

## POSTERS

## Environment and Management

**236 Effects of feeding blends of grains naturally-contaminated with *Fusarium* mycotoxins on immune parameters of broiler chickens.** H.V.L.N. Swamy<sup>\*1</sup>, T. K. Smith<sup>1</sup>, N. A. Karrow<sup>1</sup>, H. J. Boermans<sup>1</sup>, and A. E. Sefton<sup>2</sup>, <sup>1</sup>University of Guelph, Guelph, ON, Canada, <sup>2</sup>Alltech Biotechnology Center, Nicholasville, KY.

There are contradictory literature reports on the susceptibility of broiler chickens to the feeding of deoxynivalenol (DON)-contaminated grains. Earlier studies in our laboratory have shown that performance indices of broiler chickens are reduced by the feeding of grains naturally-contaminated with DON, fusaric acid (FA), zearalenone (ZEN) and 15-acetyldeoxynivalenol (15-DON). Information on the effects of feeding such materials on immune parameters of broiler chickens is limited. Three hundred and sixty, day-old male broiler chicks were, therefore, fed diets containing grains naturally-contaminated with *Fusarium* mycotoxins for 56 d. The diets included; (1) control (0.56 mg/kg DON, 15.2 mg/kg FA) (2) low level of contaminated grains (5.9 mg/kg DON, 19.1 mg/kg FA, 0.4 mg/kg ZEN, 0.3 mg/kg 15-DON) (3) high level of contaminated grains (9.5 mg/kg DON, 21.4 mg/kg FA, 0.7 mg/kg ZEN, 0.5 mg/kg 15-DON) and (4) high level of contaminated grains + 0.2% polymeric glucomanan mycotoxin adsorbent (GM polymer). Peripheral blood monocyte numbers decreased linearly in birds fed contaminated grains. The feeding of contaminated diets linearly reduced B cell count on d 56, while T cell count on d 28 responded quadratically to the feeding of contaminated grains. The feeding of contaminated diets did not significantly alter serum or bile immunoglobulin concentrations, contact hypersensitivity to dinitrochlorobenzene, or antibody response to sheep red blood cells. Supplementation of GM polymer to the contaminated diet non-specifically increased total white blood cell and lymphocyte counts, while preventing mycotoxin-induced decreases in B cell counts. It was concluded that though feeding of grains naturally-contaminated with *Fusarium* mycotoxins altered the numbers of leukocyte subpopulations in the peripheral blood of broiler chickens, the changes were not enough to cause functional alterations in immune response.

**Key Words:** Chickens, Deoxynivalenol, Fusaric acid, Immune parameters, Mycotoxins

**237 Immunomodulation with  $\beta$ -1,3/1,6-glucan (Immustim<sup>®</sup>) affects growth performance and resistance to *Escherichia coli* respiratory infection of broiler chickens.** G. R. Huff<sup>\*</sup>, W. E. Huff, N. C. Rath, J. M. Balog, and G. Tellez, USDA, ARS, PPSR, Fayetteville, AR.

There is a need to evaluate potential immunomodulators as alternatives to antibiotics for growth promotion and disease prevention. Immustim<sup>®</sup>, a feed grade  $\beta$ -1,3/1,6-glucan, is a helical polysaccharide (poly-glucose) derived from the cell wall of *Saccharomyces cerevisiae* which has immunomodulating activities. The objective of this study was to determine the ability of two Immustim<sup>®</sup> supplementation programs to protect broiler chicks from an experimental respiratory challenge with *E. coli*. Chicks were housed in battery-brooders from day of age and fed a standard starter diet or the same diet containing 20 g/ton of Immustim<sup>®</sup> either continuously (BG25d) or for only the first 7 days prior to challenge (BG7d). At day 7, half of the birds were inoculated in the thoracic air sac with 800 cfu of a serotype O2, non-motile strain of *E. coli*. All surviving birds were necropsied at day 25. Body weights of survivors ( $P=0.01$ ) and feed efficiency ( $P=0.002$ ) were protected from the adverse effects of *E. coli* by BG7d but not by BG25d. Mortality was decreased from 63% (Control) to 53% in BG25d and 47% in BG7d, but these decreases were not significant. The relative weights of the liver ( $P=0.0009$ ), heart ( $P=0.057$ ), and bursa of Fabricius ( $P=0.02$ ) were protected from the effects of the *E. coli* challenge only by BG7d. Despite positive effects in *E. coli* challenged birds, BW of non-challenged birds were decreased by both BG25d ( $P=0.04$ ) and BG7d ( $P=0.03$ ). These data suggest that supplementation of broiler diets with Immustim<sup>®</sup> may be valuable for decreasing production losses due to *E. coli* respiratory disease, but that the immune stimulation may be costly in decreased production values for birds raised in an environment with minimal disease challenges. Supplementation programs designed to stimulate immunity just prior to predicted environmental stressors and disease exposure may increase the efficacy of immunomodulating feed additives.

**Key Words:**  $\beta$ -glucan, Antibiotic alternative, Immunomodulator

**238 Addition of water to composted pine shavings and sand litter and effects on bacterial counts.** K. S. Macklin<sup>\*</sup>, J. B. Hess, S. F. Bilgili, M. K. Eckman, J. P. Blake, and R. A. Norton, Auburn University, Auburn, AL.

Litter that had been used to rear broilers to 7-weeks of age was utilized in this study. Sixteen groups containing sand and 16 with pine shavings were utilized. For each litter type 8 of the groups were composted, while the other 8 were not. Additional treatments for each group of 8 were as follows: two groups were wetted with 2 gallons of water and covered with a tarp, 2 were wetted and not covered, 2 were not wetted and covered, and 2 were not wetted and were left uncovered. Temperature readings were taken hourly from 8 of the composted groups that represented each treatment. Temperature readings of the non-composted groups were only performed on the 4 unique combinations that include the addition of water. Samples from each group were collected at the start and one week later at the trials termination. Collected samples had their water activity, moisture content and bacterial counts determined. Bacterial counts were conducted on MacConkey (MA), Plate Count Agar (PCA) and Reduced Blood Agar (RBA). All of the media were incubated at 37C for 18 hours, with MA and PCA being incubated aerobically and RBA anaerobically. Wetted, composted and covered pine had achieved the highest internal temperatures of 50+C, which it sustained until termination. The other treatments did not achieve this high of a temperature and if they were not wetted the observed temperature increase lasted less than 24 hours. Water activity was highest in treatments that had water added to them. Sand generally had higher moisture levels than pine regardless if water was added or not. Composted, covered, not wetted sand or pine shavings produced the lowest bacterial counts on all three media. The results of this experiment show that by piling the litter and covering the litter is an effective means in reducing the overall bacterial counts for both pine shaving and sand.

**Key Words:** Compost, Sand, Litter

**239 Stocking density and effects on the performance of broiler chickens grown under water fogging and positive tunnel ventilation system.** I. F. F. Tinôco<sup>\*1,2</sup>, R. S. Gates<sup>2</sup>, J. M. Fonseca<sup>1</sup>, F. C. Baêta<sup>1</sup>, A. L. A. Tinôco<sup>1,2</sup>, H. Xin<sup>3</sup>, and M. Cordeiro<sup>1</sup>, <sup>1</sup>Federal University of Viçosa, <sup>2</sup>University of Kentucky, <sup>3</sup>Iowa State University.

An experiment was conducted with the aim of evaluating the effects of bird density (14, 16 and 18 birds per m<sup>2</sup>) on broiler performance in hot weather, using water fogging and a positive tunnel ventilation system (PTVS). The test was conducted during summer conditions. For the PTVS, 18 axial fans (each 300 m<sup>3</sup> per min) were used, placed two by two, oriented along the long axis of the house, 2.0m from the floor. The fogging system consisted of three lines of nozzles running the length of the house. When house air temperature exceeded 25°C, the axial fans were activated, the curtains remained open, and the fogging system was turned off. When the ventilation was not enough to maintain the air temperature below 29°C, the curtains were shut to enhance air velocity over the birds, and the fogging system was turned on. If air relative humidity exceeded 80% then the curtains were reopened for dehumidification. Evaluations were based on the Black Globe Humidity Index (BGHI), radiant heat load (RHL), air relative humidity (RH) and litter moisture content (MC), and standard measures of bird growth performance, including weight gain (WG), feed conversion (FC), live weight (LW) and mortality rate (MR). As to the comfort thermal index, it was verified that there was a significant difference ( $P<0.05$ ) among the BGHI, RHL and RH values between the three treatments only for a few hours during the day. Therefore, no influence of the lodging density was observed in these indexes. During the experiment, the RH remained between 25 and 35%, which is favorable for broiler chicken raising. With increased lodging density, FC increased and WG and LW decreased, due to a greater competition for food. MR decreased with the increase of the lodging density, in opposition to what was expected. Rearing broiler chickens at high lodging densities was possible because a water fogging system was used in association with a positive-pressure tunnel ventilation system. Thus, all the performance indexes of the poultry evaluated in this experiment were considered within the ideal range for the Brazilian poultry industry.

**Key Words:** Broiler chickens, Lodging density, Tunnel ventilation system

**240 The effect of diet and age of photostimulation on the skeletal integrity and long term productivity of SCWL hens.** M. A. Martinez-Cummer\* and S. Leeson, *University of Guelph, Guelph, Ontario, Canada.*

An experiment was designed to assess the effect of photostimulating pullets and transferring them from a grower to a layer barn at either 15, 16, 17, 18 or 19 weeks of age and providing them with either a grower (1% Ca) or a layer ration (4% Ca) until 21 weeks of age. Thus, 10 treatments with 6 replicates and 4 birds per replicate were used with a total of 240 hens evaluated. Birds were offered water and feed ad-libitum and kept at 21°C. Feed intake, egg weight, eggshell thickness, body weight gain, and bone mechanical properties were recorded at 24, 40, 48 and 64 weeks of age. The egg production was recorded daily for the length of the trial. Feed intake was not significantly affected by age or diet in the laying barn. However, due to a shorter period in the grower barn, body weight gain was affected by treatment ( $P \leq .0003$ ). Birds photo-stimulated until 19 weeks of age and fed a grower ration did appear to gain less weight than birds transferred into the laying room at 15, 16 and 17 weeks of age. Pre-laying ration did appear to affect production up to peak production particularly with birds transferred at 17 and 19 weeks of age. However production curves tend to equalize thereafter. With respect to egg weight, at peak production birds fed a high calcium pre-layer ration did show higher weight ( $P \leq .001$ ). Throughout the trial birds fed high calcium diet prior to production and photo-stimulated at 17 weeks of age did produce heavier eggs. Shell thickness was affected by calcium level as expected during the experimental feeding period 15 to 21 weeks of age. At peak production (24 weeks), however, there are no evident carryover effects. These results suggest that the modern hen is unable to cope with even short periods of calcium deprivation and that shell quality will drop very rapidly in an attempt to protect skeletal integrity. Nevertheless, shell quality did seem to recover rapidly when proper rations were introduced. All mortalities in this trial came from birds fed low calcium diets. Attempting to delay sexual maturity until 19 weeks resulted in decreased productivity and skeletal integrity in SCWL hens ( $P \leq .003$ ) throughout the production cycle.

*Key Words:* Layer performance, Photostimulation, Skeletal integrity

**241 Environment thermal comfort and performance of broiler chickens raised at high stocking density and different positive ventilation systems under heat stress conditions.** I. F. F. Tinôco\*<sup>1,2</sup>, N. Zanola<sup>1</sup>, R. S. Gates<sup>2</sup>, A. L. A. Tinôco<sup>1,2</sup>, F. C. Baêta<sup>1</sup>, P. R. Cecon<sup>1</sup>, and R. Vigoderis<sup>1</sup>, <sup>1</sup>*Federal University of Viçosa - Brazil*, <sup>2</sup>*University of Kentucky*.

This study aimed to compare the effects of two different poultry environmental control systems (Positive Ventilation System in Tunnel, PVST, and Lateral Ventilation System, LVS), on the poultry housing thermal comfort and on the productive performance of broiler chickens under hot summer conditions. Broilers were placed at a 40% greater density than the average for growers in the region. The environmental thermal comfort was evaluated by the Black Globe Humidity Index (BGHI) and Radiant Heat Load (RHL). For the PVST, 18 axial fans (each 300 m<sup>3</sup> per min) were used, placed two by two, in the direction of the poultry house length, at a height of 2.0m from the floor. The fans started working if house air temperature exceeded 25°C. Up to a house temperature of 29°C, the curtains remained open, and the fogging system, turned off. The fogging system consisted of three lines of nozzles running the length of the poultry house. When the ventilation was not able to maintain the air temperature below 29°C, the curtains were closed and the fogging system was turned on (unless air humidity exceeded 80%). Except during rainy periods, the LVS poultry house operated with curtains always open. The cross ventilation and fogging systems were handled similarly to the PVST. For both environmental control systems, there were no significant differences in the environmental thermal comfort indexes (BGHI and RHL). Compared to the average of broiler performance indices obtained from earlier lots grown in the same experimental houses under summer conditions but with simple open-sided housing, it was verified that the use of either environmental conditioning systems allowed a 40% rise in the poultry density over current practices. Broiler performance was improved, with final live weight increasing 55g/bird and 15g/bird for PTVS and LVS respectively, and the final food conversion being 1.78, 1.83 and 2.1 for PTVS, LVS and the traditional housing respectively. The average results of the productive performance indexes of feed intake (FI) and weight gain (WG) of the broilers in the PVST were better

than those in the LVS, consequently, use of environmental conditioning systems allowed a 60% increase in the broiler placement density.

*Key Words:* Poultry environment, High placement density, Ventilation systems, Poultry performance

**242 A natural and viable alternative to antibiotic-based anticoccidials for the control of coccidiosis in broilers.** M. Daley\*<sup>1</sup>, V. G. Stanley<sup>1</sup>, and A. E. Sefton<sup>2</sup>, <sup>1</sup>*Prairie View A&M University*, <sup>2</sup>*Alltech, Guelph, Canada.*

Considering consumer concerns for a drug-free product, a trial was conducted to evaluate the effects of natu-stat<sup>®</sup>, an antibiotic-free feed additive, on the performance of broiler chicks challenged with a cocktail mixture of three species of *Eimeria* (*E. tenella*, *E. maxima*, and *E. acervulina*). Day-old broiler chicks were separated into three treatment groups; control (unchallenged and untreated) challenged and untreated, and challenged and treated with natu-stat<sup>®</sup>. Except for the control, the chicks were challenged by oral gavage with sporulated oocysts (150,000/milliliter/bird) of the mixture 14 d post-hatch. Response variables were bi-weekly body weight, feed utilization, and mortality. At Week 3 post-challenge, chicks were sacrificed to evaluate relative liver and bursa weights, and for oocysts isolation from the chicks fecal material. Chicks on the natu-stat-treated feed challenged with coccidiosis weighed 1416 g at 3 wk post-challenge compared to 1293 g for the untreated and challenged chicks. Feed utilization for natu-stat-treated chicks and challenged with the oocysts (1.76) was comparable to the control (1.74) but better than the challenged and untreated chicks (1.86). Despite being challenged, chicks receiving the natu-stat-treated feed had mortality of 3.06% compared to 5.6 % for the challenged and untreated chicks, and 2.7% for the control. The decreased relative weight of the bursa, and the increased relative weight of the spleen from the challenged and untreated chicks were restored to the level of the control with the dietary inclusion of natu-stat<sup>®</sup>. Although higher than the control, smaller number of oocysts were isolated from the fecal material of the chicks on natu-stat-treated diet despite the coccidial challenge. The litter moisture content from the pens with the natu-stat-treated group of chicks was significantly lower than the litter collected from the challenged and untreated chicks. In conclusion, the addition of natu-stat in broiler chicks diet from Day 0 appeared to be a viable alternative to in-feed antibiotic-based drugs for protection against *E. tenella*, *E. maxima*, and *E. acervulina*.

*Key Words:* *Eimeria*, Natu-stat, Broilers

**243 Performance verification of candidate environmentally superior technologies.** C. M. Williams\*, *North Carolina State University, Raleigh, NC/USA.*

Resources provided by industry agreements with the North Carolina Attorney General have resulted in the identification of several candidate animal waste treatment technologies - most of the technologies are specifically targeting swine waste, however all have applications for liquid poultry waste and some have applications for poultry litter. Many of the technologies have been constructed on commercial sites for objective performance verification. Mandated performance verification of the technologies includes monitoring and analysis for emissions of ammonia, odor, pathogens and as well as a comprehensive economic feasibility analysis. Methodologies for emission determinations and economic feasibility verification have application to environmental issues impacting poultry production. A model decision tool framework is developed to identify viable technologies based on performance data. The environmental model integrates waste residuals reductions (variables include odor, aerial ammonia, total nitrogen and phosphorus that is land applied) to cost benefits.

*Key Words:* Animal waste, Innovative technologies, Economic feasibility, Performance verification

**244 Application of plating enumerations and denaturing gradient gel electrophoresis to study turkey poult gastrointestinal tract bacterial diversity.** T. Ward\*, M. King, and T. Rehberger, *Agtech Products, Inc., Waukesha, WI.*

Bacterial enumerations and denaturing gradient gel electrophoresis (DGGE) were used to examine the bacterial diversity of the gastrointestinal tract (GIT) of turkey poults of various age. Gastrointestinal tracts from 3 poults each from 25 sites with birds ranging from 1 to 36 days of age were enumerated for *Clostridium perfringens*, *Escherichia*

*coli*, coliforms and lactic acid bacteria. DNA isolated from all GIT samples and 10 cecal samples was PCR amplified using primers targeting the V2-V3 region of the 16S RNA. Amplification products were applied to DGGE and the resulting banding patterns were examined for differences in diversity relating to age and further compared to bacterial enumeration results. Tracts with detectable populations (CFU/g) ranged from  $10^2$ - $10^4$  for *C. perfringens*,  $10^3$ - $10^5$  for *E. coli*,  $10^3$ - $10^5$  for coliforms and  $10^3$ - $10^7$  for lactic acid bacteria. Plating enumerations yielded only a selected indication of bacterial diversity, although providing direct evidence of potential pathogen presence. Poult GIT diversity as observed by DGGE appeared to decrease with age. One day old poults produced a DGGE banding pattern with approximately twice as many bands as 17-36 day poults. As poults age, the number of AT rich bands decreased. Three common bands were observed in the majority of the 17-36 day old poults. When comparing cecal samples to tract samples of one day old poults the number of bands represented are similar, although only a few bands were conserved between the two locations. As seen with the GIT samples, AT rich bands from cecal samples decreased with poult age. DGGE is a powerful tool for studying the bacterial diversity and ecological succession that exists within the GIT of turkey poults and is being further used to understand the banding patterns that are associated with turkey poult illnesses.

**Key Words:** DGGE, Turkey poult, Bacterial diversity

**245 Efficacy of KEM SAN™ liquid acidifier and other water sanitizers against select poultry and food pathogens.** P. A. Welch\*, M. Burke, T. George, D. Sanders, J. K. Murphy, and V. J. H. Sewalt, *Kemin Americas, Inc.*

A microtiter plate assay was used to compare the efficacy of organic acid-based KEM SAN™ liquid acidifier (KS), citric acid (CA), and a mineral acid product, PWT® Poultry Water Treatment (PWT) against *Escherichia coli* ATCC 25922, *Staphylococcus aureus* ATCC 25923, and *Salmonella typhimurium* ATCC 14028. KS and CA were both evaluated at 2.6 mL/L, 3.9 mL/L, and 7.8 mL/L, and PWT was evaluated at 15 g/L, 30 g/L, and 48 g/L. All treatments were diluted with sterile tap water with 2 ppm chlorine bleach added, to simulate drinking water in a typical poultry house. Organic acids confer biocidal activity against both Gram [+] and Gram [-] bacteria by lowering pH of extracellular fluids and by providing undissociated acid. The undissociated acid passively diffuses across cell walls of both G+ and G- bacteria as well as across lipid containing inner membranes of G- bacteria that repel polar molecules, e.g., mineral acids. In this experiment, all three products reduced the pH of water, with PWT and CA exhibiting the greatest reductions. KS and CA demonstrated excellent biocidal activity against test organisms across all treatment levels. PWT was marginally effective at reducing *S. aureus*, but only at the highest concentrations of PWT and against the lowest dilution of *S. aureus*. PWT did not exhibit biocidal activity against *S. Typhimurium* or *E. coli*. The results of this study indicate that efficacy of the organic acids tested [KS and CA], when compared to PWT, were more effective in controlling poultry and food pathogens in drinking water.

**Key Words:** KEM SAN™, Water sanitation, Food safety, PWT, Citric acid

**246 The effect of strain on commercial turkey tom and hen performance.** J. L. Godwin\*<sup>1</sup>, J. L. Grimes<sup>1</sup>, A. N. Crouch<sup>2</sup>, P. R. Ferket<sup>1</sup>, A. G. Gernat<sup>1</sup>, E. R. Neely<sup>1</sup>, A. D. Israel<sup>1</sup>, and K. M. Mann<sup>1</sup>, <sup>1</sup>North Carolina State University, <sup>2</sup>British United Turkeys of America.

Two experiments (E1&E2) were conducted to examine the effect of strain on commercial turkey tom and hen performance. In each experiment, birds were placed in 48 floor pens (6.2 sq m) in a randomized complete block design to provide 8 replicate pens per strain and sex. Each row of 12 pens served as a block. There were 2 reps for each treatment in 4 blocks for E1. In E2, 2 blocks were used for toms and 2 for hens with 4 reps per treatment in each block. Twenty-five tom or 35 hen poults were placed in each pen at hatch and reared according to industry practices. Feed consumption and mortality were monitored and feed conversion (FC) was calculated. In E1, birds were weighed at 2, 6, 9, 12, 15, 18, & 20 wk. Hens were processed at 12, 15, 18, & 20 wk, while toms were processed at 18 & 20 wk. In E2, hens were weighed 3, 6, 9, & 12 wk and then processed, while toms were weighed at 3, 6, 9, 12, 15, & 20 wk and then processed. Carcass yield was determined in both experiments.

Three strains were used in each experiment: Nicholas 700 (N), B.U.T.A. Big 6 (B6), and B.U.T.A. T-2 (T2) in E1 and B6 (B), N, and Hybrid Converter (H) in E2. In E1, feeds were made at the university feed mill, while all feed was provided by a commercial turkey feed mill for E2. In each experiment, the pen was the experimental unit and regression analysis, by sex, was used to determine the effect of strain on performance parameters ( $P < 0.05$ ). In E1, T2 and B6 were heavier than N toms at 20 wk (18.9, 18.4, & 17.7 kg, respectively). Hen BW were 12.6, 12.4, and 12.1 kg for T2, B6, & N ( $P = 0.10$ ). T2 toms had higher 20 wk FC than N toms (T2-2.56, B6-2.45, & N-2.38). T2 hens had higher 20 wk FC than N hens (T2-2.69, B6-2.59, & N-2.52). There were no significant differences in percent carcass yield or mortality in E1. In E2, 20 wk tom BW was different by strain (B-20.5, H-18.7, N-20.0 kg). At 12 wk, B (7.2 kg) & N (7.2 kg) hens were heavier than H hens (7.0 kg). There were no significant differences in 20 wk tom FC (2.60) or 12 wk hen FC (1.85). B (5.6 kg) & N (5.7 kg) toms had greater total breast meat at 20 wk than H (5.2 kg) toms. Bone-in-breast at wk 12 was heavier for B and N versus H hens (2.8, 2.9, & 2.7 kg). In conclusion, male and female turkeys performed differently due to strain under the conditions of this study.

**Key Words:** Commercial turkey, Strains, Toms, Hens, Performance

**247 Housing effect on behavior and production performance of laying hens: furnished cages vs. conventional cages.** K. Pohle\* and H. Cheng, *Purdue University - West Lafayette, Indiana.*

The effect of caging systems on behavior and production performance of laying hens was examined. At 19 wk of age, non-beak trimmed White Leghorn hens were randomly assigned into conventional cages at 3 hens or 6 hens per cage (645 cm<sup>2</sup> of floor space/hen), or furnished cage at 10 hens per cage (610 cm<sup>2</sup> of floor space/hen). The furnished cages contain nests, perches, scratch pads, and dust baths (Big Dutchman, Germany). Production data were collected from a period of 25 to 50 wk of age, and behavioral data were collected at 30 and 40 wk of age using 5 minute constantly scanning at each from 0700-2300. There were no differences in egg production between conventional cages and furnished cages (ANOVA,  $P > 0.05$ ), but the egg mass tended to be greater in furnished cages (ANOVA,  $P = 0.07$ ). Compared to hens in conventional cages, hens with furnished cages laid a greater proportion of dirty eggs (eggs laid in the litter areas or with blood spots), highest at 25 wk of age (1%), then consistently dropped to below 0.1% at 50 wk of age. The frequency of activity transitions and activity levels was higher in both 3- and 6-hen conventional cages than those in furnished cages, which suggests that hens in conventional cages were more restless. These results indicate that furnished cages provide a more comfortable environment for laying hens; however, further studies are needed to investigate how to decrease the laying of dirty eggs.

**Key Words:** Furnished cage, Conventional cage, Hens, Behavior

**248 The effect of litter type on commercial turkey tom and hen performance.** J. L. Grimes\*, P. R. Ferket, A. G. Gernat, E. R. Neely, A. D. Israel, K. M. Mann, and J. L. Godwin, *North Carolina State University.*

Two experiments (E1&E2) were conducted to examine the effect of litter type on commercial turkey tom and hen performance. In E1, pine shavings (PS) were compared to chopped (1-3 cm) Bermuda hay (BH) and a mixture of PS & BH (MX). In E2, PS were compared to a litter made from news print, cotton waste and gypsum (NV, Novovita, Inc, Raleigh, NC). In each experiment, the birds were placed in 48 floor pens (6.2 sq m) in a randomized complete block design to provide 8 replicate pens per treatment. There were 4 rows of pens with 12 pens per row. One row of pens served as a block. There were 2 replicates for each treatment in each block for E1. In E2, 2 blocks were used for toms and 2 for hens with 4 replicate pens per treatment in each block. Twenty-five tom or 35 hen poults were placed in each pen on day of hatch. Standard industry rearing practices were used to rear the birds. Feed consumption and mortality were monitored and feed conversion (FC) was calculated. In E1, birds were weighed at 2, 6, 9, 12, 15, 18, & 20 wk. Hens were processed at 12, 15, 18, & 20 wk, while toms were processed at 18 and 20 wk. In E2, hens were weighed at 3, 6, 9, & 12 wk and then processed, while toms were weighed at 3, 6, 9, 12, 15, & 20 wk and then processed. Carcass yield was determined in both experiments. In E1, feeds were made at the university feed mill, while all feed was provided by a commercial turkey

feed mill for E2. In each experiment, the pen was the experimental unit and regression analysis was used to determine the effect of litter type on performance parameters ( $P < 0.05$ ). In E1, there were no significant differences in 20 wk BW (toms = 18.4 kg; hens = 12.4 kg), FC (toms = 2.45; hens = 2.59), or mortality (toms = 4.7%; hens = 3.2%) due to litter material. Carcass yield was only affected at 18 wk, where BH hens had greater bone-in-breast meat than MX hens and PS hens were intermediate (4.8, 4.6, & 4.7 kg). In E2, use of NV litter resulted in heavier toms and hens at 20 wk (Toms - PS = 19.4, NV = 20.0 kg; Hens - PS = 7.06, NV = 7.23 kg). There were no differences in FC (toms = 2.62; hens = 1.74), mortality (toms = 9.7%; hens = 1.9%), or carcass yield due to litter type. In conclusion, chopped BH and NV are alternative litter materials to pine shavings.

**Key Words:** Commercial turkey, Litter, Toms, Hens, Performance

**249 Growth and development of broiler breeder males reared to early maturation.** C. A. Pietsch\*, J. B. Hess, R. J. Lien, and W. D. Berry, *Auburn University*.

Sex separate rearing allows for manipulation of the development of breeder males. Early maturation may reduce mortality and increase uniformity during rearing of replacement males. However, birds reared to early maturation may require more protein to support rapid growth. For this experiment, 3 pens, each containing 100 cockerel chicks, were started on a 20 percent protein diet. After 3 weeks, chicks were divided into 3 treatments with 4 reps containing 25 chicks. A linear body weight (BW) goal was developed for the fast growth birds targeting the goal BW suggested in the management guide for 22 weeks of age (3.32 kg) by 16 weeks. The fast growth (FG) birds were fed either a high protein grower diet (HP) with 20 percent protein or a normal grower diet (NP) with 15 percent protein and photostimulated at 16 weeks. The control group (CD) was fed a 15 percent grower diet and reared according to guidelines, with lighting at 22 weeks. Weekly BW was entered into an energy needs formula to determine feed required for the week. Plasma samples, growth measurements, and organ weights were collected throughout the experiment. Comparisons were made between birds at the same intervals post lighting (20 wk FG, 26 wk CD) and the same age (30 wk). At sexual maturation, 8 roosters per pen were placed with 80 hens, giving 2 reps per treatment with 8 roosters per breeder pen. 90 eggs per pen were collected weekly and incubated for 3 days to determine fertility. HP birds had the highest uniformity but the lowest fertility. NP birds had higher uniformity than CD birds and the best fertility among the treatments. At 4 wk after lighting, the CD group had a higher percent testes weight; however, by 30 wk here was no significant difference. FG birds had a longer keel length at 4 wk post PS and a longer shank length at 30 wk for all birds. Plasma analysis for testosterone levels is currently being performed. It was concluded that it is feasible to rear roosters using a fast growth program and introducing photostimulation at an earlier age; a higher level of protein is detrimental to overall reproductive performance.

**Key Words:** Breeder male, Accelerated maturation, Development

**250 Study of different materials for making evaporative plates and their effects on thermal comfort atmosphere of acclimatized poultry houses with systems of negative tunnel ventilation.** M. Oliveira de Paula, I. Ferreira Tinoco\*, C. Elias da Silva, and J. Nogueira da Silva, *Department of Agricultural Engineering, University of Vicosa, Brazil*.

Searching to promote thermal comfort and to improve the internal atmosphere of animal's facilities, it has been used the Adiabatic Evaporative Cooling System (AECS) made of porous materials coupled to fans and exhaust fans. In the other hand porous materials usually employed on those system are cellulose plates, that has elevated costs, low durability and are difficult to buy. The goal of this work was to study the possibility of replacing cellulose plates by others made out of expanded clay (knowing as cinasita) on AECS. Research was carried out under summer conditions, from February through March of 2001, on poultry houses facilities located in Palotina - PR, southern Brazil. Thermal comfort was evaluated by means of Black Globe Humidity and Temperature Index (BGHI), Thermal Load Radiation (TLR), Relative Humidity (RH) and productive development of broilers. Results leads to the conclusions that there was advantage of the traditional Cellulose Plates on BGHI, TLR

and RH as compared to the values obtained for the alternative material used (cinasita).

**Key Words:** Adiabatic evaporative cooling, Thermal comfort, Porous materials

**251 The influence of lining to thermal comfort in covering of ceramic tiles, asbestos clay and aluminum used in poultry houses in Brazil's winter conditions.** Marcos Oliveira de Paula, Rodrigo Couto Santos, and Ilda Ferreira Tinoco\*, *Department of Agricultural Engineering, University of Vicosa, Brazil*.

In animal facilities, the covering materials deserve special attention because they represent one of the major factors to thermal comfort. In Brazil, most of the research related to the covering materials has been concerned about the thermal cooling of these materials, considering the occurrence of very high temperatures in this Country summers. However, the covering materials used in animal facilities may not be simultaneously efficient under summer and winter conditions. Therefore, this study aimed at the following objectives to analyze different types of conventional coverings (ceramic, aluminum and cement-amianthus) and their associations with lining, commonly used in poultry house. The evaluated by the Black Globe and Humidity Index (BGHI). The experiment was accomplished with prototypes of poultry house for winter conditions, in Viosa-MG, the Rural Constructions experimental area in Federal University of Viosa. Based on conditions under which the study was accomplished and the obtained results, it was concluded that according to the values of BGHI, the use of lining with the ceramic and aluminum tiles provided a higher thermal inertia to these sets, what is desirable over winter; The cement-amianthus tiles with lining are not interesting under the thermal comfort viewpoint over winter.

**Key Words:** Thermal comfort, Facilities, Lining

**252 The impact of Sal CURB® ASF liquid antimicrobial on the performance of commercial phytase products.** A. Lamptey and V. J. H. Sewalt\*, *Kemin Americas, Inc., Des Moines, Iowa, USA*.

Recent mandates in the poultry industry have spurred the implementation of programs to ensure that pathogens, specifically *Salmonella* sp., are not detected in products leaving the processing plant and destined for the consumer's table. In order to achieve this goal, poultry producers have been encouraged to use antimicrobial products, such as the formaldehyde-based Sal CURB® ASF liquid antimicrobial (Sal CURB), in their feed rations as an aid to minimize *Salmonella* contaminated birds entering the processing plant. Poultry producers also focus on optimizing phosphorous utilization with the use of phytase enzyme supplements. The focus of this study was to investigate the impact of Sal CURB on the efficacy of three commercial phytase product lines for mash feed and post-pelleting applications. The impact was evaluated using an *in vitro* method for measuring the release of inorganic phosphate from a phytase-supplemented corn/soybean meal diet with and without added Sal CURB. Performance of the various phytase products was diminished by 0 to 13% by the presence of Sal CURB. A second experiment indicated the maximum loss of phytase efficacy to be less than 5%. There was no interaction between the type of phytase product and the presence/absence of Sal CURB. It is likely that the commercial benefits of the inclusion of a formaldehyde-based antimicrobial product would outweigh the minimal loss in phytase efficacy applied post-pelleting or in mash feeds.

**Key Words:** Sal CURB, Phytase, Formaldehyde

**253 Composition of poultry litter through laboratory analysis and in-house nutrient profiling for nutrient management plan development.** C. W. Ritz\*, A. S. Tasistro, D. E. Kissel, and P. B. Bush, *University of Georgia, Athens, GA*.

Obtaining nutrient concentration data for poultry litter is a crucial step in developing a nutrient management plan (NMP). Measuring the average nutrient concentrations of litter within a poultry house requires sampling procedures that ensure the taking of representative samples. Spatial variability of nutrient concentrations can be influenced by conditions such as litter moisture content and waste feed, though the amount of variability is not known. Following introduction of NMP programming, from July 2000 to June 2002, 3,761 poultry litter/manure samples of the following types were analyzed for nutrient composition. The mean nutrient values

in % for N, P2O5, and K2O (with standard deviations in parenthesis) for the various categories of poultry litters were:

Fresh Broiler Litter (2,903 samples): 3.15(0.60), 2.77(0.81), 2.33(0.62)  
 Stockpiled Broiler Litter (262 samples): 2.78(0.86), 2.84(0.94), 2.29(0.69)  
 Composted Broiler Litter (62 samples): 2.80(0.98), 3.00(1.00), 2.30(0.83)  
 Fresh Layer Litter (209 samples): 2.26(0.83), 3.16(1.34), 2.05(0.81)  
 Broiler Breeder Litter (325 samples): 2.12(0.79), 3.14(1.17), 1.93(0.63)

As indicated by the standard deviations, litter composition can be quite variable. One possible reason for the variability might be that the samples taken by farmers do not represent the true average nutrient composition of litter within houses because of spatial variability of nutrient

concentrations. In order to characterize this spatial variability, a broiler house was sampled at 30 uniformly spaced locations, and each sample analyzed for N and P concentrations. Both N and P concentrations varied nearly twofold. Results indicate that care must be taken in sampling poultry houses, by sub-sampling from areas such as feeders and waterers in proportion to their corresponding areas within a house. With the increased awareness of potential environmental impacts of land application of manures, poultry producers can more effectively utilize poultry litter within a NMP through improved sampling procedures.

*Key Words:* Poultry, Nutrient, Litter

## Extension and Instruction

**254 A poultry industry manager survey used to characterize employable skills for undergraduate students.** K. M. Downs\* and J. E. Mehlhorn, *Middle Tennessee State University*.

A 27-question survey instrument was developed to assess skills important to poultry managers in achieving success in the poultry industry. Twenty questions focused on evaluating subject matter competencies and employable skills. Seven questions evaluated the importance of specific recruitment efforts. A 1-5 Likert scale (1=unimportant, 5=critically important) was used for response quantification. The survey instrument was tested by 15 outside observers. Managers in all phases of the broiler and table egg industry (i.e., live production, processing, hatchery, feed mill, human resources, marketing, and distribution) were targeted. Surveys (one front page, blue paper) were mailed with an explicative cover letter, self-addressed stamped envelope, and appreciation gift (MTSU decal). At present, response rate has been low (56.2%). A majority (57%) of managers classified their current position as either live production or processing. Managers completing the survey (n=9) indicated teamwork skills (4.89) and integrity (4.89) as the most important employable skills, while originality (3.78) was considered the least important. Oral communication abilities were considered more important than written skills (4.33 vs. 4.00), and undergraduate major was moderately important in career success (3.00). Knowledge of business (3.89) and foreign language (2.67) were evaluated, respectfully, as the most and least important subject matter competencies. Likewise, departmental career fairs were considered the most important means of recruitment (3.89), while web-based job sites were considered only minimally important (2.75). In an effort to substantiate database validity, survey administration is ongoing. However, according to the current results, efforts to foster team-building skills, problem-solving abilities, and business acumen in

undergraduate students may enhance poultry career success. Moreover, industry-academia interface remains vitally important for student job placement.

*Key Words:* Poultry managers, Job placement, Undergraduate education

**255 An undergraduate laboratory course on animal cell culture techniques.** P. E. Mozdziak\*, *North Carolina State University, Raleigh NC*.

A new laboratory course emphasizing practical training in animal cell culture techniques has recently been developed at North Carolina State University. The new course is an advanced elective for the newly developed undergraduate minor in Biotechnology, which was first instituted in the fall of 2001. The course is also an elective for students in the Department of Poultry Science. The goal of the Animal Cell Culture Techniques course is for students to acquire the necessary practical skills for the isolation of animals cells for in vitro studies, maintenance of animal cells in vitro, manipulation of animal cells in vitro, and application of molecular techniques to in vitro situations. Avian cells are used as the model organism for most laboratory exercises. The course was first taught to a total of 6 graduate students in the summer session of 2001. It was successfully taught to a total of 9 undergraduate and graduate students in the spring of 2002, and there are currently 19 students registered for the spring of 2003 semester. Overall, student demand is greater than the facilities and faculty resources available to teach the course. Training in animal cell culture techniques is an essential opportunity for students studying Poultry Science and related disciplines.

*Key Words:* Tissue culture, Undergraduate education, Biotechnology

## Genetics

**256 Functional analysis of Salmonella genome for virulence genes using transposon sequence tag profiles.** M. M. Cox<sup>1</sup>, R. L. Ziprin<sup>2</sup>, L. F. Kubena<sup>2</sup>, D. J. Nisbet<sup>2</sup>, S. C. Ricke<sup>3</sup>, and Y. M. Kwon\*<sup>1</sup>, <sup>1</sup>*University of Arkansas, Fayetteville, AR*, <sup>2</sup>*USDA-ARS, College Station, TX*, <sup>3</sup>*Texas A&M University, College Station, TX*.

An increasing number of bacterial genomes have been completely sequenced. However, the biological functions of the sequences are largely unknown for the bacteria mainly due to the lack of a comprehensive method for functional screening of bacterial genome. We devised a quantitative method for functional analysis of bacterial genomes in genome-wide scale using transposon mutagenesis and sequence tags that are defined by their positions in the transposon-flanking sequences. We demonstrated that the identity and frequency of the sequence tags provide information on the level of each mutant in the pool. The results suggest that comparing the sequence tag profiles of the mutant pools before and after selection could allow identification of transposon mutants with competitive disadvantages. We applied this method to identify the Tn5 mutants of *Salmonella enteritidis* that are attenuated during infection in 5-day-old chicks. This method is a powerful approach for categorizing gene function that should be applicable to a variety of microorganisms.

*Key Words:* Bacterial genomes, Transposon, *Salmonella enteritidis*, Virulence genes, Chicks

**257 Relationship between PGC concentration and morphological parameters in early chick embryos.** C. Tomita, K. Nomura, and A. Tajima\*, *Institute of Agriculture and Forestry, University of Tsukuba*.

Stage 14 (Hamburger & Hamilton, 1951) chick embryos have been used to collect circulating primordial germ cells (PGCs) for producing germline chimeras. However, the recovery rate of circulating PGCs from the embryo varies considerably among replicates. The present study was conducted to elucidate the relationship between the concentration of circulating PGCs and morphological parameters in the stage 14 chick embryos. Three roosters and 12 hens were used in the present study. Each hen was artificially inseminated weekly with semen collected from same rooster. Collected eggs were incubated for 57.5-69.5 hours to obtain stage 14 embryos. Blood was collected from embryos using a fine glass pipette and blood cell (BC) as well as primordial germ cell (PGC) concentration was determined. After blood collection, embryo proper and vascular system surrounding embryo was removed altogether and the digital image was recorded. The morphological analysis of the embryo was conducted using the digital image. The total number of embryo samples used in the present study was 50. Average PGC and BC concentrations were  $15 \pm 1.8/\mu\text{l}$  and  $112,742 \pm 7,458/\mu\text{l}$ , respectively. Average circumference of marginal sinus, area pellucida and embryo proper were  $55.2 \pm 1.5\text{mm}$ ,  $31.6 \pm 0.8\text{ mm}$  and  $21.2 \pm 0.6\text{ mm}$ , respectively. A high positive correlation was observed among three morphological parameters. However, no significant correlation was observed between PGC or BC concentration and any of the 3 morphological parameters. On the other hand, a large variation was observed among embryos for all parameters observed in the