that QP, a bacterial derived phytase, can support performance when dietary phosphorus is limiting, in contrast to the FP source.

Key Words: Phytase, Quantum, Performance, Maize, Broiler

T109 Effects of dietary calcium and phytate on phosphorus retention and the optimal ratio of calcium to non phytate phosphorus in broiler diets. P. W. Plumstead*¹, A. B. Leytem², J. W. Spears³, R. O. Maguire⁴, P. Kwanyuen⁵, and J. Brake¹, ¹North Carolina State University, Raleigh, ²USDA-ARS, Kimberly, ID, ³North Carolina State University, Raleigh, ⁴Virginia Tech, Blacksburg, ⁵USDA-ARS, Raleigh, NC.

The effect of reduced dietary phytate phosphorus (P) from soybean meal (SBM) on the ratio of calcium (Ca) to non phytate P (NPP) required for optimal retention of phosphorus (P) was investigated. Ross 508 broiler chicks were reared in battery cages to 14 d of age and fed one of 12 experimental diets from 15 to 20 d. Excreta or ileal digesta were collected from 18-19 d and at 20 d of age, respectively, and apparent ileal digestibility coefficients and overall retention of Ca and P and excretion of Ca, P, and phytate P calculated. A 4 x 3 factorial treatment structure was used with 4 levels of dietary Ca from 0.47% to 1.16% and 3 levels of phytate P of 0.27%, 0.23%, and 0.10% that were obtained by including either High, Conventional, or Low phytate SBM in diets. Apparent prececal P digestibility decreased when dietary Ca was increased and was higher when diets contained Low phytate SBM. The percentage phytate disappearance from the distal ileum decreased at high inclusions of Ca but was not different between diets containing High or Low phytate SBM. Inclusion of Low phytate SBM reduced excreta P output by 42% and 62% compared to broilers that had been fed either conventional or High phytate SBM, respectively. The ratio of Ca:NPP that resulted in the highest P retention and lowest P excretion was 2.53:1, 2.40:1, and 2.34:1 for diets with 0.27%, 0.23%, and 0.10% phytate P. This suggested that while increased dietary Ca reduced the extent of phytate hydrolysis, the optimum Ca:NPP ratio at which P retention was maximized was not greatly altered when Low phytate SBM replaced High phytate or Conventional sources of SBM in broiler diets.

Key Words: Broiler, Phosphorus, Soybean meal, Phytate, Environment

T110 The requirement of Zn provided as organic Zn for broiler chicks fed corn-soy based diet with or without supplementation of phytase. T. Ao*, J. L. Pierce, A. J. Pescatore, A. H. Cantor, K. A. Dawson, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY.*

A study was conducted to investigate the requirement of Zn when provided as Bioplex Zn® (a chelated Zn proteinate) for broiler chicks fed a practical corn soybean meal diet (25 mg/kg Zn content) with or without supplementation of phytase. One-day-old male broiler chicks were housed in starter cages with plastic covered feeders in an environmentally controlled room for 3wk. Birds were given *ad libitum* access to feed and regular tap water with no detectable Zn (< 0.001 ppm). A 2 x 6 factorial treatment structure was used with two levels of phytase (0 or 500 U/kg) and six levels of Bioplex Zn® providing 0, 2, 4, 8, 16 and 32 mg Zn/kg. A total of 864 chicks was randomly assigned to each of twelve dietary treatments with six replicate cages of 12 chicks. Dietary inclusion of phytase increased ($P < 0.01$) the feed intake, weight gain, plasma Zn and tibia Zn content. Dietary supplementation of Bioplex Zn® linearly ($P < 0.01$) increased the feed intake, weight gain, plasma Zn concentration, liver Zn concentration and tibia Zn content. Significant interaction effects ($P < 0.05$) of phytase and Bioplex Zn® on the feed intake and weight

gain were found. When the supplemental level of Zn was below 8 mg/kg, the dietary inclusion of phytase increased ($P < 0.05$) feed intake and weight gain of the chicks. One slope, straight broken-line analysis of weight gain regressed on the supplemental Zn level provided as Bioplex Zn[®] indicated that 12 mg/kg supplemental Zn without phytase and 7.4 mg/kg supplemental Zn with phytase were required for the maximal weight gain of chicks.

Key Words: Chick, Zinc, Organic zinc, Phytase, Requirement

T111 Influence of betaine supplementation at different levels of dietary protein in diets on performance, blood composition and hepatic amino acid concentration in laying hens. K. S. Ryu* and J. H. Park, *Chonbuk National University, Chonju, South Korea.*

The effects of betaine intake on performance, internal egg quality, blood component and hepatic amino acid concentration were examined in laying hens fed diets at different levels of protein. A total of 540 Hy-Line Brown laying hens were allotted to six treatments with five replications for twenty four weeks. Treatments were factorially designed with three levels of CP (14, 16 and 18%) and two levels of betaine (0 and 600ppm). Egg production, egg mass and feed conversion improved as increase dietary protein level ($p < 0.05$), but different from betaine supplementation. Eggshell breaking strength, eggshell thickness and haugh unit were not influenced by either supplementary betaine or the level of protein. Serum albumin concentration was significantly elevated in 18% protein-fed groups compared to those fed on the other protein-fed groups ($p < 0.05$). Supplemental betaine did not affect serum total protein, albumin and BUN concentration, whereas uric acid concentration significantly increased in betaine supplemental groups ($p < 0.05$). Concentrations of hepatic amino acids were influenced by increased protein-fed groups and dietary betaine supplementation. These results suggest that betaine does not increase in laying hen's performance, but may affect protein metabolism by change in serum uric acid and hepatic amino acids.

Key Words: Betaine, Performance, Hepatic amino acid, Blood composition, Laying hens

T112 Versazyme additive improved growth performance, amino acid digestibility, and intestinal proteolytic activity in broiler chickens. H. Y. Wang^{1,3}, W. C. Huang¹, J. J. Wang², Y. M. Guo³, and J. C. H. Shih^{*1}, ¹*North Carolina State University, Raleigh,* ²*BioResource International, Morrisville, NC,* ³*China Agricultural University, Beijing, China.*

Effects of dietary supplementation of Versazyme, a keratinase based feed additive, on growth performance, ileal amino acid digestibility and intestinal proteolytic activity were studied in broiler chicks fed corn-soy diets for 3 wks from d 1 to d 21. A total of 144 male broiler chicks were randomized to 2 treatments with 9 replicate pens per treatment. Digesta samples from different gastrointestinal segments (crop, gizzard, duodenum, jejunum, ileum) were collected at d 12 and d 21. Keratinase identity was analyzed by immunoblot and total proteolytic activity based on substrates specific for trypsin, chymotrypsin and keratinase was determined respectively. The amino acid digestibility was determined amino acid analysis in the digesta

collected from the terminal ileum with celite as the undigested marker. Versazyme at 0.1% supplementation rate significantly improved average daily gain (ADG) (44.40 vs. 42.35 g, $P < 0.01$) and feed conversion ratio (FCR) (1.24 vs. 1.28, $P < 0.01$). It also significantly increased ileal amino acid digestibility. In addition, intestinal proteolytic activity was increased by 60% as measured by trypsin substrate (40 vs. 25 u/g protein) and by 66% as measured by the chymotrypsin substrate (5 vs. 3 u/g protein). The 60-66% increase of activity could be contributed by the additional keratinase activity in the Versazyme in feed and in the intestine, because keratinase is active on a wide range of substrates including the trypsin- and chymotrypsin-specific substrates. The results of this study confirmed that dietary supplementation of Versazyme improved the growth of broiler chicks. Its beneficial effect is believed to be due to the improved protein digestibility as evidenced by the increased amino acid digestibility, proteolytic activity and the presence of keratinase in the intestine.

Key Words: Versazyme, Keratinase, Ileal amino acid digestibility, Proteolytic Activity, Immunoblot

T113 Efficacy of dietary clay adsorbents for broiler chicks fed aflatoxin (AFB1). R. B. Shirley*, F. A. Uraizee, C. D. Knight, and J. J. Dibner, *Novus International, Inc., St. Louis, MO.*

The objective of this study was to determine the efficacy of the adsorbents SOLIST[™]-Base (SB) and MTB-100[®] (MTB) in ameliorating the toxic effects of aflatoxin (AFB1) in broiler chicks. Two hundred seventy five day-old male broiler chicks were assigned to one of eleven treatments (5 chicks/pen; 5 pens/treatment): 1) Control (no binder or AFB1); 2) 1 ppm AFB1; 3) 2 ppm AFB1; 4) 1 ppm AFB1 + 0.1% SB; 5) 1 ppm AFB1 + 0.2% SB; 6) 1 ppm AFB1 + 0.1% MTB; 7) 1 ppm AFB1 + 0.2% MTB; 8) 2 ppm AFB1 + 0.1% SB; 9) 2 ppm AFB1 + 0.2% SB; 10) 2 ppm AFB1 + 0.1% MTB; 11) 2 ppm AFB1 + 0.2% MTB. Body weight gain (BWG, \pm sd) was reduced from 817 \pm 26 to 732 \pm 93 and 642 \pm 92 g/chick, feed intake (FI, \pm sd) was reduced from 1,045 \pm 62 to 919 \pm 100 and 753 \pm 116 g/chick, and liver weight also increased from 2.71 \pm 0.21 to 3.20 \pm 0.36 and 4.45 \pm 0.81 g/100 g BW with the addition of 0, 1 and 2 ppm AFB1, respectively ($p \leq 0.0001$). Marked differences in the response of broilers to SB and MTB were apparent at the two levels of aflatoxin, as there was an interaction between binder type and AFB1 level. Though there was no difference in the average BWG among broilers consuming 0.1 and 0.2% SB or MTB at 1 ppm AFB1, there was an improvement in the average BWG of broilers consuming 0.1 and 0.2% SB at 2 ppm AFB1 ($p \leq 0.05$). A similar interaction was also observed for average liver weight of broilers for the two binders at the two AFB1 concentrations ($p \leq 0.02$). Increasing levels of AFB1 depressed plasma albumin, protein, calcium, phosphorus, and alkaline phosphatase ($p \leq 0.01$). Despite the use of SB and MTB, only a numerical improvement in the concentration for many of the latter biomarkers was noted. In the present study, these data indicate that SB is more efficacious than MTB in mitigating the negative effects of high dietary AFB1.

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[®]MTB-100 is a registered trademark of Alltech[®]

Key Words: Aflatoxin, Adsorbent, Broiler Chick, SOLIST[™]-Base, MTB-100[®]

T114 Impact of ochratoxin A and deoxynivalenol on selected immune parameters in broiler chicken and possible counteracting.

V. Starkl*¹ and H. Sarandan², ¹*Biomim GmbH, Herzogenburg, Austria*, ²*Faculty of Veterinary Medicine, Timisoara, Romania*.

This trial was performed to evaluate the impact of a combination of 500ppb ochratoxin A and 1000ppb deoxynivalenol on selected immune parameters and the effect of Mycofix[®] Plus counteracting immune suppression via enzymes and specific immune supportive substances.

216 day old chickens (males and females) were randomly chosen and divided into 4 treatments. Birds in treatment 1 (T1) were fed a mycotoxin free diet. Treatment 2 (T2) consisted of a diet contaminated with 500ppb ochratoxin A and 1000ppb deoxynivalenol. Diet of treatment 3 (T3) was equally contaminated as T2 but additionally treated with 1 kg of Mycofix[®] Plus. Treatment 4 (T4) only contained 1 kg of Mycofix[®] Plus. After 42 days blood samples were taken from 3 males and 3 females per treatment for hematological and immunological examination. Levels of lysozyme and properdin were selected as humoral factors. Levels of neutrophils, monocytes and eosinophils as well as the activity of macrophages as phagocytic index represent the cellular factors. Properdin and lysozyme concentration in blood serum and the phagocytic index can be characterized as indicators for the level of natural immunological reactivity. Levels of lysozyme were significantly lower in T2 in both females and males compared to T1 and T4. In females the use of 1,0 kg of Mycofix[®] Plus (T3) brought the levels back to normal. Properdin levels in T2 are significantly lower than those of treatments 1, 3 and 4, both for females and males. Natural cellular defense expressed, as phagocytic index was significantly lower in T2 compared to the other treatments 1, 3 and 4. Additionally, levels in T4 (sole product) were significantly higher than in the control T1, indicating the capacity of the product to stimulate the activity of macrophages. Levels of hematological parameters were inconclusive.

As a conclusion it can be stated that the selected contamination had a significant impact on levels of lysozyme, properdin and phagocytic index which was overcome by the inclusion of Mycofix[®] Plus.

Key Words: Ochratoxin A, Deoxynivalenol, Immune systeme, Broiler, Deactivation

T115 High *in vivo* mycotoxin binding efficacy of anti-caking aid restores immune function and improves broiler performance.

V. J. H. Sewalt, A. Lamptey, P. Maheswari, S. Wilson*, and C. N. Ramchand, *Kemin Industries, Inc., Des Moines, IA*.

A 35-day dose response performance trial was conducted to evaluate the impact of graded levels (1, 2, 3, and 4 kg/ton) of TXN-86[™] brand Dry Anti-Caking Aid (Kemin AgriFoods North America, Inc.) on weight gain and feed conversion of VenCobb broiler birds fed a corn-soy-fishmeal diet containing a mycotoxin cocktail consisting of aflatoxin, ochratoxin, citrinin, and T-2 toxin. Weight gain and feed conversion were negatively impacted by the exposure to mycotoxins ($P \leq 0.001$). Addition of TXN-86 reversed ($P \leq 0.001$) the negative effects of mycotoxins in a linear dose response, returning performance to

levels achieved by birds in the positive control group (no toxin) with the 3-4 kg/ton application rates.

Relative organ weight was increased by ingestion of mycotoxin, which, again, was overcome with the inclusion of the Anti-Caking Aid TXN-86 ($P \leq 0.001$). While no discernible relationship was evident for mycotoxins and serum biochemistry parameters, NCD virus-specific immune response depression in birds receiving mycotoxins was reduced with increasing doses of TXN-86, with birds receiving the highest dose having HI titer values equivalent to those of positive control birds ($P \leq 0.001$). Fecal excretion data indicated increased excretion of all toxins in birds receiving increasing doses of TXN-86 ($P \leq 0.001$) in a linear or quadratic manner, along with highly positive correlations between the amounts of mycotoxin excreted and weight gain. Hence, the improved performance and immune response closely reflects the *in vivo* mycotoxin binding capacity of TXN-86 Anti-Caking Aid and also validates the *in vitro* assay results previously presented at this forum.

Key Words: TXN-86, Mycotoxins, Toxin binder, Performance, Excretion

T116 Preliminary assessments of flo-bond as toxins inhibitor and preservative in animal feeds.

A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology, Ibadan, Nigeria*.

Mycotoxins and other forms of anti-nutritional factors are major limitations in the production of quality animal feeds in the humid tropics of the world, Nigeria inclusive.

Four different poultry feed of 1kg each was used for the investigations; the samples of the feeds were commercially purchased from four different feed mills in and around Ibadan, Oyo State, Nigeria. The samples were properly prepared and labeled A to H with each part containing 250g. 0.025g of Flo-bond powder was added to categories A, B, C and D that served as treatment samples, while categories E, F, G and H served as control samples (without Flo-bond). The feed samples were sealed in cellophane bags and then observed for the period of 3 weeks as ripening period.

Microbial analysis was conducted and monitored over the ripening period, on the different feed categories to determine the bacteria as well as fungal counts of the samples. Sample F had the highest bacterial count; while C had the least bacteria count. For the fungal count, sample A had the highest, while samples C, E and H recorded no fungal count.

There was no significant difference in fungal count ($P > 0.05$) but a significant difference in bacteria count ($P < 0.05$). Those samples with Flo-Bond had growth of fungi which capable of producing toxins, unlike those that are without Flo-bond powder. Thus, Flo-bond can be regarded as an effective feed preservative as well as toxin binder in animal feeds. A further study on the actual utilization of Flo-bond in on farm trial is hereby recommended.

Key Words: Mycotoxins, Feeds, Flo-bond, Bacteria, Fungus

Tuesday, January 23, 2007
Environment and Management IV
Room: B314

T117 Laboratory evaluation of advance bio-pro concentrate (ABPC) in odor and ammonia reduction in poultry droppings. A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology, Ibadan, Nigeria.*

Poultry odor and emission of ammonia is a major problem in the industry in Nigeria. As a result of this many poultry farms are being forced to stop operation due to urbanization of their locations.

The investigation was conducted to evaluate the efficacy of Advance Bio Pro Concentrate in controlling poultry odor. The experiment consists of treatment and a control sample in triplicate. Poultry droppings already generating odor were collected from the poultry farm of the College. Equal amount of poultry manure was evenly spread out into different transparent rectangular basins, improvising the dip vat under battery cage system of production.

The solution of Advance Bio-Pro Concentrate (ABPC) was prepared with dilution rate of its one part to nine (9) parts of non-chlorinated water. Hence, the diluted mixture of the ABPC was applied by spraying on the surface area of the manure in the basin via a thoroughly cleaned small flitting cylinder. The other basins with the control were not treated.

Visual and smell evaluation was conducted on the treated and the untreated samples for odor reduction at 30 minutes, 12, 24, 48 and 72hrs respectively. Finally, samples of the treated and untreated were analyzed for ammonia phosphates and chemical oxygen demand content (COD).

Initial observation (visuals and smell panel evaluation) indicated a significant reduction in odor reduction from the treated than the untreated within 30 minutes of application. After about 3hours of application, there was sharp reduction in odor formation and further laboratory analysis revealed a mean value of 52.8% reduction in ammonia and 47.6% reduction in oxygen content of the treated samples compared to the untreated samples measuring up to 93.8% and 96.9% for ammonia and oxygen respectively. Another significant observation was gradual drying of the droppings and drastic reduction in maggots production.

These encouraging results indicate the relevance of ABPC in ensuring biosecurity, odor and ammonia control; and waste management in the livestock industry

Key Words: Poultry, Odor, ABPC, Ammonia, COD

T118 Initial laboratory evaluation of SEPTROL SA 102 in digestion of human and poultry waste (Sewage). A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology, Ibadan, Nigeria.*

Sewage systems in Nigeria are not well developed for the ease of managing effectively human waste and other forms of wastes. Sewage lines are prone to blockage due to non-availability of digesting agent to degrade, digest and reduce odor formation from sewage collection systems.

Preliminary laboratory investigations were conducted to assess the effectiveness and efficiency of Septrol SA 102, in the degradation and odor/ smell reduction of sewage samples collected from pit latrine and dropping from a deep litter poultry system. Two treatment samples were set up in duplicates containing the same amount of waste samples, to one treatment; 0.22g of the septrol was administered according to the directives of the manufacturer. The treated and untreated samples were subjected to the same environmental conditions in the laboratory, and were left for 72hours for the initial inoculations to take place. After the expiration of the ripening period, the following observations were measured; rate of decomposition, odor reduction, intensity of color and volume reduction of the experimental samples. The results from the treated samples clearly showed that inclusion of Septrol reduced the volume, degraded the waste to watery substance, to almost clear solution. Also the odor was significantly reduced compared to the untreated wastes that continue to degenerate and producing maggots. The color of the waste changed from the initial dark brown to almost clear solution. From this initial evaluation, it was observed that Septrol is very effective in managing human and animal waste (sewage) in terms of digestion and odor control, most especially in pit latrine and soak away pits. With the instruction of monthly applications, Septrol is therefore recommended for sewage digestion and odor reduction.

Key Words: Septrol, Sewage, Odor control, Digestion

T119 Evaluation of poultry litter treatment (PLT) at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University, Auburn, AL.*

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 X 2.44 X 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter treatment and PLT at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft² of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump.

The 49-d bodyweight for the 150lb PLT treatment group was greatest as compared to other treatments. Litter pH was significantly lower ($P < 0.05$) for PLT treated pens as compared to CON (6.35 vs. 2.35). However by day 49 there were no differences in pH due to treatment. Results indicated that by day 35 detectable levels of ammonia could be measured and significantly lower ($P < 0.05$) ammonia levels were encountered on days 35 (c.a. 50% lower) and 42 (c.a. 46% lower) for the PLT treatments, but any influence imposed by PLT disappeared by day 49 ($P > 0.05$). Results from pH and ammonia measurements indicate that PLT remained effective on clean shavings through day 42. Litter sample analysis did not indicate an increase in the amount of nitrogen retained due to treatment. Litter moisture increased from a low of 8.9% initially to 24.4% by day 49 with no differences between treatments.

Key Words: Poultry litter treatment, PLT, Ammonia, Broiler

T120 Evaluation of aluminum sulfate (Alum) at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University, Auburn, AL.*

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 X 2.44 X 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatment comprised a control (CON) with no litter treatment and ALUM at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft² of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump.

No differences ($P > 0.05$) in growth performance were observed during the experimental period. Litter pH was variable among treatments where the highest level of ALUM maintained a significantly lower ($P < 0.05$) pH through day 42 (9.23 vs. 9.68 for CON), while other levels of ALUM were intermediate or similar to CON. By day 49 there were no differences in pH due to treatment. By day 28 detectable levels of ammonia could be measured and significantly lower ($P < 0.05$) ammonia levels were encountered on day 28 (c.a. 35% lower) and 35 (c.a. 59% lower for 100 and 150 lb application) for the ALUM treatments, but any effect due to ALUM treatment dissipated by day 42 ($P > 0.05$). Results from pH and ammonia measurements indicate that ALUM retained its effectiveness on clean shavings through day 35. Litter sample analysis did not indicate an increase in the amount of nitrogen retained due to treatment. Litter moisture increased from a low of 8.9% to 32.4% by day 49 with no differences between treatments.

Key Words: Aluminum sulfate, Alum, Ammonia, Broiler

T121 Evaluation of ferric sulfate for ammonia control in commercial broiler production. C. W. Ritz*¹, L. A. Harper¹, B. D. Fairchild¹, M. Czarick, III¹, and J. Pavlicek², ¹*The University of Georgia, Athens*, ²*Kemiron, Inc.*

In-house air quality is a major concern in poultry production. Growers spend much of their time and investment in maintaining good air quality to maximize poultry growth and performance. Previous work has correlated negative bird performance with poor indoor air quality due to ammonia (NH₃). Ventilation has been the key means of removing NH₃ from poultry houses but the use of litter treatment products that lower pH are also commonly applied. Acid-based litter treatments, though effective for short-term NH₃ reduction, may not be viable for long-term ammonia control due to the amount of product required to chemically bind NH₃, problems of application when birds are present, and the corrosiveness of the material. New products are needed that can address these issues. The purpose of this study was to evaluate the effectiveness of a new litter amendment containing ferric sulfate compared to an alum-based litter amendment. Since alum is commonly used within the broiler industry and at the request of the participating poultry company, in this study alum was used as the Control and the ferric sulfate product as the Treatment. Both Treatment and Control were applied at the same time and at the same rate of 100 lbs per 1000 ft². Litter moisture, pH, mineral content, and soluble salts were recorded throughout the study. Ammonia was measured using time weighted detection tubes and gas-washing bottles. The ferric sulfate amendment was, on average, superior to the control in reducing NH₃ concentrations during the first 15 days after bird placement with mean NH₃ concentrations for the ferric sulfate and alum at 13-19 ppm and 21-26 ppm, respectively. No significant differences were noted in mortality, body weight or feed efficiency. The ferric sulfate product is applicator-friendly with noticeably reduced dust generation upon product application and improved retention of nitrogen in the litter.

Key Words: Ferric sulfate, Ammonia, Broiler, Alum

T122 Reduced ammonia emission diets: Implementation costs and production effects. E. C. Hale III*, *EcoCal Products, LLC, Brownstown, IN.*

The effect of a manure ammonia emission reducing diet on egg production and costs at a commercial egg production facility was determined.

A total of 6 hen houses comprised the trial group. Each house had an initial population of 125,000 hens, for a total population of 750,000 hens. The houses were separated into 3 pairs, matching hen age and production status as closely as possible within each pair of houses; however, exact age/production matches were not achieved.

Each house was fed an industry standard diet appropriate to the age and production status of the hens. Production factors, feed costs, and production costs were monitored for 9 weeks prior to introducing the test diet. This data was used to determine the innate differences in feed cost/ton, total egg production, mortality, feed consumption, egg grade, and per-dozen production costs between paired houses. The averaged difference for each parameter was used to correct observed data skewing caused by differences in hen age and production status between paired houses.

Once background performance data was collected, a test diet containing 1.0% clinoptilolite zeolite and 2.5% gypsum by weight was introduced to one house selected from each pair. Production factors and costs were monitored for a total of 14 weeks after introduction of the test diet.

Data from each pair of houses was handled separately from each other pair of houses for the purposes of determining production differences caused by the test diet and its effect on production costs. Once the average differences were determined for each of the 3 pairs, the average differences in production and costs across the 3 pairs were determined.

For the entire population in the study, averaged comparative data indicates that the test diet achieved a 5.9% improvement in total egg production, a 34.6% reduction in mortality, an increase of 3.0% in feed cost/ton, an increase of 3.5% in feed consumed/week, a reduction of 24.7% in undergrade eggs, and an increase of 5.3% in Grade A large + eggs. The comparative difference in the cost to produce one dozen eggs was -3.3%.

Key Words: Dietary manipulation, Production effects, Implementation costs, Ammonia emissions, Hen performance

T123 Efficacy of Elector® PSP (spinosad) for the control of the lesser mealworm (*Alphitobius diaperinus* Panzer) in heavy broilers. S. M. Stringham*¹, D. W. Watson¹, S. Denning¹, K. A. Baker², and G. Balme¹, ¹North Carolina State University, Raleigh, ²Elanco Animal Health, Greenfield, IN.

The study evaluated the efficacy of Elector® PSP (spinosad) at two rates applied as banded or broadcast sprays against a broadcast application of Tempo® 1% Dust (cyfluthrin) and an untreated control. Production houses at two farms were randomly assigned as treatments and sampled through two nine-week flock cycles. All treatments were applied within a week of bird removal, immediately after cake-out and routine cleaning. A 0.08% spinosad spray was applied as a banded treatment under feeders, drinkers and along walls. Spinosad treatments (0.16%) were banded as described or applied as a broadcast treatment over the entire floor. Cyfluthrin dust treatments consisted of a single broadcast application at label rates using a power duster. Fifty gallons of water was applied as broadcast spray to control houses. Experimental houses were sampled using modified tube traps placed at twenty locations distributed between wall, feeder and center floor locations within the front three quarters of the houses. Traps were left in place for one week during each sampling period. Pre-treatment samples were taken one week prior to removal of the preceding flock. Subsequent samples were taken at weekly intervals for five weeks following treatment, and again at 7 weeks after treatment. Results demonstrated that, for the most part, spinosad sprays effectively suppressed larval numbers, often by a significant margin over cyfluthrin in comparisons with control houses. Cyfluthrin was more effective against beetle adults at the outset of the trial but was no more effective than spinosad beyond three weeks post treatment.

The study demonstrates that spinosyns are an effective class of insecticides for lesser mealworm control in broiler and other poultry production. It is a welcome addition to the limited array of insecticides currently available. As such, spinosad adds greater flexibility to the

insecticide rotations now necessary to manage resistance in lesser mealworms.

Key Words: Spinosad, *Alphitobius diaperinus*, Lesser mealworm, Resistance management, Broilers

T124 Management strategies for utilizing hardwood sawdust as a poultry bedding. G. Malone*¹, S. Collier¹, and D. Rider², ¹University of Delaware, Georgetown, ²Department of Natural Resources, Annapolis, MD.

Many concentrated poultry-producing areas of the USA including the Delmarva Peninsula have shortages of quality pine-base bedding materials. Yet, there are often ample supplies of cost-effective hardwood sawdust (HW) that could supplement this deficit. However, the poultry industry has been reluctant to use HW due to periodic mold-induced respiratory health concerns. A demonstration was implemented to evaluate management strategies for utilizing HW as poultry bedding. On a commercial farm growing roaster chickens; loblolly pine (LP), yellow poplar (YP) and white oak sawdust (WO) were each placed in 2 houses. For each bedding type, 1 house received fresh-cut sawdust (SD) directly from sawmills or SD that had been held in storage for 3 months. One half of each house also received a peracetic acid-base mold inhibitor prior to chick placement. The average moisture content of SD for all species at placement in Flock 1 was 31%. Moisture content of SD obtained directly from sawmills was higher (40%) compared to SD held in storage for 3 months (23%). While in storage the temperature of the SD averaged 137 F. Storage and the use of the mold inhibitor had little influence on bedding mold populations. However, there was a two-log reduction in mold populations in Flock 2 compared to Flock 1, and a one-log reduction in LP compared to the HW species. Two-week mortalities were less in Flock 2 for all bedding types. Based on the weight and content of the gizzards there were indications chick prefer consuming the WO. In Flock 1 the incidence of foot pad dermatitis was less with fresh compared to stored bedding and less with YP compared to the other bedding types for both flocks. Based on the physical, chemical and biological observations in this field demonstration, the data is suggestive that YP may be a viable alternative to LP in regions having a bedding shortage. Under conditions of this demonstration, using a mold inhibitor or placing bedding materials in storage had no distinct advantage.

Key Words: Hardwood bedding, Litter, Poultry

T125 The impact of litter type, depth and management on broiler foot pad lesions: Welfare and economic considerations. A. Atencio* and K. Opengart, *Keystone Foods LLC, Huntsville, AL.*

Each of sixteen houses on a commercial broiler farm was populated with 22,500 one-day-old Ross x Hubbard Ultra-Yield chicks. The farm was divided into 4, four house units with each house within a replicate having a different litter treatment: 1) one load of peanut hulls, 2) two loads of peanut hulls, 3) one load of pine shavings, or 3) one-half load of pine shavings on top of peanut hulls built-up litter. Birds were randomly placed and were grown using identical management and feed formulation. Foot pad lesions were scored using a scale of 0-2 (0 = no lesion, 1 = mild lesion, 2 = severe lesion) at 43 and 50 days of

age by examining the left and right foot pads of 100 birds per house at each age. At processing, foot pads from 66,080 fifty-six day old birds (19% of each house) were scored using a + or - scale to indicate the presence or absence of lesions, respectively. A highly significant treatment effect was observed. Chicks raised on pine shavings had a lower incidence and less severe paw lesions than chicks raised on peanut hulls. Lesion incidence scored in the house was 12.9^a ; 8.4^a ; 4.9^b and 0.9^c and at the processing plant was 9.7^a, 10.1^a, 1.96^b and 1.22^b % for the birds raised on one load of peanut hulls, two loads of peanut hulls, one load of pine shavings, or a half load of pine shavings on top of built up litter, respectively (means were compared using the Student-Newman-Keuls test at 5% probability). It appears that a combination of litter depth and litter source may impact incidence and severity of paw lesions. Improving paw quality has significant welfare and economic implications.

Key Words: Paw lesion, Foot pad pododermatitis, Bedding type, Animal welfare

T126 Heat recovery system: Attic ventilation. B. D. Lott*¹ and J. L. Purswell², ¹Mississippi State University, Mississippi State, ²USDA, Mississippi State, MS.

Fuel cost has increased to dramatic levels for the poultry farmer. In an attempt to help alleviate some of the burden of increased fuel cost, a system was developed to take advantage of attic heat. With the attic ventilation system, an additional set of ventilation boxes are installed in the middle of the house to pull air out of the attic. On sunny days, the temperature may range from 5° to 20° C higher in the attic than outside temperatures. In summer when the temperatures are hot, the inside temperature of the house can be increased to over 50° C without any fossil fuel usage. A vent box system in the center of the ceiling, independent of the sidewall vent boxes, was installed. Minimum ventilation was used to ventilate the brood area with attic air, rather than outside air.

The system was developed to assist normal brooder operations and reduce the brooder runtime by using the preheated air in the attic. On a sunny day, the system can save as much as 20 percent on fuel cost.

Key Words: Broiler, Attic ventilation, Fuel cost

T127 Why understanding bioethical issues is important. R. D. Reynnells*¹, C. C. Croney², and D. J. R. Cherney³, ¹US Department of Agriculture, Cooperative State, Research and Extension Service, Washington, DC, ²Oregon State University, Corvallis, ³Cornell University, Ithaca, NY.

Organizations are changed by decision makers' understanding of issues, organizational requirements and goals, and available options. Agricultural systems are no different. Decision makers may be consumers who make purchasing decisions (thus driving market demands), voters, government officials, animal producers, or company executives.

Historically, cheap food demand has been a major change agent for agriculture, as has the desire of farmers to avoid dangerous, repetitive, dirty tasks. Change has often been straight forward in the form of mechanization, consolidation of production (e.g., feed mills serve many farms), vertical integration, or use of chemicals to control diseases or insects. Today, it is increasingly difficult, and yet imperative, to balance ethical considerations with economic and pragmatic factors relative to animal agriculture. This balance is complicated by a perception that some production changes may not be truly market driven but imposed by persons apparently attempting de facto management of producer's resources.

New standards for change are not restricted to questions about how to efficiently raise food animals. Rather, they include concepts of refinement, reduction, and replacement of certain animal management and care practices, and considerations of whether or not we should use animals for food. Should science alone be the basis of our management and regulatory decisions, or should bio-ethical considerations be used in framing housing, genetics, management and disease control decisions? Should a personal or organizational vision of ethical behavior reflecting specific religious or cultural values not held by all members of society be imposed on others or should changes in agriculture come through market demand? What if consumer demand does not reflect an informed or pragmatic decision regarding animal health or welfare? Bioethics increasingly influences decisions by consumers, voters, and regulatory officials. Bioethical concepts should therefore be understood by everyone involved in agriculture in order to properly address the issues presented to society and to inform decisions made in daily practice.

Key Words: Animal welfare, Bioethics, Cheap food, Management, Standards

T128 Share poultry images with others through the animal science image gallery. J. B. Hess* and W. D. Berry, Auburn University, Auburn, AL.

As the number of faculty dedicated to teaching poultry science in the U.S. continues to decline, the need for poultry-related teaching aids for those with limited access to the poultry industry increases. The Animal Science Image Gallery was created to provide images to middle school, high school and university teachers wishing to include information on animal agriculture in their courses. With the dwindling expertise in poultry at the university level, a reference site of poultry and/or poultry industry images would be a useful teaching tool nationally. The Animal Science Image Gallery was designed to fill this role. Each image on the site comes with a limited description, making it possible for educators to collect images that fit with the portion of the industry that is being discussed. Editors review each image and the corresponding text for accuracy.

Categories exist for most types of agricultural animals, including poultry. Within the poultry site, subcategories include; anatomy and physiology, disease and pathology, housing and equipment, poultry processing and poultry species and breeds. To date, the poultry site does not have a wide range of images available to offer coverage of the many types of poultry operations in the U.S. Please consider uploading images to the site commensurate with your area of expertise. Access

the Animal Science Image Gallery at http://cygnet.richmond.edu/image_gallery to browse or upload images. Contributing to the Image Gallery will ensure that high school and university instructors will have quality poultry science materials to draw from in organizing lectures on poultry science and the poultry industry.

Key Words: Images, Poultry, Pictures

T129 Development of macrolide resistant *Campylobacter* in broilers administered subtherapeutic or therapeutic levels of tylosin. S. R. Ladely*¹, M. A. Harrison², P. J. Fedorka-Cray¹, M. E. Berrang¹, M. D. Englen¹, and R. J. Meinersmann¹, ¹USDA-ARS-Russell Research Center, Athens, GA, ²UGA-Food Science and Technology, Athens, GA.

The use of antimicrobials in food animal production, particularly those commonly used to treat infections in humans, has become a source of controversy in recent years. However, limited data are available regarding the development of resistance from subtherapeutic or therapeutic administration of antimicrobials in animal production. The objective of this study was to evaluate the effect of FDA approved levels of tylosin administration on susceptibility of *Campylobacter jejuni* and *C. coli* isolated from ceca of treated broilers. In each of three replicate studies, day-of-hatch chicks were exposed to macrolide susceptible *C. jejuni* or *C. coli*. At two weeks of age, tylosin was administered at subtherapeutic (22 ppm, continuously in the diet) or therapeutic levels (529 ppm in drinking water for 5 days). Weekly, 5 broilers per group were sacrificed. Total and resistant *Campylobacter* were enumerated from individual ceca with contents. Macrolide resistance was observed at a higher frequency ($P < 0.01$) among *C. coli* isolates 70.8% (17/24) compared to *C. jejuni* isolates 36.8% (35/95). Resistance was observed at a significantly higher frequency ($P < 0.001$) when tylosin was administered at subtherapeutic levels (62.7%, 47/75), compared to administration of therapeutic levels (11.4%, 5/44). Subtherapeutic administration resulted in recovery of 83.3% (15/18) and 56.1% (32/57) macrolide resistant isolates compared to only 33.3% (2/6) and 7.9% (3/38) of the isolates expressing macrolide resistance following administration of therapeutic levels, for *C. coli* and *C. jejuni*, respectively. Further studies are needed to determine the factors involved in the apparent difference in the acquisition of macrolide resistance in *C. coli* compared to *C. jejuni*.

Key Words: Tylosin, Macrolide resistance, *Campylobacter*

T130 Effect of a pelleted experimental chlorate product (ECP) on *Salmonella* in the ceca of market-age broilers. J. A. Byrd*, J. L. McReynolds, L. F. Kubena, and D. J. Nisbet, USDA-ARS-Food and Feed Safety Research Unit, College Station, TX.

Previously, our laboratory demonstrated that ECP can be administered in drinking water to reduce *Salmonella*, *E. coli*, and *Clostridium* in bovine, porcine and poultry. The objective of this study was to evaluate the effectiveness of a feed grade pelleted ECP and to determine if nitrate pre-adaptation will increase the bactericidal activity of ECP to control *Salmonella* Typhimurium (ST) in market-age broilers. In three trials, at 6 wk-of-age, one hundred and forty broilers were randomly assigned to seven groups of twenty birds and placed in floor pens containing pine litter. Two days prior to slaughter, broilers in group 1

were fed a control finisher diet, groups 2 and 3 were fed either a 1.0% ECP-carrier or salt control, and groups 4 and 5 were provided either 1% or 5% ECP. Groups six and seven were fed a pelleted sodium nitrate diet 4 d prior to termination and then changed to either a 1% or 5% pelleted ECP diet two days prior to termination of the experiment. Prior to placement, each bird was orally challenged with 10^9 ST. Cecal contents were aseptically collected and spread on XLT4 plates to enumerate ST, respectively. Litter was collected from each group to determine moisture content. In the groups fed the salt control diet and 5.0% ECP diets, litter moisture was significantly increased when compared to all other treatments. Mortality was not significant. Pre-nitrate adaptation-5% ECP ($0.92 \log_{10}$ cfu ST) significantly reduced the number of ST recovered from the ceca when compared to the control fed broilers ($1.87 \log_{10}$ cfu ST). These results indicate that pelleted ECP feed prior to slaughter can effectively reduce ST in broilers, and may potentially reduce the risk of contaminating poultry products.

Key Words: Broilers, Experimental chlorate product, *Salmonella typhimurium*, Sodium nitrate

T131 Temperature and oxygen conditions during the plateau stage of incubation affect long bone development in broilers and turkeys. E. O. Oviedo-Rondón*, J. Small, M. J. Wineland, V. L. Christensen, D. T. Ort, K. M. Mann, and S. L. Funderburk, North Carolina State University, Raleigh.

Previous research suggested that several organs and bone development at hatch could be altered by high temperatures (T) during the plateau stage of incubation. Trials were designed to evaluate the effects of oxygen (O_2) concentrations and the interactions between O_2 and T on bone development in both CH and turkeys (TU). Two strains of CH with low (LG) and high (HG) eggshell conductance, and one TU strain of LG were used. The first 2 trials O_2 concentrations (17, 19, 21 or 23%) were evaluated. The CH trial was analyzed as a 2x2 factorial design with O_2 concentrations and genetic strain as main effects. The TU trials data was analyzed as a completely randomized design. In the subsequent 2 trials, T (36 and 39 °C) and O_2 concentrations (17 and 23%) were evaluated in a 2x2 factorial design. At day of hatch, 15 CH or poult per strain were selected, both legs were dissected, parts weighed and relative asymmetry (RA) of each leg section calculated. The LG CH strain had heavier ($P < 0.01$) body, legs, muscles and bone weights in both trials. CH at the lowest O_2 concentrations had ($P < 0.05$) lighter and shorter tibias, lighter shanks, and increased RA of femur length compared to CH in the 23% O_2 . Poult body and part weights were not affected ($P > 0.05$) by O_2 concentrations, but poult at 23% O_2 had larger shanks and heavier tibias than TU at 17% O_2 . High T depressed BW of LG CH, but no significant effect of treatments was observed on BW of HG CH. Nevertheless, in the HG CH, high T caused lighter ($P < 0.01$) thighs and shanks; both high T and low O_2 independently caused ($P < 0.001$) shorter shanks and lighter drums. Low O_2 reduced femur and tibia weight, length, and increased RA of drums. In the LG CH, high T decreased ($P < 0.001$) shank weight and thickness; low O_2 caused shorter shanks, and both low O_2 and high T together increased ($P < 0.05$) RA in shank weight. In trial 4 with TU, high T depressed ($P < 0.01$) BW, leg muscle weights, and shank length. Low O_2 reduced ($P < 0.05$) tibia and shank %. Incubation conditions affect long bone development in CH and TU and may have an impact in leg health.

Key Words: Broilers, Turkeys, Incubation, Bone development, Leg health

Tuesday, January 23, 2007
Nutrition IV
Room: B315

T132 Meta Analysis of dietary amino acid responses of broiler chickens. W. A. Dozier, III^{*1}, M. T. Kidd², and A. Corzo², ¹USDA-ARS Poultry Research Unit, Mississippi State, MS, ²Mississippi State University, Mississippi State.

Defining the optimal balance of critical amino acids for diet formulation is of utmost importance to practicing nutritionists. This study summarized six peer-reviewed manuscripts that evaluated dietary amino acid density regimens that were published during 2003 to 2006 from USDA-ARS or Mississippi State University. Diets providing optimal growth responses during starter, grower, finisher, and withdrawal periods from the six manuscripts were used. Regression analyses were conducted with respect to bird age to generate prediction equations for dietary amino acid percentages, daily amino acid consumption, and daily amino acid consumption per unit of BW gain. Actual analysis of amino acids was used instead of calculated values. Regression equations for dietary Lys percentage, Lys consumption (mg/d), and daily Lys consumption per unit of BW gain (mg/g/d) had R² values of 0.93, 0.99, and 0.90, respectively. Predicted dietary Lys percentages were 1.36, 1.26, 1.19, 1.12, 1.06, 1.01, and 0.97 and dietary Lys consumption (mg/d) was 464, 861, 1,195, 1,466, 1,675, 1,821, and 1,904 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. The R² values for dietary TSAA percentages, TSAA consumption (mg/d), and daily TSAA consumption per unit of BW gain (mg/g/d) were 0.86, 0.99, and 0.93, respectively. Predicted dietary TSAA percentages were 0.94, 0.90, 0.85, 0.81, 0.77, 0.74, and 0.70 and dietary TSAA consumption (mg/d) was 324, 623, 873, 1,074, 1,228, 1,333, and 1,390 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. Dietary Thr percentage, Thr consumption (mg/d), and daily Thr consumption per unit of BW gain (mg/g/d) had R² values for 0.86, 0.99, and 0.92. Predicted dietary Thr percentages were 0.84, 0.81, 0.77, 0.74, 0.71, 0.69, and 0.67 and dietary Thr consumption (mg/d) was 290, 555, 779, 962, 1,104, 1,207, and 1,268 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. These results provide dietary amino acid estimates for formulating diets throughout a 7 wk production period; however, these values are based upon dietary amino acid density research and not on minimum requirements.

Key Words: Amino acid, Broiler, Lysine, Methionine, Threonine

T133 Practical dietary L-threonine inclusion and resultant impact on broiler growth, yield, and nitrogen excretion. M. T. Kidd^{*1}, A. Corzo¹, W. A. Dozier, III², C. D. Coufal¹, B. J. Kerr³, and D. Hoehler⁴, ¹Mississippi State University, Mississippi State, ²USDA, Mississippi State, MS, ³USDA, Ames, IA, ⁴Degussa Corporation, Kennesaw, GA.

The dietary inclusion of L-Thr has necessitated accurate knowledge of nutrient amino acid needs beyond Thr. Research delineating the former has been forthcoming, but remains sparse. As a result, many commercial nutritionists have included L-Thr using company historical data on CP fluctuations and bird performance. In this experiment,

practical inclusions of L-Thr were used which resulted in a 1.3% decrease in CP. Cobb x 500 (fast feathering) broilers were reared in floor pens. At d 25, male broilers were selected, tagged, and placed across 24 pens (6 birds/pen). Three dietary treatments were fed from 25 to 43 d: 19.88% CP with no L-Thr; 19.25% CP with 0.023% L-Thr; and 18.62% CP with 0.045% L-Thr (8 replications/treatment). The highest and lowest CP pelleted treatments were blended to get the middle CP level. In addition to obtaining live performance and processing data on all birds, plastic was lined in the pens to obtain a 24 h collection of feces at d 32. All pens were positioned whereby the adjacent pen contained no birds to minimize fecal contamination. Protein efficiency ratio did not differ among treatments. Other live performance parameters did not differ (P > 0.05). Percentage abdominal fat increased (P = 0.07) as L-Thr increased, but other carcass measurements did not differ. Nitrogen excretion was highest (P = 0.13) in birds fed no L-Thr. Results indicate that Cobb male broiler live performance and processing traits can be maintained in reduced CP-L-Thr containing diets, and nitrogen excretion benefits may be realized.

Key Words: Amino acid, Threonine, Broiler, Protein efficiency ratio, Nitrogen excretion

T134 Impact of feeding reduced protein diets on performance, breast yields and nitrogen emissions in broiler chickens. R. Angel^{*1}, W. Powers², S. Zamzow², T. Applegate³, and D. Hoehler⁴, ¹University of Maryland, College Park, MD, ²Iowa State University, Ames, ³Purdue University, Lafayette, IN, ⁴Degussa Corporation, Kennesaw, GA.

The impact of feeding reduced protein (RP) and industry (C) corn-soy diets on broiler performance, breast yield and litter nitrogen (N) content was determined. Ross 308 male broilers were allocated to 8 chambers and grown from hatch to 42 d. Five sequential Exp were conducted. C treatment (Trt) broilers were fed a 4 phase feeding program: starter (St), grower (Gr), finisher (Fn), and withdrawal (Wd) diets. RP Trt broilers were fed a 6 phase feeding program: prestarter (PrSt), St, Gr1, Gr2, Fn, and Wd diets. Protein concentrations were 22.1, 20.0, 17.2, and 16.6% for the C Trt St, Gr, Fn, and Wd diets, while those for the RP Trt PrSt, St, Gr1, Gr2, Fn, and Wd diets were 22.0, 18.6, 18.1, 17.3, 15.8, and 15.0%. Minimum amino acid (AA) requirements as well amino acid to lysine ratios were maintained for diets in both Trt. Synthetic Lys, Met, Ile, Thr, Arg, Trp, and Val were used to meet AA minimums in RP diets while only Met and Lys were used to meet the same minimums in C diets. Total concentrations of Lys, Met+Cys, Ile, Thr, Trp, Arg, and Val, in the St, Gr1, Gr2, Fn, and Wd RP diets were: 1.22, 0.91, 0.85, 0.82, 0.24, 1.40, 0.90%; 1.14, 0.83, 0.82, 0.68, 0.23, 1.25, 0.90%; 1.06, 0.80, 0.75, 0.74, 0.22, 0.83%; 1.01, 0.75, 0.71, 0.68, 0.20, 0.80%; and 0.96, 0.73, 0.70, 0.68, 0.19, 0.76%, respectively. Performance was determined at the end of each phase and litter was analyzed for DM, N and minerals. Ammonia (NH₃) emissions were calculated by sampling incoming air followed by sequential sampling

of each chamber. Broilers on the C Trt weighed more ($P < 0.05$) at 42 d over the five F (2.74 kg) than those fed the RP Trt (2.66 kg) but feed/gain ratio was similar (1.88 vs. 1.90 for C and RP). Twenty broilers per chamber were sampled for yield determination in F 3 and 4. Dress percent, breast weight and breast yields were not affected by Trt. Based on analyzed diet, litter and air concentrations over the 5 F, N consumed was 9.2% less, litter N 20.6% less, and mean NH₃ emissions were 16% lower in RP vs. C chambers. The study demonstrates that N emissions can be reduced substantially by feeding low-protein diets in broilers.

Key Words: Broiler, Protein, Nitrogen, Emissions

T135 Carcass defects with broilers fed requirement EAA levels from 6 to 8 weeks of age while CP and ME varied at practical extremes. E. T. Moran* and J. Galobart, *Auburn University, Auburn, AL.*

Formulating feed using commercial EAA reduces associated CP, and performance suffers when fully implemented. Experimentation examined incidence of carcass defects when CP was maximally decreased with the final feed, and if reducing ME to increase consumption of CP would provide relief. Ross X Ross 308 broilers were reared sexes-separate in floor pens from 0 to 6 weeks of age on common feeds. During the subsequent 6 to 8 weeks (25 C and 80% RH), feeds having CP at either 18.0 or 16.5% while ME was either 3250 or 3090 kcal / kg were given to 4 replicate pens of 25 chicks. All feeds employed corn, soybean meal, poultry fat, and purified essential amino acids as the central ingredients. AA analyses confirmed NRC(1994) requirement levels. Reducing CP adversely affected both live weight gain and F/G of both sexes between 6 and 8 weeks of age while reduction in ME independently increased F/G without altering growth. After on-line processing, static slush-ice carcasses were evaluated for the incidence of wings having dislocated joints, bruising, broken bones, and brachial veins having prominent blood; drumsticks with broken bones and bruising; breast bruising and broken clavicles; and back-thigh area having bruising, skin tear and scratching. ANOVA evaluated transformed percentages from each pen. Wing bruising was the defect having the greatest incidence (19.0%) and breast bruising the least (0.4%). No significant effects were detected that could be attributed to level of CP, ME or their interaction ($P > .05$). Males exhibited a greater vascular disruption of blood in the wing veins, broken drumsticks and bruising of the back than females while the converse occurred for drumstick bruising and skin tearing of back-thigh ($P < .05$). Absence of carcass defects associated with wide levels of feed CP and ME suggest infers that a minimal adverse effect on welfare audit and consumer quality exists in a practical context.

Key Words: Carcass quality, Feed formulation, Metabolizable energy, Protein nutrition, Welfare audit

T136 Dietary amino acid responses of broiler chickens from 36 to 47 d on subsequent 60 d performance. W. A. Dozier, III*¹, M. T. Kidd², A. Corzo², J. Anderson³, and S. L. Branton¹, ¹*USDA-ARS Poultry Research Unit, Mississippi State, MS*, ²*Mississippi State University, Mississippi State*, ³*Mississippi State University, Mississippi State.*

Dietary amino acid responses of broilers from 5 to 9 wk of age have not been well defined. This study examined growth responses and meat yield of broilers provided diets varying in amino acid density from 36 to 47 d of age on 60 d performance. Sixteen hundred and sixty-four Ross × Ross 708 chicks were randomly distributed into 32 floor pens (26 males and 26 females; 0.08 m²/bird) at one-d of age. All birds were fed common starter (0 to 17 d) and grower (18 to 35 d) diets. Broilers were provided diets characterized as being high (H), moderate (M), or low (L) in amino acid density from 36 to 47 and 48 to 60 d of age. The diets were formulated to contain: H (19.0% CP, 0.75% digestible (d) TSAA, and 0.92% dLys), M (18.0% CP, 0.73% dTSAA, and 0.85% dLys), and L (16.8% CP, 0.70% dTSAA, and 0.78% dLys) amino acid density from 36 to 47 d, and H (17.6% CP, 0.70% dTSAA, and 0.88% dLys) and L (16.1% CP, 0.63% dTSAA, and 0.75% dLys) amino acid density from 48 to 60 d. Dietary treatments were HH, HL, ML, and LL from 36 to 60 d of age.

Broilers provided the HH regimen had lower ($P \leq 0.05$) final feed conversion and less ($P \leq 0.05$) abdominal fat percentage than ML and LL fed broilers. Decreasing dietary amino acid density from HH to LL regimen reduced ($P \leq 0.05$) total breast meat weight and yield. Dietary treatments did not influence final BW, cumulative feed intake, cumulative mortality, or carcass weight and yield. These results indicate that reducing dietary amino acid density from H to L during 36 to 47 d negatively impacted 60 d feed conversion and breast meat yield under these experimental conditions.

Key Words: Amino acid, Broiler, Lysine, Methionine, Theonine

T137 Dietary amino acid responses of broiler chickens from 48 to 60 d on growth and carcass traits. W. A. Dozier, III*¹, M. T. Kidd², A. Corzo¹, J. Anderson³, and S. L. Branton¹, ¹*USDA-ARS Poultry Research Unit, Mississippi State, MS*, ²*Mississippi State University, Mississippi State*, ³*Mississippi State University, Mississippi State.*

Dietary amino acid responses of broiler chickens from 7 to 9 wk of age are sparse. This study examined growth responses and meat yield of broilers provided diets varying in amino acid density from 48 to 60 d of age. Sixteen hundred Ross × Ross 708 chicks were randomly distributed into 32 floor pens (25 males and 25 females; 0.08 m²/bird) at one-d of age. All birds were fed common starter and grower diets until 35 d of age. Broilers were provided diets characterized as being high (H), moderate (M), low (L), or sub-optimum (S) in amino acid density from 48 to 60 d of age. The diets were formulated to contain: H (17.9% CP, 0.70% digestible (d) TSAA, and 0.87% dLys), M (16.9% CP, 0.65% dTSAA, and 0.81% dLys), L (15.8% CP, 0.60% dTSAA, and 0.75% dLys), or S (14.8% CP, 0.55% dTSAA, and 0.69% dLys).

Broilers provided the H regimen had improved ($P \leq 0.05$) cumulative feed conversion over the other dietary treatments. Feeding the S diet to broilers decreased ($P \leq 0.05$) carcass yield compared with the other dietary treatment, whereas H fed broilers had lower ($P \leq 0.05$) abdominal fat percentage than the M, L, and S fed broilers. Providing the S diet to broilers limited ($P \leq 0.05$) total breast weight (Pectoralis major and minor muscles) compared with the H dietary treatment, but broilers fed the M and S diets had lower ($P \leq 0.05$) total breast meat yield than broilers given the H diet. The least significance difference

critical value for breast meat yield was 0.48% and the breast meat yield difference between H and L broilers was 0.46% (24.00 vs. 23.54%), thus inferring a breast meat yield difference was approaching significance between the H and L fed broilers. These data indicate that feeding the H diet from 48 to 60 d is advantageous to optimize cumulative feed conversion and maintain optimal total breast meat yield.

Key Words: Amino acid, Broiler, Lysine, Methionine, Threonine

T138 Valine marginality and needs of growing broilers. A. Corzo*¹, M. T. Kidd¹, W. A. Dozier, III², and S. L. Vieira³, ¹Mississippi State University, Mississippi State, ²USDA-ARS, MS, ³Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

Valine is likely the fourth limiting amino acid in some diets than contain feedstuffs only from vegetable origin. Three experiments (Exp) from 21 to 42 d of age were conducted to not only corroborate the previous statement, but to validate a Val deficiency and subsequently quantify an adequate ratio to lysine. A high yield broiler male (Ross×Ross 708) was used in all Exp. In Exp 1, L-Thr was included into a corn-soybean meal diet where no other essential amino acid minimums were imposed other than those for Lys, TSAA and Thr. Individually, L-Val, L-Ile, L-Arg and Gly were supplemented by 0.10% to that diet. Based on results obtained for BW gain, feed conversion and abdominal fat weight and percentage, birds were most responsive when L-Val was supplemented to the diet when compared to other supplemented amino acids. Subsequently, Exp 2 compared a corn-peanut meal diet against a corn-soybean meal diet. The corn-peanut meal based diet was formulated to be deficient in Val, which indeed occurred as observed by poor performance BW gain and feed conversion; subsequent supplementation with L-Val validated the Val deficiency. Further, a comparison between the corn-peanut meal L-Val supplemented diet and the corn-soybean meal diet of similar nutritional composition validated the use of the corn-peanut meal based diet in its ability to support adequate growth of broilers. Finally, Exp 3 used the same corn-peanut meal based diet to create a dose-response, where Val would be deficient (0.59% digestible) and gradual increments of dietary Val were accomplished by supplementing L-Val to the diet. Quadratic effects were observed for BW gain, breast meat weight and its yield, where a dietary Val to Lys ratio would be adequate between 74 and 78.

Key Words: Breast meat, Broiler, Lysine, Valine

T139 Selenium sources affect protein concentration, thioredoxin reductase activity and selected production parameters in reovirus infected broilers. S. Burgos*¹, F. W. Edens¹, J. Read-Snyder¹, A. Cantor², and S. A. Burgos³, ¹North Carolina State University, Raleigh, ²University of Kentucky, Lexington, ³University of Guelph, Guelph, ON, Canada.

Avian reoviruses (ARV) are members of the *Orthoreovirus* genus within the *Reoviridae* family. Successful ARV infection ultimately result in decreased weight gains coupled with increased mortality. Selenium (Se) is involved with Thioredoxin Reductase (TRX), an enzyme that quenches free radicals that can damage proteins, lipids

and nucleic acids. The aim of this study was to determine the effects that Se-containing diets fed to ARV-infected broilers had on protein concentrations, TRX activity, body weights and mortality. Eggs were obtained from Cobb breeders that had been maintained on isocaloric Torula yeast diets containing either no supplemental Se, sodium selenite at 0.3 ppm, or organic Se (SelPlex, Alltech, Inc., Nicholasville, KY) at 0.3 ppm. Chicks hatched from those eggs were placed on Torula yeast broiler diets containing no supplemental Se, 0.3 ppm sodium selenite, or 0.3 ppm organic Se similar to their respective parents' diets. On the day of hatch, 60 chicks per dietary Se treatment were placed into either control or ARV-infected groups in heated-growing batteries in separate isolation rooms. Chicks in the ARV-infected groups were given each an oral gavage of 0.2 mL of ARV-CU98 ($10^{4.2}$ pfu/chick), and control chicks were given the medium only. At 14 and 21 days of age, the chicks were bled, weighed, killed by CO₂ asphyxiation, and tissues collected for analyses. Data from this 2 X 3 factorially arranged completely randomized experimental design were analyzed using the GLM procedure of SAS. ARV-infected birds had significantly lower average body weights (ABW) at 14 and 21 days ($P < 0.0001$), three times higher mortality rates, and decreased tissue protein concentration ($p < 0.001$) than controls. Se treatments did not affect ABW and mortality, but did significantly improve plasma protein concentration ($p < 0.05$) and TRX activity in both, healthy and virus-challenged bird. Our findings suggest that ARV infection depresses growth, increases mortality and reduces protein concentration on various tissues, whereas Se is beneficial against ARV infection in broilers through an improved antioxidant status.

Key Words: Reovirus, Selenium, Broiler

T140 Effects of reducing dietary protein on performance of White Leghorn layers during late egg production (55 to 67 wks of age). H. M. Yakout*¹, D. Hoehler², M. Elliot³, and C. Novak¹, ¹Virginia Tech, Blacksburg, ²Degussa, Kennesaw, GA, ³Wenger's Feed Mill, Rheems, PA.

The use of low protein diets can have potential benefits on reducing N emissions and cost savings by reducing high cost protein sources. An experiment was conducted utilizing 384 Hy-Line W-36 hens which were randomly assigned to one of 4 dietary treatment groups (Trt). Corn-soybean based diets supplemented with commercially available amino acids were used as follows: [1] 17.5% CP + Met (\$131.25/ton), [2] 16.5% CP + Met, Lys and Thr (\$128.67/ton), [3] 15.5% CP + Met, Lys and Thr (\$127.56/ ton), and [4] 14.5% CP + Met, Lys, Thr and Trp (\$129.14/ton) were fed from 55 to 67 wks of age. Cage was the experimental unit (4 h/cage; 0.54 in²/h), and each Trt had 24 reps. Overall, hens had similar feed consumption (FI) in diet 1, 2, 3, & 4 of 99.0, 99.5, 99.1 and 97.9 g/h/d, respectively. Egg production (EP) ranged from 71.4 to 67.1% across all Trt with the highest producers fed diet 2 and the lowest for diet 4. Egg weights (EW) followed a similar performance, as they non significantly decreased from 63.7 g to 63.0 g with protein reduction from 17.5 to 14.5%, respectively. Egg mass (EM) was also not affected by Trt and varied from 44.08 to 44.80 g. Reducing dietary protein reduced ($P \leq 0.003$) dry albumen percent, while numerically increased dry shell percent. Albumen solids were reduced ($P \leq 0.005$) with decreasing dietary protein. Wet albumen ranged from 57.0 to 55.5% ($P \leq 0.03$) for all Trt with the highest at diet 3 and the lowest at diet 4. FI, specific gravity, dry yolk and shell and yolk solids were not significantly affected by Trt. Treatments 1, 2 and 3 were statistically similar when evaluating production performance

and egg components as compared to diet 4. Based on the information gathered from this trial, feeding the 15.5% CP diet with supplemental Met, Lys and Thr matched EP and FE of the high protein diet (17.5% CP + Met). Utilizing such a diet in the field has the potential to save the poultry industry as much as \$3.68/ton based on the current study. Additional in house or field studies are needed to validate these findings on increased profitability.

Key Words: Dietary protein, Egg production, Egg mass, Late production, Economics

T141 Effects of dietary amino acid level on egg performance of heavy versus light laying hens. R. L. Payne*¹, P. R. T. Bonekamp², J. K. W. M. Sparla², A. Lemme¹, and P. J. A. Witten², ¹*Degussa Corporation, Kennesaw, GA*, ²*Provimi B.V., Rotterdam, The Netherlands*.

According to the literature, the amino acid (AA) needs of light layer breeds are about 10% less than those of heavy breeds. Thus, the objective of this experiment was to determine the level of AAs needed for heavy and light breeds for optimal performance. Lohmann Brown Classic (heavy) and LSL Classic (light) hens (n = 564) were equally allotted to 12 treatments based on body weight and daily egg mass. Each treatment was replicated 4 times with 11 or 12 individually-housed hens, and the trial was conducted from 24 to 35 weeks of age. The treatments were arranged in a 2 x 6 factorial with 2 breeds (light vs. heavy) and 6 AA levels (550, 600, 650, 700, 750, and 800 mg of true fecal digestible Lys per hen per day (TFD Lys/h/d)). The diets were formulated based on body weight and energy requirements for the heavy or light hens with 10 g of growth per month with a calculated feed intake of 110 or 100 g/h/d, respectively. Minimum ratios of AAs relative to TFD Lys were maintained, and they were Met, 49; Met+Cys, 95; Thr, 68; Trp, 19; Ile, 79; and Val, 87. All diets were isocaloric within breed and adequate in all nutrients with the exception of AA. Laying percentage of the heavy and light breed hens increased (P < 0.05) up to 650 and 600 mg TFD Lys/h/d, respectively, but laying percentage was not different (P > 0.05) overall. Egg weight, egg mass, and feed per egg mass increased (P < 0.05) in both breeds as AA increased through 800 mg TFD Lys/h/d. Overall, the heavy breed hens produced heavier eggs with more mass (P < 0.05), while the light breed hens had improved feed per egg mass (P < 0.05). These data suggest that both breeds respond to at least 800 mg TFD Lys/h/d for daily egg mass production, which is higher than current recommendations. Furthermore, it seems that heavy breeds need about 10% more AAs than the light breeds to maximize laying percentage, while the light breeds need about 10% more AAs to produce similar egg mass as the heavy breeds.

Key Words: Amino acid, Egg mass, Laying hen, Lysine

T142 Mintrex[®] organic trace minerals and 25-hydroxycholecalciferol HyD[®] improve biomechanical properties of turkey bones. E. O. Oviedo-Rondón*¹, P. L. Mente², P. R. Ferket¹, J. D. Richards³, J. Small¹, and J. L. Grimes¹, ¹*North Carolina State University, Raleigh*, ²*North Carolina State University, Raleigh*, ³*Novus International, Inc., St. Charles, MO*.

Spiral femoral fractures and tibia fractures can cause up to 5% of the

total mortality in turkey toms. Biomechanical properties of bones can be improved by nutrition. The dietary supplementation of organic trace minerals, MINTREX Pse (MIN) and 25-hydroxycholecalciferol (HyD) was evaluated as an alternative to reduce the incidence of bone abnormalities. Day-old Nicholas 85X700 toms were randomly distributed among 48 pens (4 dietary treatments (trt) x 12 replicates) of 15 poult each. A 2x2 factorial (0 and 1% MIN; 0 and 92 mcg/kg HyD) was evaluated. MIN provided 40 ppm Zn, 40 ppm Mn, and 20 ppm Cu as methionine hydroxy analogue complex and .3 ppm Se as Se yeast. Diets were formulated to be equal in nutrient content and fed ad lib as 8 feed phases until 20 wk. Femur and tibia bones were collected at 18 wks of age from 13 toms per treatment. Compression and tension failure stresses were evaluated in tibiotarsus subjected to three-point and four-point bending. Torsional shear stresses were evaluated in femur bones subjected to external rotation in a single cycle to failure, at an angular displacement rate of 10°/s. Torque and angle data were collected during the test at 100 Hz. Data indicated that MIN increased (P<0.001) cortical thickness in the tibiotarsus. No significant (P>0.05) effect of trt was observed in the cortical thickness of femur. The maximum force, the moment and the stress required for tibia bones to break, increases (P<0.001) with MIN supplementation, but especially (P<0.05) when both MIN and HyD were added to the diet. The maximum shear stress at failure of femora bones was improved (P<0.05) by MIN and HyD supplementation, a similar effect (P=0.08) was observed for failure torque. These results indicate that the supplementation of both MIN and HyD improve the biomechanical properties of tibias and femurs in 18 wk-old turkey toms.

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Key Words: Bone, Turkeys, Biomechanical properties, Organic trace minerals, Vitamin D

T143 A real time polymerase chain reaction assay for metallothionein to measure bioavailability of zinc sources for chickens. J. D. Richards*, C. A. Atwell, C. W. Wuelling, and M. E. Wehmeyer, *Novus International, Inc., St. Charles, MO*.

It is common to measure bone or tissue zinc to compare the bioavailability of different zinc sources, or to determine the zinc status of an animal. However, zinc deposition into tissues occurs substantially downstream of intestinal zinc absorption, and only a fraction of the absorbed zinc will be deposited in the assayed tissue. Therefore, tissue or bone zinc may not be the most appropriate assay to measure bioavailability. As an alternative, the availability of zinc can be compared by detecting the expression of certain zinc-responsive genes. The metallothionein (MT) protein binds up to 7 zinc atoms, and its mRNA or protein expression has been reported to reflect zinc status in many species, including chickens. A real time polymerase chain reaction (RT-PCR) assay was developed to measure MT mRNA expression in chickens fed different levels or sources of zinc. Initial experiments demonstrated that MT was inducible by zinc in multiple tissues including small intestine, liver and kidney. In contrast, 18S rRNA was not zinc-inducible. MT mRNA levels therefore are normalized in each sample by 18S rRNA levels, as a loading control. In addition, MT levels can be compared across experiments by comparing to a known reference standard. To test whether the MT assay could distinguish between different zinc sources, broilers were placed on a moderately zinc-deficient milo-soy diet for 20 days, then placed on corn-soy treatment diets consisting of an unsupplemented basal diet, or

the basal supplemented with 70ppm zinc from zinc oxide, a zinc amino acid complex, or MINTREX[®] Zn. Jejunum scrapings were collected two days later and assayed for MT expression. Zinc oxide and the zinc amino acid complex failed to induce MT expression significantly above the basal. In contrast, MT expression in the birds fed MINTREX Zn was significantly greater than in all other treatments. These data suggest that MINTREX Zn is more bioavailable than zinc oxide or the zinc amino acid complex.

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Key Words: Metallothionein, RT-PCR, Zinc, MINTREX, Bioavailability

T144 The making of heat resistant β -Mannanase (Hemicell[®]-HR) and its positive impact on broiler growth performance. H. Y. Hsiao*, D. M. Anderson, and L. Liu, *ChemGen Corp., Gaithersburg, MD.*

Feed enzymes, in general, are sensitive to heat and, therefore, their application onto feeds is mostly carried out by spraying in the liquid form post-pelleting. However, the direct application of thermal stable dry enzyme into the mixer still has its attraction. Strains of *Bacillus lentus*, which all produce thermal stable β -Mannanase (Hemicell[®]-HR) have been obtained by modifying a few selected sites on DNA sequence of the native enzyme and, then, replacing the native gene on the same host cell. Two such mutants were selected. The native and two mutant enzymes have been purified and they were incubated in a water bath at various temperatures for 15 minutes. The native and stable β -mannanase (Hemicell[®] HR-1 and HR-2) retained its 50% activity at 65°C, 72°C and 82°C, respectively. Two mutants, in their unprotected form, showed a 7°C and 17°C improvement in thermal stability over the native enzyme. All three enzymes were granulated and their thermal stability was tested under various conditioning temperatures (65°C - 90°C) by feed mills at Kansas State University and the University of Georgia. Through the extrapolation, the pelleting temperature causing a loss of 50% activity to the granulated native and two thermal stable β -Mannanase was calculated to be 80°C, 87°C and 107°C, respectively. A 42-day broiler trial was conducted to test Hemicell[®]-HR1 and the native enzyme for growth. The native Hemicell[®] was sprayed post-pelleting and the granulated Hemicell[®]-HR-1 was applied into mixer. Both were at about 100MU/ton. All feeds were pelleted between 80-85°C. There was no significant difference in FCR as well as weight gain between these two enzymes. Both enzymes had significant better FCR than the Control (P<0.05). The thermal stable β -mannanase added into the mixer showed its full efficacy in promoting broiler growth.

Key Words: β -mannanase, Thermal stable, Mmutant, Broiler, FCR

T145 The effect of B-Mannanase (Hemicell) on the performance of 3 commercial strains of broiler chickens provided with corn-soybean meal diets. M. E. Jackson*¹ and R. W. Gordon², ¹*ChemGen Corp, Fayetteville, AR*, ²*Gold Kist Inc, Atlanta, GA.*

The enzyme B-mannanase has been shown to improve growth, feed conversion and body weight uniformity in broilers. The mechanism results in an improvement in energy utilization through degradation of highly anti-nutritive B-mannans present in all soybean meals. A 38-day trial was conducted in floor pens with straight run Ross X Cobb, Cobb X Cobb, and Ross X Ross broilers provided with corn-soybean meal based diets with commercial nutrient levels with and without B-mannanase addition at the manufacturers recommended inclusion level (100 MU/ton) for a total of 6 treatments. The study involved 50 birds/pen and 8 replicate pens per treatment. At the conclusion of the study, males and females were weighed separately. The enzyme improved weight gain and feed conversion in all strain and sex combinations at 38 days. Across all strains and sexes, the addition of B-mannanase resulted in a 2.5% improvement in weight gain (P<.05) and a 2.6 point improvement in feed conversion (P<.05). There were significant strain effects on feed conversion only and there were no significant strain x enzyme interactions. Results of this study suggest that B-mannanase improves live performance in broilers irrespective of sex or strain.

Key Words: B-Mannanase, Broilers, Strain, Sex

T146 Effect of Allzyme[®] SSF on growth performance of broilers receiving diets containing high amounts of distillers dried grains with solubles. J. L. Pierce*, T. Ao, B. L. Shafer, A. J. Pescatore, A. H. Cantor, and M. J. Ford, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY.*

Allzyme[®] SSF is an enzyme complex produced by solid state fermentation. An experiment was conducted to evaluate the effects of Allzyme[®] SSF on the growth performance of male broiler chicks when fed diets containing 26% dried distillers grains with solubles (DDGS). A 21-day growth assay was conducted with 144 Cobb broilers allotted to four dietary treatments in a randomized complete block design. The treatments were 1) corn-soy reference diet with 1.24% Lys, 22%CP and 3150 kcal/kg ME; 2) positive control diet containing 25% DDGS with 1.24% Lys, 22%CP and 3150 kcal/kg ME; 3) and 4) containing 26% DDGS with 1.11 % Lys, 21%CP and 2835 kcal/kg ME without and with 200 g/tonne Allzyme[®] SSF, respectively. Feeding 25% DDGS significantly decreased weight gain (737 vs. 691g, P<.01) and gain:feed (0.766 vs. 0.676, P <0.01) comparing with corn-soy reference diet. Reducing the dietary energy and crude protein concentration also reduced gain (691 vs. 626 g, P<0.01) and gain: feed (0.676 vs. 0.579, P<0.01). The addition of Allzyme[®] SSF tended to increase gain (626 vs. 648 g) and significantly increased gain:feed (0.579 vs. 0.610, P<0.01). These results indicate that Allzyme[®] SSF improves growth and efficiency when high levels of DDGS are used in broiler diets.

Key Words: Broiler chicks, Enzyme, Allzyme[®]SSF, DDGS, Performance

POSTERS
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P147 Four years of molecular analysis of international samples collected on FTA® paper. H. Moscoso*, G. Brown, and C. L. Hofacre, *University of Georgia, Athens.*

The Molecular Diagnostic Laboratory at PDRC performs more than 13 different tests for the detection and characterization of avian pathogens for national and international clients. We have shown that avian viruses and bacteria are rendered non-infectious upon contact with the FTA® cards thus allowing collection and transport of samples from overseas to the U.S. in compliance with federal regulations. PCR and RT-PCR have demonstrated that nucleic acids are preserved in specimens stored on FTA® and that its quality is sufficient to yield amplicons suitable for post-PCR analysis. The number of tests for molecular analysis of poultry samples requested by clients from foreign countries has increased almost 100 fold in the past 4 years; from 8 tests in 2002 to more than 800 tests in 2005. This increase is mainly due to the switch in the procedure of inactivation and transport of potential pathogens from phenol-treated to FTA®-collected specimens. The majority of the international molecular tests requested are from Latin America (88%) which is the consequence of a great deal of training and education of laboratory personnel and clinicians from governments, academia and private industries from that area of the world. Mycoplasma PCR is by far the most requested test from overseas representing 68% followed by RT-PCR of IBDV, IBV, and NDV with an average of 11%, 7%, and 5% respectively in the past 4 years. Post-PCR tests such as RFLP and nucleotide sequencing have allowed studying more closely the epidemiology of these diseases in foreign countries resulting in the differentiation of vaccines from pathogens. Cumulative positive cases was 37% for NDV (vaccine and velogenic strains), 36% for adenovirus (serotype 4, 5 and 10), 29% for IBDV (Lukert and variants A and E), 27% for MS (H vaccine and wild types), 23% for MG (ts 11, F strain and wild types), and 8% for IBV (Massachusetts). Tests request from other areas of the world might increase in the near future as sampling is facilitated and transportation cost is reduced using the FTA® cards.

Key Words: Avian pathogens, FTA®, PCR, RT-PCR, Sequencing

P148 Immunopotential of avian heterophils with microbial agonists. M. Farnell*¹, A. Donoghue², F. Solis de los Santos³, P. Blore³, B. Hargis³, G. Tellez³, and D. Donoghue³, ¹Texas A & M University, College Station, ²USDA, Fayetteville, AR, ³University of Arkansas, Fayetteville.

The immune system of neonatal chicks is functionally immature during the first week of life. Researchers have previously demonstrated that the avian humoral response can be increased through the use of probiotics. Although the humoral response provides the chick with an effective mechanism to combat pathogens, sufficient antibody titers are not attained until 7 to 10 d post infection. However, the innate immune system (i.e. heterophils) can respond much more quickly to pathogens. The objective of this study was to determine whether probiotic bacteria

can also up regulate heterophil function. Heterophils were isolated from the peripheral blood of neonatal chickens by using a discontinuous density gradient. Oxidative burst and degranulation are bactericidal mechanisms used by heterophils to kill pathogens and were used in this study as indicators of heterophil function. We found that each of the 10 "generally recognized as safe" (GRAS) probiotic isolates (designated G1-11) tested, in vitro, were capable of increasing ($P < 0.05$) heterophil oxidative burst and degranulation when compared to unstimulated controls. *Bacillus subtilis* (G3), *Lactococcus lactis lactis* (G6) and *Lactobacillus acidophilus* (G8) isolates were determined to elicit the greatest heterophil response in vitro and were subsequently fed to chicks. Phosphate buffered saline (PBS) or one of these three probiotic isolates ($\sim 2.5 \times 10^8$ cfu/chick; 50 chicks/treatment) resuspended in PBS was administered by oral gavage on the day of hatch. Heterophils were isolated from chicks from each of these four treatment groups 24 h post treatment. Significant increases in heterophil degranulation and oxidative burst were observed with the G3, G6 and G8 treated chicks when compared to heterophils isolated from birds with no probiotic treatment. These data suggest that probiotic bacteria can significantly improve heterophil oxidative burst and degranulation in broilers. To our knowledge this is the first study demonstrating a relationship between probiotics and avian heterophil function.

Key Words: Chicken, Probiotic, Heterophil, Gastrointestinal tract, Innate immunity

P149 Real-time RT-PCR for the rapid detection of avian reoviruses. K. Guo*, T. Dormitorio, and J. Giambrone, *Auburn University, Auburn, AL.*

Avian reoviruses (ARV) infect a variety of organs and may cause tenosynovitis, malabsorption syndrome, chronic respiratory disease, and immunosuppression in commercial poultry. Vaccination is the main method for preventing ARV infections. However, vaccine effectiveness in the field is variable due to the presence of different antigenic strains. Our objective is to develop a rapid and highly specific method for the detection of ARV strains utilizing Real-time RT-PCR technology. Using specific primer and probes sets, we want this test to detect all ARV infections in the poultry as well as identify specific serologic and pathologic types. The protocol consists of two phases of real-time RT-PCRs, which were conducted in a Roche LightCycler. In the first phase, primer-probe sets were compared and selected to detect all ARVs from North America. Here we report a best primer-probe set, which was designed from a highly conserved region of S4 gene, and its rapid, highly sensitive detection of 8 ARV strains. ARVs were also detected with this test from clinical samples, which were previously found to contain ARVs by other tests. The second phase of the project, the development of primer-probes sets for the detection of serologic or pathologic strains, is in progress.

Key Words: Avian Reovirus, Real-time RT-PCR, Detection

P150 Comparison of mean death time in eggs from several velogenic Newcastle disease virus strains, isolated in Mexico from 1997 to 2006. R. Merino* and N. Calderon, *Universidad Nacional Autonoma de Mexico, Mexico City, Mexico.*

Newcastle disease (ND) has major importance in poultry around the world. Exotic ND is responsible for high mortality rate and international commerce restrictions. The objective of this study was to use the mean death time in eggs (MDTE) to compare the virulence of 16 ND virus strains isolated at the UNAM between 1997 and 2006 and the Mexican reference strains Chimalhuacan and Queretaro. All strains were grown in commercial chicken embryo (CCE) and the minimum lethal dose (MLD) was calculated. All strains were standardized to 10^2 MLD/0.1 ml, inoculated into ten 11-day-old embryonating eggs, incubated at 37°C and candled at 2-4 hours intervals. The time at which each embryo was first observed as dead was recorded. The MDTE was compared by ANOVA, $P < 0.05$. All 16 strains were identified as velogenic, since the MDTE was lower than 60 hours, except for one isolate from 1998 (MDTE = 61.5 hours). The Mexican reference velogenic strain Chimalhuacan showed a very high virulence (MDTE=39.7 hours, ab), only one isolate from 2005 was similar to it (MDTE= 37.4 hours, a); 11 isolates had MDTE between 41.7 and 48.8 hours (abcdef), including the Queretaro strain (MDTE= 43.2 hours, bc); 4 isolates had MDTE between 50.3 and 59.7 hours (efgh) and only one isolate from 1998 had MDTE= 61.5 hours (h). The Chimalhuacan strain has been previously reported as highly virulent when inoculated in susceptible chickens; according to our results, the Mexican strains of NDV show difference in their virulence, at least one of them (isolated in 2005) could be related to the Chimalhuacan strain, isolated for first time several decades ago. These results show that velogenic strains of Newcastle disease virus can be differentiated by using a standardized dose even when using commercial embryonating eggs to inoculate.

Key Words: Newcastle disease, Velogenic, Mean death time, Commercial embryonating egg, Titration

P151 *In vitro* and *in vivo* transgenic expression of Newcastle disease virus HN protein using an avian adeno-associated virus vector. F. Perozo*¹, P. Villegas¹, C. Estevez², I. Alvarado¹, and L. Purvis¹, ¹*Poultry Diagnostic and Research Center, Athens, GA*, ²*USDA, Athens, GA.*

The avian adeno-associated virus (AAAV) is a replication defective non-pathogenic virus member of the family *Parvoviridae* that has been successfully used for gene delivery. The generation of recombinant AAAV virions expressing the immunogenic hemagglutinin-neuraminidase (HN) of Newcastle disease virus (NDV) and the immune response induced in chickens was assessed. The feasibility of the *in vitro* generation of the recombinant AAAV virions expressing the HN protein was demonstrated by immunohistochemistry (IHC) and electron microscopy (EM). After *in ovo* or intramuscular inoculation of the recombinant AAAV in specific pathogen free chickens, a systemic immune response measured as NDV specific antibodies detection using enzyme-linked immunosorbent assay and the hemagglutinin inhibition test was observed. Neutralizing antibodies induced by the recombinant AAAV were demonstrated by the virus neutralization test (VN) performed in embryonating eggs.

Key Words: Avian adeno-associated virus, Newcastle disease virus, Hemagglutinin-neuraminidase, Immune response

P152 Innate immune functions and intracellular signaling in wild-type and commercial turkeys. K. Genovese, H. He, C. Swaggerty, and M. Kogut*, *USDA-ARS, FFSRU SPARC, College Station, TX.*

The purpose of these studies was to compare heterophil innate immune functions and related intracellular signaling in a commercial line of turkeys to those in a wild-type line. Heterophil phagocytosis of *Salmonella* (SE) and two mechanisms of microbial killing, oxidative burst and cellular degranulation, were assayed. Heterophils from commercial Line A turkeys and from wild-type turkeys were exposed to SE, opsonized SE (OPSE), and PMA for 1 hour. Degranulation was detected by quantifying β -glucuronidase activity in the culture medium following stimulation of heterophils; heterophil oxidative burst was measured by oxidation of DCFH-DA to fluorescent DCF. Heterophils from wild-type turkeys had a significantly greater production of an oxidative burst and degranulation on days 4 and 7 post-hatch than did heterophils from Line A. No differences in the phagocytosis of SE were observed between lines. In signaling studies, heterophils were stimulated for 1 hr with SE or OPSE. After stimulation, cell lysates were tested for mitogen-activated protein kinase (MAPK) activity. Specifically, phosphorylation of extracellular signal-regulated protein kinase (ERK1/2) and p38 MAPK were assayed using commercially available ELISA kits. Total protein tyrosine kinase (PTK) activity was assayed. On both day 4 and day 7 post-hatch, heterophils from Rio Grande turkeys had significantly higher levels of ERK 1/2 and p38 MAPK kinase activity upon stimulation with either SE or OPSE ($p < 0.001$). PTK values on day 4 and 7 in Rio Grande turkey heterophils was significantly higher upon stimulation with SE than with OPSE and was significantly ($p < 0.001$) higher than the PTK levels in Line A upon SE and OPSE stimulation. In combination, these results show that heterophils from wild-type turkeys function more efficiently than do heterophils from commercial Line A turkeys and that the inefficiency of cellular function observed in heterophils from Line A turkeys may be associated with defects or insufficiencies in the intracellular signaling mechanisms related to the innate immune response.

Key Words: Turkey, Heterophil, MAP kinase, Protein tyrosine kinase, Innate immunity

P153 T-RFLP analysis of the gastrointestinal of broilers affected and unaffected with gangrenous dermatitis. K. Bos*¹, T. Neumann¹, D. Ritter², and T. Rehberger¹, ¹*Agtech Products, Inc., Waukesha, WI*, ²*Mountaire Farms of Delaware, Inc., Millsboro, DE.*

The gastrointestinal (GI) tract of a commercial broilers harbors a dense and metabolically active microbial community. This GI community has been shown to play a large role in animal performance and health status. Recently, gangrenous dermatitis (GD) has reemerged as a significant concern for poultry producers in the United States. One theory states that GD comes from pathogenic bacteria present in the GI community. GD can be treated with antibiotics, but the effects of these antibiotics on the GI microbial community are poorly understood. Classically, traditional plating methods are used to characterize microbial populations. Unfortunately, these techniques are limited in their ability to detect only cultivable microorganisms. The objective of this study was to use terminal restriction length polymorphism (T-RFLP) to: assess the GI microbial community in GD affected and unaffected birds both with and without antibiotic treatment, and

determine bacteria that are unique to each health status. GI tracts from broilers with and without GD symptoms in the same house were collected from farms in Delaware. Genomic DNA was isolated from the mucosal bacteria of the duodenum, jejunum, and ileum of each bird, and analyzed by T-RFLP to characterize the GI communities. Comparisons of terminal restriction fragment (TRF) patterns from the affected and unaffected birds indicated which TRFs appeared to be associated with diseased or healthy status. GD treatment with antibiotics altered the microflora within the GI community in a similar manner in both affected and unaffected birds. These bacterial changes are different than the changes seen in the affected and unaffected birds that had not received an antibiotic treatment. The preliminary identification of the bacteria associated with GD indicated by the TRFs are Clostridial spp., *Mycoplasma* spp. or phytoplasmas, and *Pasteurella* or *Actinobacillus* spp. While the bacteria associated with a nondiseased health status are *Lactobacillus* spp. Overall, T-RFLP has been an effective tool to monitor changes within the GI community of broilers both affected and unaffected by GD, with and without antibiotic treatment.

Key Words: T-RFLP

P154 RAPD comparison of *Clostridium perfringens* isolated from cases of necrotic enteritis and gangrenous dermatitis. T. Neumann*, S. Dunham, J. Skalecki, and T. Rehberger, *Agtech Products, Inc., Waukesha, WI.*

Clostridial diseases have become a major concern in today's poultry industry. Accompanied by high mortality and reduced efficiency they often inflict a heavy economic burden on producers. Necrotic enteritis and gangrenous dermatitis are among the most common clostridial diseases observed in broiler chickens. The anaerobic, spore-forming bacterium *Clostridium perfringens* is recognized as the causative agent of necrotic enteritis and has also been implicated in gangrenous dermatitis. This opportunistic pathogen is capable of producing a myriad of extracellular toxins and enzymes that degrade host tissues and are responsible for the necrotic lesions observed. RAPD PCR is a technique that can be used to generate a molecular fingerprint of a bacterial species or strain. These fingerprints can then be compared to determine the relationship among the organisms. The purpose of this study was to use RAPD PCR to determine if strains of *C. perfringens* isolated from cases of necrotic enteritis and gangrenous dermatitis are similar. Fourteen broilers showing signs of gangrenous dermatitis were collected for microbiological analysis from an East coast production system. Twenty-two broilers with necrotic enteritis from both East coast and West coast farms were also examined. A total of 153 *C. perfringens* isolates were recovered for the study. All of the isolates were confirmed as type A by a multiplex PCR that amplifies the four major toxins (α , β , ϵ and iota). Fingerprints generated by RAPD PCR were used to construct a dendrogram in order to study the relationship among the strains. Necrotic enteritis isolates from East and West coast sites clustered separately from gangrenous dermatitis isolates. However, East coast necrotic enteritis isolates were more related to East coast gangrenous dermatitis isolates than West coast necrotic enteritis isolates. These results show that geographic location is an important source of genomic variability in strains of *C. perfringens* type A.

Key Words: Necrotic, Enteritis, Gangrenous, Dermatitis, *Clostridium*

P155 Evaluation of combined sulfonamide activity toward *Pasteurella multocida* and *Escherichia coli* using *In Vitro* disk assays. J. Mathers* and S. Clark, *Alpharma Animal Health, Fort Lee, NJ.*

The soluble product PoultrySulfa™ is comprised of sulfamethazine, sulfamerazine, and sulfaquinoxaline at a 2:2:1 ratio, and is approved for use as an aid in controlling acute fowl cholera caused by susceptible *Pasteurella multocida* in chickens and turkeys, as well as an aid in controlling coccidiosis in chickens. An evaluation of the constituents of PoultrySulfa™ versus commercial and lab-prepared disks was made, to demonstrate activity versus poultry-derived *P. multocida* and *E. coli* and to compare with a commercial triple sulfa disk. Disks were prepared in the lab for sulfamethazine, sulfamerazine, sulfaquinoxaline, sulfadimethoxine, and PoultrySulfa™ at 0.25 mg per disk. A commercial SSS-25 disk (BD Diagnostics™, #231349) was run for comparison. Fourteen *P. multocida* strains and four *E. coli* were grown overnight and evaluated for disk susceptibility using standardized 6.5 mm diameter disks on Mueller-Hinton agar and incubation at 35°C. The inhibition zone diameters for *E. coli* were within expected QC ranges. For *P. multocida*, the SSS disk had the best zone diameter correlation with the lab PoultrySulfa™ disk ($r=0.831$) in comparison to the individual sulfonamides ($r=0.329-0.809$).

Key Words: Sulfonamide, Fowl cholera, Coccidiosis, PoultrySulfa™, Disk assay

P156 Serotyping of *Escherichia coli* isolates from an integrated poultry company in Mexico. G. A. Ramírez Barrera¹, A. Navarro Ocaña², C. Eslava Campos², and C. Rosario Cortés*¹, ¹*Aves, FMVZ, UNAM., México, D.F, Mexico,* ²*FM; UNAM, México D.F, Mexico.*

Escherichia coli is a common and important bacterial pathogen that causes at least 5% of the mortality in poultry flocks. Consequently, these bacteria are responsible for significant economic losses to the poultry industry. Pathogenic serogroups of *E. coli* are ubiquitous in environments in which poultry are raised and can cause air sacculitis, pericarditis, peritonitis, salpingitis, synovitis, osteomyelitis, cellulitis or yolk sac infections (YSI). Despite the enormous knowledge about Avian Pathogenic *E. coli* strains exists around the world, in Mexico few information is available. Recently, some articles have reported the characteristics about Mexican strains of *E. coli*. The objective of the present work was to analyze Mexican strains of *E. coli* isolated from a different company from the previously reported in order to determine the serotypes implicated in colibacillosis in Mexico. Ninety seven strains were isolated from samples obtained from Breeder Flock, Hatchery and Broiler Farm. All samples were seed onto MacConkey-Lactose agar, and Blood agar and incubated at 18 hours at 37 °C. Lactose positive strains were selected. Biochemical testing, and serotyping of *E. coli* were performed. The main serogroups identified were O? (19.58%), O20 (10.30%) O8 (7.21%), O131 (7.21%) and O25 (6.18%). These results did not correspond with those previously reported where the most important serogroups were O19 (12%), O84 (9%), O8 (6%) and O78 (5%). This data suggest that *E. coli* strains associated with colibacillosis in Mexico are diverse and it is necessary to perform further studies to determine the pathogenic properties of each group.

Key Words: *Escherichia coli*, Serotyping, Mexico, APEC

P157 Colicin production in *E. coli* strains isolated from a integrated poultry company in Mexico. S. I. Valencia García and C. Rosario Cortés*, *UNAM, México, D.F. Mexico.*

Recently, *E. coli* strains pathogenic to avian species have begun to be grouped as Avian Pathogenic *Escherichia coli* (APEC). Aside from causing embryo mortality, some common features of APEC strains including the production of colicin V, have also been described. Col V, an 88 amino acid polypeptide, is one of the most common among 20 known colicins. At present, Col V is not considered to be a pathogenic feature by itself. In a recent definition of pathogenicity; however, it was proposed that any trait that increases the proliferation or survival of a bacterium during the infection process could be classified as a virulence factor. Thus, Col V production could possibly be considered as a virulence trait since it contributes to the elimination of competing microorganisms. Moreover, it is known that plasmids that encode for colicins also contain genetic information for other virulence factors. The objective for this paper was analyzed the colicin production in *E. coli* strains isolated from a case of colibacillosis in a integrate company located in the Mexican State of Querétaro. Ninety seven strains were isolated from samples obtained from breeder flock, hatchery and broiler farm. All samples were seed onto MacConkey agar, and Blood agar and incubated at 18 hours at 37 °C. Biochemical tests to detect *E. coli* were performed. A technique for colicin detection were also performed. Forth phenotypes can be distinguished with the technique: 1) No production of colicins, 2) Production of Col V, 3) Production of Col V and other colicins and 4) Production of colicins different from Col V. The largest group was composed by those strains that produced colicins different from Col V (38.14%), followed by strains that produced Col V and other colicins (28.86%), No colicin producers (25.77%) and strains that only produced Col V (7.21 %). These results suggest that the strains associated to colibacillosis in Mexico are diverse since these results are different from those previously obtained. To better understand the importance of this feature in colibacillosis it is necessary to look for other virulence markers encoded in colicin plasmids.

Key Words: Colicin, *Escherichia coli*, Poultry

P158 Environmental management issues of arsenic in poultry litter. S. Burgos Cáceres*¹ and S. A. Burgos Cáceres², ¹*North Carolina State University, Raleigh,* ²*University of Guelph, Guelph, ON, Canada.*

Arsenic is a notoriously potent poisonous metalloid used as a component of pesticides, herbicides, insecticides and various alloys. Ingestion of arsenic, both from water supplies and animal tissues, has been scientifically linked as a potential cause of skin, liver, lung, kidney and bladder cancer. It can kill by allosteric inhibition of an important metabolic enzyme (lipothiamide pyrophosphatase) leading to multi-system organ failure, revealed post mortem by red colored mucosa due to severe hemorrhage. Poultry feedstuffs, mainly broilers, can contain trace amounts of arsenic in the form of organoarsenical feed additives such as Roxarsone for its growth-promoting and disease-controlling properties, especially to combat coccidiosis. Disposal of the resulting arsenic-bearing poultry litter is currently unregulated, and it is frequently used to fertilize croplands. Excessive manure applications as an alternative organic fertilizer coupled with abundant irrigation or torrential rains can lead to arsenic leaching and contamination of waterways. On January 22, 2001 the U. S.

Environmental Protection Agency adopted a new standard for arsenic in drinking water at 10 ppb, replacing the old standard of 50 ppb, through which all production systems must comply with the new standard by January 23, 2006. Faced with stricter federal regulations and an increasingly demanding customer base, the poultry industry must reassess the implications of managing arsenic levels in poultry wastes. Europe's ban on antibiotics -fully enforced by the beginning of 2006- and current discussions of adding more feed additives that would be faced out by 2016 places increasing pressures on poultry operators desiring to further penetrate foreign markets. In the case for organoarsenical feed additives, it has been suggested that poultry farms can adopt any combination of these three alternatives: 1) completely eliminate its inclusion and replace it with a natural non-toxic alternative, 2) drastically reduce its inclusion rate in diets, and 3) creatively devise another use for poultry wastes instead of land mass applications. Goals for the future include the replacement of coccidiostats with a vaccine.

Key Words: Arsenic, Poultry, Waste, Environment, Roxarsone

P159 Bacterial levels associated with poultry litter treatment (PLT) and aluminum sulfate (Alum). K. S. Mackln*, J. P. Blake, J. B. Hess, and R. A. Norton, *Auburn University, Auburn, AL.*

Litter treatments are commonly used to reduce ammonia and bacterial levels. In order to determine the effects of PLT and Alum on reducing bacterial levels two experiments were conducted. Both experiments were performed using clean pine shaving litter that was placed into 16 environmental chambers (2.44 x 2.44 x 2.44 m). Chicks were placed at a density of 70 chicks/pen. In both experiments there were four treatments, with each treatment getting four pens. The treatments comprised of a control (CON) and either PLT or Alum being applied at the following rates: 50, 100 and 150 lbs/1000ft². Both experiments had litter collected weekly from three areas within each pen for 7-weeks. Each sample had their pH and percent moisture determined. Bacteriologically total aerobic, anaerobic, Staphylococcus, and *C. perfringens* levels (cfu/g) were determined and the presence or absence of *Campylobacter* and *Salmonella* was determined. Bacterial counts and percent moisture data were transformed using log₁₀ and arcsine transformations, respectively. The data was analyzed using GLM with P<0.05 and significant means were separated using Tukey's.

The results for PLT show that with an application rate of 50 lb the pH was the same as the CON after 14 days (P<0.05). Both the 100 and 150 lb application rates kept the pH lower than the CON and 50 lb rate until day 49. The only difference detected bacteriologically was that the 150 lb rate had lower anaerobic bacterial numbers (11.8) then the CON (12.4) after 49 days (P<0.05). Alum treated litter produced a variable pH among the treatments; however the treatments that contained the highest levels maintained a lower pH (P<0.05) through day 49. Bacteriologically the only difference was observed at day 49 with the 150 lb Alum rate having lower anaerobic bacterial numbers (9.7) then CON (11.1) and the 100 lb treatment (11.4) at a P<0.05. From these results it was concluded that neither PLT nor Alum effect bacterial numbers significantly in fresh litter. The observation in reduced anaerobic numbers on day 49 at the highest application rate may imply that long term usage of these products may reduce some bacterial populations.

Key Words: PLT, Alum, Litter, Poultry, Bacteria

P160 Bactericidal effect of several chemicals on hatching eggs inoculated with *Salmonella* serovar typhimurium. N. A. Cox*¹, L. J. Richardson¹, R. J. Buhr¹, M. T. Musgrove², M. E. Berrang³, and W. Bright⁴, ¹USDA, ARS, Athens, GA, ²USDA, ARS, Athens, GA, ³USDA, ARS, Athens, GA, ⁴South Carolina State University, Orangeburg.

Breeder flocks and commercial hatcheries represent an early contamination point for *Salmonella* entry into commercial integrated poultry operations. Utilizing effective antimicrobial treatments for hatching eggs is a critical part of reducing the incidence of *Salmonella* colonized chicks on the farm. The objective of this study was to evaluate the bactericidal effect of several chemicals on *Salmonella* contaminated hatching eggs. Four replications (n=10/treatment) were conducted to determine the efficacy of seven commercially available compounds. The compounds tested were A) hydrogen peroxide B) water/oil emulsion droplets stabilized by detergent C) peroxyacetic acid D) four quaternary ammonium compounds attached to a polymer E) two quaternary ammonium compounds, one biquanide compound and bronopol attached to a polymer F) N-alkyl dimethyl benzyl ammonium chloride and stabilized urea and G) polyhexamethylenebiquanide hydrochloride (PHMB). A naladixic acid resistant *Salmonella* serovar Typhimurium was inoculated (10⁴ cfu/ml) onto fertile hatching eggs by drip inoculation. Controls included 1) a positive control (no spray application) and 2) water control (spray containing water to take into account rinsing effects). The E and G compounds had a 100% reduction and both of these chemicals included a biquanide. The D and C compounds were also effective with a 95% and 93.5% reduction, respectively. The B and F compounds were the least effective of all chemicals with a reduction of 40% and 47.5% respectively. Hydrogen peroxide, which has been used by the poultry industry, had a 70% reduction and the water control produced a 10% reduction. Several antimicrobials tested were more effective than hydrogen peroxide. More detailed studies will be required to adequately evaluate these antimicrobials.

Key Words: *Salmonella*, Eggs, Bactericide

P161 Efficiency of probiotics, prebiotics and synbiotics on weight increase of chickens. G. Zhang*, L. Ma, and M. P. Doyle, *University of Georgia, Griffin.*

With the ban of antibiotics use in animals in Europe, interests in using probiotics, prebiotics and synbiotics for controlling foodborne pathogens such as *Campylobacter* and *Salmonella* in poultry are increasing. There are numerous reports indicating that probiotics, prebiotics and synbiotics were effective in reducing *Campylobacter* and *Salmonella* colonization in poultry. Do they affect chicken growth? The objective of this study was to determine the effect of feeding probiotic bacteria, prebiotics, and synbiotics on weight gain of chickens. Probiotic bacteria (mixture CE 1 included 3 *Lactobacillus salivarius* strains, and mixture CE 2 consisted of CE1 and a *Streptococcus cristatus* strain) were isolated from healthy adult chickens. Prebiotics used were fructooligosaccharide (FOS) and lactose (2.5% in feed). Each treatment had 20 chickens. Day-of-hatch chickens of Ross x Ross were fed with probiotic bacteria at 10⁸CFU/chick once by gavage (Trials 1 and 2), or at 10⁶CFU/ml in drinking water for the first week except day 3 (Trial 3). On day 3, all treatment chickens were challenged with *Salmonella* Typhimurium at 10⁶CFU/chick by gavage (Trials 1 and 2) or through drinking water (Trial 3). Individual chickens

were weighed on day 9, 12, 15, 19, and 26. In Trial 1, treatments CE 1 only, CE2 plus FOS, CE2 only, and lactose only significantly ($\alpha = 0.05$) increased body weight by 83.0 to 100.5 g/chick at day 26 in comparison with control. In Trial 2, treatments CE2 plus lactose and CE2 only significantly increased body weight by 25.6 to 27.7 g/chick at day 12; treatment CE1 plus lactose significantly increased body weight by 42.3 g/chick at day 19. In Trial 3, at day 9 all treatments except for lactose only increased body weight significantly; there was no significant difference between treatments and control in body weight at day 15. It was observed that probiotics and synbiotics were effective in increasing body weight of chickens; prebiotics alone (FOS or lactose) did not have consistent effect on body weight gain of chickens. In conclusion, the probiotics and synbiotics studied could be used to increase weight gain of chickens.

Key Words: Probiotics, Prebiotics, Synbiotics, Poultry, Weight gain

P162 Determination of ileum microbial diversity by denaturing gradient gel electrophoresis analysis of 16S ribosomal DNA amplicons of broilers fed triticale- or corn-based diets and colonized by *Salmonella*. F. B. O. Santos*¹, B.W. Sheldon¹, A. A. Santos, Jr.¹, P. R. Ferket¹, M. D. Lee², A. Petroso², and D. Smith², ¹North Carolina State University, Raleigh, ²University of Georgia, Athens.

Diversity of the bacterial communities in the ileum of broilers was characterized using denaturing gradient gel electrophoresis (DGGE). DGGE separation of polymerase chain reaction (PCR) amplicons of the V2-V3 variable regions of the 16S rDNA is a common method to profile community diversity and has been used to assess the effects of diet and antibiotics on the ileal bacterial community of chickens. Broilers raised either in a litter house or in a non-litter cage system were fed either a finely ground corn- (control), a finely ground triticale- or a whole triticale-based diet from 0-42 d. Microbial DNA was extracted from the ileum content of 42 d broilers and the 16S rDNA gene was amplified by PCR and the amplicons separated by DGGE. Diversity indexes including richness, evenness, diversity, and pairwise similarities coefficient were calculated. Diversity indexes were related to the dietary treatments, housing designs and with changes in *Salmonella* populations of broiler ceca as characterized by the most probable number method (MPN). Higher microbial diversity indexes were observed among birds fed whole triticale-based diets and reared in the litter house. In contrast, finely ground grain treatments had lower microbial diversity and were more heavily colonized by *Salmonella* than the whole triticale treatment. The combination of higher dietary fiber content and increased coarseness of the diet by feeding whole triticale presumably stimulated microbial community diversity and discouraged *Salmonella* colonization through a competitive exclusion type mechanism.

Key Words: *Salmonella*, Broilers, Microbial diversity, Triticale, Whole grain

P163 Genotype analysis of *Campylobacter* spp. isolated from various internal organs of commercial broiler breeder hens. K. L. Hiett*¹, N. A. Cox¹, L. J. Richardson¹, R. J. Buhr¹, P. J. Fedorka-Cray², J. S. Bailey², and J. L. Wilson³, ¹USDA, ARS, PMS, Athens, GA, ²USDA, ARS, Athens, GA, ³University of Georgia, Athens.

Campylobacter spp. are presently believed to be the leading bacterial etiological agent of acute gastroenteritis in the human population. Evidence implicates poultry as a significant source of the organism for human illness; however, the pathways involved in *Campylobacter* spp. contamination of poultry flocks remain unclear. In an effort to further understand the dissemination of naturally occurring *Campylobacter* spp. through commercial broiler breeder hens, *Campylobacter* spp. isolates previously recovered from the primary and secondary lymphoid organs, liver/gallbladder, and ceca of broiler breeder hens were genotyped using flagellinA Short Variable Region (*flaA*-SVR) DNA sequence analysis. In general, two predominant subtypes were recovered from each flock (representing four different age groups) tested. Interestingly, the flocks tested at 22 and 66 weeks of age revealed two distinct subtypes, that upon further analyses, were determined to delineate into species specific (*C. jejuni* or *C. coli*) subtypes. Isolates that grouped in the *C. jejuni* specific subtype (all isolates recovered from week 66) were recovered from the liver/gall bladder, spleen, and thymus. However, this group did not contain any isolates recovered from the ceca. Isolates that comprised the *C. coli* specific subtype (recovered during weeks 22 and 66) were originally recovered from all locations tested. This investigation demonstrates that similar subtypes of *Campylobacter* spp. are naturally present within the internal organs of the bird's body. Further delineation of the initially observed difference in recovery locations between *Campylobacter* species is needed.

Key Words: Broiler Breeder, *Campylobacter*, Genotype, Internal organ

P164 Internal and external carriage of inoculated *Salmonella* in broilers during growout. J. A. Cason*, R. J. Buhr, L. J. Richardson, and N. A. Cox, *Russell Research Center, Athens, GA.*

Internal and external persistence of inoculated *Salmonella* and spread to uninoculated chicks in the same pens were studied by sampling ceca and rinses of feathered carcasses in two experiments. Half of the day-old chicks in pens were orally inoculated with a nalidixic-acid-resistant strain of *Salmonella Typhimurium* at three levels of inoculum (0.1 mL delivering approximately 4.0×10^2 , 10^4 , or 10^6 cfu). At 3, 6, and 8 weeks of age, equal numbers of inoculated and non-inoculated birds were electrocuted and rinsed in 400 mL of diluent, after which ceca were removed aseptically, with a total of 652 chickens sampled in the two experiments. There were no differences in *Salmonella* incidence between inoculated and non-inoculated birds at any age, so the marker *Salmonella* was well distributed within pens. Total incidence was 70%, 86%, and 83% at the 10^2 , 10^4 , and 10^6 inoculum levels, respectively. Considering both cecal and rinse samples, incidence was 81%, 84%, and 72% at 3, 6, and 8 weeks of age respectively. There were 95 positives in the cecal samples only, 149 positives in the rinses only, and 275 positives in both ceca and rinse samples, so sampling ceca alone underestimated the total incidence of the marker *Salmonella*.

Key Words: *Salmonella*, Growout, Sampling, Whole carcass rinse, Ceca

P165 Cumulative ammonia quantification from litter with instantaneous flux estimates. D. M. Miles*¹, D. E. Rowe¹, P. R. Owens², P. A. Moore, Jr.³, and D. R. Smith⁴, ¹USDA-ARS Waste

Management & Forage Research Unit, Mississippi State, MS, ²Purdue University, West Lafayette, IN, ³USDA-ARS Poultry Production and Product Safety Research Unit, Fayetteville, AR, ⁴USDA-ARS National Soil Erosion Laboratory, West Lafayette, IN.

Challenges, such as method viability and litter heterogeneity, persist in measuring NH₃ emitted from broiler housing. A chamber acid trap (CAT) system was designed to investigate NH₃ generation. The objectives of this work were to assess the variability of litter generated NH₃ using the CAT system and compare the CAT quantification of NH₃ to instantaneous (i-) flux estimates. Commercial litter, reusing pine shavings bedding, was collected prior to flock 19. The bulk sample was homogenized and randomly assigned in 50 g increments to each of 48 chambers. The CAT system provided approximately 100 ml/min of air to each 1000 ml chamber which exhausted into a series of two flasks containing boric acid. On selected days, the boric acid was titrated with HCl to assess NH₃ volatilization. The i-flux method inverted a 1.98 L container over a 93.8 cm² tray (chamber footprint) containing a litter sample. At roughly 2 min intervals, a photoacoustic gas analyzer drew in (and returned) the gas sample from the head space of the inverted container to determine NH₃ concentration. The CAT cumulative NH₃/chamber collected after 1 d averaged 9.05 ± 0.58 mg N and 52.40 ± 1.36 mg N on d 16. The cumulative NH₃ release was predicted as (mg N) = $15.7 \ln(\text{day}) + 7.16$, with $R^2=0.99$. Converting the cumulative NH₃ from the CAT experiment to flux units (mass/area/time) gave estimates of 40 mg m⁻² h⁻¹ on d 1 and 15 mg m⁻² h⁻¹ on d 16. The i-flux procedure indicated 54 mg m⁻² h⁻¹ at 2 min and 29 mg m⁻² h⁻¹ after 8.5 min. An NH₃ reduction over time is expected; the results indicate that the time selected for flux greatly impacts the magnitude of an estimate. Therefore, extreme care would be required to apply flux calculations in regulatory circumstances. The CAT system offers a viable method for lab-scale NH₃ volatilization mechanistic studies (effects of various physical/chemical/biological or systematic modifications). The relationship of cumulative NH₃ and i-flux requires further characterization, but promise exists for developing predictive models and correlation between the two methods to provide rapid assessment protocols for litter management as regulations for air quality emerge.

Key Words: Ammonia, Broiler, Flux, Litter

P166 Dietary lactose and its effect on the disease condition of necrotic enteritis. J. L. McReynolds*¹, J. A. Byrd¹, K. J. Genovese¹, T. L. Poole¹, S. E. Duke¹, M. B. Farnell², and D. J. Nisbet¹, ¹USDA-ARS-Food And Feed Safety Research Unit, College Station, TX, ²Texas A&M University, College Station.

Clostridium perfringens (CP) is the etiologic agent of Necrotic enteritis (NE) and is ubiquitous in nature. The incidence of NE has increased in poultry flocks that have stopped using antibiotic growth promoters. The mechanisms of colonization of CP and the factors involved in onset of NE are not fully understood. Previously, our laboratory has demonstrated that lactose could potentially reduce *Salmonella* and CP in ceca of poultry. In the present investigation, we hypothesized that dietary lactose would reduce the clinical signs of NE and could be used as an alternative to antibiotics. In Exp. 1, day-of-hatch broilers were fed either a non-lactose control diet, a diet with 2.5% lactose, or a diet with 4.5% lactose throughout the experiment. Birds were administered CP (10^7 cfu/mL) daily via oral gavage for three consecutive days starting on d 17. When evaluating the intestinal lesions associated with

NE, birds fed 2.5% lactose had significantly lower ($P \leq 0.05$) lesion scores ($0.70 \pm .52$) compared to the control ($1.55 \pm .52$) or the 4.5% lactose ($1.60 \pm .52$). Microbial analysis suggest that lactose did not affect bacterial populations during the 21d evaluation. In a replicate experiment the overall lesion scores in, were significantly ($P > 0.05$) reduced in birds fed 2.5% lactose compared to the birds fed the control diet with mean lesion scores of $1.10 \pm .73$ and $1.80 \pm .73$ respectively. These experiments suggest that lactose could be used as a potential alternative to growth promoting antibiotics to help control this costly disease.

Key Words: *Clostridium perfringens*, Chickens, Lactose, Necrotic enteritis

P167 Use of stochastic modeling to predict prevalence of *Salmonella* positive broilers entering the processing plant. D. E. Cosby*¹, J. S. Bailey¹, C. L. Hofacre², D. Cole³, M. Finklin², and B. J. Turner², ¹USDA, Athens, GA, ²University of Georgia, Athens, ³Georgia Dept. of Human Resources, Division of Public Health, Atlanta, GA.

In the U.S. salmonellae are responsible for approximately 15% (approximately 40,000 cases per year) of all food borne illnesses and improperly handled or undercooked poultry and eggs are often identified as a source of salmonellosis in humans. Since chickens are a major carrier for salmonellae, determining the prevalence of contaminated chickens entering a plant has become a priority in order to decrease the cross contamination of poultry products exiting the plant. Samples were collected from six individual houses on individual farms and the associated flocks at the processing plant from a single local integrator. On farm (boot socks, drag swabs, litter composites, cloacal swabs, ceca and carcass rinses) and in-plant (ceca and carcass rinses) samples were evaluated to determine the relationships between *Salmonella* prevalence on the farm to that found in the processing plant. Prevalence data was analyzed using Spearman correlation coefficients and regression to determine relationship between on farm data and plant data. Using the data collected, a stochastic model (Crystal Ball 7A®) was developed to predict the prevalence distribution of *Salmonella* spp., contaminated birds entering the plant. Boot socks showed the strongest correlation with plant carcass rinses ($r=0.7882$), and cloacal swabs were most predictive of plant ceca ($r=0.8111$), although neither was significant at $\alpha=0.05$.

Key Words: *Salmonella*, Prevalence, Stochastic Modeling, Broilers, Processing

P168 Collagen type X and transforming growth factor β -1 in tibia bones are affected by incubation conditions in broilers and turkeys. J. Small*, E. O. Oviedo-Rondón, M. J. Wineland, V. L. Christensen, D. T. Ort, K. M. Mann, M. D. Koci, and S. L. Funderburk, North Carolina State University, Raleigh.

Previous research in our lab has suggested that temperature (T) and oxygen (O₂) concentrations during the plateau stage of incubation affect several aspects of bone development. Collagen type X (colX) and Transforming Growth Factor β -1 (TGF β -1) are key indicators of the hypertrophic chondrocyte development and may have implications in tibial dyschondroplasia and other bone disorders. This experiment aimed to evaluate the effects of T and O₂ concentrations during the

plateau stage on the activity of colX and TGF β -1 in tibia bones of broilers and turkeys at day of hatch. Two experiments were conducted with broilers and two with turkeys, under similar conditions, to evaluate either 4 T (36, 37, 38 or 39 °C) or 4 O₂ concentrations (17, 19, 21 or 23% O₂). Two strains of chickens with low (LG) and high (HG) eggshell conductance, and one turkey strain of LG were evaluated in all experiments. In each experiment, standard incubation conditions were used for broiler eggs up to 17 days and turkey eggs up to 24 days. At day of hatch 10 chicks or poults per strain were randomly selected. Legs were dissected and tibias fixed for histological analyses by immunofluorescence. Cell density (cellID) in each zone of the growth plate was calculated in slides stained with H&E. Results indicated that high T depressed the fluorescence of colX and TGF β -1 in turkeys and chickens. This effect was more pronounced in the LG chicken strain. O₂ concentrations do not affect consistently the fluorescence of these proteins. CellID in the resting zone was increased ($P < 0.05$) by the high T in the incubator independently of genetic strain. Temperature also increased cellID in the P zone, but this effect varied according to the genetic line. CellID was not affected ($P > 0.05$) by T in the H zone, but both chicken strains had significantly different number of chondrocytes in this area. We concluded that high incubation T may reduce the presence of colX and TGF β -1 in chicken and turkey tibiotarsus with deleterious effects for bone development.

Key Words: Bone, Broilers, Turkeys, Collagen type X, TGF β -1

P169 Influence of lighting program, temperature, and strain on physiological stress and fear responses of broilers. L. B. Hooie*, R. J. Lien, and J. B. Hess, Auburn University, Auburn, AL.

Broilers of two strains were exposed to light and temperature treatments to evaluate effects on heterophil to lymphocyte ratio (H:L), plasma corticosterone, and tonic immobility duration (TI). Fifty males of moderate (MY) and high yield (HY) strains were placed by strain in 2 pens in each of 12 rooms. Six rooms were provided bright-long (2 FC; 23L:1D) and six rooms dim increasing (0.1 FC; 20L:4D, 1-10 d; 12L:12D, 10-21 d; 15L:9D, 21-28 d; 18L:6D, 28-35 d; 20L:4D, 35-55 d) light treatments. Beginning at 35 d, six rooms were exposed to typical temperatures (avg. daily high of 27C and low of 21C) and six rooms were subjected to cool temperatures (avg. daily high of 24C and low of 17C). Treatments and strains made up a 2 by 2 by 2 factorial arrangement.

At 53 d, H:L was unaffected by temperature but affected by a light treatment by strain interaction ($P=0.08$) in which the MY strain had increased H:L in the bright-long treatment and decreased H:L in the dim-increasing treatment; whereas, HY strain H:L were intermediate and unaffected by light treatment. Differences in plasma corticosterone at 33 d and 53 d were not significant but followed the same pattern as H:L. At 32 d, TI was significantly greater in the bright-long treatment and HY strain. At 49 d, TI was affected by a 3 way interaction in which the bright-long treatment decreased TI, except in the MY strain at typical temperatures. However, the dim-increasing treatment increased TI, except in the MY strain at typical temperatures. These results indicate that common lighting program and temperature differences may influence stress and fear responses of broiler strains differently.

Key Words: Broiler, Lighting program, Stress, Welfare, Tonic immobility

P170 Evaluation of one hydrogen peroxide disinfectant in floor eggs. V. D. Gonzalez-Reyes, G. Gómez-Verduzco, J. A. Quintana-Lopez, and O. Urquiza-Bravo*, *National University of Mexico, Mexico City, Mexico.*

All egg qualities are recognized as its structure and as a production unit, reason why today there are more exigencies in production.

Within the productive system there are many handling practices to obtain a free microorganisms product who could cause alteration like manual egg collection and the geographic location. On the other hand, the disinfection has had success in the destruction of present germs in shell surface without damage in the cuticle, and also no damage in the personnel who is applying it. Of products used in the disinfection of the fertile egg it appears the hydrogen peroxide (H_2O_2), which has demonstrated to be effective in the destruction of the microorganisms. It offers the advantage as fast evaporation or destruction (it is become in H_2O and O_2), does not leave scents disagreeable and it is not harmful to the people who apply it. That is why the objective of this work was to evaluate an hydrogen peroxide disinfectant in floor eggs, by external and internal bacteriological sampling, before and after the use of a disinfectant with hydrogen peroxide. 42 eggs from breeder Hy Line W 36 hens were collected from the Medicine Veterinary Faculty experimental farm of the National University of Mexico (UNAM). Each egg was washed with a phosphate buffered solution for an external bacteriological sampling before and after the application of the disinfectant and decimal serial dilutions were made to be plating in solid cultures. Later yolk was collected and it was plated in the same cultures. The application of hydrogen peroxide had a significant reduction ($P < 0.01$) compared to eggs with no disinfectant.

Key Words: Disinfectants, Hydrogen Peroxide, Floor Eggs

P171 The effect of egg shape and weight variation on hatchability and hatch of fertile in commercial broiler breeder flocks. J. R. Moyle*, D. E. Yoho, R. S. Harper, A. D. Swaffar, and R. K. Bramwell, *University of Arkansas, Fayetteville.*

Commercial breeder and hatchery managers have become increasingly concerned with the perceived variability of hatching eggs produced by modern broiler breeder hens. However, there is little published data in reference to the size and shape variation of broiler breeder eggs and the effect on hatchability. This study evaluated the variability in the weight and shape of eggs produced by hens of different flocks, ages and strains. Broiler breeder hatching eggs utilized were from commercial hatcheries representing different flocks, ages and strains. Individual egg weights were obtained to determine the variation within each flock. After obtaining egg weights, hatching eggs were separated by weight for that flock and returned to the commercial hatchery trays for incubation. To evaluate egg shape variation, dividing the width of each egg by its length created an egg shape index. Each egg was assigned a shape score value between 0-13 based upon this index. All eggs were incubated in commercial hatcheries by weight or shape group and a complete embryo diagnosis of the hatch residue performed. All data were analyzed using JMP statistic software comparing egg weight groups and egg shape index for differences in hatch traits. While there was no significant difference in hatchability between the heavy and average weight eggs for each flock, the light weight eggs from each group had as much as 9% lower hatchability. Additionally, eggs

assigned a shape index score that fell outside the normal curve for that flock had significantly reduced hatch of fertile (as much as 22.3% lower hatch for the more oblong eggs as compared to the normal shaped eggs). In summary, hatchability of fertile eggs within a flock is affected by the weight and shape variation within that flock with the lighter and more oblong eggs suffering higher embryo mortality as compared to the average size and shape eggs for that flock.

Key Words: Hatching egg weight, Hatching egg shape, Egg uniformity

P172 Effects of temperature variation in on-farm hatching egg holding units in commercial broiler breeder flocks. D. E. Yoho^{*1}, S. Henderson¹, A. D. Swaffar¹, S. Martin², and R. K. Bramwell¹, ¹*University of Arkansas, Fayetteville,* ²*Cobb-Vantress, Inc., Siloam Springs, AR.*

Hatching egg storage conditions have been evaluated in the past and recommendations presented to receive optimum hatchability. However, most commercial broiler breeder farms on-farm egg storage facilities are not capable of consistently maintaining the optimum storage conditions needed to maintain embryo viability. Therefore, this study was designed to study the effects of fluctuations in on-farm egg storage temperatures on hatchability and embryo livability in commercial broiler breeder flocks. Hatching eggs were obtained from commercial breeder farms the day of lay and prior to their placement in the existing on farm egg storage facilities. Hatching eggs were transported to egg storage facilities and were randomly divided into five groups of 288 eggs per group. Egg storage chambers were maintained at 66, 68, 70, 72 or 74⁰ F. All eggs were initially stored for 24 hours at 70 F (21.1 C) with the control eggs remaining at 70 F for three days. After 24 hours storage, equally sized groups of eggs were moved to either two or four degrees below or above the control group. Following this 24-hour period the eggs in the high and low temperature chambers were switched to the alternate high or low temperature group. These temperatures were selected to maintain an average of 70 degrees for all eggs for the three-day storage period. Eggs were then returned to a commercial hatchery for incubation. Following the incubation process, eggs from each treatment were subjected to a complete hatch residue breakout to determine percent hatch and hatch of fertile and embryo mortality. All data were analyzed using JMP statistical analysis program. Fluctuation of on farm egg storage temperatures reduced hatch and hatch of fertile by 3.6% and 2.9%, respectively. In summary, oscillating on-farm egg storage temperatures can cause a significant loss in hatchability.

Key Words: Hatching egg storage, On-farm egg storage, Hatchability

P173 Efficacy of the clay adsorbent, SOLISTTM-BASE, in ameliorating the toxic effects of aflatoxin in broiler chicks. H. Choudhury¹, L. B. Linares^{*1}, R. E. Kutz¹, D. R. Ledoux¹, G. E. Rottinghaus¹, A. J. Bermudez¹, R. B. Shirley², and F. A. Uraizee², ¹*University of Missouri, Columbia,* ²*Novus International, Inc., St. Louis, MO.*

An experiment was conducted to determine the efficacy of the adsorbent SOLISTTM-BASE, in ameliorating the toxic effects of aflatoxin (AF) in broiler chicks. A second objective was to determine the minimum

level of AF that would depress chick performance. Two hundred and fifty day-old male broiler chicks were assigned to a 2 x 5 factorial arrangement of dietary treatments (5 pens of 5 chicks/treatment) from hatch to day 21. Factors were level of adsorbent (0 or 0.2% SOLIS™-BASE) and concentration of AF (0, 0.75, 1.5, 2.25 or 3 mg AF/kg of diet). The addition of SOLIS™-BASE to chick diets at a level of 0.2% did not negatively affect ($P > 0.05$) chick performance, organ weight, or toe ash weight. Feed intake (FI) and body weight gain (BWG) was depressed ($P < 0.0001$) in chicks fed dietary AF concentrations of 1.5 mg AF/kg diet and higher. Feed intake depression ranged from 13 to 33%, whereas BWG gain depression ranged from 9 to 37%. The addition of SOLIS™-BASE to the AF contaminated diets ameliorated the effects of AF on FI (range 5 to 21%) and BWG (range 2 to 20%). Relative liver and kidney weights were higher in chicks fed AF ($P < 0.0001$), and the addition of SOLIS™-BASE to the AF-contaminated diets reduced ($P < 0.05$) the increase in the weight of both organs. Toe ash weights were lower ($P < 0.0001$) in chicks fed AF, and the addition of SOLIS™-BASE to the AF-contaminated diets increased ($P < 0.008$) toe ash weights. Results indicate that SOLIS™-BASE at 0.2% of the diet did not negatively affect chick performance, and was effective in reducing the toxic effects of AF. Data also indicate that a dietary concentration of 1.5 mg AF/kg diet was enough to depress chick performance.

Key Words: Aflatoxin, Adsorbent, Broiler chick, SOLIS™-BASE

P174 Effect of dietary energy and dietary protein in corn-soy diets on post-molt performance, egg components, egg solids and egg quality in phase 1 molted Hyline W-36 hens. P. Gunawardana*, G. Wu, M. M. Bryant, and D. A. Roland, *Auburn University, Auburn, AL.*

A 4 × 3 factorial experiment using four added dietary energy (fat) levels [0 (0.00), 79(1.67), 158(3.35) and 238(5.04) kcal ME/kg(%fat) and three protein levels (14.89, 16.06 and 17.38%) was conducted to determine the influence of dietary energy on performance, egg composition, egg solids and egg quality of Hy-line W-36 hens fed different protein levels. The basal diets of the 17.38, 16.06 and 14.89% protein contained 2751, 2784 and 2815 kcal ME/kg, respectively. This study lasted 12 weeks. Molted Hy-line W-36 hens (n=1440) phase 1 (70 weeks of age) were randomly divided into 12 treatments (8 replicates of 15 hens per treatment). Protein had a significant effect on feed intake, increasing dietary protein linearly increased feed intake from 93.15 to 98.75g/hen/day, resulting in a 6.01% increase of feed intake. Protein also had a significant effect on egg production, egg specific gravity, egg mass, feed conversion, egg weight, percentage of egg shell components, egg yolk color and yolk and albumen weight. Increasing dietary energy by addition of poultry oil also had a linear effect on feed intake at all three protein levels. As added dietary energy increased from 0 to 158 kcal ME/kg, feed intake linearly decreased. However a further increase of added dietary energy from 158 to 238 kcal ME/kg, had no additional effect on feed intake. Increasing dietary energy had a significant effect on egg specific gravity, body weight of hens, feed conversion and egg yolk color. There was a significant interaction between protein and dietary energy on egg specific gravity, percentage of egg yolk solids and egg yolk color. Increasing dietary energy and protein significantly improved feed conversion. Increasing protein intake significantly increased albumen and yolk weight but had no influence on yolk albumen or whole egg solids.

Key Words: Protein, Dietary energy, Hens

P175 Effect of dietary energy, protein and a versatile enzyme in corn-soy diets on hen performance, egg solids, egg composition and egg Quality of Hy-Line W-36 hens during phase two second-cycle. P. Gunawardana*, G. Wu, M. M. Bryant, and D. A. Roland, *Auburn University, Auburn, AL.*

A 4 x 2 x 2 factorial experiment of four energy levels and two protein levels with and without Rovabio was conducted to evaluate the effect of Rovabio Excel, dietary energy and protein on performance, egg composition, egg solids, and egg quality of commercial Leghorns. Hy-line W-36 hens (n=1920, 87wk old) were randomly divided into 16 dietary treatments (8 replicates of 15 hens per treatment). The trial lasted 12 weeks. Protein had a significant effect on feed intake, body weight, yolk solids, and yolk color. As dietary energy increased from 2,792 to 2,990 ME/kg, feed intake linearly decreased from 97.96 to 94.90 g per hen daily, resulting in a 3.1% decrease of feed intake. Added dietary energy had a significant linear effect on daily TSAA and lysine intake, with increase of added dietary energy from 0 to 198 kcal/kg, TSAA and lysine intake decreased by 3.09%. There was a linear response of body weight of hens to increased dietary energy. Dietary energy had a significant effect on yolk solids and yolk color. Egg weight of hens fed the diets supplemented with Rovabio was significantly higher than that of hens fed the diets without Rovabio during wk 3 and 4, and was numerically higher than that of hens fed the diets without Rovabio during other weeks. Rovabio supplementation significantly increased body weight of hens. These results suggest Rovabio had a significant influence on energy utilization of commercial Leghorns during phase 2 of second cycle. More research is needed with Rovabio in young hens to evaluate performance and profits of commercial layers at different egg and ingredient prices.

Key Words: Rovabio, Energy utilization, Hen

P176 The effect of exogenous xylanase on dietary energy, N and amino acid metabolism when included in wheat-based diets and fed to layers. V. Pirgozliev*¹, T. Acamovic¹, O. Oduguwa^{1,2}, and M. R. Bedford³, ¹Scottish Agricultural College, ASRC, Edinburgh, United Kingdom, ²University of Agriculture, Abeokuta, Nigeria, ³Syngenta Animal Nutrition Inc., Marlborough, United Kingdom.

Wheat is an important source of energy and amino acids in poultry feed throughout the World. However, the cell walls in wheat are mainly composed of non-starch polysaccharides (NSPs) that may possess antinutritive activity increasing digesta viscosity and reducing bird performance. Exogenous xylanases are enzymes that cleave the NSPs in wheat and reduce their negative effect on the performance. Most published data relates to broiler production and there is a lack of information on the effect of xylanases in layer diets and especially on the effects on dietary energy, nitrogen (N) and amino acid (AA) metabolism. Although energy relates mainly to growth performance, the metabolism of N and AA has also a significant environmental impact. To examine the effect of a novel xylanase (Quantum, Syngenta Animal Nutrition) on performance, dietary energy, N and AA metabolism, five wheat-based diets (control (C), C + 400, + 800, + 1200, + 1600 XU (xylanase units/kg feed)) were fed to eight hundred and ten Lohmann Brown laying hens (28-32w age) in 270 cages (3 birds in a cage). Xylanase supplementation improved N metabolisability and the intake of metabolisable N by 6.3% ($P=0.015$) and 4.2% ($P<0.001$) respectively. The metabolisability coefficients for total and dispensable amino acids also improved ($P<0.05$) by 7.2% and 6.5% respectively.

Dietary xylanase increased ($P=0.019$) sulphur metabolisability by approximately 2% suggesting an improvement in the utilisation of S-containing amino acids. Dietary AME tended ($P=0.152$) to increase with enzyme supplementation. Feeding xylanase also improved ($P<0.05$) the market quality of the eggs increasing the yolk colour and decreasing the number of blood spots. The results of this study showed that dietary xylanase improved the egg quality as well as the metabolisability of N and AA in diets of laying hens thereby reducing adverse environmental impacts.

Key Words: Xylanase, Layers, Amino acids, Egg quality

P177 Requirements for true digestible isoleucine, threonine, and tryptophan for 28 to 36-week-old laying hens. S. Roberts¹, B. Kerr², D. Hoehler³, and K. Bregendahl*¹, ¹*Iowa State University, Ames*, ²*NSRIC, USDA/ARS, Ames, IA*, ³*Degussa, Kennesaw, GA*.

Three separate experiments were conducted with Hy-Line W-36 hens to evaluate the true digestible (TD) Ile, Thr, and Trp requirements for egg production (EP), egg weight (EW), egg mass (EM), and feed efficiency (FE). The experiments were conducted simultaneously and were each designed as a randomized complete block design with 60 experimental units (each consisting of 1 cage with 2 hens) and 5 dietary treatments. The treatment diets consisted of a common basal diet (2987 kcal/kg ME; 12.3% CP), formulated using corn, soybean meal, and meat and bone meal. The TD amino acid contents in the basal diet were determined using the total fecal collection precision-fed assay with adult cecectomized roosters. Crystalline L-Ile, L-Thr, and L-Trp (considered 100% TD) replaced cornstarch in the basal diet to yield TD contents of 0.37, 0.50, 0.64, 0.78, and 0.92% Ile; 0.38, 0.45, 0.53, 0.60, and 0.67% Thr; and 0.09, 0.13, 0.17, 0.21, and 0.25% Trp. Crystalline amino acids were added to the test diets at the expense of cornstarch to make the respective test amino acid first limiting. The hens were fed the treatment diets from 26 to 34 wk of age, with the first 2 wk considered a depletion period. EP was recorded daily; EW was determined weekly on 48-h eggs; whereas EM (= EP × EW), feed intake (FI), and FE (= gram EM per gram feed consumed) were recorded weekly. The requirements were determined using the broken-line regression method. The daily FI of hens fed amino acid-adequate diets was 83 g/hen. The maximum responses for EP (%), EW (g), EM (g/hen), and FE (g/g) were 90.5, 53.2, 48.1, and 0.586 for Ile; 93.3, 53.4, 49.8, and 0.588 for Thr; and 91.7, 53.1, 48.7, and 0.573 for Trp; respectively. The daily requirements for maximum EP, EW, EM, and FE were 427, 394, 426, and 415 mg/hen for TD Ile and 400, 418, 414, and 461 mg/hen for TD Thr, respectively. The daily TD Trp requirements for maximum EP, EM, and FE were 119, 120, and 95 mg/hen, respectively. EW was not affected ($P > 0.05$) by Trp consumption.

Key Words: Amino acid requirements, Laying hens

P178 An adjustable nutrient margin of safety comparison using linear and stochastic programming in an Excel spreadsheet. W. B. Roush*, J. L. Purswell, and S. L. Branton, *USDA-ARS Poultry Research Unit, Mississippi State, MS*.

With the diversion of corn to the biofuel industry, it will be necessary to use feed ingredients that have highly variable nutrients. Stochastic

programming is a nonlinear programming approach to constrain risk when dealing with nutrient variability. The use of a margin of safety was suggested by Nott and Combs (1967) as a method to adjust the nutrient matrix to compensate for nutrient variability. To make the adjustment, they suggested subtracting one half of a standard deviation from the mean value of nutrients. This would increase the probability of meeting an animal's requirement from 50% for a LP to 69% for a LP. Pesti and Seila (1999) illustrated how linear programming (LP) and stochastic programming (SP) could be formulated in an Excel spreadsheet program. They used two different scenarios, one showing LP and the other showing SP. The intent of this research is to build upon the work of Pesti and Seila by demonstrating a comparison of LP and SP based on the linear problem proposed in their paper. An Excel workbook was developed consisting of two spreadsheets for LP and SP, respectively. Both approaches use the Solver function for optimization. Ingredients and nutrients were based on the formulation problem for the LP in Pesti and Seila and served as a benchmark for development of the two programs. Standard deviations for energy and the nutrients calculated from CVs, (Zhang, 1999) and from the commercial publication of sources for amino acids (Degussa, 2001). The conclusion was that the Excel spreadsheet effectively demonstrated the difference in accuracy and precision of SP versus LP in least cost formulations at a requested risk constraint. At the 50% level of risk, both programs produced the same ration formulations as was expected. At the requested 69% level of risk, the linear program formulated a ration with a 77.26% level of risk while the stochastic program formulated the requested level of 69%. The 77.26% produced a higher cost ration than the 69% stochastic ration.

Key Words: Feed formulation, Linear programming, Stochastic programming

P179 Influence of microbial phytase on true phosphorus digestibility in canola meal fed to broiler chicks. A. Akinmusire* and O. Adeola, *Purdue University, West Lafayette, IN*.

Using canola meal (CM) as a model ingredient, our objectives in the study were the application of the regression analysis technique to estimate true P digestibility (TPD) in broiler chicks and the quantification of microbial phytase influence on TPD. Two hundred and eighty eight male broiler chicks were assigned to 6 dietary treatments from day 15 to 21. Experimental diets fed consisted of three graded levels of CM with or without phytase supplementation (a total of six semi-purified and isocaloric diets) in a 3×2 factorial arrangement. Sequential diets formulated with CM (diets 1 through 3) were calculated to contain 1.06, 2.11, and 3.17 g of phytate P/kg of diet respectively. Diets 4 through 6 were identical to diets 1 through 3; except for the addition of Phyzyme XP phytase at 1,000 units (FTU)/kg. Chromic oxide was added to the diets, and P digestibility was calculated using the index method. As dietary P increased from 1.74 to 4.94 g/kg DM and from 1.65 to 4.84 g/kg DM for the phytase unsupplemented and supplemented diets, respectively, total P output in prececal digesta and total P output in excreta expressed on a dry matter intake basis linearly increased ($P < 0.01$). In addition a clear positive effect ($P < 0.01$) of phytase was observed in the total P output in prececal digesta and total P output in excreta. Estimated true prececal P digestibility was observed to differ ($P < 0.01$) between CM without phytase and with phytase (68 vs. 78% respectively). Phytase supplementation equally resulted in a difference ($P < 0.01$) between true total tract P retention (36 vs. 44%). It may be concluded from this study that approximately

68 and 36% of total P in CM could be digested and absorbed by growing chicks as measured from the prececal digesta and total tract excreta respectively; and that the addition of microbial phytase at 1000 U/kg significantly increases this true prececal P digestibility and true total tract P retention value to approximately 78 and 44% respectively.

Key Words: Canola meal, Chicks, Phosphorus, Phytase, True digestibility

P180 Implications of dietary threonine on crude mucin excretion in broiler chicks and ducklings. N. Horn* and O. Adeola, *Purdue University, West Lafayette, IN.*

The effect of dietary threonine on crude mucin excretion was investigated in male broiler chicks and White Pekin ducklings. Seventy-two birds of each species were fed a standard poultry starter diet from day 0 to day 14, then assigned to 3 dietary treatments in a randomized complete block design for a 7-day feeding trial. The dietary treatments consisted of a semipurified isonitrogenous corn-soy bean meal based diet with the addition of crystalline amino acids and graded levels of threonine. Dietary treatments contained approximately low (0.33g/kg), medium (0.58 g/kg), and adequate (0.82 g/kg) levels of threonine based on NRC recommendations. Chromic Oxide was added to the dietary treatments as an indigestible marker. Excreta was collected from day 5 to day 7 of the feeding trial, immediately frozen, and later freeze dried and analyzed for crude mucin. For broiler chicks there was a tendency for linear increase in growth performance ($P < 0.10$) for the 7 day feeding trial, and there were linear increases in dry matter retention ($P < 0.001$) and crude mucin excretion ($P < 0.05$) in response to dietary threonine. For ducklings there were linear increases in growth performance ($P < 0.01$), dry matter retention ($P < .001$), and a tendency for a linear increase in crude mucin excretion ($P < 0.10$) in response to graded levels of dietary threonine. In conclusion, dietary threonine affected dry matter retention, and crude mucin excretion in broilers, whereas in ducklings, growth performance, dry matter retention, and crude mucin excretion were affected. Dietary threonine clearly has implications in regards to dry matter retention, and may be a significant factor in mucin production, with consequences on nutrient absorption in chicks and ducklings.

Key Words: Chick, Duck, Growth, Mucin, Threonine

P181 Enzymatic process of feather meal for improved digestibility. B. E. Spencer*¹, W. C. Huang¹, J. J. Wang², and J. C. H. Shih¹, ¹*North Carolina State University, Raleigh*, ²*BioResource International, Inc., Morrisville, NC.*

Feather meal is typically produced by processing feathers by batched or continuous cooking under 130-140°C steam pressure for 30-40 min followed by drying and grinding. As a feed ingredient, feather meal, with a protein content of 85-90%, is underutilized due to its poor digestibility. A preparation of keratinase (KE, 300,000 U/gm), a feather-degrading enzyme, was tested to process feather meal with improved digestibility and nutritional value. An ANCO-Eaglin 133L pilot-scale batch cooker with internal agitator (25 rpm) was used for the study. Feather meal was produced in the lab by mixing 5 kg raw feathers with 6 L of water or buffered solution and cooking at 141°C

for 30 minutes, followed by a 5 min vent drying. The final products were dried overnight at 70°C and ground. To test the KE effect, four kinds of feather meal were produced: FMc (control), produced by the standard procedure using water, FMb, produced by using buffer solution (pH 8.0), FMKE5, and FMKE50, cooked with buffered solution and cooled to 60°C, followed by adding KE at 0.1% and 1.0% (w/w = KE: feathers) respectively. The cooked feathers were incubated for 30 minutes at 50-60°C with agitation, dried for an additional 48 hrs at 60°C and ground. Different preparations of feather meal were analyzed using 0.02% pepsin digestion, OPA soluble protein assay and HPLC amino acid analysis. With enzyme treatments, the protein digestibility determined by pepsin and OPA assays showed significant improvement from an average of 52% to 72% for FMKE5 and to 69% for FMKE50. Crude protein levels, as determined by Kjeldahl nitrogen, were highest for FMc at 90.0% and lowest for FMKE50 at 87.8%. Lysine levels were lowest in the FMc at 1.77% and highest in FMKE50 at 1.94%. Methionine levels were equal within 0.03% for all treatments. Cysteine levels were lowest in FMc at 4.89% and highest for FMKE5 at 5.72%. KE treated feather meals demonstrated better in vitro digestibility when compared to both the water and the buffer controls. Further analysis will include animal studies for the correlation of amino acid digestibility and nutritional value of the enzymatically processed feather meal.

Key Words: Feather meal, Hydrolysis, Enzyme, Keratinase, Amino acid digestibility

P182 Impact of Availa® /M on growth, feed conversion, femur spiral fracture related mortality, bone morphometrics and carcass yield in tom turkeys. T. Cheng* and T. Ward, *Zinpro Corporation, Eden Prairie, MN.*

A total of 900 Nicholas Strain 88 commercial toms were randomly placed into 36 pens. The treatments consisted of (1) Sulfates [100 ppm Zn from ZnSO₄ and 110 ppm Mn from MnSO₄]; (2) Availa-Z/M ON TOP [Availa-Z/M supplied 40 ppm of Zn and 40 ppm of Mn in addition to their respective ZnSO₄ sources]; (3) Availa-Z/M ISO [Availa-Z/M replaced 40 ppm Zn and 40 ppm of Mn from their respective ZnSO₄ sources]. No significant difference among the treatments were observed for the final body weight at 140 days of age (20.08, 19.95 and 19.81 kg, respectively). The cumulative feed conversion from the Availa-Z/M ON TOP and Availa-Z/M ISO groups were significantly better than that of the Sulfate group (2.639, 2.575 and 2.568; $P = 0.15$). Overall mortality was not statistically affected by treatments but the Availa-Z/M groups showed numerically lower 106-140 day mortality (7.1, 3.7 and 4.4%) and significantly lower percentage of mortality due to spiral fracture of femur bone (43, 10 and 3%; $P = 0.05$) when compared to the Sulfate group. The Availa-Z/M groups had numerically better breast meat yield (30.83, 31.03 and 30.94%). The long-axis diameter of femur at one third of femur length from the top was significantly longer in the Availa-Z/M groups (19.58, 20.23 and 19.89 mm; $P < 0.01$). The Availa-Z/M groups produced numerically larger cross sectional average of cortical bone wall area when compared to the sulfate group (101.55, 104.07 and 103.60 mm²). Feeding Availa-Z/M to turkeys improved bone morphometrics, reduced femur spiral fracture related mortality as well as late mortality, improved feed conversion and increased carcass weight and breast meat yield.

Key Words: Zinc, Manganese, Turkey, Femur spiral fracture, Performance

P183 A workbook to estimate parameters for nutritional response models. G. Pesti* and D. Vedenov, *University of Georgia, Athens.*

Experiments to determine nutritional requirements result in a set of ordered pairs of data consisting of the inputs and outputs. The inputs are various levels of the nutrient in question, and the outputs are response criteria like growth, feed utilization efficiency, carcass yield, measures of bone strength, etc. A Microsoft Excel (One Microsoft Way Redmond, WA 98052 USA) workbook has been prepared to fit several nutritional response models to experimental input/output data. The workbook, called "NRM.xls" and a tutorial on its use are available free of charge at (<http://pubs.caes.uga.edu/caespubs/ES-pubs/RB440.htm>). NRM.xls attempts to find the best parameter estimates for seven common nutritional models: the Broken Line (ascending linear or quadratic segments), Saturation Kinetics, three and four-parameter Logistics, Compartmental, Sigmoidal Exponential, and Exponential Models. Excel has a built-in module called "Solver" that is used in NRM.xls to minimize the sum of squared errors by changing the values of the parameter cells. In addition to parameter estimates, spreadsheets for each model also calculate the standard errors and 95% confidence intervals for the estimated parameters, as well as goodness of fit (R^2) values of the fitted models.

Each spreadsheet allows for up to 100 pairs of observations to be either entered manually or copied and pasted. Users can modify initial parameter estimates manually to achieve a "visual" fit of each regression model to the data. The "visual" fits result in good starting values for the numerical optimization algorithm and make it easier for the program to find the global minimum SSE and best parameter estimates. Knowing the confidence interval in the requirement estimate or response line enables researchers to determine the value of the experiment. Small confidence intervals suggest adequate replication and reproducible results.

Key Words: Requirement, Modeling

P184 Undergraduate teaching laboratory: Hens age, induced molting and storage effects on egg size and quality. G. M. Pesti*, R. I. Bakalli, and M. Y. Shim, *University of Georgia, Athens.*

The objectives of this laboratory exercise are 1) to demonstrate the changes in egg quality that occur during the life cycle of hens laying commercial eggs; and 2) to demonstrate the influence of egg storage time and conditions on changes in egg quality. We have been able to consistently demonstrate significant differences with HyLine W-36 leghorn : 64 young pullets (average age at start = 18.25 weeks) and 126 hens, half of which were molted (average age at start = 73.5 weeks). Birds were housed one per cage with 8 cages per replicate and 8 replicates per treatment. Two weeks before the end of experiment 12 eggs were randomly collected from each replication and half each were kept refrigerated (5 °C), and at room temperature (20-24 °C). Parameters measured/calculated include: egg weight, egg specific gravity, Haugh units (HU), relative weight of yolk and albumen, relative egg shell weight, egg shell surface, egg shell index, egg shell thickness, and egg weight decrease. Molted hens produced fewer, but 1.56 g heavier, eggs than un-molted hens (67.14 vs. 65.58, $P>0.05$). Positive significant effects were observed in specific gravity for molted hens, un-molted hens, and pullets ($P=0.0007$; 1.084^a, 1.079^b, and

1.088^a g/cm³, respectively) and HU ($P<0.001$; 79^b, 67^c, and 95^a, respectively, $P<0.05$). Significantly different egg shell surface was observed only between old and young hens. There were no significant differences between treatments in yolk or albumen relative weights, relative egg shell weights, or in shell index or egg shell thickness. Egg weight loss for molted hens, un-molted hens, and pullets was significantly different only in eggs kept refrigerated ($P=0.0335$; 0.78^a, 0.97^{ab}, and 1.21^b%, respectively). Haugh units remained better for eggs from young hens kept refrigerated ($P<0.0001$) as well as for eggs kept in room temperature ($P<0.0001$). The laboratory exercise described allows students to learn how molting, hens age and storage conditions significantly influence on egg size and quality.

Key Words: Laboratory exercise, Leghorn, Molting, Storage, Egg quality

P185 Nutrient digestibility in broilers with inclusion of inulin in the diet. J. A. Hernández Lara*¹, M. E. Juárez Silva¹, F. Pérez-Gil Romo¹, and D. Ortega Alvarez², ¹*Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, México, D.F, México,* ²*Megafarma S.A. de C.V, México, D.F, México.*

The use of inulin in the diet of chickens as an alternative of using antibiotics has improved performance and enzymatic activity in the intestinal lumen. Results about the effect of inulin on starch and protein digestibility make available information to design strategies to follow on broilers feeding. The objective of this study was to determine the effect of inulin on apparent digestibility of starch and protein during the first 3 weeks of life. 10 experimental units were used for every treatment, formed by 2 Ross chickens, being the treatments: 0.0%, 0.1%, 0.2% and 0.4% of inulin in the diets with a base of maize-soya. Samples were taken on day 7, 14 and 21 of age, Cr2O3 was included in food as a marker to determine digestibility. Results of starch and protein digestibility showed improvement on day 7 with inulin concentration of 0.4%, while for day 14 and 21 the highest values were obtained with 0.2%. A positive linear relationship between inulin concentration and digestibility for both nutrients on day 7; for day 14 the relationship stayed only for protein; and for the last period this relationship was negative for both nutrients. These results indicate that inulin concentrations to improve starch and protein digestibility during the first 21 days of chicken's life are 0.4% for the first week and 0.2% for the second to third week.

Key Words: Inulin, Digestibility, Prebiotic, Starch, Protein

P186 Supplementation with MINTREX® organic trace minerals enhances intestinal health and feed efficiency of turkey poults. D. Bohórquez*¹, A. Santos¹, P. Ferket¹, and J. Richards², ¹*North Carolina State University, Raleigh,* ²*Novus International, Inc., St. Charles, MO.*

Dietary MINTREX Pse (MIN, Novus) and 25-hydroxycholecalciferol (HYD) supplementation may improve feed efficiency by enhancing intestinal health through mucosal characteristics. Day-old Nicholas toms were randomly distributed within 12 replicate pens (15 poults/pen) per treatment (TRT) and fed diets that met or exceeded NRC recommendation until 21d. TRT were a 2x2 factorial (0 and .1% MIN; 0 and

92 mcg/kg HYD). The .1% MIN provided 40 ppm Zn, 40 ppm Mn, and 20 ppm Cu as methionine hydroxy analogue complex and .3 ppm Se as Se yeast. All the diets contained similar trace minerals levels (150 ppm Zn, 150 ppm Mn, and 145 ppm Cu). Body weight (BW) and cumulative feed:gain (cFCR) were determined at 21d of age. At 7d, ileum histomorphometry (10 villi/bird) were measured (10 poult/RTT). Villus height (VH), apical width (VAW), basal width (VBW), crypt depth (CD), muscularis depth (MD) and mucosal height (MH) were determined. Villus height-crypt depth ratio (V/C) and apparent villus surface area (VS) were calculated. At 21d, there were no TRT effects on BW, yet a significant MINxHYD effect on cFCR revealed that MIN significantly reduced cFCR only in combination with HYD (1.321 vs 1.301, $p < .05$). At 7d, significant MINxHYD effects were observed on CD, MD, and V/C. MIN increased CD (42.9 vs 62.2 mcm, $p < .01$), increased MD (63.4 vs 97.8 mcm, $p < .01$) and decreased V/C (10.2 vs 7.0, $p < .01$) with 92 mcg/kg HYD, but not without HYD. However, HYD reduced CD (62.2 vs 42.9 mcm, $p < .05$), reduced MD (97.8 vs 63.4 mcm, $p < .01$) and increased V/C (7.0 vs 10.2, $p < .05$) at 0% MIN but not with .1% MIN. VBW was significantly increased with MIN supplementation (101.7 vs 116.3 mcm, $p < .01$), whereas VAW was decreased by HYD (70.1 vs 60.7 mcm, $p < .01$). MINTREX Pse supplementation for turkeys may be an effective way to improve feed conversion, likely by enhancing lateral development of the villus, especially when supplemented in combination with HYD.

Key Words: Turkeys, MINTREX, Organic trace minerals, Feed efficiency, Gut health

P187 Reduction of *Salmonella* shedding of commercial broilers flocks of North Carolina farms by dietary wheat and enzyme supplementation. A. A. Santos Jr*, P. R. Ferket, F. B. O. Santos, and B. W. Sheldon, *North Carolina State University, Raleigh*.

Salmonella (SA) colonization in poultry may be influenced by the degree of competitive exclusion from enteric microflora affected by diet formulation. A study was conducted to determine the effect of inclusion of wheat to the diet and dietary enzyme supplementation on SA shedding of commercial broiler chickens (Cobb). As preliminary data (0d), fresh fecal samples were taken from 4 farms (4 houses/farm), such that each farm had broilers of different ages (7, 14, 21, 35d) and fed corn/soy-based diets. Subsequently, 1d old chicks were placed at 4 farms, fed corn/soy/wheat-based diets (whole wheat with 625EXU/kg of xylanase-blend mixed in before pelleting: 25% 1-14d; 5% 14-18d; 0% 18-35d) and fresh fecal samples were collected from these birds on 7, 14, 28 and 35d. Fecal SA prevalence and populations (Log MPN/g) were enumerated using the most probable number (MPN) procedure. Before inclusion of wheat to the diet (0d), SA was recovered from all farms and from 70% of the houses with an average of 2.18 Log MPN/g. After 7d, SA prevalence (75% house, 100% farm) and population (2.66 Log MPN/g) were not statistically different from the preliminary data ($P > .05$). However, SA prevalence (31% house, 50% farm) and population (1.03 Log MPN/g) were significantly ($P < .05$) lower at 14d than at 0 and 7d. After 10 d of dietary wheat withdrawal (28d), farm SA prevalence (75%) increased and was not statistically different ($P > .05$) from the levels of 0 and 7d. However, SA prevalence among the houses (38%) and population (1.29 Log MPN/g) were low and similar to the levels observed at 14d, yet different ($P < .05$) from the other days (0, 7, 35 d). At 35d (17d after wheat withdrawal), SA shedding increased and levels were similar ($P > .05$) to 0 and 7d.

Additionally, 70% of the houses and 75% of farms, were SA positive with a mean fecal population of 2.25 Log MPN/g. Intestinal colonization and fecal shedding of *Salmonella* was discouraged by dietary inclusion of whole wheat and an enzyme blend containing xylanase.

Key Words: Broilers, Whole Wheat, Xylanase, *Salmonella*, Diet Formulation

P188 Effect of a new coating on the thermotolerance of a phytase product. T. Gravesen^{*1}, S. Dalsgaard¹, and B. Fryksdale², ¹*Danisco Innovations, Brabrand, Denmark*, ²*Genencor International Inc., Palo Alto, CA*.

Phytase is used as an animal feed ingredient globally to improve phytate phosphorus digestibility. Phytases are used in the feedmill in liquid form, applied post-pelleting or in dry form added into the feed mixer. A large proportion of the feed used in the poultry industry is manufactured via steam conditioning and pelleting processes and is therefore subjected to high process temperatures, frequently in the range 85-90°C (185-194°F). Most commercially available phytases lack intrinsic thermostability and require protection in a dry form to survive the subsequent conditioning and pelleting process. A study was carried out at the Technological Institute, Kolding, Denmark to investigate the effect of a new coating on the thermotolerance of a phytase product (Phyzyme XP; 6-phytase, EC 3.1.1.3.26). The study compared the uncoated phytase product (phytase P), a test coated phytase product (coated phytase P) and another commercially available coated phytase product (phytase R). The phytase products were included in feed at a dose rate of 5000 FTU/kg feed. The feed was subjected to conditioning temperatures of 90°C (194°F) or 95°C (203°F), under standardised processing conditions, representative of the feed industry: corn diet, steam conditioning time 30 seconds; inlet steam pressure 2 bar; pellet diameter 3mm. Phytase activity in the final pelleted feed was expressed as a percentage recovery of the activity in the corresponding mash feed, before processing. Recovery values at 90°C (194°F) for phytase P, coated phytase P and phytase R were 30.3%, 98.6% (SED 6.08%) and 75.1% respectively. Recovery values at 95°C (203°F) for phytase P, coated phytase P and phytase R were 22.5%, 96.3% (SED 7.32%) and 66.4% respectively. In conclusion, applying a new coating to phytase P gave acceptable thermostability up to 95°C (203°F) and resulted in 74% and 30% more phytase activity being recovered following pelleting at this temperature, compared to the uncoated phytase P and phytase R respectively.

Key Words: Enzyme, Phytase, Pelleting, Thermostability, Recovery

P189 Effects of synbiotic and phytogenic feed additives on performance and immune status in broilers. T. Steiner¹, A. Kroismayr¹, M. Mohnl^{*1}, R. Nichol², and S. Attamankune³, ¹*BIOMIN GmbH, Herzogenburg, Austria*, ²*BIOMIN Laboratory Singapore, Lumlukka, Thailand*, ³*Kasetsart University, Kamphaengsaen Nakhon Pathom, Thailand*.

The aim of the trial was to investigate the efficacy of a synbiotic and phytogenic product in comparison to an AGP in broilers. The synbiotic preparation was based on different probiotic strains and fructooligosaccharides (FOS), whereas the phytogenic formula

contained a blend of essential oils and FOS. 2400 one-day-old Ross broiler chicks were assigned to four dietary treatments, comprising 10 replicates per treatment (5 replicates for male and 5 replicates for female) with 60 birds per replicate. The treatments were (1) negative control (NC), (2) NC + synbiotic, (3) NC + phytogetic, (4) NC + AGP (Flavomycin). The synbiotic (Biomim® PoultryStar) was applied via the drinking water on the first three days and at each vaccination, whereas the phytogetic (Biomim® P.E.P.) and AGP were added to the feed throughout the whole period. Monensin (100 g/t) was included in the starter and grower diets as anti-coccidial agent. Mash feed and water were provided ad libitum. Body weight and feed consumption were recorded on day 1, 17, 38 and 45. All birds were subjected to a vaccination program, including Newcastle Disease (ND), Infectious Bursal Disease (IBD) and Infectious Bronchitis (IB). 3 birds out of each replicate were randomly collected for taking blood samples. In these samples ND, IB, and IBD immune status on d 35 were determined by hemagglutination inhibition and ELISA test. After 45 d, performance parameters were numerically improved by supplementation of the diets with Natural Growth Promoters and AGP. Compared to the NC, synbiotic, phytogetic and AGP increased weight gain by 2.8, 4.2 and 4.5%, respectively (1894 vs. 1947 vs. 1973 vs. 1979 g, $P > 0.05$). Gain:feed ratio amounted to 0.56, 0.58, 0.58 and 0.57, respectively ($P > 0.05$), and mortality was 1.12, 0.53, 0.36 and 0.59%, respectively, in treatments 1, 2, 3 and 4. Compared to the NC, immune parameters indicated numerically better values in treatments 2, 3 and 4 for IBD and IB. Based on the performance parameters of the present trial, the synbiotic and phytogetic product represented equivalent alternatives to AGP in broiler production.

Key Words: Synbiotic, Phytogetic, Antibiotic growth promoter, Natural growth promoter, Immune status

P190 Evaluation of broiler performance as affected by acidifier and zinc bacitracin under field conditions. C. Lueckstaedt, T. Steiner, and M. Mohnl*, *BIOMIN GmbH, Herzogenburg, Austria*.

Due to recent concerns about residues in animal products and bacterial resistance to antibiotics, alternatives to in-feed antibiotics (AGP) are required. Various feed additives such as organic acids have been studied already. Many scientists reported that the inclusion of organic acids in the diet can enhance growth performance and modulate intestinal microbiota. Ban on antibiotic growth promoters creates significant opportunity for feed acidification was stated recently in a report from Frost & Sullivan. An objective of the study was therefore to test a well balanced acidifier on a sequential release medium against a commercially available AGP (Zinc Bacitracin).

The trial was conducted under field conditions in Argentina. The aim of the trial was to test a well balanced acidifier (2 kg per t of feed) against a commercial piglet diet containing Zinc Bacitracin in a dose of 0.35 kg / t. Feed and water were available ad libitum. The performance of two groups of chicken (30,000 birds in total) was evaluated. Each pen consisted of 15,000 randomly selected male and female birds (Ross line 308). They were kept in pens of 150 m length x 10 m width. The trial period lasted for 42 days, during that period pre-starter feed was given from day 1 to day 14, feed was fed from day 15 till 28 days, while the finisher feed was provided until day 42.

After 42 days broilers in the acidifier treated group were numerically heavier (2236 g vs. 2223 g for the positive control), even though this

difference was not statistically significant ($P > 0.05$). The G:F was also not statistically different ($P > 0.05$) between the two treatments (0.51 and 0.53 for acidifier and Zinc Bacitracin, respectively). Mortality in the Zinc Bacitracin treated group was slightly reduced (2.8% vs. 3.1% for the acidifier group) but again without any statistical significance.

It can be therefore concluded, that a well defined acidifier can successfully replace an AGP, such as Zinc Bacitracin, in broiler production under Argentinian conditions.

Key Words: Acidifier, Zinc Bacitracin, Broiler, Antibiotic replacement

P191 Modeling egg weight and shell quality as functions of bodyweight, protein level, and calcium particle size. K. Choate*, R. I. Bakalli, and G. M. Pesti, *University of Georgia, Athens*.

One hundred forty-four Hy-Line W-36 hens, 38 weeks of age, were used over a period of five weeks to model the effects of various protein levels and limestone particle size on production parameters and egg shell quality. Six feeding treatments, each in three replicates, were applied from 38 to 43 weeks of age. The treatments included four protein levels (PL: 12.8, 14.4, 16 & 17.6%) with 3.5 % calcium and limestone with two particle size (pulverized and coarse) in three combinations: 100% pulverized, 50% pulverized (PU) and 50% coarse (CR), and 100% coarse limestone, respectively. During the last eleven days (DOT) egg production (EP), feed consumption (FC) egg weight (EWT), egg specific gravity (SG), egg shell weight (SHWT), shell surface (SHS), shell index (SHI), and egg shell thickness (SHTH) were measured daily. Hen's body weights (BWT) were measured in start and end of the experiment, difference=BWG. Dietary protein level had no had no consistent effect on EP (83±2, 86±2, 85±1, and 81±4 percent, respectively) but did significantly effect EWT ($P = 0.0013$; 60.3^b, 61.1^a, 60.1^b, 61.5^a g, respectively), feed intake ($P = 0.0035$; 101.7^a, 100.0^{ab}, 97.3^{bc}, and 94.9^c g/day, respectively). Body gain was significantly decreased with increased protein level ($P < 0.001$; 0.023^a, 0.023^a, -0.040^d, and -0.010^c g, respectively). Geometric mean diameter (GMD) for pulverized limestone was 240 microns with 4.4 geometric standard diameter (GSD). Coarse limestone's GMD was 2396 microns with 1.1 GSD. Different limestone particle size did not significantly effect EWT and SHS, but significantly effected egg SG ($P < 0.0001$, 1.081^c, 1.083^a, and 1.082^b g/cm³), egg SHWT ($P < 0.001$; 5.35^b, 5.54^a, and 5.46^a g, respectively), SHI ($P < 0.0001$; 7.44^c, 7.68^a, and 7.56^b g/cm², respectively), and SHTH ($P < 0.0001$; 0.317^c, 0.327^a, and 0.322^b mm, respectively). Best fit prediction equations: EWT= 73.81 - 4.37793 x PL + 0.15562 x PL² + 0.01885 x FC + 8.72755 x BWT + 5.00611 x BWG + .08324 x DOT; SG= 84.35 - 0.02767 x FC + 0.05286 x PU - 0.00063 x PU² + 0.09868 x DOT; SHWT= 4.21 + 0.006130 x PU - 0.000072 x PU² + 0.734434 x BWT + 0.470304 x BWG.

Key Words: Calcium sources, Limestone, Particle size, Protein level, Egg quality

P192 Performance of broilers fed with and without prebiotic, probiotic and anticoccidian drugs and challenged with *Eimeria acervulina*. M. B. Cafe*, C. P. Cruz, J. H. Stringhini, L. F. Reis,

L. S. Chaves, and M. A. Andrade, *University Federal of Goias, Goiania, Goias, Brazil.*

A 4 X 2 factorial experiment was conducted to determine the effects of prebiotic, probiotic and anticoccidian drugs on performance of broilers challenged or not with *Eimeria acervulina* at 14 days of age with 2.4×10^5 oocysts per bird in oral inoculation. A total of 80 Cobb male chicks were randomly allocated into a metallic battery divided in eight treatments with five replicates of ten birds each, as follows: T1) diet without anticoccidian and challenged birds, T2) diet with anticoccidian (monensin) and challenged birds, T3) diet with prebiotic (mannan oligosaccharide, MOS) and challenged birds, T4) diet with probiotic and challenged birds, T5, T6, T7 and T8 were the same treatments with unchallenged birds. The performance of the birds was evaluated once a week. The results at 21 days of age showed that weight gain, feed conversion and feed consumption of the inoculated group was worse than not inoculated birds. No statistic differences were observed among unchallenged treatments. For the challenged birds, the monensin treatment showed the best weight gain but not feed conversion and feed consumption. In conclusion, birds challenged with *Eimeria acervulina* showed worse performance, whilst birds supplemented with monensin showed better weight gain. The use of probiotic and prebiotic was not efficient to enhance the performance in birds challenged with *Eimeria acervulina*.

Key Words: *Eimeria acervulina*, Performance, Anticoccidian, Probiotic, Prebiotic

P193 Digestibility of nutrients of diet of broilers fed with and without prebiotic, probiotic and anticoccidian drugs and challenged with *Eimeria acervulina*. M. B. Cafe*, C. P. Cruz, L. F. Reis, J. H. Stringhini, L. S. Chaves, and N. S. Mogyca, *University Federal of Goias, Goiania, Goias, Brazil.*

A 4 X 2 factorial experiment was conducted to determine the effects of prebiotic, probiotic and anticoccidian drugs on digestibility of fat and dry matter (DM) of broilers challenged or not with *Eimeria acervulina* at 14 days of age with 2.4×10^5 oocysts per bird in oral inoculation. A total of 80 Cobb, male chicks were randomly allocated into a metallic battery divided in eight treatments with five replicates of ten birds each. The treatments were divided in: T1) diet without anticoccidian and challenged birds, T2) diet with anticoccidian (monensin) and challenged birds, T3) diet with prebiotic (mannan oligosaccharide, MOS) and challenged birds, T4) diet with probiotic and challenged birds, T5, T6, T7 and T8 were the same treatments with unchallenged birds. The digestibility trial was performed from 18 to 21 days and was conducted by the traditional method of total excreta collection. Fat and dry matter digestibilities were calculated. The results showed that the digestibility of DM of the inoculated group was 68.1% and for intact birds (not inoculated) 77.2%. For fat digestibility the results showed 32.9% for inoculated birds and 84.1% for not inoculated birds. Among treatments without *Eimeria acervulina* challenged the DM digestibility was not statistic ($P > 0.001$) different. For fat digestibility in challenged birds the monensin treatment showed the better digestibility, 64.1%, that was statistic ($P < 0.001$) better than Prebiotic, 55.2%, Probiotic, 55.2% and Without Anticoccidian, 59.4%. For not inoculated birds were observed no difference in fat digestibility among treatments. In conclusion, birds challenged with *Eimeria acervulina* decrease dry matter and fat digestibility. Birds supplemented with monensin showed better digestibility. The use of probiotic and prebiotic was

not efficient to enhance the digestibility in birds challenged with *Eimeria acervulina*.

Key Words: Digestibility, Anticoccidian, Probiotic, Prebiotic, *Eimeria acervulina*

P194 Nutritional performance of broiler chickens fed diets containing GAT4601 (DP-356043-5) soybean fractions. J. McNaughton*¹, B. Delaney², and B. Smith², ¹*Solution BioSciences, Inc., Salisbury, MD,* ²*Pioneer Hi-Bred International, Inc., Johnston, IA.*

Soybeans plants containing event DP-356043-5 (356043) were produced by insertion of the *gat* gene from *Bacillus licheniformis* and the *gm-hra* gene modified from the herbicide-sensitive soybean *gm-als* gene. The gene expression products are the glyphosate acetyltransferase (GAT4601) and GM-HRA proteins that confer tolerance to the herbicidal active ingredient glyphosate and acetolactate synthase inhibiting herbicides, respectively. Diets were produced with soybean fractions (meal, hulls, and oil) from a non-transgenic near-isoline (Control), 356043, 356043 treated with herbicides (356043+Gly/SU), and three non-transgenic commercial varieties and were fed to Ross x Cobb broilers (n = 120/treatment group, 50% M and 50% F). Starter (0-21d), Grower (22-35d), and Finisher (36-42d) commercial-type diets contained 30%, 26%, & 21.5% soy meal, respectively. Hulls and oil were added at 1.0 and 0.5%, respectively, across all diets. Pen data was collected weekly. Performance and carcass traits from broilers fed 356043, 356043+Gly/SU, and Control diets were compared to 95% tolerance intervals constructed on 99% of the population using data from broilers fed diets produced with commercial soy varieties. Differences between Control and 356043 or 356043+Gly/SU groups were evaluated at $p < 0.05$. No statistically significant differences were observed in mortality, weight gain, feed efficiency (corrected for mortalities), and carcass yields between broilers consuming diets produced with 356043 or 356043+Gly/SU soybean fractions and those consuming diets produced with Control soybean fractions. Additionally, all response variables in Control, 356043, and 356043+Gly/SU groups fell within the tolerance intervals calculated from broilers fed diets produced with the commercial soybean fractions. Based on the results from this study, it was concluded that 356043 soybean was nutritionally equivalent to Control soybean with a comparable genetic background.

Key Words: Soybeans, *Bacillus licheniformis*, GAT4601, GM-HRA, Chicken

P195 A 49 day evaluation of Bio-Mos® replacement of roxarsone in a commercially based feeding program for broilers. T. Herfel*¹, A. McElroy¹, A. Sefton², and C. Novak¹, ¹*Virginia Tech, Blacksburg,* ²*Alltech Inc., Guelph, ON, Canada.*

The inclusion of Bio-Mos as a roxarsone replacement in broilers was evaluated in a 49-day trial. Three thousand and ten broilers were randomly assigned to 1 of 5 dietary corn-soybean meal based trts (14 reps/trt). Dietary trts included a negative (NEG) and positive control (POS; NEG + 27 ppm Bacitracin MD), roxarsone trt (ROX; POS + 50 ppm of roxarsone), Bio-Mos trt (BIO; POS + 0.15 and 0.5%

Bio-Mos added during the starter and grower periods, respectively), and Bio-Mos + All-Lac XCL trt (BIO+LAC; POS + 0.2, 0.1, and 0.05% Bio-Mos during the starter, grower and finishing periods respectively and 0.25g All-Lac XCL/bird sprayed at hatchery). On day 14, 7 pens/trt were infected with *Eimeria maxima* (3 x 10⁴ oocysts/bird) via feed (CH). Production parameters were evaluated at feed change. Right tibias were collected (one bird/pen) on day 28 and 49 to determine bone-breaking strength. Non-challenged (NCH) birds had higher body weight gains (BWG) and lower feed conversion (F:G) from day 0 to 49 than CH birds (P < 0.05). Dietary trts were similar from day 0 to 49. On day 28, CH birds had shorter tibias and lower BWG than NCH birds (P < 0.5). Bone-breaking strength was similar for all trts. From day 0 to 35, ROX (2.07 kg; 3.23 kg) birds had lower BWG and FI than BIO (2.17 kg; 3.41 kg) and BIO+LAC (2.16 kg; 3.33 kg) birds (P < 0.05), while F:G was similar. Additionally, F:G improved by 4 points in BIO+LAC birds compared to BIO birds (P < 0.05), while BWG was similar. A trt/challenge interaction occurred from 0 to 35 days (P < 0.05) affecting F:G for BIO birds. BIO and BIO+LAC birds performed as well as the NEG and POS birds from 0 to 35 days. FI was depressed by supplementing roxarsone causing lower BWG, but no significant differences were noted in F:G compared to feeding Bio-Mos. Bio-Mos improved BWG compared to roxarsone by increasing FI. Bio-Mos-nor roxarsone improved production parameters compared to control fed birds in the present trial.

Key Words: Bio-Mos[®], Roxarsone, Coccidia, Broiler, Performance

P196 Yucca schidigera and quillaja saponaria supplementation in broiler diets. A. Corzo*¹, M. T. Kidd¹, D. Miles², W. A. Dozier, III², and P. R. Cheek³, ¹Mississippi State University, Mississippi State, ²USDA-ARS, Mississippi State, MS, ³Oregon State University, Corvallis, OR.

Yucca schidigera and *quillaja saponaria* are both rich in saponins and polyphenolic compounds, and have been associated with supplementary effects that improve livestock production with some ammonia emission reduction characteristics. Thus, a broiler study evaluated live performance, carcass characteristics, lymphoid organs, immune responses, and intestinal histology of broilers, and litter pH, N %, moisture %, and ammonia flux. Ross×Ross 708 male broilers were fed either a corn-soybean meal-poultry meal control (C) diet, the C diet plus a commonly used antibiotic (bacitracin methylene disalicylate), C diet plus supplementation with 100 ppm of *yucca schidigera* and *quillaja saponaria* (YQ), or the C diet supplemented with 150 ppm of YQ. Feeds were provided in a 3 phase program either as crumbles (0-7d/prestarter; 7-21d/starter) or pellets (21-42d/grower). Body weight at 7, 21, and 42 d was unaffected by the dietary treatments. Cumulative feed conversion was also unaffected at 7 and 21 d, but a trend (P=0.08) was observed at 42 d, where both YQ supplemented diets were superior along with the BMD diet when compared to the C treatment. Furthermore, the experimental treatments had superior (P<0.01) livability at 21 and 42 d when compared to the birds fed the C diet. Bursa and spleen relative weights were unaffected by dietary treatments. Immune responses, expressed as a primary antibody response to SRBC inoculation and % inflammation to PHAP, were not affected by the dietary treatments fed. Carcass traits were similar among treatments. Jejunal-villi length and width did not differ between the treatments fed. Litter characteristics and ammonia emission were similar across all treatments. Trends were observed in live production and livability that indicate beneficial effects of YQ supplementation

in commercial broiler diets. However, further research is warranted to corroborate such results and further evaluate potential ammonia emission reductions.

Key Words: Breast meat, Broiler, *Quillaja saponaria*, *Yucca schidigera*

P197 Marine phytoplankton supplementation in broiler diets. A. Corzo*¹, M. T. Kidd¹, and W. A. Dozier, III², ¹Mississippi State University, Mississippi State, ²USDA-ARS, Mississippi State, MS.

Many therapeutic attributes have been elucidated over the years to marine products and by-products. For that purpose, a study was conducted to evaluate the response of broilers to dietary supplementation with marine phytoplankton. This product, in dry form, was supplemented at 0 (control), 5,000 and 10,000 ppm to a corn-soybean meal based diet, and fed to Ross×Ross male broilers. Diets were formulated to meet or exceed NRC (1994) recommendations, and were fed in mash form as a starter (0-21 d) and a grower (21-42 d) feeding phase.

On Day 21, live performance was unaffected by marine phytoplankton supplementation with the exception of feed conversion (P<0.05), which was increased at 10,000 ppm when compared to the 5,000 ppm and the control group. Body weight was unaffected by dietary treatments, but the treatment with 10,000 ppm supplementation of marine phytoplankton had an increase in feed consumption (P<0.05) which translated into an increase in feed conversion (P<0.01) when compared to the control and 5,000 ppm-supplemented treatment. At Day 42, birds were processed and no differences were observed for absolute and relative weights of carcass, breast meat and abdominal fat of broilers fed the different dietary treatments. Thymus, spleen and bursa were weighed from a bird corresponding to each experimental unit, and no differences in their relative weights were observed between dietary treatments. There was a numerical increase in early livability with marine phytoplankton supplementation at Day 21 (5,000 and 10,000 ppm = 99%, control = 95.8; P<0.16). Further studies are warranted to explore possible benefits of marine phytoplankton supplementation in broiler diets.

Key Words: Breast meat, Broiler, Marine phytoplankton

P198 Effect of the supplementation of the yeast wall cell on the humoral and cellular immune response on commercial broilers diets. G. Gomez Verduzco*¹, M. A. Baladez Lopez², A. Cortes Cuevas², C. Lopez Coello¹, and E. Avila Gonzalez², ¹National University of Mexico, Distrito Federal, D.F, Mexico, ²National University of Mexico, Distrito Federal, D.F, Mexico.

The world-wide tendency is the cattle production using only the genetics, nutrition, handling and health of the animals; reason why the manipulation of the immunological system through the inclusion on the diet of some prebiotics that function immuno-modulating effects, could be considered as an alternative for the control of diseases and the improvement in the poultry production. The yeast walls cells (YWC) have been demonstrated great amount of kindness; the control of viral infections, the resistance in the presentation of diseases, as well as to

increase the efficiency in vaccination. The objective of this study is the use of a YWC in diets for commercial broilers to evaluate the humoral and cellular immune response. A study was conducted on commercial broilers Ross x Ross, they were placed on an open floor housing and they were used with 4 treatments (diets), 1 commercial diet (CD), 2 CD + YWC, 3 CD + antibiotic and 4 CD + PCL + antibiotic. The broilers were vaccinated at 10 days age. 7 and 14 days post vaccination the serum were evaluated with the hemagglutination inhibition test and ELISA against Newcastle virus disease. The cellular immune response was evaluated with mediated cutaneous basophilic hypersensitivity by an interdental skin test. The groups that were supplemented with YWC demonstrated an improvement in the humoral and cellular immune response. In this work the YWC have a positive immunomodulating effect.

Key Words: Yeast, Immune, Humoral, Cellular, Supplementation

P199 The performance of layers fed plant-protein based diets supplemented with fish meal analogue. O. A. Alalade*¹ and A. A. Fatufe², ¹University of Ibadan, Ibadan, Oyo state, Nigeria, ²Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.

The move towards the use of diets devoid of ingredients of animal origin will exacerbate the effect of anti-nutrients on bird's performance and nutrient excretion in the environment. An experiment was carried out to evaluate the effect of fish analogue supplementation on the performance of layers fed plant-protein based diets. Sixty 35-weeks old black Nera layers (1.67±0.02 BW) were randomly assigned to 4 treatments with 5 replicates containing 3 birds each in a cage system. Four isonitrogenous diets containing 0, 0.5, 1.0 and 1.5% fish analogue (Biogro Super 70% 5030P, Dawe™s Inc. USA) were formulated from a corn-soybean meal basal diet of 17.25% crude protein and 2534kcal/kg ME. Adjusting the levels of soybean meal and wheat bran equalized crude protein. From the results obtained, birds fed fish analogue supplemented diets had a slight decrease ($p < 0.05$) in egg weight and egg mass compared with the control. However, differences observed in feed intake, feed efficiency, egg production and body weight gain were negligible. Egg weights were 49.5, 46.6, 45.6 and 47.4g while hen-day productions were 86.5, 82.4, 84.1 and 81.2% on 0, 0.5, 1.0 and 1.5% fish analogue respectively. Overall, the result of this experiment showed that fish meal analogue supplementation did not improve the performance of layers fed plant-protein based diets

Key Words: Layers, Fish meal analogue, Plant-protein based diet, Performance, Feed intake

P200 The use of low protein diets combined with varying levels of metabolizable energy in commercial White Leghorn hens. A. S. Parsons*, D. M. Denbow, and C. Novak, Virginia Tech, Blacksburg.

Feeding layers a low protein diet typically reduces feed intake (FI), which consequently reduces the intake of other nutrients. The objective of this study was to evaluate the effects of feeding low protein diets with different levels of energy on production parameters, egg yield, physiological status as determined by plasma amino acid levels, and FI regulation as determined by brain catecholamine levels to better

understand the mechanism by which low protein diets decrease FI in laying hens. Corn, SBM and wheat midd-based diets consisted of two protein levels (high HP; 18% or low LP; 13%) and two energy levels (high HE; 2850 kcal/kg or low LE; 2780 kcal/kg). All nutrients, less protein and energy, were formulated to meet peak egg production with amino acids (Lys, Met, Thr and Trp) being similar across diets. Diets were randomly assigned to six replicate raised wire cages containing three, 24 week-old commercial White Leghorn Hens (72 in²/hen). Diet and water were provided for ad libitum consumption from 24 to 36 wks of age. Feed intake ($P = 0.0001$) was decreased in layers fed LP independent of energy level. There was a significant interaction between dietary energy and protein and their affect on brain norepinephrine, epinephrine, dopamine, S-HIAA, HVA and serotonin levels. Brain norepinephrine was lowest in birds fed the low protein diet whereas DOPAC, S-HIAA and serotonin were lowest in birds fed the high protein diet. Brain serotonin and S-HIAA was higher in those birds fed the low protein diet, which appears to correlate with decreased FI. Furthermore, egg production ($P = 0.008$) and egg weight ($P = 0.0003$) were decreased in layers fed LP diets compared to those fed HP diets suggesting that dietary energy and nutrients were shunted from egg production for use in meeting maintenance energy requirements.

Key Words: Low protein, Low energy, Feed intake, Neurotransmitters, Laying hens

P201 Impact of ochratoxin A on broiler kidneys, associated increased levels of uric acid in blood serum and possible counteraction. V. Starkl*¹ and H. Sarandan², ¹Biomin GmbH, Herzogenburg, Austria, ²University of Veterinarian Medicine, Timisoara, Romania.

This trial was performed to evaluate the impact of a combination of 500ppb ochratoxin A and 1000ppb deoxynivalenol on histopathology of kidneys and the level of uric acid in the blood serum. Additionally Mycofix[®] Plus was evaluated on its ability to prevent renal impact of ochratoxin A.

216 day old chickens (males and females) were randomly chosen and divided into 4 treatments. Birds in treatment 1 (T1) were fed a mycotoxin free diet. Treatment 2 (T2) consisted of a diet contaminated with 500ppb ochratoxin A and 1000ppb deoxynivalenol. Diet of treatment 3 (T3) was equally contaminated as T2 but additionally treated with 1 kg of Mycofix[®] Plus. Treatment 4 (T4) contained 1 kg of Mycofix[®] Plus and no mycotoxins.

At slaughter, on day 42, organs were examined macroscopically, yet there were no visible changes in color or signs of renal or visceral uric gout. Weights of kidneys were reported in corresponding percentages to the respective bodyweight. No significant differences were found between treatments and sexes. Kidney samples were fixed in alcohol, included in paraffin, sliced and stained using hematoxyline-eosine. No necrotic lesions were found in T1 and T4. T2 was generally more severely affected than T3. Necrotic lesions were present in T2 predominantly in the proximal tubules, showing disappearance of the tubular lumen and hypertrophy of renal glomerules with disseminated focal necrosis and vascular lesions. In T3 less affected epithelium of the proximal tubules was found and additionally it was less necrotic compared to T2 found. Determination of the level of uric acid in blood serum confirmed the damage of the kidneys. The level of uric acid in

T2 was significantly higher compared to T1, T3 and T4. This correlates very well with the severity of renal lesions in T2. Males were more affected than females.

The obtained data confirmed the negative impact of ochratoxin A on kidneys and level of uric acid and suggest that Mycofix® Plus can alleviate nephrotoxicity.

Key Words: Ochratoxin A, Nephrotoxicity, Uric acid, Deactivation

P202 Comparison of organic and inorganic trace mineral sources for growth and production of brown shell laying hens.

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The effect of varying levels and sources (organic vs. inorganic) of trace mineral supplements on growth and egg production performance was studied using a commercial strain of brown shell laying hen (Hy-Line Brown). Eight replicate groups of 16 replacement pullets, 2 wk of age, were assigned to each of six dietary treatments, using a randomized block experimental design. Pullets were housed in cages and given *ad libitum* access to feed and tap water. Trace mineral mixes that contained Cu, Mn, Fe and Zn at 25, 50 or 100 per cent of the NRC requirements in the form of inorganic salts or proteinates (Bioplex®, Alltech, Inc.) were added to corn-soybean meal-based grower and layer diets in a 3 X 2 factorial arrangement of treatments. At 16 wk of age, the number of pullets was reduced to 12 per replicate, the pullets were transferred to layer cages (2 per cage) and switched to layer diets, and the photostimulation program was initiated. During the growing period and the first 24 wk of production, body weight was unaffected by treatments. There were no effects of mineral source and level or their interaction on overall hen-day egg production (mean = 81.5%) and shell breaking strength. Mineral level significantly ($P < 0.05$) affected per cent hen-day production during Weeks 1-4 and Weeks 21-24. However, these effects were not persistent. Significant interactive effects of mineral level X source upon egg weight were noted after 12 and 24 wk of production, but not after 8, 16, and 20 wk. Compared with the organic mineral source, per cent shell was significantly higher for the inorganic mineral treatment after 8 wk of production (9.7 vs. 9.5), but not thereafter. The results of this study indicated that the lowest levels of Cu, Mn, Fe and Zn supplied as inorganic salts or proteinates added to corn-soybean meals were adequate for supporting growth and production of brown shell hens.

Key Words: Laying hens, Trace minerals, Proteinates, Organic minerals, Egg production

P203 Egg production performance of pearl grey guinea fowl pullets fed diets varying in metabolizable energy and crude protein concentrations from hatch to sixteen weeks of age.

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This study was undertaken to assess dietary metabolizable energy (ME) and crude protein (CP) concentrations for optimum performance of pearl gray guinea fowl replacement pullets. In a 3 x 3 factorial

arrangement, 540 1-day-old pearl gray guinea keets were randomly assigned to experimental diets with 2,900, 3,000 and 3,100 kcal of ME/kg of diet; each contained 20, 22 and 24% CP, respectively, from 0-8 week of age (WOA). From 9-16 WOA, experimental diets had 3,000, 3,100 and 3,200 kcal of ME/kg of diet, and each contained 17, 19 and 21% CP, respectively. At 17-22, 23-27 and 28-56 WOA all experimental birds were fed the same diet at each age period which containing 3,000, 2,900 and 2,800 kcal of ME/kg of diet, respectively. The diets had 18, 17 and 16% CP, respectively. Each dietary treatment was replicated 4 times, and feed and water were provided *ad libitum*. Body weight were measured weekly from hatch to 16 WOA and at 28-56 WOA the experimental birds were observed for feed consumption (FC), hen-day egg production (HDEP), egg weight (EW), egg mass (EM), feed conversion ratio (FCR), internal egg quality (IEQ), shell thickness (ST) and body weight (BW) at the end of each 28-day lay period for 7 consecutive periods. Mortality was recorded as it occurred. Overall, BW gains were significantly higher ($P < 0.05$) in birds fed 3,000 and 3,100 Kcal of ME/kg of diet and 24% CP from hatch to 8 WOA than other dietary treatments. Percent HDEP, EM and IEQ were higher ($P < 0.05$) and FCR was lower ($P < 0.05$) in pullets fed diets containing 3,000 and 3,100 kcal of ME/kg of diet than those on 2,900 kcal of ME/kg of diet at 0-8 WOA. Birds on 22 and 24% CP diets also exhibited higher HDEP, EM and lower FCR than those on 20% CP diets. However, differences in mean EW, BW and ST were not significant ($P > 0.05$) among dietary ME and CP treatments. Thus, feeding 3,000-3,100 Kcal of ME/kg of diet and 22-24% at 0-8 WOA and 3,100-3,200 Kcal of ME/kg of diet and 19-21% CP at 9-16 WOA improved HDEP, EM, IEQ and FCR of Pearl Grey guinea fowl laying pullets at 28-56 WOA.

Key Words: Pearl gray guinea fowl pullets, Metabolizable energy, Crude protein

P204 Effects of paractin (14-Neo-Andro) on vaccine performance, mortality and coccidiosis in chicken. J. Hancke¹ and A. Eng^{*2}, ¹*Universidad Astral de Chile, Valdivia, Chile,* ²*HP Ingredients, Bradenton, FL.*

PURPOSE OF EXPERIMENTS: In the first experiment, we are exploring the effects of using nanomolar concentration of the 14-Neo-Andro compound as feed additives to potentiate vaccine and increase cellular immune response. In the second experiment, we evaluate the effect of PARACTIN as feed additive to reduce the symptoms and mortality of coccidiosis.

MATERIAL & METHODS: New Castle: 960 chickens were divided into two groups. Group 1 (n: 480) were fed with a standard diet (Control). Group 2 (n: 480) received the same diet, but added with 28g of 14-Neo-Andro compound per ton of feed. At day 7, all chickens were vaccinated with Newcastle and at day 10 with infectious bronchitis. At day 10, 21 and 28, samples of blood serum were taken for analysis. Average Daily Gain, Feed Conversion, and Mortality rate were calculated every week. Coccidiosis: 75 chickens randomly divided into 5 groups after the first week. Group 1, control group (n:15) were fed with a standard diet as above. Group 2 to 5 (n: 15) received the same diet, but added with 14-Neo-Andro compound at different levels: 50g/ton, 100g/ton, 150g/ton, and 200g/ton after the first week. At week 3, coccidia were spread into the bedding of all coops. Blood was collected when the chickens were 2, 4 and 6 weeks of age for analysis. Chicken were sacrificed at 6 weeks for lesion scoring.

Average Daily Gain, Feed Conversion, and Mortality Rate were calculated every week.

RESULTS & CONCLUSION: Lose Dose of the 14-Neo-Andro compound was capable to significantly increase the hemoagglutination titers against New Castle vaccine by 60% to 70%, increasing cellular immunity, and lower the mortality rate (8.45% vs 11%). 14-Neo-Andro compound increase average daily gain in chickens infected with Coccidiosis, and significantly reduce mortality rate (46.66%, 33.33%, 20%, 20%, and 0%) and lesion scoring. We conclude that PARACTIN (14-Neo-Andro) is a new immuno-modulating feed addition exhibiting strong potential immuno-stimulating and anti-inflammatory properties.

Key Words: New Castle, Cellular immunity, Coccidiosis, T cell

P205 The dominance of the *Salmonella* serovar Kentucky in chickens is due to its persistence in the gastrointestinal tract of mature birds. A. A. Pedroso*, M. D. Lee, and J. J. Maurer, *University of Georgia, Athens.*

Recently, *Salmonella enterica* serovar Kentucky has supplanted *S. Enteritidis* and Typhimurium as the most prevalent serotype in poultry. However, *Salmonella* Kentucky is not commonly associated with human illnesses in the United States. We believe that *S. Kentucky* represents a serovar that is best adapted to colonizing and persisting in poultry, which may explain its dominance on broiler chicken farms. To test this hypothesis, an *in vivo* competition experiment was performed between *Salmonella* serovars Kentucky and Typhimurium. One day-old chicks were raised until 42 days of age in four separate isolator units. Animals were orally inoculated with either *S. Typhimurium* RifR (n=30), *S. Kentucky* NaIR (n=30), or both serovars combined (n=30); as well as negative control birds administered saline (n=30). Small intestine, cecum, liver, spleen and feces were collected at 18, 25, 32, and 39 days after inoculation, homogenized and colony counts were recorded after grown on XLT4 containing the appropriate antibiotic. Twenty-five days after inoculation, *S. Typhimurium* numbers decreased significantly in cecum and feces (4 log₁₀ CFU/g decline), while *S. Kentucky* numbers in the cecum remained relatively high (1x10⁴ CFU/g). This phenomenon was observed in whether the birds were administered pure cultures or a mix of the two organisms. This suggests that *S. Kentucky* did not inhibit *S. Typhimurium* growth *in vivo*. In addition, *S. Kentucky* persisted in the chicken's cecum longer and at levels significantly higher than *S. Typhimurium*. These colonization dynamics could explain the spread and eventual dominance of *S. Kentucky* within poultry integrators.

Key Words: Competition, *S. Typhimurium*, Microflora

P206 Effect of probiotic treatment of chicks on phagocytosis of *Salmonella* by isolated macrophages. S. E. Higgins*, J. P. Higgins, G. F. Erf, S. N. Henderson, A. D. Wolfenden, G. Gaona-Ramirez, and B. M. Hargis, *University of Arkansas, Fayetteville.*

Previous data have indicated that a *Lactobacillus*-based probiotic culture (FM-B11™) is efficacious for reducing *Salmonella enteritidis* (SE) colonization within 24 h when administered within 1 h of

challenge. We hypothesized that the innate immune system, specifically macrophages, may play a role in the observed reduction of colonization. In two experiments, we evaluated the ability of macrophages isolated from chicks to phagocytose SE *in situ*. Chicks were obtained on day-of-hatch, and two groups were challenged with SE by oral gavage (Exp 1: 2.5 x 10³ cfu/chick, Exp 2: 1.4 x 10³ cfu/chick) while two groups received vehicle. One h later one challenged and one unchallenged group were treated with probiotic by oral gavage, and the alternate groups received vehicle. At this time, all chicks were also injected IP with 0.5 mL of a 3% sephadex solution. Macrophages were isolated from the peritoneal cavity of chicks 24 h following injection, and cecal tonsils were collected for enrichment and determination of SE colonization. In both experiments, probiotic treatment significantly reduced cecal SE recovery incidence as compared to controls (exp.1: 12% vs 76%, exp. 2: 41% vs 100%, respectively). Macrophages were maintained in tissue culture plates overnight and then assayed for phagocytic activity. Cells were incubated with SE for 30 min, then in medium with gentamicin for 45 min to kill any extracellular SE. The cells were lysed with 10% triton in PBS, and then SE recovered (cfu) per macrophage was determined. In experiment 1, significantly (p<.05) more SE were recovered from macrophages derived from probiotic-treated chicks (4.28 cfu/cell) than any other treatment (control 2.10 cfu/cell, SE challenged 1.94 cfu/cell, SE challenged and probiotic treated 2.28 cfu/cell). However, in experiment 2, no significant differences between groups were observed (phagocytosis of SE was less than 1 cfu/ cell in all groups). Although not conclusive, the relatively small phagocytosis enhancement in exp. 1, and lack of observed probiotic effect in exp. 2, may suggest the macrophages are not involved in the SE prophylaxis due to probiotic treatment.

Key Words: *Salmonella*, Probiotic, Macrophage, Chick, Phagocytosis

P207 Evaluation of *in vitro* and *in vivo* *Salmonella* reduction potential of bacteriophages isolated from different sources. R. L. Andreatti Filho*¹, J. P. Higgins², S. E. Higgins², G. Gaona-Ramirez², A. D. Wolfenden², G. I. Tellez², and B. M. Hargis², ¹Sao Paulo State University, Botucatu, SP, Brazil, ²University of Arkansas, Fayetteville.

Salmonella enteritidis (SE)-lysing bacteriophages (Ø) isolated from poultry or human sewage sources were used to reduce SE *in vitro* and in experimentally infected chicks. Cocktails of 4 different Ø obtained from commercial broiler houses (CB4) and 45 Ø from a municipal wastewater treatment plant (WT45) were evaluated. In experiment 1, an *in vitro* crop assay was conducted with selected Ø concentrations (10⁵, 10⁶, 10⁷, 10⁸, or 10⁹ pfu/mL) to determine ability to reduce SE in the simulated crop environment (16x100mm glass tube, 2 g sterile feed, 6.5 mL saline containing Ø and SE). Following 2 h at 37 C, CB4 or WT45 reduced SE recovery by up to 1.5 or 5 log, respectively, as compared to control. However, CB4 did not affect total SE recovery after 6 h due to Ø-resistant SE growth, whereas WT45 resulted in up to 6 log reduction of SE. In experiment 2, day-of-hatch chicks were challenged orally with 3x10³ cfu/chick SE and treated cloacally with 1x10⁹ WT45 pfu/chick one h post-challenge, and then one h later, treated or not with a commercially available probiotic (FM-B11™). Both treatments significantly reduced SE recovery from cecal tonsils at 24 h following treatment as compared to controls, but no additive effect was observed with the combination of Ø and probiotic. In experiment 3, day-of-hatch chicks were challenged orally with 9x10³ cfu/chick

SE and treated via oral gavage with 1×10^8 CB4 pfu/chick, 1.2×10^8 WT45 pfu/chick, or a combination of both, one h post-challenge. All treatments significantly reduced SE recovered from cecal tonsils at 24 h as compared to untreated controls, but no significant differences were observed at 48 h following treatment. These data suggest that some \emptyset can be efficacious in reducing SE colonization in poultry during a short period of 24 h or less, but under these conditions, persistent reductions were not observed.

Key Words: *Salmonella enteritidis*, Bacteriophage, Crop assay, Probiotic, Chicken

P208 Nested PCR to detect infectious laryngotracheitis virus (ILTV). O. A. Fagbohun*, J. J. Giambone, T. V. Dormitorio, and K. Macklin, *Auburn University, Auburn, AL.*

A highly sensitive nested PCR was developed to detect ILTV in the litter or from tracheas of chickens, which were vaccinated, exposed to vaccinated birds, or placed on contaminated litter. Tracheal swabs and fecal samples were taken from experimental birds or litter, and examined for ILTV DNA by conventional and nested PCR. Total DNA was extracted from the samples using Qiagen kits. Amplification of the 440bp fragment from the ILTV infected cell protein 4 (ICP4) gene was by the conventional PCR and an internal 190bp fragment was produced by the nested-PCR. Samples from unvaccinated chickens or chickens reared on non-contaminated litter were negative by both tests. ILTV gene fragments amplified by the conventional PCR were faint and sometimes absent, whereas fragments from nested-PCR were clear and always present from ILTV infected birds or contaminated litter. This new test is an improvement over the conventional PCR.

Key Words: Chickens, ILTV, Nested-PCR, Conventional PCR, Gene

P209 Interrelations of ACTH infusion and dietary electrolyte balance on physiological parameters of broiler chickens. H. Olanrewaju*¹, J. Thaxton², W. Dozier¹, and S. Branton¹, ¹*USDA/ARS, Poultry Research Unit, Mississippi State, Mississippi*, ²*Mississippi State University, Mississippi State.*

The aim of this study was to compare acid-base balance in broiler chickens provided diets containing two diverse dietary electrolyte balances (DEB) administered either ACTH or saline. Diets were moderate (M; 174 mEq/kg) or high (H; 241 mEq/kg) DEB by altering Na-K-Cl based upon actual analysis. These diets were fed ad libitum from d 0 to 49 d of age. Osmotic pumps delivered 8 IU ACTH in saline/kg BW/d for 7 d or the same saline volume as used in ACTH at $\mu\text{L/h}$ for 7 d. Pumps were implanted on d 35 following sample collection. Post-implantation blood samples were taken on d 42 and 49. The experiment was designed as a split plot with main unit consisting of 4 treatments with factorial treatments structure (2 ACTH treatments \times 2 diets) arranged in a completely randomized design. Significant DEB \times ACTH interactions ($P \leq 0.04$) were determined for $p\text{CO}_2$ and $p\text{O}_2$ at 49 d. These differences infer when the H DEB diet was fed to the control and ACTH groups that $p\text{CO}_2$ and $p\text{O}_2$ were altered, whereas when the M DEB diet was fed to the control and ACTH groups, $p\text{CO}_2$ and $p\text{O}_2$ were without change. Infusion of ACTH increased

($P \leq 0.05$) hematocrit, hemoglobin, $p\text{CO}_2$, corticosterone, osmolality, mean corpuscular hemoglobin concentration (MCHc), and HCO_3^- and reduced ($P \leq 0.05$) $p\text{O}_2$, Na^+ , K^+ , anion gap, pH, Ca_2^+ , BW, and Cl^- compared to the control group on d 42 and 49. Birds fed the H DEB diet exhibited higher ($P \leq 0.05$) $p\text{O}_2$ than birds provided the M DEB diet. The diet formulated to H DEB partially blocked the effect of ACTH on $p\text{O}_2$ and $p\text{CO}_2$. However, due to the increased need for O_2 to support gluconeogenic energy production, the bird responded by increased erythropoiesis. This adaptive response provided greater numbers of erythrocytes and thus a higher amount of circulating hemoglobin to deliver O_2 for metabolism. Diet formulated to the H DEB partially attenuated adaptive stress condition.

Key Words: Dietary electrolyte balance, Acid-base balance, Stress, ACTH, Broiler

P210 Effect of dietary copper source and level on in vitro nitric oxide production. E. A. Koutsos¹, V. J. Arias¹, and J. I. Cohen*², ¹*California Polytechnic State University, San Luis Obispo*, ²*Micronutrients, Indianapolis, IN.*

Research has shown that dietary copper, when fed at levels above the minimum requirement can modulate intestinal physiology and immune responses in growing chickens. This research examined the response of an avian macrophage-like cell line (HD11 cells) to plasma from broiler chicks fed no supplemental copper (8 mg/kg diet; control), Copper Sulfate (188 mg/kg diet; CS) or Tri-basic copper chloride (188 mg/kg diet; TBCC). HD11 cells were cultured with 10% heterologous serum, and the nitric oxide (NO) response was measured in response to lipopolysaccharide (LPS). The initial level of NO in media was greater for TBCC vs. control or CS treatment ($p < 0.01$; 0.4% difference); however, the level of NO (24h and 48h post-LPS) was greater for the control and CS vs. TB treatment ($p < 0.01$; 50% difference). Subsequent in vitro trials (same in vivo trial serum) examined 4 combinations of TBCC and control serum. NO responses after LPS were reduced as the proportion of TBCC plasma increased ($P < 0.01$; $R^2 = .93$). Serum was then obtained from another in vivo broiler trial and experiments were run again. HD11 cells incubated with 100% TBCC plasma had a higher NO response at 48 h post-LPS as compared to those incubated with control plasma ($p < 0.05$). Additionally, plasma was collected from birds treated with LPS in vivo, and with no in vitro stimulation, NO levels were significantly greater from control plasma than from TBCC plasma (34.2 $\mu\text{mol}/106$ cells vs 18.8 $\mu\text{mol}/106$ cells; $p < 0.05$). These data demonstrate that copper source affects in vivo plasma parameters such that the NO response to LPS stimulation is altered. Additionally, macrophages cultured with TBCC had a dampened NO response (duration and/or magnitude) compared to macrophages cultured with control or CS plasma.

Key Words: Copper, TBCC, Nitric oxide

P211 PCR-based assay for the differentiation of *Pseudomonas* spp. isolated from poultry. I. Hanning*, A. O'Leary, and M. Slavik, *University of Arkansas, Fayetteville.*

The *Pseudomonads* are the predominate bacteria on spoiled poultry products, can be present in poultry chill waters and processing

equipment, and can be readily isolated from hatcheries, broiler farms, and fresh eggs. The bacteria have several roles within the poultry processing environment, including food spoilage, primary biofilm formers and, in the case of *P. aeruginosa*, as a pathogen. Currently, only traditional agar methods and biochemical based assays are available for detection and differentiation. Biochemical assays take 5 days for results, are expensive, and often produce erroneous results. The objective of this study was to design a rapid PCR based method that could not only distinguish *P. aeruginosa* from other poultry significant Pseudomonads, but also differentiate *Pseudomonas* spp. from non-*Pseudomonas* bacteria in a single PCR reaction. 16s rRNA sequences from 9 poultry significant Pseudomonads were aligned to determine conserved regions from which genus specific primers could be designed. The Gyrase B sub-unit genes from the 9 species of Pseudomonads were used to design species specific primers for the detection of *P. aeruginosa*. The PCR reaction was optimized using the Qiagen Multiplex Kit according to the manufacturer's instructions. The reaction was tested against 16 *P. aeruginosa* strains, 18 *Pseudomonas* non-*aeruginosa* strains, and 17 non-*Pseudomonas* bacterial strains composed of 7 genera and 11 species. The reaction was 100% specific. Furthermore, the assay could be started in as quickly as 20 hours or as soon as bacterial colonies appeared on the agar plate to which the sample had been applied. When compared to methods of traditional plating on differential or selective agar, biochemical assays, and gene sequencing, the PCR based assay was able to eliminate 4 to 6 days from total detection time. In addition, the PCR assay was the least expensive, costing around \$0.15 per reaction. Because this PCR based assay reduced detection time to 24 hours and simplified the identification process, it may be used to reduce food spoilage and foodborne illness by identifying sources of contamination and speed the diagnosis of ill birds.

Key Words: Pseudomonas, Detection, PCR, Poultry, Spoilage

P212 Bacteria recovery from genetically featherless broiler carcasses after forced cloacal evacuation. J. K. Northcutt*¹, W. D. McNeal², K. D. Ingram¹, D. L. Fletcher³, and R. J. Buhr¹, ¹USDA-ARS, Athens, GA, ²Meyn America. LLC, Ball Ground, GA, ³University of Connecticut, Storrs.

A study was conducted to determine external microbiology of genetically featherless broiler carcasses after forced evacuation of cloacal material. Full-fed featherless broilers were shackled, stunned, suffocated, weighed and divided into treatments groups (S, W and SW). Carcasses from all treatments were transferred to a separate shackle line and passed through a machine designed to express (squeeze) and remove feces (wash). Treatments were obtained by turning on or off the squeezing and washing components. After treatment, carcasses were subjected to a whole carcass rinse for microbiological analyses. Treatments were as follows: S carcasses were squeezed but not washed; W carcasses were not squeezed but were washed; and SW carcasses were squeezed and washed. When carcasses were washed, they gained weight (8.6 and 2.1 g for W and SW, respectively), while unwashed carcasses (treatment S) lost approximately 6 g of feces. Recovery of *Escherichia coli* (EC), coliforms (CF), and *Campylobacter* (CP) from carcasses did not vary with treatment and levels were approximately 3.4, 3.7 and 2.7 log₁₀ cfu/mL of rinse, respectively. A slightly lower (0.3 log), but significant difference in total aerobic bacteria (APC) was observed for SW carcasses compared to W carcasses. *Salmonella* (SAL) prevalence was similar for all treated carcasses (83 to 90%

positive). When the water from the machine's washing component was analyzed, counts for APC, EC, and CF were 3.6, 0.8, and 1.0 log₁₀ cfu/mL lower for W carcasses than for SW carcasses ($P < 0.05$). CP and SAL prevalence in the water collected from the machine after W carcasses were washed was 1/4 and 0/4, respectively. CP and SAL prevalence in the water collected from the machine after SW carcasses were washed was 3/4 and 2/4, respectively. Data from the present study show that fecal material may be expressed and washed off of carcasses immediately after slaughter. This equipment could be used to minimize deposition of organic material onto the carcass and into the scald and improve bird uniformity at evisceration.

Key Words: Poultry, Carcass bacteria recovery, Broiler carcass evacuation, Carcass washing

P213 Characterization and antimicrobial resistance of *Salmonella* isolated from internal tissues, ceca and rinse samples from commercial broiler chickens. J. S. Bailey*¹, N. A. Cox², P. Fedorka-Cray¹, L. J. Richardson², and J. Buhr², ¹USDA, ARS, BEAR, Athens, GA, ²USDA, ARS, PMS, Athens, GA.

The presence, species, and antimicrobial resistance profile of *Salmonella* from internal tissues (spleen, liver/gall bladder, thymus, Meckel's diverticulum, and free floating yolk), ceca and carcass rinse samples were determined from six-week-old (n=30) and eight-week-old (n=40) commercial broilers from the rehanging line before evisceration. *Salmonella* Typhimurium was the predominate (153/175, 87%) serotype of the seven serotypes identified. *S.* Typhimurium isolates were more frequently associated with internal tissues (102/153, 67%) than with ceca and rinse samples (3/22, 14%). The seven isolates that were pan susceptible were from ceca and rinse samples while 156 of 158 (99%) of isolates resistant to two or more antimicrobials were from internal tissue samples. These data indicate that chickens can harbor the same serotypes with different antimicrobial patterns in tissue samples compared to ceca and rinse samples. Further studies are warranted to determine the relatedness of isolates.

Key Words: *Salmonella*, Antimicrobial resistance, Broilers

P214 A survey of the quality of six retail brands of boneless skinless chicken breast fillets obtained from retail supermarkets in Athens, Georgia area. H. Zhuang*, E. Savage, S. Kays, and D. Himmelsbach, USDA-ARS, Athens, GA.

To assess the variation in quality of chicken breast fillets available from retail supermarkets, six brands of boneless skinless fillets without additives were obtained from the fresh counter at grocery stores Athens, GA and the surrounding area during fall of 2005. The samples were stored at -20°C before being cooked using a Henny Penny MCS-6 combi oven. Quality parameters of the fillets were measured on the cooked chicken breast fillets including cook yield, descriptive sensory flavor and texture profiling, and Warner-Bratzler (WB) shear force. Our results show that the average cook yield ranged from 78.1% to 80.9%, the average intensity of descriptive sensory characteristics was less than 5.4 in a 0-15 universal scale, and WB shear force values were less than 5.2 kg. There were no significant differences in the intensity among brands of all flavor attributes and the texture characteristics

associated with moisture. However, significant differences were found among the brands for cook yield, mechanical properties of texture (including springiness, cohesiveness, hardness and chewiness) and WB shear force values. The variation of WB shear force measurements (coefficient of variation) depended on brand. These results indicate that differences exist in the quality and texture consistency among brands of boneless skinless chicken breast fillets available in Athens, Georgia and the surrounding area.

Key Words: Chicken, Breast, Boneless, Sensory, Quality

P215 The effect of the addition of a novel source of docosahexaenoic acid (DHA) to layer diets on the DHA content of eggs. A. J. Pescatore*, J. L. Pierce, A. H. Cantor, T. Ao, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY.*

A novel source of docosahexaenoic acid (DHA) that is a by product of food grade DHA production was used to enhance the DHA content of eggs. The DHA containing additive was added to corn-soy based layer diets (16% cp, 2815 kcal/kg) at a rate of 1% or 2% of the diet. Dietary treatments were randomly assigned to 27 hens per treatment. The treatment diets were fed for 27 days. Egg samples were collected at day 0 and day 27. The DHA content of the eggs from all hens at the start of the experiment was 1.06 % total fat (w/w). The eggs from hens fed the zero additional DHA diet showed no increase in DHA (1.05%) at 27 days. Eggs from hens fed the DHA source for 27 days had a DHA content of 2.85 and 3.40 % (w/w) for the 1 and 2 % inclusion rates, respectively. The levels compare favorably to commercial omega 3 enhanced eggs. The results of this experiment indicate that the inclusion of this DHA source at the rate of 1% will increase DHA level in eggs. Only a slight increase was seen with the 2% inclusion rate compared with 1% inclusion rate and may not warrant the added cost of the higher rate.

Key Words: Layer hen, DHA, Egg

P216 Dietary flaxseed supplementation affects processing yields and meat technological properties. M. Betti*¹, M. J. Zuidhof², B. L. Schneider², R. A. Renema¹, V. L. Carney², F. E. Robinson¹, and D. R. Korver¹, ¹*University of Alberta, Edmonton, AB, Canada,* ²*Alberta Agriculture Food and Rural Development, Edmonton, AB, Canada.*

Consumers are becoming more aware of the impact of the food they eat on their health. One of the ways they hope to reduce their risk of cardiovascular disease is by consuming more foods enriched with polyunsaturated fatty acids (PUFA), particularly omega-3 (n-3) fatty acids. Due to the high content of alpha-linolenic, flaxseed is a good source for increasing the omega-3 fatty acid in poultry meat. However, flaxseed has anti-nutritional properties that negatively impact broiler performance. For this reason, a study was conducted to identify an optimum level of enrichment of broiler diets with flaxseed and the optimal length of time they must be provided to ensure a) good processing yield and b) acceptability of broiler meat functional properties such that processing and further processing efficiencies are not compromised. This experiment was conducted as a 2 x 8 factorial, with two dietary levels of ground flaxseed (10 and 17%), and eight durations of inclusion in the diet prior to processing (0 [Control], 4, 8, 12, 16, 20, 24, and 35 d). Six hundred and fifty-six Ross x Ross 308 mixed-sex broilers were evaluated in this study. One hundred twenty-eight carcasses were used for evaluating processing yields and breast and thigh meat quality. No statistical interactions were found between treatments for meat quality traits. With more than 20 d of feeding duration, the diet containing 17% flaxseed decreased BW, and carcass and breast yield compared to the diet containing 10% flaxseed ($p < 0.0001$). Carcass temperature was higher ($p < 0.001$) in birds fed 10% flaxseed. Feeding 17% flaxseed also decreased cooking yield ($p < 0.001$). The duration of feeding flaxseed strongly affected processing yields and technological meat properties. Ultimate pH and cooking yield were strictly related to each of the periods tested ($p < 0.0001$; $p < 0.001$). In particular, feeding flaxseed for 35 d resulted in a final pH of 5.79, compared to 6.20 in the control. In conclusion, different levels and durations of flaxseed feeding significantly affected yields and technological characteristics of broiler meat.

Key Words: Flaxseed, Polyunsaturated fatty acids, Alpha-linolenic acid, Processing yield, Technological properties

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