
Objectives of this study were to explore the untoward effects of cottonseed meal (CSM) on male reproductive performance of broiler breeders and ameliorating effects of lysine addition in rations. A total of 80 broiler breeder males of 40 weeks of age were divided in to 8 groups. The four groups were fed diets containing CSM @ of 0, 10, 20 and 30%, respectively. The remaining four groups were given same diets with the supplementation of 2% lysine. Duration of the experiment was 10 weeks. Body weight, comb area, vent length, semen volume and sperm counts were determined weekly. A significant decrease in body weight, comb area and vent size was observed in 20 and 30% CSM fed groups compared to control group. A decrease in serum testosterone, semen volume and sperm counts occurred with the increase in dietary level of CSM. Testes volume, absolute and relative weights were significantly lower in all the groups as compared to control birds. No pathological lesions were observed in testes of males kept on ration containing up to 20% CSM fed groups. Testes of males of group given 30% CSM showed increased connective tissue proliferation in the intertubular spaces. In most of the tubules round spermatids had necrotic nuclei. In some birds seminiferous tubules had smaller diameter than those of birds of control group and were lined with 1-2 layers of cells having vesicular nuclei with a nucleolus and fine chromatin. No or partial amelioration of the adverse effect of cottonseed meal was observed upon parameter related to reproductive system like testes size, testes weight, volume, semen volume, sperm count and serum testosterone level. Similarly histopathologically only partial or no amelioration was observed by adding of lysine along with CSM.

It was concluded from the study that 10% CSM incorporated in diets of broiler breeder males was found with out adverse effects on the reproductive performance. Lysine supplementation in the ration only partially alleviated the deleterious effects produced by cottonseed meal.

Key Words: Cottonseed meal, Male broiler breeders, Semen, Testes, Pathology

M2 Evaluating the thermostability of Bacillus subtilis PB6 under commercial pelleting conditions. S. Moore* and Y. Lao, Kemin Industries, Des Moines, IA.

Research studies were conducted at Kansas State University (Manhattan, KS) to evaluate the thermotolerance of a proprietary/patented microorganism when exposed to challenges encountered during commercial pelleting processes. Mash feed was inoculated with CloSTAT™ brand Direct-Fed Microbial (CloSTAT) – a blend of B. subtilis PB6 and inert carriers – to attain a concentration of 10^{10} spores/T feed. Two studies using treatment x temperature factorial designs were conducted in triplicate. In Study One, mash feed was exposed to conditioner temperatures set at 70, 80 or 90°C prior to pelleting. In Study Two, conditioned feed (82°C) was processed through an annular gap expander prior to pelleting. Thermostolerance was determined via a plate count method incorporating measures selective for Bacillus sp. recovery. In both studies, differences were observed between non-inoculated and inoculated mash feed (P<0.05, Study One; P<0.001, Study Two) verifying that the targeted levels of PB6 were achieved. In Study One, hot pellet temperatures ranged from 78.8 – 89.1°C and, in Study Two, hot pellet temperatures ranged from 92.8 - 98.3°C. As temperatures increased, survivability of the organism decreased (P<0.01, Study One; P<0.05, Study Two). While biological systems are inherently variable, it can be generalized that, when hot pellet temperatures reach ≥90°C, there is a statistical probability that a minimum of 1 log of microorganisms will be lost. The results of the KSU expander study closely paralleled previous work where similar losses were observed under commercial expander/pelleting conditions. A research trial conducted at Southern Poultry Research (Athens, GA) demonstrated that PB6 inoculated into mash feed at 109cfu/T (103cfu/g feed on an as-fed basis) was effective in reducing necrotic enteritis mortality and related production losses.

Key Words: Bacillus subtilis PB6, Thermostability, CloSTAT™ brand direct-fed microbial, Pelleting

M3 Effects of supplemental dietary phytase and 25-hydroxycholecalciferol on the performance 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, Agricultural Research Service, USDA, Mississippi State, MS, 3Clemson University, Clemson, SC.

The effects of dietary supplementation with phytase and 25-hydroxycholecalciferol on the performance characteristics of commercial layers that were inoculated prelay (12 wk of age) or at the onset of lay (22 wk of age) with F-strain Mycoplasma gallisepticum were assessed. Experimental layer diets that included a basal control diet or the same diet supplemented with 0.025 % phytase and 25-hydroxycholecalciferol were fed from 20 through 58 wk of age. Weekly and total egg production were determined from 22 through 58 wk, and egg weight, and various internal egg and eggshell quality characteristics were examined at 34, 50, and 58 wk of age. F-strain M. gallisepticum inoculation decreased egg production at the beginning of lay (wk 22 and 23), but increased post-peak lay
M6  Bacterial flora of skin of processed broilers after multiple washing in potassium hydroxide and lauric acid. A. Hinton, Jr* and J. Cason, Russell Research Center, Athens, GA.

The number of various types of bacteria on skin of processed broilers was determined after each of five consecutive washings in mixtures of potassium hydroxide (KOH) and lauric acid (LA). Breast skin was taken from carcasses obtained from a commercial poultry processing facility. Portions of skin were washed using a Stomacher laboratory blender to stomach skin in distilled water (control) or in mixtures of 0.25% KOH-0.50% LA or 0.50% KOH-1.00% LA. After each wash, skin was transferred to fresh solutions and washing was repeated to provide skins samples washed for 1, 2, 3, 4, or 5 times in each solution. Washed skin was stomached in Butterfield’s Phosphate Buffer, and the bacterial flora of the rinsates was enumerated on Plate Count (PC) Agar, Staphylococcus (STA) Agar, Levine Eosin Methylene Blue (EMB) Agar, Lactic Acid Bacteria (LAB) Agar, and Perfringens (PER) Agar with TSC supplement. Results indicated that there was no significant difference in the number of bacteria recovered on PC, STA, EMB, LAB, or PER agar from skin washed 1 or 5 times in water. Significantly fewer bacteria were recovered on PC, STA, and EMB agar from rinsates of skin washed 5 times in 0.25% KOH-0.50% LA than from skin washed 1 time in this solution. There was no significant difference in the number of bacteria recovered on LAB or PER agar from skin washed 1 to 5 times 0.25% KOH-0.50% LA, however. Finally, no bacteria were recovered on LAB agar from rinsates of skin washed 3 or more times in 0.50% KOH-1.00% LA or on PER and EMB agars from rinsates of skin washed 4 or 5 times in this solution. Significantly fewer bacteria were recovered on PC Agar from skin washed 5 times in 0.50% KOH-1.00% LA than from skin washed 1 time in the solution, but there was no significant difference in the number of bacteria recovered on STA Agar from skin washed 1 to 5 times in 0.50% KOH-1.00% LA. Findings indicate that although bacteria can be continually shed during repeated washing of poultry skin, bactericidal surfactants can be used to remove and kill several types of bacteria found on chicken skin.

Key Words: Broilers, Bacterial flora, Processing, Lauric acid, Potassium hydroxide

M7  Omega-3 Enrichment of chicken meat using ground flaxseed: Effect of level and duration on fatty acid composition of triacylglycerols and phospholipids. T. I. Perez1*, M. Bett1, M. J. Zuidhof2, B. L. Schneider2, R. A. Renema2, V. L. Carney3, and R. D. Korver1, 1University of Alberta, Edmonton, AB, Canada, 2Alberta Agriculture and Food, Edmonton, AB, Canada.

Nowadays, consumers are aware of the food impact on their health. Researchers suggest that diets enriched with polyunsaturated fatty acids (PUFA), particularly omega-3 (n-3), could reduce risk of cardiovascular disease. Due to alpha-linolenic acid (ALA) content, flaxseed is a good source for enhancing n-3 fatty acids in poultry meat. However, it is not clear if the enrichment is limited to the adipocytes or if it is also enriching the phospholipids membrane of the muscle cells. A Study was conducted to establish the distribution of n-3 PUFAs between triacylglycerols (TG) and phospholipid fractions (PL). The experiment was a 2 x 8 factorial with two dietary levels of ground flaxseed (10 and 17%) and eight durations of inclusion prior to processing (0 Control, 4, 8, 12, 16, 20, 24, and 35 d). A total of 656 Ross x Ross 308 mixed-sex broilers were evaluated to 35 d of age. Breast fatty acid composition was analyzed on 128 carcasses. ALA was higher in TG fraction compared to PL fraction (188 vs 3 mg/100g of meat; P<0.001). After feeding 10 or 17% flaxseed for 16 days, ALA concentration in TG fraction tripled (243 and 242, respectively, vs 74 mg/100g of meat in the control group; P< 0.05). No ALA enrichment was found in the PL fraction. n-3 long chain PUFAs (EPA, DPA, DHA) were higher in the PL fraction compared to the TG fraction (23 vs. 5 mg/100g of meat P<0.001). The 17% flaxseed diet increased the n-3 long chain PUFAs levels after 4 days of duration (18 vs 26 mg/100 g of meat; P< 0.01), while 24 days with 10% flaxseed were necessary for a significant increase (18 vs 23 mg/100 g meat; P<0.05). Long chain n-3 PUFAs also increased in the TG fraction after 4 days of duration (2.1 vs 4.7 mg/100 g of meat; P< 0.01).

Key Words: Flaxseed, Phospholipids, Polyunsaturated fatty acids, Alpha-linolenic acid
M8 The effect of low atmosphere stunning and deboning time on broiler breast meat quality. V. Battula*, M. W. Schilling, Y. V. Thaxton, J. B. Williams, J. Behrends, and T. B. Schmidt, Mississippi State University, Mississippi State.

A randomized complete block design with three replications (n=432, 72 broilers per treatment) was utilized to evaluate the effects of electrical (ES) and vacuum stunning (VS) on broiler breast meat quality. Electrical stunning was performed by applying 11.5 volts, <0.05 mA, AC to DC current for 3 s for each broiler. Vacuum stunning was accomplished by exposing the birds to low atmospheric pressure of 597 to 632 mm Hg in an air-tight decompression chamber. Breast removal was then performed at 0.75, 2, and 4 h postmortem for each stunning method. Color, pH, cook loss, and shear force values were measured on breasts that were removed from the right side of the carcass. Breasts removed from the left side of the carcass were utilized for consumer acceptability testing. The L* values were lower (p<0.05) for VS than ES at 4 h and 2 h deboning times. On average, 15 min and 24 h pm pH values were not different (p>0.05) for both stunning method and deboning time. Shear force did not differ (p>0.05) between stun methods but decreased (p<0.05) as deboning time increased. On average, no differences (p>0.05) existed in consumer acceptability (appearance, texture, flavor, overall) among breast meat from ES or VS birds that were deboned at 2 or 4 h. However, consumers could be clustered into 8 groups based on preference and liking of samples regarding overall and texture acceptability. Sixty-five percent of consumers (3 clusters) liked all broiler breast treatments. Within these three clusters, some consumers preferred (p<0.05) 4 h deboned samples over those deboned at 2 h (Cluster 7), and other consumers preferred (p>0.05) those deboned at 2 h over 4 h samples (Cluster 6). Data reveals that both stunning methods provide high quality breast meat with minimal product differences.

Key Words: Electrical stunning, Vacuum stunning, Deboning time, Breast meat quality, Consumer acceptability

M9 Developmental changes in enterocyte morphology in the small intestine of avian embryos. D. M. Karcher*1 and T. J. Applegate2, 1Michigan State University, East Lansing, 2Purdue University, West Lafayette, IN.

This study evaluated the formation of tight junctions in the small intestinal segments of the chicken, duck, and turkey in the final days of incubation and initial days post-hatch. Embryos (3) were sampled every other day from d 14 for chicken and d 18 of incubation for duck and turkey through 7 d post-hatch. All 3 segments of the small intestine were collected, fixed, and embedded for transmission electron microscopy. Measurements of tight junctions and enterocyte morphology were evaluated in the jejunum on days -7, -4, 0 (hatch), 1, 3 with the duodenum and ileal samples evaluated at day of hatch in all 3 species. Four micrographs were evaluated in the jejunum on days -7, -4, 0 (hatch), 1, 3 with the duodenum and ileal samples evaluated at day of hatch in all 3 species. Four micrographs were taken in the crypt and villus tip of each segment resulting in 8 micrographs used for measurements. Jejunal enterocyte membrane percentage (EMP) involved in tight junctions decreased (25%) from d -7 to hatch increasing (15 to 40%) post-hatch. No difference in EMP was observed across species or intestinal segments at day of hatch. However, the EMP is influenced by enterocyte size. The jejunal microvillus length changes during development with chicken and duck increasing (350%) in microvillus length from d -4 to d 3 post-hatch while that in the turkey is negligible (6%). The microvillus length on the villus tip increases following hatch while the crypt microvillus length remains static regardless of the small intestinal segment. The observations made in cellular structure and morphology are similar to reports by other researchers, but this is the first report of those observations in both duck and turkey. Potential for “embryonic” enterocytes exist with appearance of a goblet cell originating along the basolateral membrane and extruding enterocytes at d of hatch. The tight junctions appear to be ensconced by d of hatch with little change in cell perimeter in the next 24 hr. Therefore, tight junctions are structurally sound by d of hatch but further investigations need to evaluate the functionality during this time period.

Key Words: Chicken, Duck, Turkey, Small intestine, Tight junction

M10 Gonadotropin and steroid hormone regulation of the activin type IIA and IIB receptors in cultured granulosa cells from broiler breeder hens. B. M. Stevens*, M. E. Freeman, and A. J. Davis, University of Georgia, Athens.

Previous research suggests that the activin family of hormones have regulatory roles in chicken follicular development. ActivinA and B receptors complex consists of an activin type I receptor (ActRI) and an activin type II receptor (ActRII). Previously, we determined the expression pattern of the mRNA for the activin receptors in the theca and granulosa cells of the preovulatory follicles of the broiler breeder hen. In the current research, gonadotropin (LH and FSH) and steroid hormone (estradiol and testosterone) regulation of the mRNA expression of the two forms of the ActRII receptor (ActRIIA and ActRIIB) was investigated in cultured granulosa cells, 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 x 10^{-6} M testosterone or 17β estradiol (5 replicate experiments). Total RNA was extracted from all cultured granulosa cell samples for subsequent real-time RT-PCR analyses of ActRIIA, ActRIIB and GAPDH (endogenous control) mRNA expression using gene specific primer pairs and a Taqman minor groove binding probe for each gene. Testosterone significantly depressed the mRNA expression of ActRIIA in the granulosa cells from all three follicle sizes. Estradiol had no effect on the mRNA expression of either ActRIII except for inhibiting the mRNA expression of ActRIIB in granulosa cells isolated from SYF. The addition of LH or FSH to the cell culture media significantly lowered the expression of both ActRIIA and ActRIIB in the granulosa cells from all follicle sizes, with the exception of F1 granulosa cells in which FSH did not significantly depress the mRNA expression of ActRIIB. The results suggest that the presence of LH, FSH and testosterone in vivo may decrease the sensitivity of granulosa cells to activin.

Key Words: Activin, Chicken, Follicle

M11 Expression of the mRNA for zona pellucida protein B2 in the developing follicles of the broiler breeder hen. M. N. White*, M. E. Freeman, 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. In the domestic chicken six distinct zona pellucida genes have been identified (ZPA, ZPB1, ZPB2, ZPC, ZPD and ZPX). In the present research, the expression of the mRNA for ZPB2 was investigated in theca and granulosa cells of the developing preovulatory follicles of 8 broiler breeder hens. Individual theca and granulosa layers were isolated form the F1-F4 follicles. Theca and granulosa cells were enzymatically separated from one another in the nonhierarchical follicles which were pooled by size in the following categories less than 2 mm, 2-5 mm, 5-8 mm and 8-12 mm in diameter. The isolated theca and granulosa cells from each follicle size from two birds were combined to create four replicate samples for each follicle size. Total RNA was extracted from the samples and DNase treated for two step real-time PCR analyses of ZPB2. Taqman minor groove-binding probes and primers for detecting ZPB2 and GAPDH (endogenous control) were designed using Primer Express (Version 2.0, Applied Biosystems) based on published nucleotide sequences of these genes. Granulosa cell expression of ZPB2 was highest in the less than 2 mm sized follicles, followed by the 2-5 mm diameter and F4 follicles. Expression of ZPB2 in theF2 and F3 follicle was lower than the expression found in the F4 follicle. Interestingly, ZPB2 mRNA was not detected in the granulosa cells isolated from the F1, 5-8 mm, or 8-12 mm sized follicles or in any of the theca samples from the hierarchical follicles. Significant theca cell expression of ZPB2 was detected in the theca cells from the smallest follicles. The results suggest that unlike ZPC and ZPD which are known components of the IPVL and which have high mRNA expression only in granulosa cells from the largest hierarchical follicles, that ZPB2 may have a role in early follicle development.

Key Words: Zona pellucida, Chicken
M12  Grehlin and reproduction in the broiler breeder hen. M. E. Free-
man* and A. J. Davis, University of Georgia, Athens.

Grehlin is a hormone produced predominantly in the proventriculus of birds in response to energy status. There are two forms of circulating grehlin, unacylated grehlin (UAG) and acylated grehlin. The two forms share the same amino acid sequence but UAG undergoes an acylation of its third amino acid residue to become acylated grehlin which can bind to the grehlin receptor (GHSR). There is increasing evidence that grehlin directly affects reproduction in mammalian species. Previously we reported that GHSR mRNA was expressed in both the theca and granulosa cells of the preovulatory follicles of the broiler breeder hen ovary and that fasting increased GHSR mRNA expression in the theca cells. The goal of the current research was to determine if plasma levels of total or acylated grehlin increased in fasted broiler breeder hens and if grehlin influenced progesterone (P4) production in cultured granulosa cells. Blood samples were collected from hens 6 and 96 hours after feeding. Plasma was extracted from each blood sample and acidified to prevent degradation of acylated grehlin. Using synthesized acylated chicken grehlin (Phoenix Pharmaceuticals) it was determined that Millipore™ total grehlin RIA kit was not suitable for measuring total grehlin levels in hen plasma, but their acylated grehlin kit was validated. The concentration of plasma acylated grehlin was significantly greater in the samples collected from the hens after 96 hours of fasting versus those collected at 6 hours. In 4 replicate experiments, granulosa cells were isolated from the F1, F3, and small yellow follicles from 3 hens. The cells for each follicle size were then cultured in M199 or M199 containing 50 ng/ml acylated grehlin, 50 ng/ml LH, or 50 ng/ml of grehlin and LH. The addition of grehlin to the granulosa cell culture media did not alter P4 production or GHSR mRNA expression nor did it impact the stimulation of P4 production and the depression of GHSR mRNA expression by LH in cultured cells from the hierarchical follicles. The results indicate that fasting elevates plasma grehlin levels in hens, but that elevated levels of grehlin likely do not directly affect granulosa cell production of P4 or mRNA expression of GHSR.

Key Words: Grehlin, RIA


Studies focusing on avian oocytes and their development are in need of advance-
ment, and isolation and culturing techniques are important aspects of this ad-
vancement. This study is focused on dispersing and isolating the oocytes of immature chickens. The ovaries of immature chickens were removed and placed in ice-cold calcium/magnesium free Hanks balanced salt solution (HBSS). The ovaries were then washed several times in HBSS containing antibiotics/antimy-

Nutrition I


Three common species of aquatic plants in the tropics; water hyacinth Eichhornia crassipes, water fern Azolla africana and Duck weed Spirodea polyrrhiza were freshly harvested, washed and killed by heating at a temperature of 105°C for 35 minutes. Temperature was reduced to 70°C, dried for 72hrs and pulverized. Analytical methods for crude protein, ash, ether extract, crude fibre and mois-
ture content of the plants were determined using AOAC (1990). The proximate chemical analysis result revealed that the crude protein content of the plant ranges from 22.8 to 28.9 % for the three aquatic plants. There is no significant difference in crude protein for water fern and duck weed (27.8±0.6% and 26.8±0.2% respectively, P≤0.05) while significant difference exists for water hyacinth (21.8±0.6%, P<0.05). The mineral constituents of the plants varied among species with duck weed having the highest values for Na, Ca, and Fe. Duck weed had highest EAA values except for methionine which was highest in water fern (0.73%). At 20% inclusion level of the aquatic plants replacement of fish meal it was revealed that weight gain of broilers fed with water fern and duck weed were not significantly different (P≤0.05) and should be encourage for adoption by poultry farmers. In conclusion, the value of EAA in dehydrated aquatic plants such as water fern and duck weeds is quite comparable to most forage leguminous crops used for poultry diets.

Key Words: Comparative, Nutritive, Aquatic, Plants, Broilers.


The present study was designed to investigate the hypocholesterolemic mecha-
nisms of dietary Rhodobacter capsulatus by determining the hepatic cholesterol and bile acid, fecal cholesterol and bile acids, and studying the incorporation
M12  Ghrelin and reproduction in the broiler breeder hen.  M. E. Free-  
man* and A. J. Davis, University of Georgia, Athens.  

Ghrelin is a hormone produced predominantly in the proventriculus of birds in  
response to energy status. There are two forms of circulating ghrelin, unacylated  
ghrelin (UAG) and acylated ghrelin. The two forms share the same amino acid  
sequence but UAG undergoes an acylation of its third amino acid residue to  
become acylated ghrelin which can bind to the ghrelin receptor (GHSR). There  
is increasing evidence that ghrelin directly affects reproduction in mammalian  
species. Previously we reported that GHSR mRNA was expressed in both the  
theca and granulosa cells of the preovulatory follicles of the broiler breeder hen  
avary and that fasting increased GHSR mRNA expression in the theca cells.  
The goal of the current research was to determine if plasma levels of total or  
acylated ghrelin increased in fasted broiler breeder hens and if ghrelin influenced  
progesterone (P4) production in cultured granulosa cells. Blood samples were  
collected from hens 6 and 96 hours after feeding. Plasma was extracted from  
each blood sample and acidified to prevent degradation of acylated ghrelin. Using  
synthesized acylated chicken ghrelin (Phoenix Pharmaceuticals) it was deter-  
mained that Millipore™ total ghrelin RIA kit was not suitable for measuring  
total ghrelin levels in hen plasma, but their acylated ghrelin kit was validated.  
The concentration of plasma acylated ghrelin was significantly greater in the  
samples collected from the hens after 96 hours of fasting versus those collected  
at 6 hours. In 4 replicate experiments, granulosa cells were isolated from the F1,  
F3, and small yellow follicles from 3 hens. The cells for each follicle size were  
then cultured in M199 or M199 containing 50 ng/mL acylated ghrelin, 50 ng/mL  
LH, or 50 ng/mL of ghrelin and LH. The addition of ghrelin to the granulosa cell  
culture media did not alter P4 production or GHSR mRNA expression nor did  
it impact the stimulation of P4 production and the depression of GHSR mRNA  
expression by LH in cultured cells from the hierarchical follicles. The results  
indicate that fasting elevates plasma ghrelin levels in hens, but that elevated  
levels of ghrelin likely do not directly affect granulosa cell production of P4 or  
mRNA expression of GHSR.  

Key Words: Ghrelin, RIA  

M13  Method for isolating and culturing immature chicken oocytes.  C.  
R. James*, W. D. Berry, S. S. Oates, and L. M. Stevenson, Auburn University,  
Auburn, AL.  

Studies focusing on avian oocytes and their development are in need of advance-  
ment, and isolation and culturing techniques are important aspects of this  
advancement. This study is focused on dispersing and isolating the oocytes of  
immature chickens. The ovaries of immature chickens were removed and placed  
in ice-cold calcium/magnesium free Hanks balanced salt solution (HBSS). The  
ovaes were then washed several times in HBSS containing antibiotics/antimy-  
cotics, and cut into very small pieces. An enzyme solution containing Type 2  
collagenase, hyaluronidase, and pronase was introduced to the sample tissues.  
This mixture was placed in a shaking water bath at 37°C for 45 minutes. After  
this incubation period, the mixture was filtered through a 100-micron filter and  
centrifuged at 250x g for four minutes. The cell pellet was very gently resuspended  
by trituration in Media 199. This solution was again centrifuged at 250x g for  
eight minutes. This pellet was again gently resuspended by trituration in Media  
199. The resulting avian cells were placed into culture flasks and incubated in  
CO2 conditions for at least one hour. The immature avian oocytes were then  
examined. This work was supported by the Alabama Agricultural Experiment  
Station and the U.S. Poultry and Egg Association.  

Key Words: Cell culture, Oocyte isolation, Avian oocyte, Cell dispersal,  
Immature oocyte  

M14  Energy source levels in the liver of three-day-old broilers and their  
associations with percent incubational egg weight loss and time of hatch.  R.  
W. Keirse*, E. D. Peebles, D. A. Braasch, and P. D. Gerard, Mississippi State  
University, Mississippi State, 1 Clemson University, Clemson, SC.  

Liver lipid (LL) concentrations of 3-d-old broilers were found to be positively  
correlated to their time of hatch (TOH; P ≤ 0.03). Conversely, liver glyco-  
gen (LGLY) concentration of 3-d-old chicks was negatively correlated with 0-18 d  
percent incubational egg weight loss (PEWL; P ≤ 0.05). Furthermore, positive cor-  
relations were noted between concentrations of LGLY and liver glucose (LGLU;  
P ≤ 0.005), and between concentrations of LGLY and liver protein (LPRO; P ≤  
0.0001). Yolk lipid (YL) concentration was also negatively correlated with rela-  
tive yolk weight (P ≤ 0.0001). During incubation, PEWL was significantly higher  
for chicks that hatched at 480 h compared with those that hatched at 486 h. The  
LL of 3-d-old chicks was significantly higher when they hatched at 492 h than  
when they hatched at 480 h; whereas, LGLU increased numerically with TOH  
between 480 and 486 h, and again between 486 and 492 h. Because PEWL is a  
function of eggshell conductance and the incubational environment, the embryo  
must compensate for increases and decreases in PEWL through alterations in  
TOH and the utilization of available energy sources. Lipid reserves in the chick  
 liver may be conserved when hatched from eggs with lower PEWL rates and with  
a longer TOH. The accumulation of LL with TOH may impact the utilization of  
alternate energy sources including LPRO, LGLU, and LGLY. Adjustments in  
PEWL can be made through changes in the incubational environment in accor-  
dance with eggshell conductance. Resulting PEWL may directly affect TOH and  
its modification may be necessary to optimize the utilization of available energy  
reserves, leading to improved broiler performance.  

Key Words: Broiler, Incubational egg weight loss, Liver glycogen, Liver lipid,  
Time of hatch  

Nutrition  

M15  Comparative analysis of nutritive value of three common species of  
aquatic plants as sources of protein in broiler production.  B. O. Iyamu*,  
F. A. Iyoha, C. O. Imarihagbe, and E. O. Uwagboe, Auburn University College  
of Education, Auburn, AL, Nigeria; 2College of Agriculture and Natural  
Resources, Benin City, Edo State, Nigeria; 3Cocoa Research Institute of Nigeria,  
Ibadan, Oyo State, Nigeria.  

Three common species of aquatic plants in the tropics; water hyacinth Eichornia  
crassipes, water fern Azolla africana and Duck weed Spirodela polyrrhiza were  
freshly harvested, washed and killed by heating at a temperature of 105°C for  
35 minutes. Temperature was reduced to 70°C, dried for 72hrs and pulverized.  
Analytical methods for crude protein, ash, ether extract, crude fibre and mois-  
ture content of the plants were determined using AOAC (1990). The proximate  
chemical analysis result revealed that the crude protein content of the plant  
ranges from 23.8 to 28.9 % for the three aquatic plants. There is no significant  
difference in crude protein for water fern and duck weed (27.8±0.6% and  
26.8±0.2% respectively, P>0.05) while significant difference exists for water  
hyacinth (21.8±0.6%, P<0.05). The mineral constituents of the plants varied  
among species with duck weed having the highest values for Na, Ca, and Fe.  

Duck weed had highest EAA values except for methionine which was highest  
in water fern (0.73%). At 20% inclusion level of the aquatic plants replacement  
of fish meal it was revealed that weight gain of broilers fed with water fern and  
duck weed were not significantly different (P>0.05) and should be encourage  
for adoption by poultry farmers. In conclusion, the value of EAA in dehydrated  
aquatic plants such as water fern and duck weeds is quite comparable to most  
forage leguminous crops used for poultry diets.  

Key Words: Comparative, Nutritive, Aquatic, Plants, Broilers.  

M16  The hypocholesterolemic mechanisms of dietary Rhodobacter  
capsulatus in laying hens.  A. G. Miah*, U. Salma, and H. Tsuji, Shinshu  
University, Nagano, Japan.  

The present study was designed to investigate the hypocholesterolemic mecha-  
nisms of dietary Rhodobacter capsulatus by determining the hepatic cholesterol  
and bile acid, fecal cholesterol and bile acids, and studying the incorporation
of $^{14}$C-palmitic acid into lipids and lipid fractions in hepatocytes. A total 32 laying hens (20-week old) were assigned into 2 dietary treatment groups, and fed diets supplemented with (0.04%) or without R. capsulatus for 60-day feeding period. The dietary R. capsulatus reduced hepatic cholesterol 46% and triglycerides 32%, and increased bile acids 33%, respectively compared to the control diet over a 60-day of feeding period. The dietary supplementation of R. capsulatus significantly increased (P<0.05) the excretion of cholesterol, triglycerides and bile acids through feces. Among the lipid fractions, incorporation of $^{14}$C-palmitic acid into the phospholipids fraction was significantly decreased (P<0.05), and coincidentally, the incorporation of $^{14}$C-palmitic acid into triglycerides and cholesterol fractions were significantly increased (P<0.05) by R. capsulatus supplemented diet compared with the control diet. In conclusion, the dietary R. capsulatus induced the hepatic metabolism of lipids, lipid fractions and bile acids, and reduced the concentration of cholesterol and triglycerides in serum and egg-yolk through increasing the fecal excretion of cholesterol, triglycerides and bile acids.

Key Words: Cholesterol, Hypocholesterolemic mechanisms, Incorporation, Laying hens, R. capsulatus

M17 Effects of guar meal against eimeria tenella infection in broiler chicks. S. M. Hassan*, A. K. El Gayar, D. Caldwell, C. A. Bailey, and A. L. Cartwright, Texas A&M University, College Station.

Guar meal contains relatively high levels of saponins which are known to have antiprotozoal activity and may be effective against coccidioides. A 2x2 factorial experiment investigated the impact of guar meal (0 or 5%) corn-soy starter diets on chicks unchallenged or challenged with Eimeria tenella. At one day of age, one hundred twenty unsexed Ross x Ross broiler chicks were randomly distributed among four treatment groups. Chicks were challenged with 5x103 sporulated oocysts of E. tenella in 0.5 mL at 10 d of age by oral gavage. Weekly body weight, feed conversion and mortality were recorded for chicks fed from 0 to 21 d of age. Oocysts per gram feces were recorded from 6 to 10 d post infection. All chicks were slaughtered at 21 d of age to determine cecal lesion score and duodenal pH. Body weight of unchallenged and challenged chicks fed 0% guar meal were significantly higher than those fed 5% guar meal at 2 wk of age. Unchallenged chicks fed 0% guar meal were heavier than unchallenged and challenged chicks fed 5% guar meal at 3 wk of age. Unchallenged chicks fed either 0 or 5% guar meal showed lower feed conversion ratios than challenged chicks fed 5% guar meal. No significant differences were observed between challenged chicks and the other groups at the 2nd wk of age. Unchallenged chicks fed 5% guar meal were significantly lower feed conversion ratios than those fed 0% guar meal, but no significant differences were observed between unchallenged and challenged chicks that were fed 0% or 5% guar meal at the 3rd wk of age. Challenged chicks fed 0% guar meal had significantly higher oocysts per gram feces than the others only at 7 d post infection. No significant differences among treatment groups in mortality, cecal lesion score and duodenal pH were observed. Results indicated that including 5% guar meal in the diet of chicks challenged with E. tenella decreased oocysts per gram feces, but without effect on body weight and feed conversion ratio.

Key Words: Guar meal, Eimeria tenella, Chicken, body weight, Oocyste

M18 Evaluation of distiller’s dried grains as a feed ingredient for laying hens and broilers. B. Y. Jung1, P. D. Sedlacek1, A. B. Batal1, and L. R. Previtt2, 1University of Georgia, Athens, 2Agreeco, LLC, Chesterfield, MO.

Two experiments (Exp) were conducted to evaluate the feeding value of distiller’s dried grains (DDG) using a special fractionated process on laying hen and broiler performance. In Exp 1, five diets were fed to 15 replications of 6 Hy-line W36 laying hens per treatment. The five dietary treatments consisted of a commercial layer diet with 0, 3, 6, 9, or 12% DDG. Egg production was measured daily and egg weights were measured weekly for mean egg weight and total egg mass. In addition yolk color, haugh units, and specific gravity were measured every four wk. The addition of 3% DDG to the commercial layer diet significantly (P > 0.05) improved egg production and egg mass over the positive control (0% DDG). However, there was no difference in egg production between the diets with 6, 9, and 12% DDG as compared to the positive control or the diet with 3% DDG. There was no significant difference in specific gravity, haugh units, yolk color, body weight, or feed efficiency during the first 5 wks (21 to 26 wks of age) due to the addition of up to 12% DDG. This experiment will be carried out to 41 wks of age. In Exp 2, 1-d-old male broiler chicks were placed in Petersime battery brooders and maintaining on a 24 h lighting schedule in a thermosatically controlled room. Chicks were randomly assigned to 6 dietary treatments (0, 3, 6, 9, 12, and 16% DDG) with 8 replicate pens containing 6 chicks each. Body weight gain and feed intake were measured on 0, 7, 14 and 20 d of age. The addition of 3% DDG to the diet significantly improved (P > 0.05) weight gain as compared to the broilers fed the diet with 0, 6, 9, 12 and 16% DDG. Increasing the level of DDG in the diets to 16% significantly (P > 0.05) depressed weight gain, feed intake, and feed efficiency as compared to the 0 or 3% DDG diets, likely due to a deficiency in lysine. The addition of 3% DDG to a commercial layer or broiler diet significantly improved performance and thus, DDG (up to 6%) is a highly acceptable feed ingredient for poultry diets.

Key Words: Distiller’s dried grain, Laying hens, Broilers

M19 Dried distillers grains with solubles in laying hens ration (Phase I). M. K. Masa’deh*, and S. E. Scheideler, University of Nebraska, Lincoln.

A study was conducted to test the effect of Dried Distillers Grains with solubles (DDGS) inclusion rates in laying hens on feed intake, body weight and egg parameters for phase one of production. Two hundred eighty-eight Bovan White laying hens were fed diets containing 0, 5, 10, 15, 20, or 25% DDGS from 24 to 46 weeks of age. The diets were formulated to provide 2775 Kcal/kg ME (metabolizable energy), 16.5% protein, 0.83% lysine and 0.75% TSSA. Six hens were placed per cage with 8 replicate cages per dietary treatment in an unbalanced randomized complete block design. Average feed intake was similar (p > 0.1) between treatments with an average of 109g/hen/d. Average hen weights were similar (p > 0.1) between dietary levels of DDGS. There was no difference in hen weight gain (p > 0.1) between treatments. However, hen fed 20 & 25% DDGS had lower weight gain (100g) compare with 0, 5, 10, or 15% DDGS (140g). Egg production was not affected by dietary DDGS levels (p > 0.1) averaging 91% EP. Egg wt. was significantly (p< 0.1) affected by DDGS treatment. Hens fed 0, 5, 10, 15, 20 or 25% DDGS had an average egg wt. for the trial of 60.6, 60.4, 60.8, 60.0, 59.0, and 59.0 grams respectively. There was no difference (p > 0.1) in egg Haugh unit, albumen height, and specific gravity between the levels of DDGS. Yolk color increased with increasing DDGS level with the highest Roche color fan score (p< 0.05) of 7.2 for hens fed 25% DDGS. In Summary, feeding up to 25% DDGS during Phase 1 of production had no negative effects on feed intake, egg production, haugh unit and specific gravity; and improved yolk color at the highest levels. However, increasing DDGS level beyond 15% cause a reduction in egg weight.

Key Words: DDGS, Dried distillers grains with solubles, Laying hens

M20 Evaluation of DDGS as an alternative ingredient for broiler chicken. M. Y. Shinn1, G. M. Pesti2, R. I. Bakalli1, P. B. Tillman2, and D. Hoehler3, 1University of Georgia, Athens, 2Ajimoto Heartland LLC, Chicago, IL, 3Degussa Corporation, Kennessaw, GA.

The utilization of the co-product of ethanol production distillers dried grains with solubles (DDGS) was examined. Cobb × Cobb 500 commercial broilers were housed in floor pens (35 birds per pen) for 42 days across 6 pens per treatment. Corn, soybean meal, DDGS and poultry grease based diets were formulated for starter (0 - 18 d), grower (18 - 35 d) and finisher (35 - 42 d) phases on a digestible amino acid basis. Supplementation of L-Lysine HCl, L-Threonine and crude protein level increased with each increase in DDGS inclusion rates in laying hens and broiler diet significantly improved performance and thus, DDG (up to 6%) is a highly acceptable feed ingredient for poultry diets.
when birds were fed DDGS (avg. = 0.717 kg) versus all corn (0.688 kg). BWG (2.496, 2.487, 2.469 and 2.494 kg) and feed utilization were similar at 42 days (1.686, 1.715, 1.715 and 1.711 kg/kg) for birds fed 0, 8, 16 and 24 % DDGS, respectively. Fat pads (0.058, 0.054, 0.049 and 0.048 kg) and breast meat yields (0.475, 0.486, 0.486 and 0.489 kg) were also similar at 42 days for 0, 8, 16 and 24 % DDGS respectively. Carcass quality did not show any differences up to 24 % DDGS compared to the corn and soybean control diet. Since DDGS and fat levels increased together, increased fat and DDGS levels decreased pellet durability. In the finisher phase, pellet durability was 74.20, 69.51, 60.18 and 49.66 % for 0, 8, 16 and 24 % DDGS, respectively. DDGS can be a good alternative ingredient for broiler chickens, provided diets are formulated and balanced based on digestible amino acids.

Key Words: DDGS, Broiler, L-Lysine HCl, L-Threonine


Increased government pressure for biofuels has led to a significant increase in biodiesel production resulting in increased cost for fat. Glycerin, a by-product of biodiesel production, may be used as an alternative source of fat in broiler diets. Thus, the purpose of this study was to evaluate the nutritional and feeding value of glycine. The proximate analysis, TMEmin, mineral content, and fatty acids of four glycine samples were determined. The TMEmin of the glycine samples ranged from 4800-6700 kcal/kg. The samples had approximately 25-35% fat, 8-12% moisture, 4% ash. The methanol content ranged from 0.01 to 1.8%. Minerals present in greater than trace amounts were calcium and potassium at 70 and 800 ppm, respectively. The principle fatty acids of the glycine samples were oleic acid and linoleic acid. One of the glycine samples was added to a broiler diet as a partial fat replacement and fed in a 42 d experiment. Six diets were fed to eight replications of 40 chicks consisting of: 1) a positive control with 3.6% poultry fat (3.085 Kcal/kg); 2) a negative control with 1% poultry fat (2.920 Kcal/kg); 3) 5% glycine, 1% poultry fat (3.085 Kcal/kg); 4) 2.5% glycine, 1% poultry fat (3.085 Kcal/kg), achieved by blending treatment 1 and 3 in a 1:1 ratio; 5) 2.5% glycine, 1% poultry fat (2175 Kcal/kg), achieved by blending treatment 2 and 3 in a 1:1 ratio; and 6) 7.5% glycine, 1% poultry fat (3.085 Kcal/kg). There were no significant differences in weight gain or feed intake between the positive and negative control diet or the 2.5% glycine diet (3.085 kcal/kg). Weight gain and feed intake decreased significantly for the 2.5% glycine (2175Kcal/kg), 5% and 7.5% glycine diets for all periods except the grower period. During the grower period there were no differences in weight gain or feed intake and no differences in feed efficiencies were observed. The reduction in body weight gain and feed intake with increasing levels of glycine may be due to the high methanol content of the glycine used (1.7% methanol). Glycine may be used at low levels (2.5%) as a partial fat replacement in broiler diets.

Key Words: Glycine, Poultry fat, Broiler diet

M22 The interactive effects of glycine, total sulfur amino acids, and lysine addition to corn-soybean meal diets on growth performance and serum uric acid of 0-to 18-day old broilers. S. Powell*, T. D. Bidner, and L. L. Southern, LSU Agricultural Center, Baton Rouge.

Research was conducted to assess Gly addition to corn-soybean meal diets for growth performance and serum uric acid of 0-to 18-day old broilers. S. Powell*, T. D. Bidner, and L. L. Southern, LSU Agricultural Center, Baton Rouge.

An experiment was conducted to evaluate the effectiveness of OptiPhos® in liquid and dry form on male broiler growth performance and bone mineralization when fed phosphorus-deficient diets from 1 to 21 d of age. Diets were corn and soybean meal based and calculated to contain an available phosphorus content of 0.20% (P-deficient). Liquid OptiPhos® L2500 was applied to P-deficient diets at 250 FTU/kg and 500 FTU/kg, while the dry form, OptiPhos® PF, was applied at 250 FTU/kg. Liquid application consisted of spray applying onto crumbles following the pelleting process. A diet containing 0.35% available phosphorus (P-adequate) was included as it has been previously shown to maximize growth performance and bone mineralization of battery-reared male chicks from 1 to 21 d of age. Three hundred and sixty Cobb male broilers were randomly placed in brooder batteries and fed one of five treatments: P-adequate, P-deficient, P-deficient + 250 FTU/kg of OptiPhos® L2500, P-deficient + 500 FTU/kg of OptiPhos® L2500, and P-deficient + 250 FTU/kg of OptiPhos® PF. Treatments consisted of six replicates with 12 broilers per pen. Body weights and feed consumptions were determined on d 7, 14, and 21. On day 21, tibias were removed for bone ash determination. The P-deficient diet increased mortality (P<0.05), decrease body weight (P<0.05) and bone ash percentage compared to all other treatments. Phytase supplementation of P-deficient diet increased (P<0.05) weight gain and ash percentage at all inclusion levels. OptiPhos® L2500 added at 500 FTU/kg and OptiPhos® PF at 250 FTU/kg increased body weight to a level higher (P<0.05) than broilers fed the P-adequate diet and reduced feed conversion ratios (P=0.05) compared to P-deficient and P-adequate fed broilers. These data indicate that OptiPhos® supplementation in liquid and dry form can enhance broiler growth characteristics and bone mineralization when fed diets containing deficient levels of available phosphorus.

Key Words: Broiler, Bone ash, Phytase, Performance

M24 Response of vaccinated starting broilers to diets with varying levels of crude protein with and without gelatin supplementation. R. Lehman*, J. Hess, D. Hochler, and E. T. Moran, Jr., Auburn University, Auburn, AL, 2Degussa Feed Additives, GA.

Vaccination for coccidiosis is preferred to dietary inclusion of coccidostats given the consumer’s preference for antimicrobial free feed. Previous experimentation indicated that NEAA, particularly glycine and proline, from gelatin enhanced mucosal repair in vaccinated broilers and relieved early stress of vaccination. The value of gelatin for this relief in vaccinated broilers was investigated at increasing levels of dietary crude protein (CP). Day-old male Ross X 708 broilers were spray vaccinated for coccidiosis with Coccivac®-D prior to placement into 64 floor pens (23 chicks/pen) with used litter. Isocaloric corn-soybean meal starter diets were formulated to provide 20, 21, 22, and 23% CP while the minimum requirements for all EAA were maintained through supplementation of commercial free forms as needed. Gelatin was either excluded from formu-
lotion or included to a fixed amount of 2%. Each feed was steam pelleted and presented in crumb form. Birds received the 8 experimental feeds to 3 weeks of age. Increasing the amount of protein in the diet led to increased feed intake (P < 0.01) as well as feed conversion (P < 0.01). Birds fed diets supplemented with 2% gelatin had improved feed conversion (P < 0.01) and a decrease in feed consumption, although the difference was not statistically significant. Subsequent AA analyses indicated that isoleucine and valine were marginally adequate with the 20% CP feed, regardless of gelatin. Gelatin is of commercial significance because of its prevalence in most animal source feedstuffs. Glycine-proline in gelatin appears to favor formation of membrane-associated and secretory mucins that are immediately involved in mucosal integrity. Vaccination for coccidiosis likely creates an intense temporary need for mucin and, in turn, the amino acids, threonine-serine and glycine-proline, of which it is composed.

Key Words: Gelatin, Coccidiosis, Vaccination, Crude protein, Broiler

M25 Dynamics of total tract nutrient retention of broilers with age and enzymes supplementation. O. A. Olukosi* and O. Adeola, Purdue University, West Lafayette, IN.

Four-hundred and fifty broiler chicks were used in a 21-d experiment to study the dynamics of total tract nutrient retention with age and enzyme supplementation. At 1 d of age, the broilers were allocated to 5 treatments in a randomized complete block design. The treatments were: (1) positive control (PC) with adequate P and metabolizable energy (ME), (2) negative control (NC) marginally deficient in P and ME; (3) NC plus phytase supplemented to supply 1,000 FTU/kg; (4) NC plus enzyme cocktail added to supply 650, 1,650 and 4,000 U/kg of xylanase, amylase and protease (XAP), respectively; and (5) NC plus phytase and XAP at levels in 3 and 4, respectively. The diets were corn-wheat-soybean meal based and were fed throughout the experiment. Excreta were collected on the last 3 d of every wk and analyzed for dry matter, N, energy, P, and Ca. Overall, total tract retention of all the nutrients increased with age (P < 0.01) with total tract retention being at the lowest in wk 1. Dry matter retention improved (P < 0.05) above the level in NC treatment by supplementation of phytase alone both in wk 1 and 2 but not in wk 3. Nitrogen retention was improved (P ≤ 0.05) by phytase supplementation alone throughout the 3 wk of the experiment. Combination of phytase and XAP only improved (P < 0.01) N retention in wk 3. Phytase alone or combined with XAP improved (P < 0.05) phosphorus retention at all ages of the broilers. Total tract Ca retention was improved (P ≤ 0.05) by supplementation of phytase alone or in combination with XAP in wk 1 and 2. Cocktail of XAP improved (P < 0.05) Ca retention in wk 1 and 3. Improvement in P retention by phytase supplementation decreased from 16 percentage points in wk 1 to 5 percentage points in wk 3 whereas for N, the improvement decreased from 5 percentage points in wk 1 to 3 percentage points in wk 3. It is concluded that the potential for phytase to reduce nutrient excretion in manure is greatest at early age and decreases as the bird grows older.

Key Words: Age, Broilers, Enzymes, Nutrient retention

M26 The glycine requirement of broilers fed low crude protein, corn-soybean meal diets. A. Waguespack*, T. Bidner1, L. Southern2, and R. L. Payne2, 1LSU Agricultural Center, Baton Rouge, 2Degussa Corporation, Kennessaw, GA.

Three experiments (Exp.) were conducted to determine the Gly requirement in a low CP, corn and soybean meal diet with 0.25% L-Lys•HCl, a level which previously has been shown to maximize growth performance of Ross x Ross 708 broilers. Experiments were conducted with male Ross 308 (Exp. 2) or 708 (Exp. 1 and 3) broilers in brooder batteries from 0 to 18 d posthatching. Treatments contained 7 replicates with 6 birds per replicate. Diet 1 was the positive control (PC) diet with no Gly or L-Lys•HCl. Diets 2 to 8 contained 0.25% L-Lys•HCl and added crystalline Gly in 0.125% increments from 0 to 0.75%. Diet 9 was formulated to be isonitrogenous to the 0.75% Gly diet by supplementing 1.47% L-Glu. The addition of Glu did not affect (P > 0.10) daily gain (ADG), feed intake (ADFI) or gain:feed (GF) compared with broilers fed the 0% Gly added diets, except for GF in Exp. 2 (P < 0.01). Broilers fed the PC diet had greater GF in all Exp. and ADG in Exp. 3 than broilers fed the 0% Gly diet (P < 0.10). Broilers fed the PC diet had decreased ADFI in Exp. 2 than broilers fed the 0% Gly diet (P < 0.10). Glycine addition to the diet did not affect ADG in any Exp. nor ADFI in Exp. 1 and 3 (P > 0.10). In Exp. 1, Gly addition linearly increased (P < 0.01) GF, but a requirement estimate could not be made with either a single or two-slope broken line analysis. In Exp. 2, Gly addition linearly increased (P < 0.05) decreased ADFI and had a linear and quadratic increasing effect (P < 0.10) on GF. A single slope, breakpoint analysis of GF estimated the Gly + Ser requirement to be 2.085% in a diet with 0.25% L-Lys•HCl (P < 0.05). In Exp. 3, Gly addition tended to linearly increase (P = 0.11) GF. A single slope, breakpoint analysis of GF estimated the Gly + Ser requirement to be 2.239% in a diet with 0.25% L-Lys•HCl (P = 0.37). When the GF data from all 3 Exp. were combined, a single slope, breakpoint analysis estimated the Gly + Ser requirement to be 2.078% (P < 0.03). The response to Gly is not a result of added nitrogen from Glu. Based on GF, there is a consistent response to added Gly.

Key Words: Broiler, Glycine, Requirement, Low crude protein


Research was conducted to assess serum uric acid (SUA), urea nitrogen (SUN), and ammonia (SA) concentrations on amino acid (AA) adequacy diets for broilers, 0 to 14 or 18 d old. Each treatment had at least 6 reps with 6 to 18 birds per pen (2 to 3 birds per pen were bled). Experiment 1 (Exp.) consisted of a diet (1.26% total Lys with 0.25% L-Lys•HCl) adequate or deficient in AA. Broilers were bled at the end of the Exp. with no fasting. Gain (ADG), feed intake (ADFI), and gain:feed (GF) were reduced (P < 0.03) in broilers fed the AA-deficient diet, but SUA, SUN, and SA were not affected (P > 0.10). Experiments 2 to 5 had 4 diets; a diet with 1.35% Lys (0.25% from L-Lys•HCl) with and without added Met (0 or 0.356%) or Gly (0 or 0.415%). The Met addition increased (P < 0.03) ADG, ADFI, and GF in all Exp. The Gly addition increased (P < 0.07) GF in all Exp. There was an increased response to Met with Gly added (P < 0.10; Met × Gly) in ADG (Exp. 3 and 5), ADFI (Exp. 5), and GF (Exp. 4 and 5). In Exp. 2, birds were fasted for 2 h, bled, re-fed, and then bled at 0.5 and 1 h after feeding. After the 2 h fast, SUA, SUN, and SA were decreased (P < 0.10) by Met, and SUA and SUN was decreased (P < 0.05) by Gly. At 0.5 h postfeeding, SUA was decreased (P < 0.01) by Met. At 1 h postfeeding, SUN was decreased (P < 0.02) by Gly. In Exp. 3, 4, and 5, birds were fasted for 2 h, fed for 20 min, bled at time 0 (immediately after eating), and then at 1, 2, and 3 h in Exp. 3, 2, 3, 4, and 5 h in Exp. 4; or at 2 h in Exp. 5. In Exp. 3, SUA and SUN were decreased (P < 0.02) by Met at all times, and SUA was decreased (P < 0.06) by Met at 1 and 3 h. In Exp. 4, Met decreased SUA (P < 0.05; 0, 2, and 5 h), SUN at all times (P < 0.04), and SA (P < 0.02; 0 and 4 h). Glycine decreased (P < 0.02) SUN at 2 h. In Exp. 5, SUN and SUA were decreased (P < 0.04) at 2 h by Gly and Met, and SUA was decreased more when the 2 AA were combined (P < 0.08). In summary, SUA and to some extent, SUN can be used to assess responses to AA deficiency or adequacy in the diet.

Key Words: Broilers, Amino acid, Uric acid

M28 In-ovo feeding and dietary β-hydroxy-β-methylbutyrate effects on poult quality, growth performance and ileum microanatomy of turkey poult's from 1 to 11 days of age. D. V. Bohórquez*, A. A. Santos Jr2, and P. R. Ferkel1, 1North Carolina State University, Raleigh, 2Florida Hospital College of Health Sciences, Orlando, FL.

Mortality rates can reach 5% in turkey poult's during the first week after hatch and the survivors’ performance depends on early enteric development and health. Early feeding strategies such as in-ovo feeding (IOF) and/or dietary supplementation of β-hydroxy-β-methylbutyrate (HMB) may enhance poult vigour and early enteric development. A 2x2 factorial experiment was done to evaluate 2 incubation treatments (TRT) at 23E (control and 0.4ml of an IOF-solution) and 2 levels of HMB (0 and 0.1% of diet) fed from day of hatch to 11d. Poult activity (# lethargic birds/pen) was recorded at 1 and 4 hours after placement.
Body weight (BW) and cumulative feed:gain (cFCR) were determined at 4 and 11d of age. Ileum histomorphometry (8 villi/bird) were measured (10 pouls/ TRT) at 1, 4 and 11d of age. Villus height (VH), crypt depth (CD), mucosal height (MH), Villus height-crypt depth ratio (V/C) and apparent villus surface area (VS) were determined. At hatch, there were no significant (P>0.05) differences in BW between incubation TRT. One hour after placement, only 24% of IOF pouls showed no activity compared with 46% of the controls (2.455 vs. 4.667 lethargic birds/pen, P<0.02). At 1d, IOF pouls had higher CD (1.251 vs 1.105 µm/g, P<0.01) and MH (5.00 vs 4.436 µm/g, P<0.01) than controls. At 4d, dietary HMB significantly reduced CD (1.517 vs 1.611µm/g, P<0.01), ML (5.808 vs 6.349 µm/g, P<0.05), and VS (380.6 vs 418.6 µm²/g, P<0.01). At 11d, only VS was significantly lower (P<0.05) in IOF pouls (309.3 vs 386.9 µm²/g, P<0.05) as compared to controls. But by then, IOF-treated pouls had 5% higher body weights (240 vs. 228 g, P<0.05) and 6% lower cFCR (1.266 vs 1.343 g/g, P<0.05) than controls. In-vivo feeding enhanced eating activity and early enteric development (higher CD and VH) of pouls, which may improve nutrient absorption and performance; although, these effects can be quenched by dietary HMB (0.1% of diet) during the brooding phase.

**Key Words:** Poult quality, Performance, Gut health

---

**Environment & Management I**


The inception of Peri-urban agriculture in Nigeria especially livestock rearing to supplement the grossly inadequate protein intake of citizens is a welcome development. This study examined livestock activities among Peri-urban households in Ibadan Metropolis of Oyo state, Nigeria. Systematic random sampling technique was used to select 120 respondents out of 400 registered livestock farmers and questionnaire was used to elicit information from the respondents. Descriptive statistics such as frequency counts, percentages, charts were used for data presentation while Chi-Square was used for the analysis. The result revealed that all (100%) of the respondents are literate with primary education (57%) secondary (29%) and tertiary (14%); and 60% take poultry farming as their primary farming occupation. Majority (57%) of the respondents were within the age range of (30-50 years) with a mean age of 37 years. It was also revealed that the type of livestock mostly reared by the respondents was poultry (76%). Respondents indicated that benefits derived from rearing of livestock include; serving as source of protein food for the family (35%) and source of income (65%). Chi-Square test was used to verify the occurrence of differences, while Chi-Square was used for the analysis. The result revealed that all (100%) of the respondents are literate with primary education (57%) secondary (29%) and tertiary (14%). Marital status (X²=21.62, P<0.05) are significantly related to their livestock activities. In conclusion, most of the livestock reared by the respondents is poultry and it serves as their primary farming occupation. Hence concerted efforts should be geared towards improving livestock production through training of the Peri-urban dwellers on improved technologies in poultry production. This will increase animal protein intake, enhance income and improve food security.

**Key Words:** Livestock, Peri-Urban, Households, Ibadan, Nigeria

---


The objective of this study was to determine the effects of dietary aflatoxin (AF) on hepatic gene expression in male broiler chicks. Seventy five day-old male broiler chicks were assigned to three dietary treatments (5 replicates of 5 chicks each) from hatch to day 21. The diets contained 0, 1 and 2 mg AF/kg of feed. Aflatoxin reduced (P<0.05) feed intake, body weight gain, serum total proteins, serum Ca and P but increased (P < 0.01) liver weights in a dose dependent manner. Microarray analysis was used to identify shifts in genetic expression associated with the affected physiological processes in chicks fed 0 and 2 mg AF/kg of feed to identify potential targets for pharmacological/toxicological intervention. A loop design was used for microarray experiments with 3 technical and 4 biological replicates per treatment group. RNA was extracted from liver tissue and its quality was determined using gel electrophoresis and spectrophotometry. High quality RNA was purified from DNA contamination, reverse transcribed, and hybridized to an oligonucleotide microarray chip. Microarray data were analyzed using a 2-step ANOVA model and validated by quantitative real-time PCR. Genes with false discovery rates less than 12.5% and fold change greater than 1.4% were considered as differentially expressed. Compared with controls, various genes associated with energy production and fatty acid metabolism (carnitine palmitoyl transferase), growth and development (insulin like growth factor), antioxidant protection (glutathione S transferase), detoxification (epoxide hydrolase), and immune protection (interleukins) were down-regulated, whereas genes associated with cell proliferation (ornithine decarboxylase) were up-regulated in birds fed AF. This study demonstrates that AF exposure results in physiological responses associated with altered gene expression in chick livers.

**Key Words:** Gene expression, Aflatoxin, Chick liver, Microarray analysis

---

**M31 Effect of pellet quality and manufacturing method on fat distribution in a commercial feed system.** C. Hancock*, R. S. Beyer, C.M. Rude, K. Dobbelleare, and J. Burden, Kansas State University, Manhattan.

In the poultry industry, flock uniformity is critical. This study was designed to determine the effects of an industry pan feeder system on the proportion of pellets to fines in pelleted broiler feed and to examine the distribution of nutrients. Previous work indicated that an incremental increase from 8.7% fines in the first pan to 33.7% fines in the last pan was observed in feed with a pellet durability index (PDI) of 79 while an increase from 8.2% to 27.7% fines was observed in feed with an 85 PDI. Even when feed is sifted, an increase from 3.2% to 20.18% fines was observed in 79 PDI feed while an increase from 2.64% to 15.25% fines was observed in 85 PDI feed. A Chore-Time Model C2 Plus feed line with Brock feed bin and Model 75 auger line with surge bin was constructed with 93 pans spanning a 240 foot line. For these studies, feed was added directly to the surge bin. Feed was collected at pre-determined pans. In this trial, we examined pellets coated with 4.85% soybean oil and conducted fat analysis to determine fat distribution in select pans along the line. The pellets were placed in a Davis S-3 mixer and then coated with soybean oil by mixing for two min. The feed was then placed in the surge bin, passed through the feed line and collected at 12 pre-selected pans. The results indicated fines increased along the line from 1.53% to 2.49% while pellets decreased from 98.47% to 97.51%. The samples were extracted with ether and the fat content was determined. The results indicate that the fat content increased from 6.96% to 7.31% in the pellets and decreased from 7.94% to 7.69% in the fines. The difference in fat content indicates that nutrient inconsistencies in the line could contribute to uniformity problems in a flock. Further examination may be necessary to determine if other nutrients differ when feed is passed through long feeder systems.

**Key Words:** Feeding systems, Fat, Distribution, Pellet quality, Fines

---

**M32 Embryonic incubation and post-hatch transportation effects on intestinal nutrient transporter expression during the perinatal period in broilers.** A. Barrie*, E. Wong, R. Dalilou1, M. Wineland2, and A. P. McElroy1.

1Virginia Polytechnic Institute And State University, Blacksburg, 2North Carolina State University, Raleigh.

Modern broilers are incubated and hatched under guidelines established for poultry not capable of the tremendous growth parameters that the current genetic lines have. Evidence suggests that failure to satisfy optimum incubation requirements has potential to result in poor chick quality and decreased performance. Compromised development of the intestine pre-hatch or at hatch can result in delayed mucosal development and subsequent detrimental broiler performance.
**Environment & Management I**


The inception of peri-urban agriculture in Nigeria especially livestock rearing to supplement the grossly inadequate protein intake of citizens is a welcome development. This study examined livestock activities among peri-urban households in Ibadan Metropolis of Oyo state, Nigeria. Systematic random sampling technique was used to select 120 respondents out of 400 registered livestock farmers and the questionnaire was used to elicit information from the respondents. Descriptive statistics such as frequency counts, percentages, charts were used for data presentation while Chi-Square was used for the analysis. The result revealed that all (100%) of the respondents are literate with primary education (57%) secondary (29%) and tertiary (14%); and 60% take poultry farming as their primary farm-development. This study examined livestock activities among Peri-urban households in Ibadan, Nigeria.

**Key Words:** Livestock, Peri-Urban, Households, Ibadan, Nigeria


The objective of this study was to determine the effects of dietary aflatoxin (AF) on hepatic gene expression in male broiler chicks. Seventy five day-old male broiler chicks were assigned to three dietary treatments (5 replicates of 5 chicks each) from hatch to day 21. The diets contained 0, 1 and 2 mg AF/kg of feed. Aflatoxin reduced (P<0.05) feed intake, body weight gain, serum total proteins, serum Ca and P but increased (P<0.01) liver weights in a dose dependent manner. Microarray analysis was used to identify shifts in genetic expression associated with the affected physiological processes in chicks fed 0 and 2 mg AF/kg of feed to identify potential targets for pharmacological/toxicological intervention. A loop design was used for microarray experiments with 3 technical and 4 biological replicates per treatment group. RNA was extracted from liver tissue and its quality was determined using gel electrophoresis and spectrophotometry. High quality RNA was purified from DNA contamination, reverse transcribed, and hybridized to an oligonucleotide microarray chip. Microarray data were analyzed using a 2-step ANOVA model and validated by quantitative real-time PCR. Genes with false discovery rates less than 12.5% and fold change greater than 1.4% were considered as differentially expressed. Compared with controls, various genes associated with energy production and fatty acid metabolism (carnitine palmitoyl transferase), growth and development (insulin like growth factor), antioxidant protection (glutathione S transferase), detoxification (epoxide hydrolase), and immune protection (interleukins) were down-regulated, whereas genes associated with cell proliferation (ornithine decarboxylase) were up-regulated in birds fed AF. This study demonstrates that AF exposure results in physiological responses associated with altered gene expression in chick livers.

**Key Words:** Gene expression, Aflatoxin, Chick liver, Microarray analysis

**M31 Effect of pellet quality and manufacturing method on fat distribution in a commercial feed system.** C. Hancock*, R. S. Beyer, C.M. Rude, K. Dobbellear, and J. Burden, Kansas State University, Manhattan.

In the poultry industry, flock uniformity is critical. This study was designed to determine the effects of an industry pan feeder system on the proportion of pellets to fines in pelleted broiler feed and to examine the distribution of nutrients. Previous work indicated that an incremental increase from 8.7% fines in the first pan to 33.7% fines in the last pan was observed in feed with a pellet durability index (PDI) of 79 while an increase from 8.2% to 27.7% fines was observed in feed with an 85 PDI. Even when feed is sifted, an increase from 3.2% to 20.18% fines was observed in 79 PDI feed while an increase from 2.64% to 15.25% fines was observed in 85 PDI feed. A Chore-Time Model C2 Plus feed line with Brock feed bin and Model 75 auger line with surge bin was constructed with 93 pans spanning a 240 foot line. For these studies, feed was added directly to the surge bin. Feed was collected at pre-determined pans. In this trial, we examined pelleted coated with 4.85% soybean oil and conducted fat analysis to determine fat distribution in select pans along the line. The pellets were placed in a Davis S-3 mixer and then coated with soybean oil by mixing for two min. The feed was then placed in the surge bin, passed through the feed line and collected at 12 pre-selected pans. The results indicated fines increased along the line from 1.53% to 2.49% while pellets decreased from 98.47% to 97.51%. The samples were extracted with ether and the fat content was determined. The results indicate that the fat content increased from 6.96% to 7.31% in the pellets and decreased from 7.94% to 7.69% in the fines. The difference in fat content indicates that nutrient inconsistencies in the line could contribute to uniformity problems in a flock. Further examination may be necessary to determine if other nutrients differ when feed is passed through long feeder systems.

**Key Words:** Feeding systems, Fat, Distribution, Pellet quality, Fines

**M32 Embryonic incubation and post-hatch transportation effects on intestinal nutrient transporter expression during the perinatal period in broilers.** A. Barr1*, E. Wong1, R. Dalloul2, M. WineLand2, and A. P. McElroy3.

1Virginia Polytechnic Institute And State University, Blacksburg, 2North Carolina State University, Raleigh.

Modern broilers are incubated and hatched under guidelines established for poultry not capable of the tremendous growth parameters that the current genetic lines have. Evidence suggests that failure to satisfy optimum incubation requirements has potential to result in poor chick quality and decreased performance. Compromised development of the intestine pre-hatch or at hatch can result in delayed mucosal development and subsequent detrimental broiler performance.

**Key Words:** Feeding systems, Fat, Distribution, Pellet quality, Fines
This study evaluated effects of embryonic incubation and post-hatch transportation temperatures on gene expression in the brush border of the small intestine of commercial broilers. 5200 Cobb 500 eggs were incubated at egg-shell temperatures of low (L, 36.7°C), standard (S, 37.5°C), and high (H, 39°C). All eggs were incubated at S during d8-17, with combinations of the other temperatures occurring on d1-7 and d18-21 to generate four treatments: SS, SH, LS, and LH. At d0, chicks were separated into two transportation groups: control (T1) and heat-stressed (T2). Resulting groups were: LS1, SS1, LH1, SH1, LS2, SS2, LH2, and SH2. On d0, 4 and 6 post-hatch, intestinal mucosal samples were collected for gene expression analysis of 5 nutrient transporters (SGLT1, GLUT2, GLUT5, PepT1, and EAAT3) in duodenum, jejunum and ileum. Real time PCR was performed using the relative quantification method. On d0, incubation temperature and temperature by transportation interactions influenced expression of PepT1 and EAAT3 in ileum and jejunum. PepT1 and EAAT3 were more highly expressed in ileum with SS incubation and in jejunum with LS incubation. On d0, higher levels of SGLT1 expression in ileum and jejunum were observed with T2, and in jejunum, transportation by temperature interactions were also observed. Expression of GLUT2 in duodenum was higher on d0 with T1. On d6, GLUT5 had higher expression in duodenum from LH chicks, T2 chicks, and temperature and transport interactions were also observed. Data suggests that expression of intestinal nutrient transporters is altered by embryonic incubation and post-hatch transport temperatures.

**Key Words:** Incubation, Transportation, Nutrient transport

### M33 Embryonic incubation and post-hatch transportation effects on organ development and performance in broiler chickens. A. Barry1, S. Martin3, M. Wineland2, M. Farnell5, D. J. Caldwell3, and A. P. McElroy1, 1Virginia Polytechnic Institute And State University, Blacksburg, 2North Carolina State University, Raleigh, 3Texas A&M University, College Station, 4Cobb-Vantress, Siloam Springs, AR.

Reports indicate in ovo and perinatal developmental stages as crucial periods in the chick’s life, but few are available to demonstrate that temperature stressors at these early phases affect development of digestive and immune organs with subsequent impact on performance of commercial broilers. This study evaluated effects of embryonic incubation and post-hatch transportation temperatures on broiler performance and development of digestive and immune organs. 5200 Cobb 500 eggs were incubated at egg-shell temperatures of low (L, 36.7°C), standard (S, 37.5°C), and high (H, 39°C). All eggs were incubated at S for d8-17, with combinations of L and H on d1-7 and d18-21 to generate four treatments: SS, SH, LS, and LH. At hatch, chicks were separated into two transportation groups: control (T1) and heat-stressed (T2). The resulting groups were: LS1, SS1, LH1, SH1, LS2, SS2, LH2, and SH2. At d0 (pre and post transport), 2, 4, and 6 post-hatch, body and organ weights (yolk sac (YS), small intestine (SI), SI with gizzard & proventriculus (GI), spleen and bursa) were collected. Performance data was collected on d14, 28, and 42 corresponding with diet changes. Differences are significant at p<0.05. On DOH pre-tranport, LH had heavier and SS lighter YS as compared to LS and SH, while GI, SI and bursa were heavier from SS and SH chicks. At DOH post-tranport, GI and SI were heavier in SS than LH, and chicks from T2 had heavier GI than those of T1. An interaction between incubation temperature and transport was observed for GI. On d2 and d4, SS, SH, and LH had higher BW than LS, and there was an interaction between temperature and transport on BW, YS, and GI. In birds reared for performance measurements, incubation temperature had an effect on post-hatch BW on d0, d14, and d28 and interactions were observed on d0, d14, and d28. Differences in BWG were observed on d14 (SH1 increased) and d42 (T1 increased BWG as compared to T2). Data indicate that embryonic incubation and post-hatch transportation temperature have significant impacts on organ development and post-hatch performance of commercial broilers.

**Key Words:** Incubation, Transportation, Performance

### M34 Effects of in ovo injection of metabolic compounds and stimulants, and of the volume of select salt solutions on broiler embryo livability and growth. B. M. McGruder1, E. D. Peebles1, D. A. Braasch1, M. A. Dekich2, M. M. Keralapurath3, P. D. Gerard3, and R. W. Keirs2, 1Mississippi State University, Mississippi State, 2AviTech, LLC, Salisbury, MD, 3Clemson University, Clemson, SC.

Effects of automated in ovo injection of various volumes of physiological salts, of various types of metabolic compounds, and of various stimulants on the livability and growth of broiler embryos were investigated in separate trials. Solutions were injected into the amnion of embryos at d 16 of incubation. Embryo mortality; relative embryo weight and moisture content; relative dry embryo weight; and relative yolk sac weight and yolk moisture content were evaluated on d 18 of incubation in each trial. Potassium chloride (5.5 mM; KCl) and physiological saline (117 mM; NaCl) were tested at 200, 400, 800, and 1200 mL volumes. The efficacies of metabolic compounds, carried in 5.5 mM KCl, including a carbohydrate/electrolyte solution (CEN), tripotassium citrate (TPC), or sodium monophosphate (NaPO4) were investigated in a single trial. The efficacies of 1 mM caffeine, theophylline, creatine monohydrate, or L-arginine, carried in 5.5 mM KCl, were investigated in a separate trial. None of the injected solutions had a significant effect on embryo mortality. The 800 and 1200 mL volumes of NaCl and KCl decreased d 0-18 percent egg weight loss. However, d0-18 percent egg weight loss was not affected by the injection of 200 and 400 mL volumes of NaCl or KCl or, alternately, by the injection of CEN, TPC, or NaPO4 solutions. Injection of NaCl, NaPO4, or the CEN caused a decrease in percent embryo moisture. The loss was negated by the injection of TPC, which returned the embryo moisture levels to those of the non-injected controls. These data suggest that injection of the aforementioned solutions may reestablish an ideal moisture level for injected eggs, and that they have potential for use individually or in combination in the commercial injection of broiler hatching eggs to promote subsequent hatchability and post-hatch growth.

**Key Words:** Automated injection, In ovo nutrition, Stimulant, Metabolic compound, Volume

### M35 Effect of the inclusion of phytase in low available phosphorus broiler breeder diets on fecal moisture. M. Arguelles-Ramos1, A. B. Leytem2, and J. T. Brake1, 1North Carolina State University, Raleigh, 2USDA-ARS, NWISRL, Kimberly, ID.

An experiment was performed to evaluate the effect of inclusion of phytase in diets deficient in available phosphorus (AvP) on fecal moisture and performance of broiler breeders. Forty-eight 30-wk-old Ross 308 broiler breeders were placed in individual cages equipped with aluminum trays and cups for feces and urine collection. The design of the trays and cups was such that a crude separation of feces and urine could easily be made. Mixed feces and urine samples were collected for gene expression analysis of 5 nutrient transporters (SGLT1, GLUT2, GLUT5, PepT1, and EAAT3) in duodenum, jejunum and ileum. Real time PCR was performed using the relative quantification method. On d0, chicks were separated into two transportation groups: control (T1) and heat-stressed (T2). The resulting groups were: LS1, SS1, LH1, SH1, LS2, SS2, LH2, and SH2. At d0 (pre and post transport), 2, 4, and 6 post-hatch, body and organ weights (yolk sac (YS), small intestine (SI), SI with gizzard & proventriculus (GI), spleen and bursa) were collected. Performance data was collected on d14, 28, and 42 corresponding with diet changes. Differences are significant at p<0.05. On DOH pre-tranport, LH had heavier and SS lighter YS as compared to LS and SH, while GI, SI and bursa were heavier from SS and SH chicks. At DOH post-tranport, GI and SI were heavier in SS than LH, and chicks from T2 had heavier GI than those of T1. An interaction between incubation temperature and transport was observed for GI. On d2 and d4, SS, SH, and LH had higher BW than LS, and there was an interaction between temperature and transport on BW, YS, and GI. In birds reared for performance measurements, incubation temperature had an effect on post-hatch BW on d0, d14, and d28 and interactions were observed on d0, d14, and d28. Differences in BWG were observed on d14 (SH1 increased) and d42 (T1 increased BWG as compared to T2). Data indicate that embryonic incubation and post-hatch transportation temperature have significant impacts on organ development and post-hatch performance of commercial broilers.

**Key Words:** Incubation, Transportation, Performance
M36 Correlation comparison between Coccidiosis lesion scores and fecal oocyst counts. J. Bray1,2, T. Cherry3, J. Carey2, and C. Taylor1,2, 1Stephen F. Austin State University, Nacogdoches, TX, 2Texas A&M University, College Station.

In the United States, Coccidiosis lesion scoring by the Johnson and Reid Method is the poultry industry’s preferred method of evaluating a Coccidiosis control program. In Mexico, fecal oocyst counts are the preferred method of evaluation. With the use of both methods there remains the question, are the two correlated? A study was conducted to determine if there is a correlation between Coccidiosis lesion scores and fecal oocyst counts. In Guadalajara, Mexico broiler chickens were lesion scored using the Johnson and Reid method. Birds were checked for E. acervulina, E. maxima, and E. tenella. Bird necropsies were performed on flocks at approximately 2, 3, 4, 5, 6 and 7 weeks of age. Ten birds per house were randomly selected from each farm for every age group. At the same time, fecal samples were taken from each house at each farm for all age groups. Fecal floatations were conducted for each sample and the oocyst counts were recorded for E. acervulina, E. maxima, and E. tenella. All birds sampled were on their second grow-out using a Coccidiosis vaccine program. After graphing the data, it was determined if there is a correlation between the Coccidiosis lesion score method and the fecal oocyst count method for each of the three species. Lesion scores and fecal oocyst counts progressed in a manner normal for a Coccidiosis vaccine program. E. acervulina lesion scores and fecal oocyst counts were greatest at 2 weeks of age and then subsided throughout the remaining weeks. E. maxima lesion scores and fecal oocyst counts peaked between 3 and 4 weeks, while E. tenella lesion scores and fecal oocyst counts were minimal throughout the study. Oocyst production peaks were seen at 2, 4, and 6 weeks of age, demonstrating the cycling of oocyst through the bird, while lesion scores diminished through the weeks.

Key Words: Coccidiosis, Vaccine, Broilers, Oocyst, Eimeria


During the grow-out phase of broiler production, ammonia (NH₃) is generated and released into the environment. It has been proposed that addition of ozone (O₃) can oxidize NH₃ thereby reducing concentration. This project evaluated the effects of air ozonation on live performance, NH₃ and O₃ concentrations ([NH₃] and [O₃]), and bacterial populations in commercial broiler houses. On a single broiler farm, 2 paired houses were selected and O₃ was constantly added to the air, while the other 2 houses served as controls. Trial 1 was run on litter that held 8 previous flocks. New wood shavings were placed and trials 2 and 3 were run. Portable Multi Gas Units using Draeger dataloggers were used to measure [NH₃] and [CO₂] over a 48 hour sampling period weekly. [O₃] outside the houses were obtained bi-weekly using 3 O₃ meters. Trial 1 showed (P<0.05) heavier male and female birds in the control houses at 42d. 56d BW showed that held 8 previous flocks. New wood shavings were placed and trials 2 and 3 were run. Portable Multi Gas Units using Draeger dataloggers were used to measure [NH₃] and [CO₂] over a 48 hour sampling period weekly. [O₃] outside the houses were obtained bi-weekly using 3 O₃ meters. Trial 1 showed (P<0.05) heavier male and female birds in the control houses at 42d. 56d BW showed no significant differences in any of the three trials. The control birds weighed 50g more at processing, with a feed conversion ratio (FCR) 0.01 g:g better, but mortality was increased by 0.34%. 0-10ppm [NH₃] reductions were observed at processing, with a feed conversion ratio (FCR) 0.01 g:g better, but heavier male and female birds in the control houses at 42d. 56d BW showed that held 8 previous flocks. New wood shavings were placed and trials 2 and 3 were run. Portable Multi Gas Units using Draeger dataloggers were used to measure [NH₃] and [CO₂] over a 48 hour sampling period weekly. [O₃] outside the houses were obtained bi-weekly using 3 O₃ meters. Trial 1 showed (P<0.05) heavier male and female birds in the control houses at 42d. 56d BW showed no significant differences in any of the three trials. The control birds weighed 50g more at processing, with a feed conversion ratio (FCR) 0.01 g:g better, but mortality was increased by 0.34%. 0-10ppm [NH₃] reductions were observed in the ozonated houses with no statistical difference between treatments. The external [O₃] remained 0.01-0.1 ppm over the course of the 3 trials. In Trial 2, male birds were heavier (P<0.05) in the ozonated houses at 42d. At processing birds from the ozonated houses were 86g heavier, but mortality was 1.79% higher, and the FCR was 0.01 worse. 0-8 ppm [NH₃] reductions were observed in the ozonated houses with no statistical difference between treatments. Trial 3 male and female control house birds were heavier (P<0.05) at 42d. At processing the control houses weighed 82g more, mortality was 0.8% higher, and the FCR was 0.08 better. No consistent trends in airborne or litter bacterial populations (total aerobes, Enterobacteriaceae, and Salmonella) were observed between the control and ozone-treated houses. While in some instances, small improvements in broiler performance due to ozonation, were noted, these improvements were inconsistent.

Key Words: Ozonation, Broilers, Ammonia, Performance, Bacteria

M38 Contaminated larval and adult darkling beetles can serve as vectors in transmission of Salmonella Typhimurium in a broiler flock. A. J. Roche1, R. J. Buhr2, L. J. Richardson2, N. A. Cox3, B. D. Fairchild3, G. R. Siragusa2, and N. C. Hinkle1, 1University of Georgia, Athens, 2Poultry Microbiological Safety Research Unit, Russell Research Center, Athens, GA, 3University of Georgia, Athens.

Understanding the role darkling beetles serve in Salmonella transmission is critical in order to develop better foodborne pathogen intervention strategies on the broiler farm. Prior studies have shown that Salmonella can persist in darkling beetles (Alphitobius diaperinus) up to 63 d, more than long enough to contaminate subsequent broiler flocks. The objective of this study was to assess the spread of S. Typhimurium in a broiler flock via seeders chicks gavaged with colonized adult or larval beetles. Day-of-hatch chicks were challenged with a naladixic acid resistant strain of S. Typhimurium at 10⁶ CFU/bird by either a peptic suspension or gavage with 4 adult or 4 larval beetles. Either 1 or 2 seeder chicks for each challenge type were then placed into pens containing non-inoculated chicks. Each pen contained a total of 40 chicks at a density of 0.7 lb/bird. Cecal samples were taken at 3 and 6 wk of age. For the peptone challenge pens, 29% of the seeders broilers and 10% of the sampled pen mates were positive at 3 wk of age and 2% at 6 wk. For the adult beetle challenge pens, 0% of the seeders broilers and 15% of sampled pen mates were positive at 3 wk and 7% at 6 wk. For the larval beetle challenge pens, 33% of the seeders broilers and 45% of sampled pen mates were positive at 3 wk and 11% at 6 wk. In this study, seeders became colonized with Salmonella by oral gavage of either adult or larval beetles and spread Salmonella to pen mates. These results demonstrate that beetles colonized with Salmonella could be a significant vector for the transmission of Salmonella to chicks when ingested and readily spread Salmonella throughout a broiler flock.

Key Words: Alphitobius diaperinus, Salmonella Typhimurium, Darkling beetles, Lesser mealworm, Broilers

M39 Effects of crude protein dietary levels on nitrogen mass balance of commercial broilers. C. Taylor1,2, J. Bray1,2, J. Carey1, T. Cherry3, and D. Hoelzer1, 1Texas A&M University, College Station, 2Stephen F. Austin State University, Nacogdoches, TX, 3Degussa Corporation, Kennesaw, GA.

A major concern facing the poultry industry is the amount of nitrogen that is produced within a commercial broiler facility. Ammonia emissions are positively correlated to nitrogen production. Ammonia is considered an air pollutant and nuisance to commercial facility neighbors, high ammonia concentrations also lead to reduced animal performance. In this study, dietary crude protein levels were adjusted utilizing methionine, threonine, and lysine. The study was conducted under simulated commercial conditions to more accurately determine the amount of litter moisture, litter nitrogen, caked litter nitrogen, bird performance, and nitrogen loss. Broilers were housed in twenty-four 10⁶ FTM X 10⁶ TFM pens with 134 broilers placed per pen, such that at 49 days of age 0.75 square foot per bird was allowed. The four dietary treatments were an average industry diet (A) and 3 diets where crude protein was reduced by 0.5% (B), 1.0% (C), and 1.5% (D) for starter, grower, and finisher periods. Samples of incoming and outgoing sources of nitrogen and broiler weights were taken at Day 0 and 49 of age. Mass balance was calculated on a dry matter basis. For Day 49 litter nitrogen, no significant difference was detected at alpha = 0.05 level (A = 3.5598%, B = 3.3641%, C = 3.4942%, D = 3.5684%). A significant difference (p < 0.05) was detected between trt B (4.1543%) and trt C (4.9108%) for caked litter nitrogen. For caked litter percent moisture (A = 29.4722%, B = 24.3844%, C = 27.3443%, D = 25.7142%). A significant difference was present across the treatments for ending litter percent moisture (A = 29.4722%, B = 24.3844%, C = 27.3443%, D = 25.7142%). For caked litter percent moisture, there was no significant difference (A = 50.9685%, B = 44.4125%, C = 46.1813%, D = 49.8887%). There was a significant difference for trt A (2.9988 kg) and trt D (3.1170 kg) for Day 49 bird weights. For nitrogen loss (g/kg of bird marketed), there was no significant difference detected (A = 4.0691, B = 4.5792, C = 4.2383, D = 4.7177). This experiment aids in determining the impact of crude protein levels on litter characteristics and nitrogen loss in a commercial broiler facility.

Key Words: Broiler, Nitrogen mass balance, Moisture, Litter, Crude protein
**M40** Disinfection of eggshells using ultraviolet light and hydrogen peroxide independently and in combination. J. Wells*, C. Coufal, H. Parker, and C. McDaniel, Mississippi State University, Mississippi State.

Eggshell bacteria are decreased by ultraviolet light (UV) or hydrogen peroxide (HP) alone, however, the antimicrobial effects of these two treatments combined as well as optimum length for UV exposure are not known. Therefore, the objectives were to obtain the optimum length of UV exposure for maximum bacteria reduction and to determine if a greater bacterial reduction would occur when using a combination of UV and HP as opposed to either treatment alone. The first experiment was conducted to find the optimum length of UV exposure by exposing eggs to 4, 8, 16 and 32 min of UV. Three experiments were conducted to determine what concentration of HP in combination with UV exposure would yield maximum bacterial reduction. For experiment 2, treatments consisted of a control and UV alone, as well as 0, 1, 2 and 3% HP alone and in combination with UV. For experiment 3, treatments consisted of a control, UV alone, 3% HP alone, as well as 0, 0.5, 1, 1.5, 2, 2.5 and 3% HP in combination with UV. Experiment 4 contained 10 treatments including control, 1.5, 2 and 2.5% HP at UV exposure times of 2, 4 and 8 min for each HP concentration. After each treatment, eggs were placed in a sterile bag, and 50 ml of sterile phosphate buffered saline (pH 7.2) was added. Rinsate (0.5 mL) from diluted samples was spread plated on tryptic soy agar in duplicate and incubated for 48 h prior to bacterial enumeration. Every control eggshell contained bacteria with an average bacterial count of 4 log. Exposure to only UV for 8 min yielded optimum bacterial reduction. When administered independently, HP and UV each reduced the bacterial count by 2 log, yielding no bacteria on 16% and 30% of the plates for HP and UV, respectively. The combination of HP and UV reduced bacterial counts by a maximum of 3 log and the percentage of eggs positive for bacteria by 65%. Because bacterial contamination was further reduced by using a combination of UV and HP, hatchability and chick quality of broiler breeder eggs may be improved by these treatments.

**Key Words:** Eggshell sanitation, Bacteria, Hydrogen peroxide, Ultraviolet light

**M41** Shaking eggs during incubation: An alternative to turning. H. R. Cutchen*, M. J. Wineland, and K. M. Mann, North Carolina State University, Raleigh.

The process of turning eggs during incubation causes reduced air flow across eggs potentially leading to hot spots in the machine (Buhr, 1989). However, not turning eggs correlates strongly with decreased hatchability. This project was designed to study the effects of shaking eggs during various periods of incubation. Two customized Chickmaster setters were used, one that turns eggs (turns) and one that oscillates (osc) (shakes) through 4.5 cm. Three trials are reported. In trial 1, the shaker ran at 1osc/sec for 20sec every 30min. In trial 2, the duration and frequency increased to 1osc/sec for 30sec every 10min. In trial 3, the speed was increased to 1.25osc/sec for 20sec every 20min. Each of the trials contained 6 treatments: turn control (TC), 1osc/sec and 7osc/sec every 20min. In the shake control (SC), 3osc/sec and 7osc/sec every 10min. The controls remained in the setter for 18 days of incubation. The T3 and S3 groups started in their respective setter then were switched to the other setter at d3 of incubation and the T7 and S7 groups at d7. This was performed to determine if there is a critical time period during which eggs should be turned vs. shaken. In all 3 trials, the hatch of fertile was significantly lower in the SC group than the TC group due to significantly high early (d1-3) and late (d17-20) embryonic mortality. There were significantly higher numbers of pipped chicks in SC in trial 2 and trial 3 than the other treatments. Egg temp was monitored in trial 3 using temp probes. In the shake machine the average difference in egg temp between the top and bottom of the machine was 0.2°F, which was significantly different from 0.5°F in the turn machine. In conclusion, shaking 1osc/sec for 30sec every 10min can produce an adequate hatch of fertile, though still significantly lower than turning. Shaking faster is very detrimental and shaking less frequently is not as beneficial to hatch of fertile. Turning eggs for 7 days then moving to the shaker actually improved hatch of fertile in trials 2 and 3.

**Key Words:** Shaking, Incubation, Egg temperature, Turning, Critical period


1Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, 2College of Education, Ekuadinor,Benin City, Nigeria, 3Ministry of Agriculture and Natural Resources, Benin City, Nigeria, 4University of Ibadan, Ibadan, Oyo State, Nigeria.

The demand for animal protein is on the increase due to growth in population in Nigeria. For poultry industry to meet this demand research result need to be utilized for the improvement in poultry production. This study assessed farmers interest in the use of two experimental diets; kola pod husk and cassava peels. Specifically, the study was to investigate the socio economic characteristics of commercial poultry farmers, examine interest of farmers on the research result and examine the constraints militating against the use of by-products. The study was carried out in the Agricultural Development Programme poultry farm in Benin City. Thirty commercial farmers were randomly selected from the list of 300 members of Poultry Association of Nigeria Edo State to participate in the experiment and information was elicited with the use of questionnaire. The data were presented with frequency counts, percentages and charts while analysis was carried out using Chi-Square. The result revealed that the commercial farmers had mean age of 41 years with 85% having post secondary education and 60% have more than 5 years in poultry business. The Chi-Square result revealed that there is a significant relationship between level of education and interest in research results ($X^2=14.56$, $P<0.05$). Based on responses to the constructed attitudinal statements on preferences and constraints, most (60%) of the respondents preferred kola pod husk while (40%) preferred cassava peels. In conclusion, farmers preferred the use of locally acquired by-products as a means of increasing income and reducing the heavy reliance on maize as source of energy for broiler birds.

**Key Words:** Farmers, Participatory, Evaluation, By-products, Broilers

**Nutrition II**


1Cocoa Research Institute of Nigeria, Ibadan, Oyo, Nigeria, 2University of Ibadan, Oyo, Nigeria, 3Cocoa Research Institute of Nigeria, Ibadan, Oyo, Nigeria, 4University of Ibadan, Oyo, Nigeria.

Many by – products that are considered as wastes in Nigeria have great potentials as poultry feed ingredients if properly handled, processed and incorporated into rations. One of such neglected by – products is Cocoa bean shell (CBS). Nigeria is the fourth largest producer of cocoa in the world and cocoa bean shell is abundantly wasting on all cocoa processing factories in Nigeria. This trial focused on detheobrominising cocoa bean shell through application of enzyme and fermentation in order to enhance its nutritional value for layers. Two hundred and ten (210) six – week – old laying hens were used for this trial with thirty birds, randomly allotted to seven experimental diets containing ten birds per replicate in a 3 × 3 factorial design. These diets were: A (0% CBS – control); B (5% raw CBS); C (10% raw CBS); D (5% CBS with enzyme); E (10% CBS with enzyme); F (5% fermented CBS); and G (10% fermented CBS). The layers on each diet were offered feed and water ad – libitum throughout the experimental period. The results obtained indicated that there were significant differences ($P < 0.05$) in feed intake, hen – day production and egg weight. Significant ($P < 0.05$) differences were also recorded in internal quality characteristics (yolk weight, yolk height, yolk width, albumin weight, albumin height, yolk colour, haugh unit) and the external quality characteristics (egg length, egg width, shell width, shell thickness and shell percentage) of the eggs from the experimental layers. The enzyme treatment and fermentation technique improved the nutritive quality of cocoa bean shell in layers.

**Key Words:** Biochemical treatments, Cocoa bean shell, Laying hens, Egg quality
M40  Disinfection of eggshells using ultraviolet light and hydrogen peroxide independently and in combination. J. Wells*, C. Coufal, H. Parker, and C. McDaniel, Mississippi State University, Mississippi State.

Eggshell bacteria are decreased by ultraviolet light (UV) or hydrogen peroxide (HP) alone, however, the antimicrobial effects of these two treatments combined as well as optimum length for UV exposure are not known. Therefore, the objectives were to obtain the optimum length of UV exposure for maximum bacteria reduction and to determine if a greater bacterial reduction would occur when using a combination of UV and HP as opposed to either treatment alone. The first experiment was conducted to find the optimum length of UV exposure by exposing eggs to 4, 8, 16, and 32 min of UV. Three experiments were conducted to determine what concentration of HP in combination with UV exposure would yield maximum bacterial reduction. For experiment 2, treatments consisted of a control and UV alone, as well as 0, 1, 2, and 3% HP alone and in combination with UV. For experiment 3, treatments consisted of a control, UV alone, 3% HP alone, as well as 0, 0.5, 1, 1.5, 2, 2.5, and 3% HP in combination with UV. Experiment 4 contained 10 treatments including control, 1.5, 2 and 2.5% HP at UV exposure times of 2, 4, and 8 min for each HP concentration. After each treatment, eggs were placed in a sterile bag, and 50 ml of sterile phosphate buffered saline (pH 7.2) was added. Rinse (0.5 ml) from diluted samples was spread plated on tryptic soy agar in duplicate and incubated for 48 h prior to bacterial enumeration. Every control eggshell contained bacteria with an average bacterial count of 4 log. Exposure to only UV for 8 min yielded optimum bacterial reduction. When administered independently, HP and UV each reduced the bacterial count by 2 log, yielding no bacteria on 16% and 30% of the plates for HP and UV, respectively. The combination of HP and UV reduced bacterial counts by a maximum of 3 log and the percentage of eggs positive for bacteria by 65%. Because bacterial contamination was further reduced by using a combination of UV and HP, hatchability and chick quality of broiler breeder eggs may be improved by these treatments.

Key Words: Eggshell sanitation, Bacteria, Hydrogen peroxide, Ultraviolet light

M41  Shaking eggs during incubation: An alternative to turning. H. R. Cutchin*, M. J. Wineland, and K. M. Mann, North Carolina State University, Raleigh.

The process of turning eggs during incubation causes reduced air flow across eggs potentially leading to hot spots in the machine (Buhr, 1989). However, not turning eggs correlates strongly with decreased hatchability. This project was designed to study the effects of shaking eggs during various periods of incubation. Two customized Chickmaster setters were used, one that turns eggs (turns) and one that oscillates (osc) (shakes) through 4.5 cm. Three trials are reported. In trial 1, the shaker ran at 1osc/sec for 20 sec every 10 min. In trial 2, the duration and frequency increased to 1osc/sec for 30sec every 10 min. In trial 3, the speed was increased to 1.25osc/sec for 20 sec every 20 min. Each of the trials contained 6 treatments: turn control (TC), 3 (T3), and 7 (T7) as well as shake control (SC), 3 (S3) and 7 (S7). The controls remained in the setter for 18 days of incubation. The T3 and S3 groups started in their respective setter then were switched to the other setter at d3 of incubation and the T7 and S7 groups at d7. This was performed to determine if there is a critical time period during which eggs should be turned vs. shaken. In all 3 trials, the hatch of fertile was significantly lower in the SC group than the TC group due to significantly high early (d1-3) and late (d17-20) embryonic mortality. There were significantly higher numbers of pipped chicks in SC in trial 2 and trial 3 than the other treatments. Egg temp was monitored in trial 3 using temp probes. In the shake machine the average difference in egg temp between the top and bottom of the machine was 0.2°F, which was significantly different from 0.5°F in the turn machine. In conclusion, shaking 1osc/sec for 30sec every 10 min can produce an adequate hatch of fertile, though still significantly lower than turning. Shaking faster is very detrimental and shaking less frequently is not as beneficial as hatch of fertile. Turning eggs for 7 days then moving to the shaker actually improved hatch of fertile in trials 2 and 3.

Key Words: Shaking, Incubation, Egg temperature, Turning, Critical period


The demand for animal protein is on the increase due to growth in population in Nigeria. For poultry industry to meet this demand research result need to be utilized for the improvement in poultry production. This study assessed farmers interest in the use of two experimental diets; kola pod husk and cassava peels. Specifically, the study was to investigate the socio economic characteristics of commercial poultry farmers, examine interest of farmers on the research result and examine the constraints militating against the use of by-products. The study was carried out in the Agricultural Development Programme poultry farm in Benin City. Thirty commercial farmers were randomly selected from the list of 300 members of Poultry Association of Nigeria Edo State to participate in the experiment and information was elicited with the use of questionnaire. The data were presented with frequency counts, percentages and charts while analysis was carried out using Chi-Square. The result revealed that the commercial farmers had mean age of 41 years with 85% having post secondary education and 60% have more than 5 years in poultry business. The Chi-Square result revealed that there is a significant relationship between level of education and interest in research results (X²=14.56, P<0.05). Based on responses to the constructed attitudinal statements on preferences and constraints, most (60%) of the respondents preferred kola pod husk while (40%) preferred cassava peels. In conclusion, farmers preferred the use of locally acquired by-products as a means of increasing income and reducing the heavy reliance on maize as source of energy for broiler birds.

Key Words: Farmers, Participatory, Evaluation, By-products, Broilers


The enzyme treatment and fermentation technique improved the nutritive value of biochemically treated cocoa bean shell through application of enzyme and fermentation in order to enhance its nutritional value for layers. Two hundred and ten (210) six-week-old laying hens were used for this trial with thirty birds, randomly allotted to seven experimental diets containing ten birds per replicate in a 3×3 factorial design. These diets were: A (0% CBS – control); B (5% raw CBS); C (10% raw CBS); D (5% CBS with enzyme); E (10% CBS with enzyme); F (5% fermented CBS); and G (10% fermented CBS). The layers on each diet were offered feed and water ad libitum throughout the experimental period. The results obtained indicated that there were significant differences (P < 0.05) in feed intake, hen – day production and egg weight. Significant (P < 0.05) differences were also recorded in internal quality characteristics (yolk weight, yolk height, yolk width, albumin weight, albumin height, yolk colour, haugh unit) and the external quality characteristics (egg length, egg width, shell width, shell thickness and shell percentage) of the eggs from the experimental layers. The enzyme treatment and fermentation technique improved the nutritive quality of cocoa bean shell in layers.

Key Words: Biochemical treatments, Cocoa bean shell, Laying hens, Egg quality

Nutrition II

Poult. Sci. 87 (Suppl. 1)

The study was designed to compare the effect of cassava peels and kola pod husk on the performance of broiler finisher. One hundred and twenty, four-week old Hybro and Ross broilers were assigned randomly to two experimental diets of cassava peels and kola pod husk in triplicates of 15 birds each in complete randomized design. The proximate compositions of dried cassava peels; Crude protein 2.75±0.49% and ME (kcal/g) 4.66 ±0.18% and kola pod husk; Crude protein 17.60% and ME (cal/kg) 2555. The treatments were used at four levels of 0, 10, 20 and 30% replacement for maize. Data were collected daily for 4 weeks and analyzed with analysis of variance (ANOVA). The result shows that body weight gain, feed consumption and feed conversion ratio were not significantly different (P>0.05) as the two levels of the experimental diets increased. There was no significant difference (P>0.05) in the weight of feather, wing, gizzard, liver and length of intestine. It was observed that kola pod husks and cassava peels on broiler finisher performance was not significantly different and could be used efficiently in broiler finisher feeds. This will increase farmers’ income as they would spend less on maize as source of energy for broiler finisher feed.

Key Words: Evaluation, Cassava peels, Kola pod husk, Performance, Broiler finisher

M45 Dietary protein and energy effects on broiler live performance to 42 days. F. I. L. Hernandez*1, D. R. Korver2, R. A. Renema3, and M. J. Zuidhof4, 1Alberta Agriculture and Food, Edmonton, AB, Canada, 2University of Alberta, Edmonton, AB, Canada.

A study was carried out to investigate the effects of energy and protein levels on performance of Cobb Avian 48 broilers to 42 d. Chicks were randomly assigned to a 2 x 2 x 3 x 5 factorial arrangement of treatments, with 2 sexes; 2 levels of early nutrition (0 to 11 d); and after 11 d, 3 metabolizable energy (ME) levels and 5 dietary balanced protein (DBP) levels, balanced for 4 limiting amino acids. The three ME levels were 94, 97, and 100% of Cobb-Vantress dietary specifications for maximum growth rate and feed conversion ratio (FCR). The five DBP levels were 85, 92.5, 100, 107.5, and 115% of these same specifications. Two pre-starter nutrient densities were used, based on CobbatTM starter recommendations for maximizing growth rate and FCR (HIGH), or for reduced feed cost (LOW). From 12 to 42 d of age, the pre-starter treatment was nested within pens, which housed ME x DBP x sex interactions. By 6 wk, the HIGH pre-starter increased BW (2.73 vs. 2.661 kg; p<.0001). Male broilers were heavier than females (p<.005) in all levels of ME and DBP. Among treatment means, BW ranged from 2.70 to 3.02 kg; p<.0001). Male broilers were heavier than females (p<.005) in all levels of ME and DBP. Among treatment means, BW ranged from 2.70 to 3.02 kg; p<.0001). In males, DBP did not affect cumulative FCR at 42 d; females fed 85% DBP had a lower cumulative FCR than those fed 100% DBP. Covariate analysis indicated that breast yield (corrected for BW) was higher at 100% than 95% at 115% for DBP and at 85% (range: 494–500 g vs. 480 g, respectively; p<.0001). The low ME level increased breast yield relative to the high ME level (p<.08). Males had higher eviscerated BW and wing yield. In conclusion, HIGH pre-starter improved growth rate, males were more efficient than females, and high DBP levels increased breast yield.

Key Words: Live Performance, Yield, Broilers, Metabolizable Energy, Dietary Balanced Protein

M46 Effect of protein and energy level in feed on posthatch chick performance. R. Molenaar*1, I. A. M. Reijrink, R. Meijerhof1, J. K. W. M. Sparing, and P. J. A. Wijnman1, 1HatchTech BV, Veennendaal, the Netherlands, 2Prosvin BV, Rotterdam, the Netherlands.

Previous studies demonstrated that early feeding of chicks improves post hatch development, especially in combination with optimum brooding conditions. However, optimum feed formulation for especially the first days of life are not well known. This study evaluates the effect of protein and energy level on body weight and feed intake of chicks till 4 days posthatch in a brooding system, designed to keep birds on optimum body temperature. A total of 400 chicks originating from a broiler breeder flock of 48 weeks, were randomly assigned to 4 feed treatments, with 5 replicates for each treatment. Feed treatments were: A. High digestible lysine (12.5 g/kg), high energy (2950 kcal); B. High digestible lysine (12.5 g/kg), low energy (2800 kcal) C. Low digestible lysine (10.8 g/kg), high energy (2950 kcal) D. Low digestible lysine (10.8 g/kg), low energy (2800 kcal). Body weight and feed intake were measured daily till 4 days posthatch.

Results showed that at day 4 posthatch, feed A and B resulted in significant higher body weights than feed C and D (P<0.05), while feed B showed a higher trend in body weight than feed A (P<0.10). Feed intake was not influenced by diet composition. When analyzing bodyweight gain of all birds, a general negative correlation (P<0.05) was found within all treatments, between bodyweight at hatch and body weight gain during the first day. High protein levels in feed seems more beneficial for growth of posthatch chicks than high energy levels. High energy levels were achieved by including fat in the diet, which is more difficult for day old chicks to digest than protein, due to an impaired development of the intestinal tract. Regulation of feed intake by energy intake in day old chicks seems to be limited, as feed consumption was not influenced by energy level. Chicks that did not grow the first day might have hatched later and therefore were less dehydrated, indicated by the higher body weight at the start.

Key Words: Nutrient requirements, Protein, Energy, Early feed intake

M47 The role of feeding regimens in regulating metabolism of sexually mature broiler breeders: hepatic lipid metabolism, plasma hormones and metabolites. M de Beer*1, R. D. Ekmany2, R.W. Rosebrough3, M.P. Richards3, J. P. McMurtry3, and C. N. Coon3, 1Aviagen, Huntsville, AL, 2University of Arkansas, Fayetteville, 3USDA-ARS, Beltsville, MD.

A trial was conducted to determine the effects of different rearing feed regimens on plasma hormone and metabolite levels and hepatic lipid metabolism on sexually mature broiler breeders. A flock of Cobb 500 birds was divided into two groups at 35 days of age and fed either everyday (ED) or skip-a-day (SKP). At 168 days of age, all birds were switched over to an ED regimen. At 185 days (26 weeks) of age, 28 ED-reared and 28 SKP-reared birds were randomly selected and sacrificed at intervals after feeding. Liver and blood samples were collected and analyzed. Glycogen, Total Liver Fat and Liver Fat % increased upon feeding regardless of treatment. The magnitude of the increase was greater for SKP birds with peaks achieved by hour 12. Similar findings were reported for birds at 16 weeks of age. Relative Liver Weight increased only in SKP birds. The overall mean gene expression of ICDH, AST, and ACC was not significantly different between treatments. Both ME and FAS were higher in SKP birds and peaked at 8 hours; indicative of continued lipogenesis and consistent with liver fat data. Corticosterone and IGF-2 levels were significantly higher (P<0.05) in SKP birds. Elevated corticosterone levels can be attributed to increased hunger and stress. SKP birds were also higher in Leptin, Glucagon, and T3. The increase in leptin is a reversal of what was reported during the rearing phase. In summary, different feeding regimens alter metabolic responses which carry over into sexual maturity and exhibit metabolic memory.

Key Words: Broiler breeders, Lipogenesis, Gene expression, Metabolic hormones
distributed into 96 floor pens at 1 d of age and were fed a common starter diet until 13 d of age. At 14 d of age, all pens were equalized with 15 birds (0.09 m²/bird) and fed the experimental diets until 28 d of age. Two diets consisting of corn, soybean meal, and peanut meal were formulated to be surfeit in limiting amino acids and contained 0.85 or 1.25% digestible Lys. Diet dilution was used with L-Lys HCl to create 9 titration diets from 0.85 to 1.25% digestible Lys in 0.05% increments (10 pens/treatment). A control diet containing surfeit Lys was used to validate the titration diets (6 pens/treatment).

Dietary Lys content of the experimental diets containing 0.85 and 1.25% were in close agreement with the calculated values based upon a cecectomized rooster assay resulting in digestible Lys of 0.84 and 1.21%, respectively. Significant (P<0.03) quadratic trends were observed for BW, BW gain, feed intake, Lys intake/BW gain, and feed conversion. Dietary treatments did not affect the incidence of mortality. Dietary digestible Lys requirements for BW gain, BW gain, feed intake, and feed conversion were estimated as 1.10, 1.10, 1.06, and 1.13%, respectively, based on 95% of the optimum response. These results indicate that the Lys requirement for Ross × Ross TP16 male broilers is higher than Lys levels predicted from regression equations from Dozier et al., 2007 using mixed sexed Ross × Ross 508 and 708 broilers.

Key Words: Amino acid, Broiler, Lysine

M49 Dietary lysine requirement of female broilers from 14 to 28 days of age. A. Corzo1, W. A. Dozier2, M. T. Kidd3, and P. Tillman3, 1Mississippi State University, Mississippi State, 2USDA-ARS Poultry Research Unit, Mississippi State, MS, 3Ajinomoto Heartland LLC, Chicago, IL

Dietary Lys needs of female broilers have been rarely evaluated because traditionally the needs for dietary Lys of males have served to describe an overall Lys requirement. A study was conducted evaluating increasing concentrations in dietary digestible Lys from 14 to 28 d of age. One-thousand-forty-eight female Ross × Ross TP16 d-old female broiler chicks were randomly distributed into 96 floor pens. These chicks were fed a common starter diet in crumbled form, formulated to meet or exceed all dietary nutrient requirements. At 14 d of age, all pens were equalized in bird number (12 birds/pen; 0.09birds/m2). Two diets consisting primarily of corn, soybean meal, and peanut meal were formulated to be surfeit in limiting amino acids and contained 0.85 or 1.25% digestible Lys. Diet dilution was used with L-Lys HCl to create 9 experimental titration diets from 0.85 to 1.25% digestible Lys in 0.05% increments (10 pens/treatment). A control diet containing surfeit Lys was used to validate the titration diets (6 pens/treatment). All experimental diets were fed from 14 to 28 d of age, and offered in pellet form. Diets were analyzed for digestible Lys content based on a precision-fed cecectomized rooster assay. Calculated and analyzed digestible Lys values of the experimental diets were in close agreement (0.84 and 1.21% digestible Lys for the diets formulated to 0.85 and 1.25%, respectively). BW gain and lysine intake displayed significant linear responses. Feed conversion exhibited a significant quadratic trend resulting in a digestible Lys requirement estimate of 1.06% based on 95% of the minimum response. Incidence of mortality was unaffected by the dietary Lys levels fed. The results from this study indicate that the Ross × Ross TP16 female broiler requires a minimum of 1.06% digestible Lys from 14 to 28 d of age, and in agreement with results obtained in the companion study using male broilers.

Key Words: Amino acid, Broiler, Lysine

M50 Determination of the effect of methionine and lysine on feed intake of growing broilers. C. O. Imahighie1, E. O. Uwagboe1, F. A. Iyoha1, and B. O. Iyamu1, 1Ministry of Agriculture and Natural Resources, Benin City, Edo State, Nigeria, 2Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria, 3College of Education, Ekaedolor, Benin City, Nigeria.

In most developing countries especially in Sub-Sahara Africa, there is acute protein calorie malnutrition particularly that from animal sources. It has been observed that the average protein intake of every Nigerian falls dissimally below the WHO requirement. To overcome this effect therefore, the producing animals and their genetic potentials have to be substantially improved. Hence, a need to determine the effect of methionine and lysine in feed intake of growing broilers. This experiment was conducted on deep litter system at the livestock division of the Department of Agricultural Services of the Ministry of Agriculture and Natural Resources farm in Oko–Ogba, Benin city. The experimental design was a 3 x 3 x 2 factorial design which is three sources of feed, three levels of lysine and methionine, and two breeds of birds. A total of 120 birds were subjected to three treatments ration. The aim of the experiment was to find out the effect of three levels of lysine and methionine (0, 5 and 10%) on feed intake, daily weight gain and protein efficiency ratio in growing broilers. The experiment lasted for eight weeks and records were taken daily. The data were analyzed with analysis of variance (ANOVA). The result shows that there was no significant difference in the three levels of methionine and lysine in feed intake, daily weight gain and protein efficiency ratio in growing broilers (P>0.05). In conclusion, broilers performed well at these three levels and poultry farmers should be dissuaded from the use of excess commercial methionine and lysine which could initiate microbial growth in the intestine. This could help farmers conserve resources and prevents nutrient inhibition.

Key Words: Determination, Methionine, Lysine, Utilization, Broilers

M51 Comparison of apparent and standardized amino acid digestibility of feed ingredients in cecectomized roosters, laying hens, and broilers. S. A. Adedokun1, C. M. Parsons2, O. Adeola1, M. Lilburn3, and T. J. Applegate1, 1Purdue University, West Lafayette, IN, 2University of Illinois, Urbana, 3Ohio State University, Wooster.

The aim of this study was to determine the effect of strain of bird and method of standardization on standardized amino acid digestibility (SAAD) of five plant source and one animal source feed ingredients. The SAAD were obtained by correcting apparent amino acid digestibility (AAAD) values for basal endogenous amino acid (EAA) flow obtained from feeding a N-free diet (NFD) in 21 d-old broilers and laying hens or on fasted EAA flow from cecectomized roosters. Each feed ingredient served as the only source of protein and each diet was formulated to contain 20% CP, except for the corn diet. The AAAD were not different between broilers and roosters in four of the six feed ingredients. Broilers had higher (P<0.05) AAAD than laying hens and roosters for the corn diet while roosters AAAD was higher (P<0.05) than for broilers for meat and bone meal (MBM) diet. Apparent amino acid digestibility for the three strains of bird was similar for the dark distillers dried grain with solubles (dark DDGS), canola meal and soybean meal. Lysine digestibility for the dark DDGS was very low (15%) in the cecectomized roosters. Roosters' SAAD values were higher (P<0.05) than broilers' in four of the six feed ingredients. There was no difference, however, between SAAD values for corn and dark DDGS for broilers and roosters. Within the cecectomized roosters, there were no differences on SAAD in light DDGS, dark DDGS, and canola meal for the three (fasted, nitrogen-free, or highly digestible protein) methods of standardization used. However, for corn, soybean meal and MBM, NFD and HDP methods resulted in higher (P<0.05) SAAD values for most of the amino acids than the fasted method of standardization. Results from this study showed that both the apparent and standardized amino acid digestibility values in cecectomized roosters and 21 d-old broilers in some feed ingredients were similar, yet there were differences in amino acid digestibility of other feed ingredients.

Key Words: Broiler, Laying hen, Rooster, Standardized amino acid digestibility

M52 Production control I: The key to profits. D. A. Roland1, M. M. Bryant1, M. Farmer2, and A. Roland3, 1Auburn University, Auburn, AL, 2Ridley Inc., Mankato, MN, 3Roland Poultry Services, LLC, Auburn, AL.

Even though the single greatest influence on egg price and profits is egg supply, little effort has been devoted to controlling supply versus improving production efficiency. The reason is the organizational management required for effective supply management is complex. However, with enhanced industry consolidation and higher feed cost creating longer down turns and larger swings in egg
prices, the industry may be entering a new ball game. This fact, along with new tools becoming available to assist in controlling egg supply, should encourage more emphasis on supply management. In this presentation we will discuss the importance of production efficiency versus supply management and describe research effort and data required to develop the new technology (Econometric Feeding and Production Control) available to help improve both. The availability of econometric feeding and production control programs along with hen reduction and molting should allow producers more control over supply management and profits. Although changing a century of feeding for maximum performance will be difficult and not without some learning pains, the potential gain in profits (literally billions of dollars) for even slight improvements in supply management is too much for industry to ignore.

Key Words: Production control, Supply management, Nutrition

M53 Production control II: The key to profits, a software demonstration. D. A. Roland*, M. M. Bryant, M. Farmer, and A. Roland, 1Auburn University, Auburn, AL, 2Ridley Inc., Mankato, MN, 3Rolland Poultry Services, LLC, Auburn, AL.

The Econometric Feeding and Production Control program has five components (feed formulation, traditional feeding program, record keeping, econometric feeding and production control) integrated into a single software program. To run the program the producer enters current feed ingredient and egg prices. All diets are then re formulated with a printout showing returns (cents per dozen) for each diet. Based on the returns shown, the producer can select the diet for optimal returns and/or performance as desired. With some egg and feed prices the produce can reduce losses by feeding less protein. This can result in automatic production control (reducing egg supply with low egg prices and increasing egg supply with high egg prices). In other instances any reduction in performance will increase losses. There are no reasons producers should not feed economically, because it optimizes returns regardless of what other producers do and at the same time it helps control egg supply. To activate the production control features of the econometric feeding and management program egg producers will have to agree to use as a group. With the econometric feeding and management software program demonstrated, producers can know the increased cost associated with production control. That knowledge, along with the fact that small reductions in egg supply could quickly take returns from red to black, should encourage greater voluntary participation in supply management.

Key Words: Production control, Supply management, Nutrition

M54 Effects of sorghum variety on growth and carcass characteristics in broiler chicks reared in West Africa. S. Issa*, J. D. Hancock1, M. R. Tuinstra1, I. Kapran2, and S. Kaka2, 1Kansas State University, Manhattan, 2National Institute for Agricultural Research, Niamey, Niger.

A total of 840 1-d-old broiler chicks (Arbor line with an average initial body weight of 31 g) was used in a 60-d experiment to determine the effects of sorghum variety on growth and carcass characteristics. There were 40 chicks per pen and seven pens/treatment with feed and water consumed on an ad-libitum basis. The control diet was corn-based with fishmeal and peanut cake used as the primary protein supplements. The diet was formulated to 1.3% Lys, 2.03% Met+Cys, 1.5% Ca, and 0.52% available P. Sorghum was used to replace the corn on a wt/wt basis so that treatments were: 1) corn (imported from Nigeria)-based control; 2) a locally adapted landrace variety of sorghum (Mota Galmi) with red seed, purple plant, and no detectable tannins. Average daily gain (ADG) and average daily feed intake (ADF) were greater (P < 0.001) for chicks fed corn vs the sorghums. However, most of this difference was caused by the low ADG and ADF for chicks fed the improved sorghum variety vs the locally adapted sorghum variety (P < 0.001). Gain to feed ratio (G:F) was not different (P > 0.28) among chicks fed the treatments. Carcass weight, carcass yield, and carcass fat were not different for corn vs the sorghums (P > 0.35) but chicks fed the locally adapted sorghum variety had greater carcass weights and yield than those fed the improved sorghum variety (P < 0.02). For the corn, locally adapted landrace sorghum, and agronomically improved sorghum, ADG was 37, 35, and 31 g/d, ADFI was 77, 72, and 65 g/d, G:F was 0.48, 0.49, and 0.48 g/g, carcass weight was 2.054, 2.061, and 2.018 g, and carcass yield was 76.0, 76.6, and 74.7%, respectively. In conclusion, the locally adapted landrace sorghum was superior in nutritional value to the agronomically improved sorghum and comparable in nutritional value to imported corn.

Key Words: Sorghum, Corn, Poultry


High cost of conventional feed ingredients is a limiting factor to the growth of the poultry industry in Nigeria. Animal nutritionists are therefore investigating into some industrial wastes that are both abundantly available and have nutritional potentials for use as alternative feed ingredients. This approach will not only reduce the cost of conventional feed ingredients but also alleviate man / animal competition for these ingredients. Spent tea leaf (STL) is one of such industrial wastes constituting disposal problems on all tea processing industries in Nigeria. This study focused on the effect of feeding treated and untreated STL in the diet of broiler chicks. Two hundred and sixty four (264) day old broiler chicks were randomly allotted to eight dietary treatments of 33 birds, replicated thrice with eleven birds each in a completely randomized design. These treatments were: C1WE (Control with enzyme); C2NE (Control with no enzyme); D3NE (Diet 3 with no enzyme); D4WE (Diet 4 with enzyme); D5NE (Diet 5 with no enzyme); D6WE (Diet 6 with enzyme); D7NE (Diet 7 with no enzyme); and D8WE (Diet 8 with enzyme). Each of these diets was fed ad-libitum to the experimental broiler chicks. The trial lasted four weeks. The parameters measured included feed intake, body weight gain, feed conversion ratio and feed cost per Kg gain. Feed intake and body weight gain were significantly (P < 0.05) higher in the birds fed the enzyme treated diets than those fed the untreated spent tea leaf. The result revealed that 5% (raw) and 10% (enzyme treated) inclusion of spent tea leaf improved the performance of the broiler chicks.

Key Words: Utilization, Spent tea leaf, Performance, Broiler chicks


Spent tea leaf (STL) is a waste of the tea processing industries in Nigeria and constitutes a serious disposal problem. Besides, the STL is being used to adulterate tea products and this act of sabotage is causing economic havoc to the tea industries in Nigeria. The use of the spent tea leaf as a feed ingredient offers a viable avenue for the utilization of the STL. This trial is designed to evaluate the STL as a feed ingredient for broiler finishers. A total of two hundred and sixteen (216) finishing broilers were randomly distributed to eight dietary treatments with 27 birds replicated thrice with nine birds each in a completely randomized design. The treatments were: C1WE (Control with enzyme); C2NE (Control with no enzyme); D3NE (Diet 3 with no enzyme); D4WE (Diet 4 with enzyme); D5NE (Diet 5 with no enzyme);
D6WE (Diet 6 with enzyme); D7NE (Diet 7 with no enzyme); and D8WE (Diet 8 with enzyme). Each of these diets was fed ad libitum to the experimental broiler finishers. The trial lasted twenty-eight days. The feed intake, weight gain, cost per gain (N/Kg) and carcass characteristics were the parameters evaluated. There were significant differences (P < 0.05) in feed intake, weight gain and carcass characteristics of broiler finishers fed the experimental diets. The result revealed that inclusion of enzyme in the spent tea leaf – based diets enhanced the performance of the finishing broilers.

Key Words: Evaluation, Spent tea leaf, Growth response, Finishing broilers

SCAD I (Avian Diseases)


The objective of the study was to determine if a Natustat starter/grower, BioMos finisher program would reduce Necrotic Enteritis and salmonella shedding. The treatments were nonmedicated, no Clostridium perfringens (CP) challenge (NM No CP), nonmedicated, CP challenge (NMCP), Natustat 2 lbs/ t (starter and grower) and BioMos 1 lb/t (finisher) CP challenge (NAT/BIO). A complete randomized block design was used with 6 replications of each treatment. Sixty male broiler chickens were placed into each pen. Prior to placement all birds were vaccinated with the coccidial vaccine, Covvac-vacc. Half of the birds from each pen were tagged and dosed with Salmonella heidelberg. On Days 20 and 21, NMCP and NAT/BIO treatment birds were dosed with CP. On Day 22, ten birds per pen were Necrotic Enteritis lesion scored. The birds fed Natustat had significantly lower NE lesion score and NE mortality compared to NMCP birds. NMCP treatment birds had significantly poorer performance on Days 22 and 42 compared to the other treatments. NAT/BIO birds’ performance, both feed conversions and weight gains, were not significantly different from the birds that were not dosed with CP (NM No CP). Salmonella drag swab samples on Day 14 showed that Salmonella was detectable in all pens, confirming the validity of the disease model. Salmonella drag swab samples on Day 42 showed significantly lower number of positive samples in the NAT/BIO compared to the NM No CP and NMCP pens. This study demonstrated the benefits of feeding Natustat in the starter and grower feeds and BioMos in the finisher feeds of broiler chickens exposed to Clostridium perfringens and Salmonella.

Key Words: Necrotic Enteritis, Bio-Mos, Natustat, Salmonella, Coccidia


Salmonella continues to cause significant cases of foodborne illnesses in the United States. With poultry recognized as an important vehicle in past outbreaks, pressure has been placed on the poultry industry to reduce poultry and egg contamination with Salmonella. To be able to effectively reduce or eliminate Salmonella from poultry operations will require identifying its source(s), and while serotyping has been helpful, it has not been sufficient in identifying Salmonella to strain level. Pulsed-field gel electrophoresis (PFGE) has been a useful tool in typing most S. enterica serovars. However, S. Enteritidis (SE) is refractory to typing by PFGE, due to its clonal nature. We have been able identify genetic differences in SE isolates using random polymorphic DNA amplification (RAPD) PCR. While we were able to discern some differences in SE isolates by RAPD, no single typing, PCR primer was sufficient to type SE by this method. However, when we collate the different RAPD DNA patterns for each typing primer into a single phylogenetic tree, we could identify sufficient genetic differences to discriminate SE isolates. From our analyses, we were able to identify geographic differences in the distribution of SE types, as well as discern source(s) of SE within a poultry integrator. This molecular approach to typing SE will prove a powerful epidemiological tool in determining the source of SE in poultry and layer operations.

Key Words: Salmonella, SE, Typing, PCR, Epidemiology


Salmonella enterica serovar typhimurium continues to be one of the most frequently isolated strains in human salmonellosis worldwide, and is commonly found in the intestine of broilers. The use of Probiotics for reducing intestinal Salmonella colonization has been recommended. Probiotics are live microbial feed supplements that beneficially affect the host animal by improving its intestinal microbial balance by competitively excluding pathogens. Protexin® is a commercially available probiotic designed for use in chickens. An experiment was conducted to evaluate the efficacy of Protexin® in reducing cecal Salmonella Typhimurium (ST) colonization in broiler chicks. Day-old ST-free chicks (126) were obtained from a commercial hatchery and randomly allocated to 3 treatments; treatment 1 (control, CN) consisted of chicks not challenged with ST; treatment 2 (CST) consisted of chicks that were challenged with ST; and treatment 3 (CPST) consisted of chicks given Protexin® (1.2 x 10^9 / bird from 1 to 7 days of age, and 3.0 x 10^7 / bird from 8 to 14 days of age) and challenged with ST. On day 3 of experiment, chicks in CST and CPST were orally gavaged 1 mL of nalidixic acid-resistant ST inoculum containing 10^9 CFU/mL. Throughout experiment (day 1 to 14), chicks in all treatments were fed an unmedicated corn-soybean meal diet. On days 7 and 14, growth performance of chicks (weight gain, feed intake, and feed conversion (FC)) was evaluated and the ceca of chicks were also cultured to enumerate ST levels. Results showed no significant difference (P > 0.05) in growth performance of chicks in all treatments. Microbiological enumeration of ST showed that chicks in the CN treatment remained ST-free throughout this study. Also, ST levels were similar for chicks in both CST and CPST treatments on days 7 and 14. Although ST level in the CPST treatment was numerically reduced from 4.0 log CFU on day 7 to 3.66 log CFU on day 14, the effectiveness of Protexin® in reducing intestinal ST levels in broiler chicks was not significantly apparent.

Key Words: Protexin®, Salmonella, Broiler chicks

M60 Effect of Pectin-Protexin® symbiotic therapy on the concentration of Salmonella typhimurium in the cecum of broiler chicks. Y. O. Fasina*, J. W. J. Bowers, and S. R. Mckee, Auburn University, Auburn, AL.

Synbiotic therapy comprising of a probiotic and a prebiotic has been proposed for use to reduce intestinal Salmonella colonization in poultry. Probiotics are live microbial feed supplements that competitively exclude pathogenic bacteria from the intestine. Prebiotics are non-digestible but fermentable polysaccharides that function as substrates to promote the growth of specific probiotic bacteria. Protexin® is a commercially available probiotic designed for use in chickens, while pectins are soluble indigestible polysaccharides that are fermented by intestinal microflora. It was hypothesized that sugar beet pectin would serve as prebiotic for the beneficial bacteria in Protexin® and subsequently reduce cecal Salmonella levels in chicks. An experiment was conducted to determine the effect of pectin-Protexin® symbiotic therapy on cecal concentration of Salmonella Typhimurium (ST) in broiler chicks. Day-old ST-free chicks (320) were obtained from a commercial hatchery and randomly allocated to 4 treatments; treatment 1 (control, CN) consisted of chicks not challenged with ST; treatment 2 (CST) consisted of chicks that were challenged with ST; treatment 3 (CPST) consisted of chicks given Protexin® (0.15g/kg feed) and challenged with ST; and treatment 4 (CPSTE) consisted of chicks given Protexin® (0.15g/kg feed) and sugar beet pectin (5g/kg feed) and then challenged with ST. All chicks were fed unmedicated corn-soybean meal diet. On day 4 of experiment, chicks in CST, CPST and CPSTE were orally gavaged 1 mL of nalidixic acid-resistant Salmonella Typhimurium (ST) inoculum containing 10^9 CFU/mL. Throughout experiment (day 1 to 14), chicks in all treatments were fed an unmedicated corn-soybean meal diet. On days 7 and 14, growth performance of chicks (weight gain, feed intake, and feed conversion (FC)) was evaluated and the ceca of chicks were also cultured to enumerate ST levels. Results showed no significant difference (P > 0.05) in growth performance of chicks in all treatments. Microbiological enumeration of ST showed that chicks in the CN treatment remained ST-free throughout this study. Also, ST levels were similar for chicks in both CST and CPST treatments on days 7 and 14. Although ST level in the CPST treatment was numerically reduced from 4.0 log CFU on day 7 to 3.66 log CFU on day 14, the effectiveness of Protexin® in reducing intestinal ST levels in broiler chicks was not significantly apparent.

Key Words: Protexin®, Salmonella, Broiler chicks

The objective of the study was to determine if a Natustat starter/grower, BioMos finisher program would reduce Necrotic Enteritis and salmonella shedding. The treatments were nonmedicated, no Clostridium perfringens (CP) challenge (NM No CP), nonmedicated, CP challenge (NMCP), Natustat 2 lbs/1 (starter and grower) and BioMos 1 lb/v (finisher) CP challenge (NAT/BIO). A complete randomized block design was used with 6 replications of each treatment. Sixty male broiler chickens were placed into each pen. Prior to placement all birds were vaccinated with the coccidial vaccine, CocciVac-C. Half of the birds from each pen were tagged and dosed with Salmonella heidelberg. On Days 20 and 21, NMCP and NAT/BIO treatment birds were dosed with CP. On Day 22, ten birds per pen were Necrotic Enteritis lesion scored. The birds fed Natustat had significantly lower NE lesion score and NE mortality compared to NMCP birds. NMCP treatment birds had significantly poorer performance on Days 22 and 42 compared to the other treatments. NAT/BIO birds’ performance, both feed conversions and weight gains, were not significantly different from the birds that were not dosed with CP (NM No CP). Salmonella drag swab samples on Day 14 showed that Salmonella was detectable in all pens, confirming the validity of the disease model. Salmonella drag swab samples on Day 42 showed significantly lower number of positive samples in the NAT/BIO compared to the NM No CP and NMCP pens. This study demonstrated the benefits of feeding Natustat in the starter and grower feeds and BioMos in the finisher feeds of broiler chickens exposed to Clostridium perfringens and Salmonella.

Key Words: Necrotic Enteritis, Bio-Mos, Natustat, Salmonella, Coccidia


Salmonella continues to cause significant cases of foodborne illnesses in the United States. With poultry recognized as an important vehicle in past outbreaks, pressure has been placed on the poultry industry to reduce poultry and egg contamination with Salmonella. To be able to effectively reduce or eliminate Salmonella from poultry operations will require identifying its source(s), and while serotyping has been helpful, it has not been sufficient in identifying Salmonella to strain level. Pulsed-field gel electrophoresis (PFGE) has been a useful tool in typing most S. enterica serovars. However, S. Enteritidis (SE) is refractory to typing by PFGE, due to its clonal nature. We have been able to identify genetic differences in SE isolates using random polymorphic DNA amplification (RAPD) PCR. While we were able to discern some differences in SE isolates by RAPD, no single typing, PCR primer was sufficient to type SE by this method. However, when we collate the different RAPD DNA patterns for each typing primer into a single phylogenetic tree, we could identify sufficient genetic differences to discriminate SE isolates. From our analyses, we were able to identify geographic differences in the distribution of SE types, as well as discern source(s) of SE within a poultry integrator. This molecular approach to typing SE will prove a powerful epidemiological tool in determining the source of SE in poultry and layer operations.

Key Words: Salmonella, SE, Typing, PCR, Epidemiology


Salmonella enterica serovar typhimurium continues to be one of the most frequently isolated strains in human salmonellosis worldwide, and is commonly found in the intestine of broilers. The use of Probiotics for reducing intestinal Salmonella colonization has been recommended. Probiotics are live microbial feed supplements that beneficially affect the host animal by improving its intestinal microbial balance by competitively excluding pathogens. Proxinet® is a commercially available probiotic designed for use in chickens. An experiment was conducted to evaluate the efficacy of Proxinet® in reducing cecal Salmonella Typhimurium (ST) colonization in broiler chicks. Day-old ST-free chicks (126) were obtained from a commercial hatchery and randomly allocated to 3 treatments; treatment 1 (control, CN) consisted of chicks not challenged with ST; treatment 2 (CST) consisted of chicks that were challenged with ST; and treatment 3 (CPST) consisted of chicks given Proxinet® (1.2 x 10^4 / bird from 1 to 7 days of age, and 3.0 x 10^2 / bird from 8 to 14 days of age) and challenged with ST. On day 3 of experiment, chicks in CST and CPST were orally gavaged 1 mL of nalidixic acid-resistant ST inoculum containing 10^6 CFU/mL. Throughout experiment (day 1 to 14), chicks in all treatments were fed an unmedicated corn-soybean meal diet. On days 7 and 14, growth performance of chicks (weight gain, feed intake, and feed conversion (FC)) was evaluated and the ceca of chicks were cultured to enumerate ST levels. Results showed no significant difference (P > 0.05) in growth performance of chicks in all treatments. Microbiological enumeration of ST showed that chicks in the CN treatment remained ST-free throughout this study. Also, ST levels were similar for chicks in both CST and CPST treatments on days 7 and 14. Although ST level in the CPST treatment was numerically reduced from 4.0 log CFU on day 7 to 3.66 log CFU on day 14, the effectiveness of Proxinet® in reducing intestinal ST levels in broiler chicks was not significantly apparent.

Key Words: Proxinet®, Salmonella, Broiler chicks

M60 Effect of Pectin-Proxinet® synbiotic therapy on the concentration of Salmonella typhimurium in the ceca of broiler chicks. Y. O. Fasina*, J. W. J. Bowers, and S. R. Mckee, Auburn University, Auburn, AL.

Synbiotic therapy comprising of a probiotic and a prebiotic has been proposed for use to reduce intestinal Salmonella colonization in poultry. Prebiotics are live microbial feed supplements that competitively exclude pathogenic bacteria from the intestine. Prebiotics are non-digestible but fermentable polysaccharides that function as substrates to promote the growth of specific probiotics. Proxinet® is a commercially available probiotic designed for use in chickens, while pectins are soluble indigestible polysaccharides that are fermented by intestinal microflora. It was hypothesized that sugar beet pectin would serve as prebiotic for the beneficial bacteria in Proxinet® and subsequently reduce cecal Salmonella levels in chicks. An experiment was conducted to determine the effect of pectin-Proxinet® synbiotic therapy on cecal concentration of Salmonella Typhimurium (ST) in broiler chicks. Day-old ST-free chicks (320) were obtained from a commercial hatchery and randomly allocated to 4 treatments; treatment 1 (control, CN) consisted of chicks not challenged with ST; treatment 2 (CST) consisted of chicks that were challenged with ST; treatment 3 (CPST) consisted of chicks given Proxinet® in feed (0.15g / kg feed) and challenged with ST; and treatment 4 (CPST3E) consisted of chicks given Proxinet® (0.15g / kg feed) and sugar beet pectin (5g / kg feed) in feed, and then challenged with ST. All chicks were fed unmedicated corn-soybean meal diet. On day 4 of experiment, chicks in CST, CPST and CPST3E were orally gavaged 1 mL of nalidixic acid-resistant...
ST inoculum containing 10^6 CFU/mL, and the ceca of chicks were cultured on days 3 and 10 post-challenge (PC) to enumerate ST levels. Chicks in the CN remained ST-free throughout experiment. At both 3 and 10 days PC, there were no differences (P > 0.05) in cecal ST concentration of chicks in CST, CPST and CPSTE. The combination of pectin-Protexin® used in this study did not have any beneficial effect on cecal ST levels.

**Key Words:** Symbiotic, Pectin, Protexin®, Salmonella, Broiler chicks


Probiotics (direct fed microbials, DFM) have been used extensively in agriculture to enhance animal performance, however; their mechanism of action is still unclear. Previous studies in our laboratory have investigated the effect DFM has on poultry physiology. This study examined the effects of DFM on energy metabolism and immune response in chickens. Day-old male broilers (n=216) were divided into two diet groups. One group (Con) was fed a control starter diet (CSD). The second (DFM) was fed a CSD plus Primalac® (0.3% w/w). Within each diet treatment birds were divided into two subgroups which were either vaccinated (+) with sheep red blood cells (SRBCs) or mock vaccinated (-) with phosphate buffered saline (PBS) at d7, d14 and d21. Feed consumption, tissues and peripheral blood leukocytes (PBL) O2 consumption, and PBL and macrophage ATP concentration were assayed to monitor energy metabolism. DFM- birds had the highest feed efficiency (1.33 g feed/g gain); however, the feed efficiency of DFM+ was the least (1.41 g feed/g gain). Interestingly, the ATP content of PBL and macrophages isolated from DFM- birds were significantly decreased (P<0.01) as compared with Con- and DFM+. Additionally, the O2 consumed by PBL, thymus and spleen from DFM- birds were lower than other groups. In spite of the reduced energy utilization by non-challenged DFM birds, the Ab response to SRBCs was similar between the two diet groups. These data suggest DFM supplementation decreased basal energy consumption by immune cells. Further investigations are needed to better understanding the mechanism(s) by which DFM alter immune energy consumption.

**Key Words:** Direct fed microbial, Immunity, ATP, Energy metabolism, Antibody

**M62 Femoral head epiphysiolysis in broiler chickens.** V. Durairaj*1,2, N. C. Rath1, K. S. Rasaputra1,2, L. Kannan1, C. C. Coon1, W. E. Huff2, G. R. Huff2, and F. D. Clark1, 1University of Arkansas, Fayetteville, 2Agricultural Research Service/USDA, Fayetteville, AR.

Femoral head necrosis (FHN) and ‘epiphysiolysis’ are femoral growth plate-disarticulation disorders that cause lameness in broiler chickens. These conditions can lead to bacterial infections and/or ostecymatitis. The etiologies of these poultry leg problems are unknown. Based on the results of a comparative study of serum chemistry which showed elevated cholesterol, triglycerides, and low density lipoproteins (LDL) levels in birds with femoral head lesions, we hypothesized that epiphysiolysis may be associated with problems of fat metabolism. Thus, we fed groups of 30 chickens isonitrogenous diets containing 4- (control), 6- and 8% chicken fat from day 1 through 37 to find whether high fat diets would increase the incidences of femoral head disarticulation. There was no significant incidence of femoral head disarticulation or any changes in the growth parameters in chickens fed with 6 and 8% fats diets. However, when such control fed birds were administered prednisolone (~2mg/kg) by subcutaneous injections on two alternate days during the last week of the experiment, they showed a significant increase in the incidence of femoral head disarticulation. These chickens also had statistically significant increase in the levels of serum cholesterol, triglycerides, and LDL. However, the birds treated similarly with cholesterol showed neither femoral head disarticulation nor any change in the serum fat metabolite concentrations. These results suggest that femoral head disarticulation disorders may be associated with stress physiology.

**Key Words:** Femoral head necrosis, Epiphysiolysis, Fat, Serum chemistry, Chicken

**M63 Efficacy of a live E. coli vaccine given at day-of-age, with or without previous administration of antibiotics.** K. C. Cookson* and K. S. Macklin1, 2Fort Dodge Animal Health, Overland Park, KS, 3Auburn University, Auburn, AL.

Poulvac® E. coli is a modified live vaccine that is applied by coarse spray. In vitro assays have already established that Poulvac® E. coli is sensitive to both gentamicin (GM) and Naxcel® (Nax). Because day-of-age spray is an effective way to deliver respiratory vaccines and most broiler chicks receive an injection of GM or Nax in the hatchery, our objective was to measure any effect this common practice might have on the (in vivo) efficacy of Poulvac® E. coli. **Study Design:** 216 SPF leghorns were wing-banded and divided into 6 treatments (36 per). Groups 1 and 2 received a half dose of GM or Nax in ovo, while groups 3 and 4 received a half dose, respectively, subcutaneously (subQ). Groups 1-5 were also sprayed at hatch with a full dose of Poulvac® E. coli, then 2 birds from each group (10 per cage) were placed into batteries 1 and 2. Group 6 birds remained unvaccinated and were placed into cages in a third battery. At 42 days of age all birds were challenged intratracheally (IT) with 1.18x10^10 pathogenic O78 E. coli. **Results:** Statistical analysis (see Table) indicates that all vaccine treatments had significant reductions in the incidence and severity of airsacculitis-by far the most common lesion. In addition, there was no difference in E. coli protection between vaccine groups, regardless of prior antibiotic prophylaxis. **Discussion:** The efficacy of Poulvac® E. coli given at day-of-age by coarse spray was not compromised by prior gentamicin or Naxcel® injection, either in ovo or subQ. This suggests that the levels of these antibiotics were not sufficient to interfere with the interaction between this vaccine and the day-of-age chick's immune system.

<table>
<thead>
<tr>
<th>Group</th>
<th>Antibiotic treatment</th>
<th>Spray Vaccine treatment</th>
<th>Airsac Mean lesion score</th>
<th>Airsac Lesion1 scores &gt;1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>in ovo gentamicin</td>
<td>Poulvac® E. coli</td>
<td>1.77b</td>
<td>69%b</td>
</tr>
<tr>
<td>2</td>
<td>in ovo Naxcel®</td>
<td>Poulvac® E. coli</td>
<td>1.86b</td>
<td>67%b</td>
</tr>
<tr>
<td>3</td>
<td>subQ gentamicin</td>
<td>Poulvac® E. coli</td>
<td>1.71b</td>
<td>62%b</td>
</tr>
<tr>
<td>4</td>
<td>subQ Naxcel®</td>
<td>Poulvac® E. coli</td>
<td>1.59b</td>
<td>59%b</td>
</tr>
<tr>
<td>5</td>
<td>None</td>
<td>Poulvac® E. coli</td>
<td>1.56b</td>
<td>58%b</td>
</tr>
<tr>
<td>6</td>
<td>None</td>
<td>Poulvac® E. coli</td>
<td>2.46a</td>
<td>92%a</td>
</tr>
</tbody>
</table>

**Groups having a different letter are significantly different (P<0.01 or P<0.052).**

**M64 Development of a multilocus sequence typing scheme to examine clonal relationships among avian isolates of Clostridium septicum.** A. P. Neumann* and T. G. Rehberger, Agtech Products, Inc, Waukesha, WI.

Clostridium septicum is a spore-forming anaerobe capable of causing histotoxic infections in animals. Examples in poultry production include avian malignant edema and gangrenous dermatitis. Birds experiencing C. septicum infection exhibit signs of severe toxemia characterized by depression, inappetence and ataxia. The clinical course of infection is brief, beginning in a seemingly spontaneous manner. Most often birds are found dead before any prior symptoms are observed. The result of infection is extensive myonecrosis with massive fluid accumulation in the subcutaneous tissues. Although C. septicum is not believed to be a member of the normal intestinal microbiota it has been cultured from the feces of healthy animals. It is also notable that, unlike most gangrenous infections caused by Clostridium perfringens, disease involving C. septicum often occurs with no visible disruption in the epithelium. This suggests that the intestine provides the main portal of entry to the body for the organism. In order to gain a better understanding of the diversity and population structure of avian isolates of C. septicum, eight housekeeping genes were partially sequenced and compared for this study. A diverse collection of 108 field isolates plus the C. septicum type strain ATCC 12464 were examined. The loci included for analysis were gyrA, groEL, dnaK, recA, tsp, gmk, dkl, and glpK. Most of these genes were chosen because of their inclusion in similar studies performed on isolates of C. perfringens and C. difficile. Less genetic diversity within these loci was observed than...
has been reported for other clostridia of clinical importance. Two major clonal lineages were identified from the analysis. One of these lineages was endemic to the East Coast and Southern United States. Interestingly, the C. septicum type strain was very closely related to the majority of avian isolates examined. To our knowledge this work provides the first description of the population structure of this poorly understood but significant pathogen.

**Key Words:** Clostridium septicum, Gangrenous dermatitis, Malignant edema, MLST

### Nutrition III

**M65** Observations on changes in nutrient concentration of broiler feed as affected by pellet quality. J. Wills* and Z. Aslam, *Grand Mills for Flour & Feed Co, Abu Dhabi, Abu Dhabi, UAE.*

It is well known that the feeding of pelleted feed improves broiler performance but scant data has shown the differences in the nutrient levels due to the per cent pellets and fines in the feeder pan. Two commercial broiler farms were selected to determine the per cent pellets and fines at the feed hopper, the fourth feeder pan from the feed hopper, mid point feeder pan and fourth feeder pan from the control feeder pan from the feed line next to the input auger from the bulk feed bin from 10 broiler houses on each farm. The criteria for pellets was all feed that was retained on a US # 6 sieve (3.360 mm), crumbs was all the feed retained on a US # 6 sieve (0.841 mm where as fines were all feed that passed thru a US # 20 sieve (0.841 mm). All of the feed was removed from each selected feeder pan then the feeder pans were refreshed with fresh feed by running the feeder line. All feed was then removed from each of the pans to determine the per cent pellets, crumbs, and fines. Per cent crude protein, calcium and phosphorus were determined on the pellets, crumbs, and fines fractions.

The average per cent pellets for the three locations in the feed line was 56.0 percent with the per cent fines averaging 12.3 percent for Farm 1 where as the average per cent pellets was 91.6 and per cent fines was 2.6 per cent for Farm 2. The per cent pellets in the fourth feeder pan from the feed hopper was significantly higher for both farms compared to the per cent pellets in the fourth feeder pan from the control feeder pan. Per cent crude protein was significantly higher in the pellets, 19 and 22 per cent from either farm compared to the per cent protein in the fines, 15 and 20 per cent for Farm 1 and Farm 2, respectively. Per cent calcium was significantly higher, 1.26 and 1.37 per cent in the fines fraction for Farm 1 and Farm 2, respectively. This data points out the differences in nutrient density in the three feed fractions of the broiler feed fed as affected by the feed form texture.

**Key Words:** Pellets, Crumbles, Fines, Broiler, Feed

**M66** The effects of sunflower and enzyme on performance of broiler chickens. A. Sheikhlar*, University Putra Malaysia, Malaysia.

Seven hundred twenty strain run day-old broilers were randomly allocated to 4 treatments, each of which had 9 pens of 20 chicks. This study was conducted to investigate the effects of an enzyme on growth performance and litter quality parameters. Four iso-caloric and iso-nitrogenous diets were fed ad libitum from day 1 to 56. The soybean meal in starter, grower and finisher diets were replaced with 15, 15, and 5% sunflower meal, respectively. Experimental groups from day 1 to 56. The soybean meal in starter, grower and finisher diets were replaced with 15, 15, and 5% sunflower meal, respectively. Experimental groups from day 1 to 56.

The enzyme inclusion lowered moisture content of litter, this effect was statistically significant (P<0.05). Enzyme inclusion in soy based diets statistically improved BW, BWG and FCR (P<0.05) and reduced litter pH. Despite the improvement in litter moisture, there was no statistically significant effect of dietary enzyme inclusion on litter moisture at the end of the experiment (P>0.05).

**Key Words:** Broiler, Sunflower, Enzyme, Soy-bean diet, Litter


An experiment was conducted to examine the effect of selenium (Se) supplementation of broiler breeder hens on the Se status of their progeny. Breeder hens and roosters were fed a low-Se semi-purified basal diet alone or with 0.3 ppm supplemental Se provided by sodium selenite or Se yeast (Sel-Plex®, Alltech Inc., Nicholasville, KY). Egg Se concentration was significantly higher for the Se yeast treatment than for the selenite treatment (0.25 vs. 0.19 ppm). Egg Se levels for these treatments were significantly higher than that for the basal treatment (0.04 ppm). Sixteen replicate groups of five straight-run chicks produced from each of the breeder treatment groups were housed in cages and fed a low-Se corn-soybean meal diet for 21 days. Samples of blood and liver, pooled from two or three birds from each of four pens per breeder treatment, were collected during the trial for Se analysis. On Day 1, plasma Se for the basal treatment (0.02 ppm) was significantly lower (P < 0.05) than the value for both Se-supplemented treatments (0.10 ppm). At Day 13, whole blood Se in chicks from both Se-supplemented treatments was similar (~0.05 ppm) and significantly higher than that for the basal treatment (0.04 ppm). The Se level in liver sampled on Day 1 was significantly higher for chicks from hens supplemented with Se yeast (0.52 ppm, fresh basis) compared with those from the selenite-supplemented hens (0.33 ppm). Liver Se in chicks from the basal treatment was only 0.12 ppm. By Day 22, liver Se levels in chicks from both Se-supplemented groups decreased to ~0.10 ppm but were still higher than that for the basal treatment (0.08 ppm). The results show that the Se status of progeny chicks is improved at hatching by supplementing breeder hens with Se yeast (vs. selenite). However, the benefit is not long lasting when chicks are fed a low Se diet.

**Key Words:** Selenium yeast, Selenite, Liver, Breeder diet, Chicken

**M68** Effect of choline and folacin on performance and egg phospholipid composition in laying hens. P. Krishnan* and S.E. Scheideler, University of Nebraska, Lincoln.

Choline is an essential nutrient for all animals and a required dietary supplement for poultry. The study was designed to determine the effect of added choline and folacin on egg production, egg quality parameters and the phospholipid composition of egg yolk in laying hens. A corn-soy based diet was formulated with three levels of supplemental choline (0, 500 and 1000 ppm) and three levels of supplemental folacin (0, 2 and 4 ppm) in a 3 x 3 factorial arrangement. The nine experimental treatments were arranged in a randomized complete block design with four replicate cages and four birds per cage for a total of thirty six cages. Folacin at 2 ppm increased egg production significantly (P<0.05) at all levels of choline inclusion. Egg wt was significantly (P<0.05) higher at highest level of choline and lowest level of folacin supplementation. There were significant choline by folacin interaction effects (P<0.05) on feed intake, albumen wt, yolk wt and haugh unit. At lower levels of choline supplementation (0 and 500) 4 ppm folacin inclusion increased feed intake, egg albumen and haugh unit while at the highest level of choline inclusion (1000 ppm) high folacin (2 and 4 ppm)
has been reported for other clostridia of clinical importance. Two major clonal lineages were identified from the analysis. One of these lineages was endemic to the East Coast and Southern United States. Interestingly, the C. septicum type strain was very closely related to the majority of avian isolates examined. To our knowledge this work provides the first description of the population structure of this poorly understood but significant pathogen.

**Key Words:** Clostridium septicum, Gangrenous dermatitis, Malignant edema, MLST

### Nutrition III

**M65 Observations on changes in nutrient concentration of broiler feed as affected by pellet quality.** J. Wills* and Z. Aslam, Grand Mills for Flour & Feed Co, Abu Dhabi, Abu Dhabi, UAE.

It is well known that the feeding of pelleted feed improves broiler performance but scant data has shown the differences in the nutrient levels due to the per cent pellets and fines in the feeder pan. Two commercial broiler farms were selected to determine the per cent pellets and fines at the feed hopper, the fourth feeder pan from the feed hopper, mid point feeder pan and fourth feeder pan from the control feeder pan from the feed line next to the input auger from the bulk feed bin from 10 broiler houses on each farm. The criteria for pellets was all feed that was retained on a US # 6 sieve (3.360 mm), crumbs was all the feed retained on a US # 6 sieve (0.841 mm where as fines were all feed that passed thru a US # 20 sieve (0.841mm). All of the feed was removed from each selected feeder pan then the feed pans were recharged with fresh feed by running the feeder line. All feed was then removed from each of the pans to determine the per cent pellets, crumbs, and fines. Per cent crude protein, calcium and phosphorus were determined on the pellets, crumbs, and fines fractions.

The average per cent pellets for the three locations in the feed line was 56.0 percent with the per cent fines averaging 12.3 percent for Farm 1 where as the average per cent pellets was 91.6 and per cent fines was 2.6 per cent for Farm 2. The per cent pellets in the fourth feeder pan from the feed hopper was significantly higher for both farms compared to the per cent pellets in the fourth feeder pan from the control feeder pan. Per cent crude protein was significantly higher in the pellets, 19 and 22 per cent from either farm compared to the per cent protein in the fines, 15 and 20 per cent for Farm 1 and Farm 2, respectively. Per cent calcium was significantly higher, 1.26 and 1.37 per cent in the fines fraction for Farm 1 and Farm 2, respectively. This data points out the differences in nutrient density in the three feed fractions of the broiler feed fed as affected by the feed form texture.

**Key Words:** Pellets, Crumbles, Fines, Broiler, Feed

**M66 The effects of sunflower and enzyme on performance of broiler chickens.** A. Sheikhlar*, University Putra Malaysia, Malaysia.

Seven hundred twenty strain run day-old broilers were randomly allocated to 4 treatments, each of which had 9 pens of 20 chicks. This study was conducted to investigate the effects of an enzyme on growth performance and litter quality parameters. Four iso-caloric and iso-nitrogenous diets were fed ad libitum from day 1 to 56. The soybean meal in starter, grower and finisher diets, were replaced with 15, 15, and 5% sunflower meal, respectively. Experimental groups from day 1 to 56. The soybean meal in starter, grower and finisher diets, were replaced with 15, 15, and 5% sunflower meal, respectively. Experimental groups were: 1- corn-soy, 2- diet 1 plus enzyme, 3- corn-soy-sunflower meal without enzyme, and 4- corn-soy-sunflower meal with enzyme. Randomly selected birds from each dietary treatment were slaughtered and dissected for poultry. The study was designed to determine the effect of added choline and folacin on egg production, egg quality parameters and the phospholipid composition of egg yolk in laying hens. A corn-soy based diet was formulated with three levels of supplemental choline (0, 500 and 1000 ppm) and three levels of supplemental folacin (0, 2 and 4 ppm) in a 3 x 3 factorial arrangement. The nine experimental treatments were arranged in a randomized complete block design with four replicate cages and four birds per cage for a total of thirty six cages. Folacin at 2 ppm increased egg production significantly at all levels of choline inclusion. Egg wt was significantly lower at highest level of choline and lowest level of folacin supplementation. There were significant choline by folacin interaction effects at the highest level of folacin inclusion (1000 ppm) on feed intake, albumen wt, yolk wt and haugh unit. At lower levels of choline supplementation (0 and 500) 4 ppm folacin inclusion increased feed intake, egg albumen and haugh unit while at the highest level of choline inclusion (1000 ppm) high folacin (2 and 4 ppm)
decreased feed intake, egg albumen and haugh unit. Specific gravity did not show any significant difference at any levels of choline and folacin. Phosphatidylcholine and phosphatidylethanolamine concentration was higher at the highest level of choline inclusion and at the highest and lowest level of folacin supplementation respectively. No significant (P>0.05) treatment by time interaction effects were observed for any of the parameters. Results indicated that folacin had a positive effect on egg production with decreased egg weight; choline at lower level increased egg weight.

Key Words: Choline, Folacin, Phospholipids

M69 Statistical meta-analysis of data from four European Union efficacy studies conducted with and without dietary Bacillus subtilis C-3102 spores (CALSPOREIN®) for broiler chickens in litter pens. M. I. Gracia1, P. Medel1, S. Fuji2, T. Marubashi2, M. Kato2, and D. M. Hooge*3, 1Ishmade Agropecuraria, S.L., Madrid, Spain, 2Calpis Co. Ltd, Tokyo, Japan, 3Hooge Consulting Service, Inc., Eagle Mountain, UT.

Four 42-d broiler pen trials were conducted with dietary Bacillus subtilis C-3102 spores (Bs C-3102; CALSPORIN®; 1 x 10^6 cfu/g feed) or without the direct-fed microbial (nCON) at contract research facilities in Belgium (INVE-CLO, Dendermonde), Scotland (Roslin Nutrition, Midlothian), Denmark (Danish Research Centre, Foulum), and Spain (IRTA, Reus). The feeding trials began in September 2003 (mash), October 2003 (pelleted), January 2004 (pelleted), and June 2004 (pelleted), respectively. Results were used for approval by the European Commission (Official J. of the E.U., L 271/19, 30.9.2006). Broiler strains were Ross 308 (13 pens 36M and 12 pens 36F/trt), Ross 308 (16 pens 40M and 16 pens 40F/trt), Ross 308 (24 pens of 12M=12F/trt), and Cobb 500 (14 pens of 50M and 14 pens of 50F/trt), respectively. Litter was once used (80% chopped wheat straw and 20% peat) + new in a 50:50 blend, once used wood shavings + top dressing, fresh wood shavings, and once used wood shavings + top dressing in the respective trials. There were no coccidiosis vaccinations. Dietary cocciidistats were diclazuril (1-10d) and monensin (11-35d), none, none, and none, respectively. Diets were primarily based on wheat-corn, wheat, wheat-barley-corn, and wheat, respectively. Across 4 trials, 42-d BW averaged <0.001). The average daily gain per bird was 77.0 g/d for nCON vs 79.9 g/d for Bs C-3102 treatment (+63.6g or +2.68%; P<0.001). The FCR was 1.82 for nCON vs 1.77 for Bs C-3102 treatment (+0.05 or +2.68%; P=0.007). Mortality was 3.61% for nCON vs 3.43% for Bs C-3102 treatment (+0.18% actual; P=0.999).

Dietary Bs C-3102 spores at 1 x 10^6 cfu/g feed were effective in improving 42-d broiler chicken BW and FCR performance based on results of a meta-analysis of 4 E.U. controlled pen trials.

Key Words: Bacillus subtilis C-3102, Broiler chicken, Calsporin, Direct-fed microbial, Meta-analysis

M70 Efficacy of a DFM (Bacillus licheniformis DSM5749) controlling necrotic enteritis caused by Clostridium perfringens in broiler chickens. I. Knap1, B. T. Land1, A. Knareborg, and G. Mathis2, 1Chr. Hansen A/S, Hoersholm, Denmark, 2Southern Poultry Research, Athens, GA.

Purpose of study: Evaluate if a DFM (B. licheniformis) could prevent necrotic enteritis in a C. perfringens challenge study. Trial design: A Clostridia perfringens challenge cage study was carried out at Southern Poultry Research, Inc. in the study was 6 treatment T1 positive control (non infected), T2 negative control (no medicated), T3 B. licheniformis 8 X 105 CFU/G feed, T4 B. licheniformis 8 X 106 CFU/G feed, T5 B. licheniformis 8 X 107 CFU/G feed, T6 Virgaminycin 1.5g/t. An unmedicated commercial chicken starter feed commonly used in the United States was used. Feed and water were available ad libitum throughout the trial. Eight male birds (Cobb X Cobb) per cage, 6 cages per block, 8 blocks. On day 14, all birds were orally inoculated with a coccidial inoculum containing 5,000 oocysts of E. maxima per bird. Starting on day 19, all birds, except T1, were given a broth culture of C. perfringens 108 cfu/ml. The birds were administered the fresh broth culture once daily for 2 days on day 19 and day 20. On day 22, three birds from each cage were selected, sacrificed, weighed, and examined for the degree of presence of Necrotic Enteritis lesions. The scoring was based on a 0 to 3 score, with 0 being normal and 3 being the most severe. All birds were weighed by cage on day 0, 14, 22, and 28. Feed was weighed in on day 0 and remaining feed was weighed on day 14, 22 and 28. The trial was terminated on day 28. Means for cage weight gain, feed consumption, feed conversion, lesion scores, and mortality were calculated. Results: All treatment was significant different form the negative control (T2) regards lesion score, mortality, weight gain and FCR. There was no significant difference between the B. licheniformis treatments and the Virgaminycin treatment with regards to mortality and lesion score. Conclusion: B. licheniformis used as DFM could prevent necrotic enteritis in broiler chicken.

Key Words: DFM, B. licheniformis, Necrotic enteritis, Chickens, C. perfringes


Purpose of study: To investigate changes in the dominant bacterial communities following introduction of Gallipro a commercial DFM in the feed for broiler chickens and hereby elucidate whether a growth enhancing effect of feeding Gallipro is mediated through its effect on the intestinal microbiota. Trial Design: A total of 3000 day-old male chickens (Ross 308) were housed in 12 pens (250 animals per pen. 2 experimental diets were made, one control standard basal diet (corn, soy based) and the basal diet supplemented with Gallipro (500g/t feed) corresponding to 8 x 105 CFU/g feed (6 replicate units). Feed conversion and growth rate were calculated on a pen basis. At the end of the production period, three birds/pen were randomly selected and killed by cervical dislocation. Immediately after killing, the small intestine was collected and stored at -20°C until DGGE analyses. Nucleic acids extraction from ileal content and subsequent PCR-DGGE analyses using universal primers were performed. The bacterial origin of DNA fragments present in the majority of profiles from birds fed Gallipro and absent in control birds were excised and identified by sequencing. Results: Final body weight was significantly improved by 2% (P<0.05) using Gallipro. FCR was numerically improved by Gallipro.

The ileal bacterial community profiles were very consistent within the chickens of the control group showing a uniform and simple microbial composition. In contrast, Gallipro clearly increased the microbial diversity. DNA fragments from the Gallipro treatment were identified by DNA sequencing as Lactobacillus salivarius, and Lactobacillus paracasei, and the last fragment as member of the genus Streptococcus. Conclusion: Feeding chicken supplementation with Gallipro enhanced chick performance as well as enriched the birds with a more diverse and complex bacterial composition in the gut, which expectedly provides a more robust microbiota less susceptible towards diseases and infections.

Key Words: Gallipro®, DGGE, Ileal flora, DFM

M72 Growth response, haematology and serum biochemistry of broiler chicken fed variously treated cocoa bean testa based – diets. M. D. Olumide1, A. A. Hamzat2, O. O. Uwagboe2, and A. O. Akinsoyinu1, 1University of Ibadan, Oyo, Nigeria, 2Cocoa Research Institute of Nigeria, Ibadan, Oyo, Nigeria.

Cocoa bean testa (CBT) is a waste on all cocoa processing industries in Nigeria. It constitutes economic waste in that the cocoa industries invest huge amount of money in disposing it. Previous trials revealed the influence of theobromine (an anti – nutrient in CBT). Hence this study focused on evaluating the application of fermentation and enzyme treatment in the deethebrominating CBT for broilers.

Two hundred and thirty one (231) broiler chickens were randomly allotted to seven dietary treatments replicated thrice in a 3 x 3 factorial design. The dietary treatments were: A (0% CBT – control); B (5% raw CBT); C (10% raw CBT);
Environment & Management II

M73  Assessment of a rural community-based poultry organization to rural development in Nigeria. A. Odeh*1 and E. O. Uwagboe2, 1Ajanal Farms, Ibadan, Oyo State, Nigeria, 2University of Ibadan, Ibadan, Oyo State, Ibadan.

In Nigeria, rural areas lack the enabling infrastructure required for both the transformation of rural space, enhancement of productivity and welfare of rural dwellers. The Government and Community Based Rural Development Organizations (CBRDOs) have executed some infrastructural projects such as potable water, transportation services, electricity, modern communication, and housing to solve problems of rural areas. This study therefore seeks to assess the contribution of Ajanal poultry farms towards rural community development. Systematic random sampling technique was used to select sixty respondents from the community. Questionnaire was used to elicit information from members of the community on their perception towards the contributions and constraints of this poultry organization to the development of their community. The data collected were presented with frequencies, percentages and analyzed with Pearson Product Moment Correlation (PPMC).

The result revealed that the mean age of the respondents was 35 years and most (75%) of the respondents are educated. Majority of the respondents agreed to have benefited from facilities provided by the farms as follows; electricity (80%), road (70%), employment (65%) clean water (50%) while few (20%) agreed to have benefited from health care and (10%) communication services. There is a significant relationship between the age, ranking of constraints and perception of the respondents towards the contribution of the farm to the community (P≤0.05). Most (70%) of the respondents were favourably disposed to the contribution of poultry farms to the community while 30% were not favourably disposed. Members of the community have benefited from the facilities provided by this poultry farms towards the development of the community but still need to focus on provision of health care facilities and communication

Key Words: Assessment, Poultry, Organization, Rural community-based, Development

M74  Efficacy of polymers in combination with biocides as sanitizers of Salmonella inoculated broiler hatching eggs. A. R. Ritter*1, R. J. Buhr2, L. J. Richardson3, N. A. Cox2, W. Bright3, and J. L. Wilson3, 1University of Georgia, Athens, 2USDA-ARS, Russell Research Center, Athens, GA, 3South Carolina State University, Orangeburg.

Salmonella contamination of broiler hatching eggs can be carried through the hatchery and with the hatched chick into the broiler house. Commercially available chemical hatching egg sanitizers have achieved acceptable levels of eggshell decontamination of >70% reductions when applied prior to setting. To evaluate the potential benefits of recently formulated combination chemicals (polymers in combination with multiple biocides) by Byotrol Inc. on eggshell decontamination a series of experiments was conducted. Replicate trials containing 10 eggs/chemical/trial were drip inoculated with a naladixic acid resistant Salmonella serovar Typhimurium (10⁴ cfu/egg). After drying at room temperature for 1 h, eggs were spray sanitized with either water, hydrogen peroxide (common effective chemical), MC4 (2 quaternary ammoniums, a biquanide, and a bro- nopol associated in a polymer solution), NIP5 (4 quaternary ammoniums and a polyhexamethyleneguadichloride associated in a polymer solution), OPF4 (4 quaternary ammoniums associated in a polymer solution), Polysphere (4 quaternary ammoniums associated in a polymer solution), or remained as an untreated positive control. In addition, the relative safety of these sanitizing chemicals (at the same concentrations) on embryo viability and hatchability was also evaluated. The incidence of Salmonella recovery was 86% for the untreated control eggs, 83% for water spray control, 9% for hydrogen peroxide, 20% for Polysphere, 7% for OPF4, and 0% for both MC4 and NIP5. Hatchability of fertile eggs sanitized with these chemicals was not significantly different (87 - 93%) when compared to the control value of 91%. Furthermore, hatch quality of eggs sprayed with these chemicals was also not different from that of the controls. Combination chemicals can effectively reduce eggshell Salmonella contamination and both MC4 and NIP5 consistently eliminated Salmonella present on eggshells below the level of recovery without any signs of a depression in hatchability or chick quality.

Key Words: Broiler hatching eggs, Eggshell disinfection, Hatchability, Combination chemical, Salmonella


Weighing sample birds within a broiler breeder flock begins during the first few weeks of life and continues into the hen house. This practice is critical when evaluating the growth and development of breeders and the effectiveness of feed restriction programs. Therefore, body weights obtained must accurately reflect the flock average. In the pullet house, birds are weighed on “off feed” days to ensure no effect of feed in the crop. However, in the hen house birds are fed every day so feed in the crop could alter body weights. Commercially, hens are weighed following an extended period after feeding in order to avoid the effect of feed in the crop. Therefore, this study was designed to evaluate the procedure of catching and weighing penned birds and also to determine the correct time to weigh birds in the hen house to avoid the effects of feeding. In the first study, a pen of 71 birds was corralled in a catch pen and weighed with data recorded in the order birds were caught. This was repeated 24 times. Data were analyzed in groups of ten birds by order caught with the mean values for each subgroup compared. Results showed that the last group of birds weighed within a catch pen are significantly lighter than the first birds caught. In the second study, the same pen of broiler breeder hens were weighed individually before feeding, at feed clean-up, and at two, four, six, eight and ten hrs post feed cleanup. The experiment was repeated at 24, 28, 34 and 41 wks of age on the same pen of birds. Analysis of the data showed that anytime after feed clean-up bird weight was not significantly different. Data were analyzed using JMP statistical software comparing the mean values. In summary, data from this research indicates that all birds caught in a catch pen must be weighed to obtain an accurate pen average and that anytime after feed clean-up, broiler breeder hens can be weighed without feeding time having an effect on average body weight values.

Key Words: Broiler breeders, Body weight, Time of weigh


A study examined how length of starter feed use (2 wk vs 6 wk) for both broiler breeder males and females interacted with the shape of the female feeding program during rearing to affect subsequent reproductive performance and mortality in a 2 x 2 factorial design. Ross 344 males and Ross 708 SF females were reared separately to 21 wk of age. An 18% CP starter diet was fed to females

D (5% CBT with enzyme); E (10% CBT with enzyme); F (5% fermented CBT); and G (10% fermented CBT). The experiment lasted eight weeks. At the starter and finisher phases (0 – 8 weeks), there were significant differences (P < 0.05) between the treatments in the feed intake, weight gain and feed conversion ratio. The serum and hematological parameters (total protein, albumin, glucose, creatinine, cholesterol, white blood cell, red blood cell, packed cell volume and haemoglobin) studied were significantly different (P ≤ 0.05) on all the diets. The noticeable trend in the result indicated that application of enzyme treatment and fermentation of the cocoa bean testa, improved the performance, hematology and serum biochemistry of broilers.

Key Words: Broilers, Cocoa bean testa, Growth response, Haematology, Serum biochemistry
D (5% CBT with enzyme); E (10% CBT with enzyme); F (5% fermented CBT); and G (10% fermented CBT). The experiment lasted eight weeks. At the starter and finisher phases (0 – 8 weeks), there were significant differences (P < 0.05) between the treatments in the feed intake, weight gain and feed conversion ratio. The serum and hematological parameters (total protein, albumin, glucose, creatinine, cholesterol, white blood cell, red blood cell, packed cell volume and haemoglobin) studied were significantly different (P < 0.05) on all the diets. The noticeable trend in the result indicated that application of enzyme treatment and fermentation of the cocoa bean testa, improved the performance, hematology and serum biochemistry of broilers.

Key Words: Broilers, Cocoa bean testa, Growth response, Haematology, Serum biochemistry

Environment & Management II

M73 Assessment of a rural community-based poultry organization to rural development in Nigeria. A. Odhe1 and E. O. Uwagboe2, 1Ajana Farms, Ibadan, Oyo State, Nigeria, 2University of Ibadan, Ibadan, Oyo State, Ibadan.

In Nigeria, rural areas lack the enabling infrastructure required for both the transformation of rural space, enhancement of productivity and welfare of rural dwellers. The Government and Community Based Rural Development Organizations (CBRDOs) have executed some infrastructural projects such as potable water, transportation services, electricity, modern communication, and housing to solve problems of rural areas. This study therefore seeks to assess the contribution of Ajana poultry farms towards rural community development. Systematic random sampling technique was used to select sixty respondents from the community. Questionnaire was used to elicit information from members of the community on their perception towards the contributions and constraints of this poultry organization to the development of their community. The data collected were presented with frequencies, percentages and analyzed with Pearson Product Moment Correlation (PPMC).

The result revealed that the mean age of the respondents was 35 years and most (75%) of the respondents were educated. Majority of the respondents agreed to have benefited from facilities provided by the farms as follows; electricity (80%), road (70%), employment (65%) clean water (50%) while few (20%) agreed to have benefited from health care and (10%) communication services. There is a significant relationship between the age, ranking of constraints and perception of the respondents towards the contribution of the farm to the community (P≤0.05).

Most (70%) of the respondents were favourably disposed to the contribution of poultry farms to the community while 30% were not favourably disposed. Members of the community have benefited from the facilities provided by this poultry farms towards the development of the community but still need to focus on provision of health care facilities and communication

Key Words: Assessment, Poultry, Organization, Rural community-based, Development

M74 Efficacy of polymers in combination with biocides as sanitizers of Salmonella inoculated broiler hatching eggs. A. R. Ritter1*, R. J. Buhr2, L. J. Richardson2, N. A. Cox3, W. Bright4, and I. L. Wilson5, 1University of Georgia, Athens, 2USDA-ARS, Russell Research Center, Athens, GA, 3South Carolina State University, Orangeburg.

Salmonella contamination of broiler hatching eggs can be carried through the hatchery and with the hatched chick into the broiler house. Commercially available chemical hatching egg sanitizers have achieved acceptable levels of eggshell decontamination of >70% reductions when applied prior to setting. To evaluate the potential benefits of recently formulated combination chemicals (polymers in combination with multiple biocides) Byntrol Inc. on eggshell decontamination 10 eggs / chemical / trial were drip inoculated with a naladixic acid resistant Salmonella serovar Typhimurium (103 cfu/egg). After drying at room temperature for 1 h, eggs were spray sanitized with either water, hydrogen peroxide (common effective chemical), MC4 (2 quaternary ammoniums, a biquainane, and a bronopol associated in a polymer solution), NIP5 (4 quaternary ammoniums and a polyhexamethylenebiguanide hydrochloride associated in a polymer solution), OPF4 (4 quaternary ammoniums associated in a polymer solution), Polysphere (4 quaternary ammoniums associated in a polymer solution), or remained as an untreated positive control. In addition, the relative safety of these sanitizing chemicals (at the same concentrations) on embryo viability and hatchability was also evaluated. The incidence of Salmonella recovery was 86% for the untreated control eggs, 83% for water spray control, 9% for hydrogen peroxide, 20% for Polysphere, 7% for OPF4, and 0% for both MC4 and NIP5. Hatchability of fertile eggs sanitized with these chemicals was not significantly different (87 - 93%) when compared to the control value of 91%. Furthermore, hatch chick quality of eggs sprayed with these chemicals was also not different from that of the controls. Combination chemicals can effectively reduce eggshell Salmonella contamination and both MC4 and NIP5 consistently eliminated Salmonella present on eggshells below the level of recovery without any signs of a depression in hatchability or chick quality.

Key Words: Broiler hatching eggs, Eggshell disinfection, Hatchability, Combination chemical, Salmonella


Weighing sample birds within a broiler breeder flock begins during the first few weeks of life and continues into the hen house. This practice is critical when evaluating the growth and development of breeders and the effectiveness of feed restriction programs. Therefore, body weights obtained must accurately reflect the flock average. In the pullet house, birds are weighed on “off feed” days to ensure no effect of feed in the crop. However, in the hen house birds are fed every day so feed in the crop could alter body weights. Commercially, hens are weighed following an extended period after feeding in order to avoid the effect of feed in the crop. Therefore, this study was designed to evaluate the procedure of catching and weighing penned birds and also to determine the correct time to weigh birds in the hen house to avoid the effects of feeding. In the first study, a pen of 71 birds was corralled in a catch pen and weighed with data recorded in the order birds were caught. This was repeated 24 times. Data were analyzed in groups of ten birds by order caught with the mean values for each subgroup compared. Results showed that the last group of birds weighed within a catch pen are significantly lighter than the first birds caught. In the second study, the same pen of broiler breeder hens were weighed individually before feeding, at feed clean-up, and at two, four, six, eight and ten hrs post feed cleanup. The experiment was repeated at 24, 28, 34 and 41 wks of age on the same pen of birds. Analysis of the data showed that anytime after feed clean-up bird weight was not significantly different. Data were analyzed using JMP statistical software comparing the mean values. In summary, data from this research indicates that all birds caught in a catch pen must be weighed to obtain an accurate pen average and that anytime after feed clean-up, broiler breeder hens can be weighed without feeding time having an effect on average body weight values.

Key Words: Broiler breeders, Body weight, Time of weigh


A study examined how length of starter feed use (2 wk vs 6 wk) for both broiler breeder males and females interacted with the shape of the female feeding program during rearing to affect subsequent reproductive performance and morality in a 2 x 2 factorial design. Ross 344 males and Ross 708 SF females were reared separately to 21 wk of age. An 18% CP starter diet was fed to females
and males to either 2 wk or 6 wk of age followed by 15% CP grower and layer diets. From 3 to 21 wk of age, two female feeding programs (Line or Curve) were used followed by the same feeding program and diet to 64 wk of age. The Line and Curve feeding programs provided the same cumulative female nutrition to 21 wk of age. At 21 wk, birds were moved to a curtain-sided slat-litter house and photostimulated. There were 60 females and 6 males allocated to each of the 16 pens during the layering period. BW was determined on a regular basis. Egg production and mortality were determined on a daily basis while percentage fertility and hatchability were evaluated on a weekly basis from sets of 60 eggs per replicate pen. The 6 wk starter feeding period significantly decreased female, but not male, hen-house mortality so that females that received 6 wk starter feed produced more eggs on a hen-housed basis. The interaction of 2 wk of starter feed for females with 6 wk of starter feed for males produced numerically the most female mortality while the interaction of 6 wk starter feed for both sexes produced numerically the least female mortality. This may have been related to a more robust female that could better withstand the rigors of mating and activity in a slat-litter pen. There were no other significant differences due to starter feed feeding period or female feeding program on hen-day egg production, fertility, or hatchability.

Key Words: Broiler breeder, Starter diet, Mortality, Feeding program


Determining the optimum feeding regimen for broiler-breeder pullets is critically important to get pullets started off correctly. This is an ever-changing challenge as genetic advances in growth and feed efficiency make it necessary to continually alter growth curves of broiler-breeder pullets. This study was conducted to evaluate two growth curves and two dietary energy levels and their affect on broiler-breeder performance. Cobb 500 FF pullets (4080) were obtained at day of age and were reared in four treatment groups, consisting of two separate growth curves constituting a 2 X 2 factorial design. The two growth curves were a standard pullet growth curve and a modified curve. The modified curve held bird body weight early in the rearing stage and then accelerated the growth towards lighting. Data were analyzed using JMP statistical software to compare mean values. Each curve had a high caloric feed (1280 kilocalories) and low caloric (1197 kilocalories) feed treatment with the high caloric group receiving that feed from 16-21 weeks of age. This resulted in the four treatment groups: Standard/Low (SL), Standard/High (SH), Modified/Low (ML), and Modified/High (MH).

After rearing (21 wks of age), pullets were moved into a production house and fed and managed the same until 65 wks of age. Egg production, egg weight, body weight hatchability, fertility, and mortality were recorded. The ML treatment group produced significantly fewer eggs than the SH treatment (158.7, and 163.7 eggs/hen housed, respectively). There was no significant difference in any of the variables based on growth curve or calorie level. Data indicates that when pullets are reared on a standard linear growth curve that they should be fed a high caloric diet in order to ensure maximum egg production.

Key Words: Pullet rearing, Pullet nutrition, Broiler breeders

M78  Maintaining broiler breeder pullets on skip-a-day feeding after photostimulation until 5% egg production is reached alters ovarian development.  S. M. Wiggle*, M. E. Freeman, J. L. Wilson, and A. J. Davis, University of Georgia, Athens.

Previously we reported that initiating an every day (ED) feeding program at the time of photostimulation for reproduction compared to continuing a skip-a-day (SAD) feeding program until 5% egg production is reached results in a significant increase in egg production in broiler breeder hens through 65 weeks of age. The objective of the current research was to investigate the impact of continuing a SAD feeding program after photostimulation on ovarian development. Cobb 500 slow feathering broiler breeder pullets were reared under a SAD feeding program. At 21 wk of age 140 of these hens were placed into individual cages and photostimulated for reproduction. Half of the pullets were switched to an ED feeding schedule while the other half was maintained on a SAD feeding schedule. The hens in the ED feeding treatment initiated lay during wk 23 of age and by the end of wk 25 of age, 53% of these hens were in production. In contrast, the SAD pullets initiated lay during wk 25 of age and reached 5% egg production at the end of wk 25 of age. The day that the SAD pullets reached 5% egg production, 40 of the SAD and 40 of the ED hens were killed for ovarian assessment. Fifty % of the SAD hens were found to have cystic ovaries compared to only 15% of the ED hens. Plasma estradiol concentrations did not differ between the SAD and ED hens at 25 wk of age. Plasma levels of total triiodothyronine (T3) and free T3 did differ between the SAD and ED hens from wk 21-25 of age. During this period, plasma concentrations of total and free T3 were significantly lower in the SAD hens compared to the ED hens on days that the SAD hens were not fed, but were significantly higher in the SAD hens on the days when both groups were fed. These results indicate that continuing SAD feeding after photostimulation delays ovarian maturation and may promote the development of ovarian cysts. These results also suggest that the significant shifts that occur in plasma thyroid concentrations in hens fed on a SAD feeding program after photostimulation need to be further investigated in relation to normal ovarian development.

Key Words: Thyroid hormone, Estradiol


Commercial broiler breeder managers have reported differences in fertility between strains of birds and concluding that hens with fewer feathers on their back were a result of more frequent mating. To further understand this difference, two studies were undertaken to compare the mating behavior of two different lines of broiler breeder hens and roosters. In the first study, the same male line was housed separately with a single hen strain for 15 mating behavior observations. In the second study, two male lines were housed separately with a single hen strain and observed 31 times at various age intervals. Data were analyzed using JMP statistical software comparing the means from the observations. Results of the first study showed that while there was no significant difference in the number of attempted matings, the number of completed matings was significantly different. Results showed that the hen strain with greater feather loss had fewer completed matings indicating the feather loss is not a good indicator of mating activity. Sperm penetration, fertility and hatchability were not different between the hen lines. In the second study, results showed no significant difference between the two lines in any of the observed categories. In conclusion, it was found that while mating behavior varies in some lines of broiler breeders it does not fully explain the differences in feather loss or fertility.

Key Words: Mating behavior, Broiler breeder, Hatch
M80  Apparent metabolizable energy of glycerin for broiler chickens.  W. A. Dozier III*, B. J. Kerr2, A. Corzo3, M. T. Kidd1, T. E. Weber2, and K. Bregendal1, USDA-ARS Poultry Research Unit, Mississippi State, MS, 1USDA-ARS Swine Odor and Manure Management Research Unit, Ames, IA, 1Mississippi State University, Mississippi State, 4USDA-ARS Poultry Research Unit, Ames, IA.

Crude glycerin is a co-product from biodiesel production. In 2006, approximately 250,000 million gallons of biodiesel were produced, which translates to 75,000 metric tons of glycerin. Glycerin contains approximately 3,650 kcal/kg of gross energy and, as such, may be a potential dietary energy source for poultry. Three energy balance experiments were conducted to determine AMEn of glycerin using broiler chickens of diverse ages. In experiment (Exp.) 1, 2 dietary treatments were fed from 4 to 11 d of age. Dietary treatments consisted of a control diet containing 6% added glycerin (94% control diet + 6% glycerin). Four dietary treatments were provided in Exp. 2 (from 17 to 24 d of age) and 3 (from 38 to 45 d of age). Diets in Exp. 2 and 3 were: 1) control diet (no added glycerin); 2) 3% added glycerin (97% control diet + 3% glycerin); 3) 6% added glycerin (94% control diet + 6% glycerin); 4) 9% added glycerin (91% control diet + 9% glycerin). Diets in Exp. 1 and 2 were identical. The diet used in Exp. 3 had reduced nutrient levels based on bird age. In Exp. 2 and 3, broilers were fed 91, 94, 97, and 100% of ad libitum intake so that differences in AMEn consumption were only due to glycerin. Slaughter weight of single source of glycerin was used in all experiments. Exp. 1, AMEn utilization determined the difference approach by subtracting AMEn of the control diet from AMEn of the test diet. In Exp. 2 and 3, AMEn intake was regressed against feed intake with the slope estimating AMEn of glycerin. Regression equations were Y = 3.331x − 72.59 (P ≤ 0.0001) and Y = 3.349x − 140.18 (P = 0.0001) for Exp. 2 and 3, respectively. The AMEn of glycerin was determined as 3.621, 3.331, and 3.349 kcal/kg in Exp. 1, 2, and 3, respectively. The average AMEn of glycerin across the 3 experiments was 3.434 kcal/kg, which is similar to its gross energy content. These results indicate that AMEn of glycerin is utilized efficiently by broiler chickens.

Key Words: Broiler, Mm metabolizable energy, Glycerin

M81  DDGS in laying hen diets: Virginiamycin residue analysis using the enzyme linked immunosorbent assay procedure.  E. C. Hale III*, Rose Acre Farms, Seymour, IN.

Virginiamycin is commonly used to control the presence of unwanted microbes during industrial ethanol production. US Food and Drug Administration (FDA) regulations state that Virginiamycin residue in laying hen feed or feed components is an adulterant. Feeding laying hens a ration containing measurable levels of Virginiamycin residues is against FDA regulations. FDA regulatory language does not differentiate between active and inactive Virginiamycin residues as an adulterant. The microbial inhibition test method generally used by the FDA identifies only active Virginiamycin residues. The heat used to dry DDGS is thought to render Virginiamycin inactive. Other than general manufacturer specifications indicating that Virginiamycin is stable up to at least 200 degrees F, no data exists on the relationship between heat and inactivation or outright destruction of Virginiamycin. Because of the ambiguity in FDA regulations regarding what constitutes Virginiamycin residues, DDGS samples were subjected to Enzyme Linked Immunosorbent Assay (ELISA) test procedures to determine the presence of Virginiamycin residues, whether active or inactive. Twelve (12) samples of DDGS from five different suppliers were tested, and of the twelve samples tested, five returned a positive result for the presence of Virginiamycin above the test detection limit of 0.5 ppm.

Key Words: Laying hen, Virginiamycin, DDG, Ethanol, Food and Drug Administration

M82  Influence of narasin on broiler live performance and yield during the withdrawal period.  K. S. Macklin and J. B. Hess*, Auburn, University, Auburn, AL.

In this trial, live performance and processing yield were assessed in broilers fed Narasin during the withdrawal period. Seeder birds (20% stock rate) were placed in each pen and raised for 10 days at which time they were challenged with E. coli (100,000 sporulated oocytes), E. maxima (20,000) and E. tenella (2,500) via oral gavage. Seeder occupied the pens for 14 days and were removed 4 days prior to trial initiation. Each treatment was fed to 8 pens of 50 female broilers. Birds were fed one of the 4 treatments in a 3 feed program. Starter feed was fed to 14 days, grower from 14 to 28 days and withdrawal from 28 to 49 days. Starter and grower feeds contained Narasin at 72 g/ton. Withdrawal treatments included an unmedicated control, Narasin at 72 g/ton, Narasin at 54 g/ton and Virginiamycin at 15 g/ton. Body weights, feed consumption, feed conversion and mortality were calculated at 14, 28 and 49 days. Ten birds per pen were processed at 50 days for carcass and parts yield determination. Chilled carcass weight, leg, fillet and tender weights and yields were determined after deboning.

Withdrawal treatments did not influence final body weight, feed consumption, feed conversion or cumulative mortality. Lean carcass yield was improved with coccidiostat or virginiamycin in the withdrawal (Control, 71.7%; Narasin 72, 72.9%; Narasin 54, 73%; Virginiamycin 15, 73.2%). Improvements in fillet yield were not significant at 0.35% of live weight (Control, 18.07%; Narasin 72, 18.42%; Narasin 54, 18.27%; Virginiamycin 15, 18.41%). Compared to a withdrawal program with no feed additives, feeding Narasin in the withdrawal feed improved lean carcass yield in broilers.

Key Words: Broiler, Coccidiostat, Withdrawal, Narasin

M83  Identification of an inflammatory compound for chicks in soybean meal.  N. M. Dale*, D. M. Anderson2, and H. Hsiao2, University of Georgia, Athens, ChemGen Corp, Gaithersburg, MD.

An extensive literature exists linking microbial structures containing mannan to the generation of an innate immune response. Mannose containing compounds are membrane or cell wall components of numerous pathogens, and are recognized by pattern recognition receptors that initiate an innate immune response. It has been suggested that mannoside containing compounds in certain feed ingredients including soybean meal (SBM) may have enough structural similarity to microbial mannoside compounds such that they also stimulate an innate immune response. If so, such a response would be pointless and depress productivity. Two experiments (Exp) were conducted to explore whether β-galactomannan (β-mannan) in SBM stimulates an innate immune response in chickens. SBM is the principal source of mannans in most practical feeds. Plasma levels of the acute phase protein AGP were used to reflect the degree of innate immune response. In both Exp mixed sex broiler chicks were reared to 14 days of age in battery brooder units. In Exp 1, test diets contained 27, 24, or 0% SBM, the final ration either with or without 2% guar gum, a rich source of β-mannan. These latter two diets contained isolated soy protein (ISP) to provide the same amino acid composition as the SBM feeds but with little β-mannan. Plasma AGP levels were significantly reduced (less immune response) by removing SBM, but significantly increased when guar was added. In Exp 2, diets contained 34, 17 or 0% SBM, again employing ISP. Each diet was prepared with and without 100 units/g of β-mannanase enzyme (Hemicell® ChemGen Corp.). A positive relationship was again seen between levels of SBM and AGP, confirming the effect seen in experiment 1. Enzymatic hydrolysis of β-mannan consistently, but not significantly, reduced AGP in chicks receiving SBM. It is concluded that diet formulation can stimulate an innate immune response, and that β-mannan in SBM (or guar) appears to be a causative agent. Plant derived β-mannan can thus be considered to be a PAMP (pathogen associated molecular pattern) analog for poultry, engendering a metabolically expensive over-stimulation of the innate immune system.

Key Words: Soybean meal, Acute phase proteins, Broilers, Mannan
M84 The effect of supplemental guanidino acetic acid in Brazilian type broiler diets at summer conditions. J. Ringel1, A. Lemme1, and L. F. Araujo2, 1Evonik Degussa GmbH, Hanau, Germany, 2University of Sao Paulo, Sao Paulo, Brazil.

Guanidino acetic acid (GAA) is naturally occurring in animal tissues playing a major role in the energy metabolism as a precursor of creatine. The objective of the study was to examine potential effects of GAA (CreAMINO™) supplementation in purely vegetable diets compared to a positive control. Therefore a total of 780 male ROSS 308 broiler chickens were assigned to one of the following three diets: positive control (6% meat and bone meal), negative control (vegetable diet) and a vegetable diet supplemented with 0.6 g CreAMINO™/kg feed. Performance parameters were recorded from day 14 to day 35 and at the end of the experiment 5 chickens per pen (26 pens) were utilized for carcass quality determination in terms of carcass percentage, breast yield, leg yield, wing yield and abdominal fat yield. Additionally, meat quality in breast meat samples including pH, color, drip loss was measured. Overall weight gain of the broilers did not differ between positive control and the CreAMINO™ supplemented diet while broilers fed the purely vegetable diet showed significantly lower weight gain (p<0.05). Feed conversion was significantly lower in the treatment with CreAMINO™ supplementation compared to both positive and negative control (p<0.05), while mortality remained unaffected by treatment. Only numeric differences between treatments for carcass quality could be determined. Furthermore, pH, drip loss, tenderness evaluation and lightness (L*) yellowness (b*) did not show any effect, only redness (a*) was found to be lower in the CreAMINO™ treatment. It can be concluded that supplementation of CreAMINO™ in purely vegetable diets improves broiler performance to levels achieved with a diet containing meat and bone meal, while carcass and product quality are not affected by supplemental CreAMINO™.

Key Words: Guanidino acetic acid, Broiler, Vegetable diets, Feed conversion, Meat quality

M85 Productive parameters in broiler chicks vaccinated against coccidiosis and with a diet that has yeast cell walls (Saccharomyces cerevisiae) added. R. Morales1, A. García1, F. García1, S. Solórzano1, and J. Arce2, 1Safmex S.A. de C.V, Toluca, Mexico, 2UMSNH. Morelia, Michoacán, Mexico.

Two-thousand two-hundred, one-day-old broiler chicks were maintained in production until 45 days of age, completely randomized in seven treatments with six replicates (treatments 1, 4, 5, 6 and 7) and seven replicates (treatments 2 and 3) of 50 birds each: T-1) Negative control without coccidoidosis (NC); T-2) Positive control with coccidiostat (PC); T-3) NC + coccidiosis vaccine; T-4) NC + S. cerevisiae cell walls (YCW or Saf-Mannan®) (600 mg/kg feed); NC + YCW (750 mg/kg feed); T-5) NC + YCW (600 mg/kg feed) + coccidiosis vaccine; T-6) NC + YCW (750 mg/kg feed) + coccidiosis vaccine. Final results at 45 days, showed that broilers that received YCW, at different doses, with and without vaccine had similar body weights when using coccidiostat (P=0.05) (2433b; 2626a*, 2397b; 2583a*, 2604a*, 2646a*, and 2587g). Vaccine application caused a reduction in feed consumption when compared to group NC, while treatments with coccidiostat and YCW (vaccinates and not vaccinates), showed feed consumptions that were similar among themselves and higher than the groups NC and NC + coccidiosis vaccine (P<0.05) (4379b; 4626c; 4012a*, 4626c; 4736c; 4717c; and 4643cg). The lowest feed conversion index corresponded to group NC + coccidiosis vaccine that was similar to the groups with coccidiostat and with YCW (600 mg/kg feed) + coccidiosis vaccine (1.81b; 1.78ab; 1.70b; 1.81b; 1.78ab; and 1.81b g/g). Results showed that YCW added to chicken feed, with or without vaccine against coccidiosis, may have effects on the productive parameters, similar to those obtained with the use of coccidiostat.

Key Words: Yeast cell walls, S. cerevisiae, Coccidiosis vaccine, Broilers, Coccidiostat

T87 Identification of infectious bursal disease virus field isolates with unusual antigenicity using reverse genetics. A. Icard, H. Sellers, C. Hofacre, and E. Mundt*, University of Georgia, Athens.

Currently, commercial and autogenous IBDV vaccines are used in the field to provide protection in poultry from humoral immunosuppression caused by circulating variant IBDVs. Recently, it has been observed that during the last third of the rearing period, chickens exhibited an increase in clinical respiratory disease. However, antibody response to vaccinations was low as measured by ELISA. This finding leads to the conclusion that viruses causing immunosuppression might play a role. To investigate the antigenicity of currently circulating IBDV field strains, the reverse genetics approach was used as a diagnostic tool. To this end, the coding region of VP2 encompassing the complete antigenic variable region of VP2 was amplified by RT-PCR and ligated into a full length plasmid of IBDV segment A. The insert of the resulting chimeric plasmids was sequenced. The chimeric segment A was subsequently used for co-transfection experiments employing the reverse genetics approach. Antigenicity was evaluated by monoclonal antibody (mAb) reactivity patterns obtained using immunofluorescence to characterize antigenic subtypes of IBDV. 50% of the analyzed constructs resulted in no reactivity with any of mAbs in the panel. This indicates IBDV strains with an unknown antigenic subtype are co-circulating in the field. Interestingly, most of the nucleotide sequences of the unknown IBDV field isolates grouped with the E/Del subtype in phylogenic analysis indicating that use of phylogenic analysis alone would lead to an incorrect conclusion regarding the field isolate subtype. Alignment of the deduced amino acid (aa) sequence and the localization of aa in the crystal structure of VP2 of IBDV was performed. Most of the observed aa exchanges in the unknown phenotype VP2s
M84  The effect of supplemental guanidino acetic acid in Brazilian type broiler diets at summer conditions. J. Ringel1, A. Lemme1, and L. F. Araujo2, 1Evonik Degussa GmbH, Hanau, Germany, 2University of Sao Paulo, Sao Paulo, Brazil.

Guanidino acetic acid (GAA) is naturally occurring in animal tissues playing a major role in the energy metabolism as a precursor of creatine. The objective of the study was to examine potential effects of GAA (CreAMINO™) supplementation in purely vegetable diets compared to a positive control. Therefore a total of 780 male ROSS 308 broiler chickens were assigned to one of the following three diets: positive control (6% meat and bone meal), negative control (vegetable diet) and a vegetable diet supplemented with 0.6 g CreAMINO™/kg feed. Performance parameters were recorded from day 14 to day 35 and at the end of the experiment 5 chickens per pen (26 pens) were utilized for carcass quality determination in terms of carcass percentage, breast yield, leg yield, wing yield and abdominal fat yield. Additionally, meat quality in breast meat samples including pH, color, drip loss was measured. Overall weight gain of the broilers did not differ between positive control and the CreAMINO™ supplemented diet while broilers fed the purely vegetable diet showed significantly lower weight gain (p<0.05). Feed conversion was significantly lower in the treatment with CreAMINO™ supplementation compared to both positive and negative control (p<0.05), while mortality remained unaffected by treatment. Only numeric differences between treatments for carcass quality could be determined. Furthermore, pH, drip loss, tenderness evaluation and lightness (L*), yellowness (b*) did not show any effect, only redness (a*) was found to be lower in the CreAMINO™ treatment. It can be concluded that supplementation of CreAMINO™ in purely vegetable diets improves broiler performance to levels achieved with a diet containing meat and bone meal, while carcass and product quality are not affected by supplemental CreAMINO™.

Key Words: Guanidino acetic acid, Broiler, Vegetable diets, Feed conversion, Meat quality

M85  Productive parameters in broiler chicks vaccinated against coccidiosis and with a diet that has yeast cell walls (Saccharomyces cerevisiae) added. R. Morales1, A. García1, F. García1, S. Solotro1, and J. Arce2, 1Safmex S.A. de C.V., Toluca, México, 2UMSNH. Morelia, Michoacán, México.

Two-thousand two-hundred, one-day-old broiler chicks were maintained in production until 45 days of age, completely randomized in seven treatments with six replicates (treatments 1, 4, 5, 6 and 7) and seven replicates (treatments 2 and 3) of 50 birds each: T-1) Negative control without coccidiosis vaccine (NC); T-2) Positive control with coccidiosis vaccine (PC); T-3) NC + coccidiosis vaccine; T-4) NC + S. cerevisiae cell walls (YCW or Saf-Mannan®) (600 mg/kg feed); NC + YCW (750 mg/kg feed); T-5) NC + YCW (600 mg/kg feed) + coccidiosis vaccine; T-6) NC + YCW (750 mg/kg feed) + coccidiosis vaccine. Final results at 45 days, showed that broilers that received YCW, at different doses, with or without vaccine had similar body weights when using coccidiostat (P=0.05) (2433b; 2626ª; 2397ª; 2583ª; 2604ª; 2646ª; and 2587ª). Vaccine application caused a reduction in feed consumption when compared to group NC, while treatments with coccidiostat and YCW (vaccinates and not vaccinates), showed feed consumption that were similar among themselves and higher than the groups NC and NC + coccidiosis vaccine (P<0.05) (4379b; 4626c; 4012ª; 4626c; 4736c; 4717ª; and 4634cg). The lowest feed conversion index corresponded to group NC + coccidiosis vaccine that was similar to the groups with coccidiostat and with YCW (600 mg/kg feed) + coccidiosis vaccine (1.81b; 1.78ab; 1.70ª; 1.81b; 1.81b; 1.78ab; and 1.81b g/g). Results showed that YCW added to chicken feed, with or without vaccine against coccidiosis, may have effects on the productive parameters, similar to those obtained with the use of coccidiostat.

Key Words: Yeast cell walls, S. cerevisiae, Coccidiosis vaccine, Broilers, Coccidiostat


SUMMARY. A 100,000 broiler flock was divided in two groups in order to compare the hyper immune, egg yolk immunoglobulins anticoccidial efficacy, compared to dual program, nicarbazine plus salinomycin in-feed anticoccidial program. Powdered egg yolk immunoglobulins were administered at 200 ppm during the production cycle. The anticoccidial program consisted on 125 ppm nicarbazine (days 0-6ª-14) and 66 ppm salinomycin (SAL) (days 15ª-35). Group B was considered as a control. The weight gain was used as an evaluation parameter in this experiment. Weight gain at 35 days was greater in birds that received egg yolk immunoglobulins as compared with the nicarbazine plus salinomycin group. This difference caused a significant (P<0.05) results. The performance data, lesion scores, and oocyst counts showed that the immunoglobulins treatment was successful. Immunoglobulins can thus be used as an alternative program instead of a dual program salinomycin and nicarbazine.

Key Words: Coccidiostat, Immunoglobulins, Coccidiosis, Eimeria, Anticoccidial drug

Tuesday, January 22, 2008
SYMPOSIA AND ORAL SESSIONS
SCAD II
confirmed by MALDI/TOF MS-MS. Sera were raised against both proteins in rab
purified by affinity chromatography. The identity of the purified proteins was
in the nucleus. To this end RNA was isolated from chicken cells, RT-PCR was
performed and the genes of both proteins were cloned and sequenced. By using
the recombinant Baculovirus technology recombiant proteins were subsequently
purified by affinity chromatography. The identity of the purified proteins was
confirmed by MALDI/TOF MS-MS. Sera were raised against both proteins in rab-
bits. In studies employing immunofluorescence the localization of both proteins
was investigated in cells infected with infectious bursal disease virus (IBDV).
Interestingly, in infected cells the proteins NF45 and p68 were present in the
cytoplasm. In non-infected cells the proteins were observed only in the nucleus
of the cell. In double-labeling studies using monoclonal antibodies raised against
IBDV proteins, a co-localization of cellular proteins was observed only with VP3.
This indicates that the investigated cellular proteins interact with VP3. It is known
that VP3 interacts with the viral RNA-dependent RNA-polymerase VP1. Thus,
our findings indicate an involvement of the investigated cellular proteins in the
viral replication machinery. To investigate whether VP3 alone or the presence of
VP1 is necessary for the observed phenotype, transfection experiments with
cRNA of only the full length segment A or in combination with segment B of
IBDV were conducted. The results showed that the presence of VP3 alone was
not sufficient to observe the presence of the investigated cellular proteins in the
cytoplasm of the double-transfected cells. This is an additional sign that VP1
needs to be present for the observed phenotype of the cellular proteins.

**Key Words:** IBDV, dsRNABP proteins, Interaction, Replication, Colocaliza-
tion

**T89** Rapid detection and monitoring of avian reovirus shedding in broiler
chicken cloacal swabs using real-time RT-PCR. K. Guo*, T. Dormitorio, and
J. Giambrone, Auburn University, Auburn, AL.

Avian reoviruses (ARV) cause a variety of diseases, such as tenosynovitis, malab-
sorption syndrome, chronic respiratory disease, and immunosuppression in young
commercial poultry. Early detection is critical for choosing proper vaccines and
for the prevention of ARV related diseases. Sigma NS Taqman probe real-time
PCR was developed and used to detect and monitor ARV virus shedding from
cloacal swabs using the Roche LightCycler®. Virus shedding was monitored and
quantified for three weeks. Results indicated that viral RNA can be detected
as early as the first day post-infection (dpi) using the enteric ARV strain 2408.
Reovirus-infected commercial broilers with maternal immunity against reovi-
ruses displayed a peak release of virus in fecal material at 2 dpi, and thereafter,
it decreased rapidly throughout the study. On the other hand, specific pathogen
free broilers showed much higher and fluctuating amounts of virus secretion in
their feces. Results confirmed the high sensitivity of this test, and that maternal
immunity greatly reduced viral replication and shedding in chickens.

**Key Words:** Avian reovirus, Real-time RT-PCR, Detection, Cloacal swab
sample

**T90** Distinguishing infectious bronchitis vaccine viruses from field viruses
in commercial poultry. E. T. McKinley*, D. A. Hilt, H. Moscoso, and M. W.
Jackson, Georgia State University, Athens.

Infectious bronchitis vaccine viruses have been implicated in causing upper-
respiratory disease in poultry flocks because viruses isolated from outbreaks are
often found to be the same serotypes used to vaccine the birds. Unique sequences
in the S1 gene of vaccine viruses from the field were not known; therefore, it was
not possible to differentiate vaccine viruses from true field isolates. Infectious
bronchitis vaccine viruses recovered from vaccinated and contact exposed SPF
chicks have several amino acid changes in the S1 gene sequence that are unique
to re-isolated vaccine viruses. In our analysis, we compared the S1 sequences of
thirty-nine IBV field isolates, collected over a five-year period, to the S1
sequence from re-isolated vaccine viruses. Our data showed that vaccine viruses
were re-isolated from flocks experiencing increased mortality.

**Key Words:** Infectious bronchitis viruses

**T91** Challenge study to evaluate vaccine protection against infectious
laryngotracheitis virus (ILTV). A. Rodriguez* and M. Garcia, University of
Georgia, Athens.

A challenge study was conducted to evaluate the protection elicited by the
tissue culture origin (TCO) vaccine against a currently circulating ILTV field
strain. Protection was evaluated by scoring clinical signs, mortality, body weight
increases in clinical signs score, mortality, and body weight gained were observed
among vaccinated/challenge, non-vaccinated/challenge, and sentinel chickens.
Viral DNA was detected and virus isolated only from sentinel chickens in the non-
vaccinated/challenge group. Results showed that the utilized vaccine protected
against clinical signs, mortality, weight losses, and viral shedding.

**Key Words:** Laryngotracheitis, Tissue culture origin, Real-time PCR, Virus
isolation, Sentinel chickens

**T92** Development of a recombinant avian influenza vaccine in yeast. J.
J. Giambrone*1, H. Wu2, T. V. Dormitorio1, and N. Singh1, 1Auburn University,
Auburn, AL, 2Alabama State University, Montgomery.

Vaccines are part of a program to prevent avian influenza virus (AIV) outbreaks
in poultry flocks in Southeast Asia, where the virus is endemic. AIV vaccines
can reduce virus shedding and transmission. Inactivated AI vaccines, and recom-
binant fowl pox (FP) and Newcastle disease (ND) H (hemagglutinin) vectored
vaccines against H5N1 virus are licensed and used in these countries. However,
the first two vaccines must be injected and the later two are adversely affected
by maternal immunity and immunity derived from prior vaccination against fowl
pox or NDV. Yeast-expressed recombinant protein provides advantages over viral
vectored vaccines. Yeast are used in poultry to control bacteria as probiotics in
feed or water, are not affected by maternal immunity, and can be administered
by mass application in the field. Our previous work confirmed a yeast-derived
sigma C protein induced immunity against avian reovirus, when given orally to
young chickens. We designed primers based on the 15 and 21 terminal segment
specific nucleotides of the genomic RNA, which are conserved in all AIVs and
are unique for each fragment. We amplified the H gene from a non-pathogenic
H10N7 isolate from Alabama aquatic wild birds. The resulting gene (1.8 kb) was cloned into Schizosaccharomyces (S) pombe. The H gene expressed a 62.2 KD protein as demonstrated by Western blotting. This protein was purified and its expression efficiency was 0.1% of the total soluble protein. We plan to optimize protein expression to increase its immunogenicity prior to work in chickens.

Key Words: AIV, Poultry, Yeast, Recombinant vaccine

T93 Role of different genes in the pathogenesis of H5N1 avian influenza virus in chickens. J. L. Wasielenko*1, C. W. Lee2, L. Sarmento1, E. Spackman1, D. L. Suarez1, and M. J. Pantin-Jackwood1, 1Southeast Poultry Research Laboratory, Athens, GA, 2Department of Food Animal Health Research Program, Wooster, OH.

The determinants of pathogenicity of Avian Influenza (AI) virus are not totally defined. Previous studies have pointed towards the importance of different influenza virus genes in determining virulence in various hosts. We used reverse genetics to generate recombinant viruses in order to better understand the role of recombination in AI pathogenesis and to determine which viral genes contribute to the virulence of AI viruses in chickens. A recombinant virus, CK/Indonesia/03, displayed 50-75% mortality in chickens. Single genes in this virus were then replaced with those from a rEgret/HK/02 virus which displays 100% mortality and high viral titers in tissues. Exchange of the HA gene considerably affected virulence which was reflected in increased mortality, increased viral replication and spread in tissues, demonstrating the importance of the HA gene in pathogenesis of the virus. The HA genes had identical cleavage sites however there were 11 amino acid differences, 5 located in the receptor binding site of the glycoprotein, which could explain the difference observed in pathogenicity of the viruses. Exchange of the NS, NP or M genes also resulted in decreased mean death times (MDT), increased viral replication and spread of the virus in tissues compared to the rIndonesia/HK/02 parent virus. Replacing the NP gene resulted in a virus with the shortest MDT and increased viral spread in tissues, surpassing that of the HA gene recombinant. Exchanging either the PB2 or PB1 genes did not result in increased virulence suggesting these polymerase genes may function more effectively as a unit derived from the same viral strain.

Key Words: H5N1, Influenza, Pathogenesis, Virus, Chickens


Previously, an attenuated ΔaroA Salmonella enteritidis strain (∆SE) expressing two M2e epitope sequences with an immune-enhancing CD154 sequence on the cell surface provided high and persistent titers against several influenza serotypes and produced neutralization titers in embryos and cell culture when administered post-hatch. Presently, we evaluated in ovo (air cell) administration of this vector on hatchability, seroconversion and performance. Embryos (240, 18 dE) from a commercial broiler hatchery were divided into 2 groups: 0.25 mL PBS containing 3.25x10^3 cfu ∆SE/embryo into the air cell or vehicle alone (control). Liver/spleen and cecal tonsils were aseptically cultured for ∆SE strain recovery, and blood samples were obtained for determination of M2e and ∆SE specific IgG antibody response. The hatchability for the treated group was 91.52% vs. 86.55% for vehicle-treated controls. ∆SE (positive/total) recovery was as follows: liver/spleen: Day 1 20/20 (100 %); d 7 10/20 (50 %); d 14 5/20 (25 %); d 21 2/10 (20 %); and d 28 0/10 (0 %). For cecal tonsils: Day 1 20/20 (100 %) with an average of 1.87x10^11 ∆SE/gram of cecal contents; d 7 20/20 (100 %); d 14 18/20 (90 %); d 21 3/10 (30 %); and d 28 4/10 (40 %). No ∆SE was recovered from control chicks. The M2e serum antibody levels (S/P ratio) were higher at day 7 and decreased weekly (day 7, 8; day 14, 2; day 21, 15; and day 28, 1). The ∆SE serum antibody levels showed a low response at 7 d in the vaccinated group and decreased during the 4 weeks of the study. Weekly body weights during the experimental period did not show any statistical difference between the vaccinated embryos when compared with control embryos (P>0.05). These data suggest that in ovo ∆SE administration does not affect the hatchability of broiler embryos nor the performance of the chickens. A strong immunological response was observed during the first week of age against the M2e. The clearance of the ∆SE in liver and spleen was observed at day 28 (0/10). Further studies to evaluate secondary immune response and clearance from the cecal tonsils are currently being conducted.

Key Words: Embryo, Vector, Avian Influenza, M2e

Nutrition V

T95 Utilization of poultry production information among poultry farmers in Ibadan metropolis, Nigeria. I. O. Oladeji* and E. O. Uwagboe, University of Ibadan, Ibadan, Oyo State, Nigeria.

Ibadan is a prominent area for poultry production in Nigeria. Increase in poultry production information in this era of Information Communication Technology (ICT) is an issue that needs to be addressed. A multistage random sampling technique was used to select 3 Local Government Areas (LGAs) out of the 9 LGAs in Ibadan Metropolis while systematic random sampling technique was used to select 120 poultry farmers out of a population of 200 registered farmers and questionnaire was used for data collection. Frequency counts and percentages were used for descriptive statistics while Chi-Square was used for data analysis. The result shows that all (100%) of the respondents are educated and majority (82%) has above secondary school level. Few (14%) of the respondents obtained information from Extension agents and all (100%) rear less than 1,500 birds. The Chi-Square result revealed that significant relationship exists between education (X²= 21.66, P<0.05), level of production (X²= 11.870, P<0.05) and level of utilization of information. In conclusion, poultry farmers in the study area are educated but have inadequate poultry information hence operate at small scale level. There is a need for an intensive animal husbandry extension services to facilitate adoption of improved poultry production practices and enhance farmers income generation.

Key Words: Utilization, Information, Poultry, Farmers, Nigeria

T96 Influence of endogenous phytase activity on exogenous phytase pellet stability evaluation. S. Dalsgaard*, M. F. Isaksen1, M. Hruby2, and T. Gravesen1, 1Genencor, Danisco, Denmark, 2Danisco Animal Nutrition, St. Louis, MO.

Today, a large proportion of monogastric feed is enriched with microbially derived phytases to improve the digestibility of phosphorus. Phytate is the major phosphorus source in wheat and corn, and approximately 75% of all phosphorus in the grains is bound within phytate molecules. Phytate cannot be degraded by the animal itself, and the animal needs exogenous phytase to degrade the phytate in vivo. The exogenous phytase pellet stability is an important topic for the feed industry. The primary way of evaluating exogenous phytase thermostability is by running pelleting tests in commercial feed mills. However, endogenous phytase from the raw materials can influence the outcome of the test results. The endogenous phytase originates mainly from wheat or wheat by-products, which are, in many markets, ingredients used at high levels in animal feed. The presence of endogenous phytase can then cause an incorrect interpretation of thermostable phytase product thermostability.

The evaluation dealt with two aspects of how endogenous phytase influences the outcome of pelleting trials. First, a commercial pelleting trial, where the endogenous phytase is inactivated at 90°C and second, a test of endogenous phytase thermostability over a temperature range of 75°C to 95°C. The results show 85% inactivation of the original endogenous phytase activity at 95°C. The

Previously, an attenuated ΔaroA Salmonella enteritidis strain (ΔSE) expressing two M2e epitope sequences with an immune-enhancing CD154 sequence on the cell surface provided high and persistent titers against several influenza serotypes and produced neutralization titers in embryos and cell culture when administered post-hatch. Presently, we evaluated in ovo (air cell) administration of this vector on hatchability, seroconversion and performance. Embryos (240, 18 dE) from a commercial broiler hatchery were divided into two groups: 25 mL PBS containing 3.25×10^3 cfu ΔSE/embryo into the air cell or vehicle alone (control). Liver/spleen and cecal tonsils were aseptically cultured for ΔSE strain recovery, and blood samples were obtained for determination of M2e and ΔSE specific IgG antibody response. The hatchability for the treated group was 91.52% vs. 86.55% for vehicle-treated controls. ΔSE (positive/total) recovery was as follows: liver/spleen: Day 1 20/20 (100 %); d 7 10/20 (50 %); d 14 5/20 (25 %); d 21 2/10 (20 %); and d 28 0/10 (0 %). For cecal tonsils: Day 1 20/20 (100 %) with an average of 1.87×10^1 ΔSE/gram of cecal contents; d 7 20/20 (100 %); d 14 18/20 (90 %); d 21 3/10 (30 %); and d 28 4/10 (40 %). No ΔSE was recovered from control chicks. The ΔM2e serum antibody levels (S/P ratio) were higher at day 7 and decreased weekly (day 7, 8; day 14, 2; day 21, 15; and day 28, 1). The ΔSE serum antibody levels showed a low response at 7 d in the vaccinated group and decreased during the 4 weeks of the study. Weekly body weights during the experimental period did not show any statistical difference between the vaccinated embryos when compared with control embryos (P>0.05). These data suggest that in ovo ΔSE administration does not affect the hatchability and mortality of broiler embryos nor the performance of the chickens. A strong immunological response was observed during the first week of age against the M2e. The clearance of the ΔSE in liver and spleen was observed at day 28 (0/10). Further studies to evaluate secondary immune response and clearance from the cecal tonsils are currently being conducted.

Key Words: Embryo, Vector, Avian Influenza, M2e

T96 Influence of endogenous phytase activity on exogenous phytase pellet stability evaluation. S. Dalsgaard*1, M. F. Isaksen1, M. Hruby2, and T. Gravesen1, 1Genencor, Danisco, Denmark, 2Danisco Animal Nutrition, St. Louis, MO.

Today, a large proportion of monogastric feed is enriched with microbially derived phytases to improve the digestibility of phosphorus. Phytate is the major phosphorus source in wheat and corn, and approximately 75% of all phosphorus in the grains is bound within phytate molecules. Phytate cannot be degraded by the animal itself, and the animal needs exogenous phytase to degrade the phytate in vivo.

The exogenous phytase pellet stability is an important topic for the feed industry. The primary way of evaluating exogenous phytase thermostability is by running pelleting tests in commercial feed mills. However, endogenous phytase from the raw materials can influence the outcome of the test results. The endogenous phytase originates mainly from wheat or wheat by-products, which are, in many markets, ingredients used at high levels in animal feed. The presence of endogenous phytase can then cause an incorrect interpretation of thermostable phytase product thermostability.

The evaluation dealt with two aspects of how endogenous phytase influences the outcome of pelleting trials. First, a commercial pelleting trial, where the endogenous phytase is inactivated at 90°C and second, a test of endogenous phytase thermostability over a temperature range of 75°C to 95°C. The results show 85% inactivation of the original endogenous phytase activity at 95°C.

Key Words: Utilization, Information, Poultry, Farmers, Nigeria
overall conclusion is that the endogenous phytase is not thermostable; however, it is present and active in mash feed before pelleting and if the recovery of added (exogenous) phytase product is calculated based on the activity in mash feed, the recovery and thereby the thermostability of the added phytase can be underestimated.

Key Words: Endogenous phytase, Thermostability, Corn, Wheat

T97 Evaluation of heat stable phytases in pelleted diets fed to broilers from day 0 to 35. J. R. Timmons*1, R. Angel1, J. M. Harter-Dennis2, W. Saylor1, and N. Ward3, 1University of Maryland, College Park, 2University of Maryland Eastern Shore, Princess Anne, 3University of Delaware, Newark, 4DSM, Parsippany, NY.

Broiler rations are typically pelleted to promote improved broiler performance. Before advent of heat stable (HS) phytase product forms, phytases (Ph) were generally added post-pelleting to prevent Ph inactivation from high pelleting temperatures. The objective of this study was to evaluate retained Ph activity of two HS phytase enzymes (PhA and PhB) in pelleted diets fed to 0-35d old straight run Ross 708 broilers. Ph diets were deficient in non-phytate phosphorus (NPP) (0.28, 0.185, and 0.11% NPP, starter (S), grower (G), and finisher (F) diets, respectively) and all treatments (TRT) were fed at 93.3°C. A RCB design was used and percent retained Ph activity (RPhA), weight gain (WG), feed efficiency (F/G), and percent tibia ash (TA) were measured. TRT included a positive control (PC) (0.45, 0.40, 0.35% NPP; in S, G, F diets, respectively), negative control (NC) (0.35, 0.25, 0.16% NPP in S, G, F diets, respectively), 0.5XPbA, 1XPbA, 2XPbA, 0.5XPbB, 1XPbB, and 2XPbB (TRT 1-8, respectively). Manufacturer recommended enzyme level was 1X RPhA (averaged over 3 diet phases) was not different (P=0.07, SEM 4.15) between TRT 3-8 (64.3, 69.8, 80.0, 81.0, 73.2, and 69.5 %, respectively) suggesting heat stability of both PhA and PhB are similar. No differences (P=0.05) between TRT were detected in WG (average 659.2; d21 and 1,618.5 g; d35). F/G of 35 d old birds fed TRT 5-7 was 3% lower (P≤0.05) than F/G of birds fed NC. Differences were detected in TA at d 21 and 35. Day 21 TA of TRT 1 (51.0%) was higher (P≤0.05) than TA of TRT 2-8. However, no differences (P=0.05) were detected in TA of birds fed 1XPbA and 1XPbB (49.4 and 49.1%, respectively). Day 35 TA values were 50.51a, 47.95c, 48.90bc, 48.95bc, 49.60ab, 48.87c, 49.51ab, and 50.10%ab for TRT 2-8. However, no differences (P>0.05) were detected in TA of birds fed the PC diet, and in TA at d 21 and 35. Day 21 TA of TRT 1 (51.0%) was higher (P≤0.05) than TA of birds fed the NC diet. However, TA of birds fed TRT 2XPbA, 2XPbB, and 1XPbB were not different (P=0.05) than the TA of birds fed the PC diet, and no differences in TA were detected between any Ph TRT. Results suggest that supplementing NPP deficient diets with a pre-pelleting HS Ph will improve TA of birds fed pelleted diets.

Key Words: Phytase, Phosphorus

T98 Impact of a bacterial phytase on broiler chickens when fed simple or complex diets. T. M. Parr*1, R. Upton1, C. L. Wyatt1, and S. W. Davis2, 1Syngenta Animal Nutrition, Research Triangle Park, NC, 2Colorado Quality Research, Wellington, CO.

An evolved, thermo-tolerant bacterial phytase (Quantum Phytase™; QP) has been evaluated in many broiler studies which utilized diets typically composed of a commercial corn-soy-animal protein base. With increasing ingredient prices, more non-traditional feedstuffs are being considered thus the objective of this study was to compare the response of feeding QP to broilers in a simple corn-soya, semi-complex or a complex diet (containing corn, soybean meal, canola meal, rice bran and sunflower meal). The phytate content in the corn-soya averaged 0.23% whereas the phytate levels increased in the complex diet (average 0.38%). For each of the diets AvP, Ca, ME and aa were lowered to result in a negative control (NC) which matched the positive control (PC). Phytase was added to the NC diets at 200 or 300g/mt (equivalent to 500 or 750FTU/kg, respectively) and fed as pellets for 42d. Body weight, feed intake, FCR and mortality were recorded over the trial period. At 42d, left tibias were collected for bone ash analysis. The addition of phytase at either inclusion level improved body weight and bone ash in broilers fed NC diets achieving performance equivalent to the PC group. Increasing dietary phytate levels by including non-traditional feedstuffs negatively impacted performance within the NC groups only. This study demonstrates the ability of QP to effectively reduce the negative effects of dietary phytate regardless of diet complexity.

Key Words: Phytase, Thermo-tolerant, Phytate, Complex diet

T99 Performance of broilers fed commercial forms of phytases with different biochemical characteristics: P. lycii, A. niger and E. coli. P. W. Waldroup1, F. Yan1, N. E. Ward2, and J. Wilson2, 1University of Arkansas, Fayetteville, 2DSM Nutritional Products, Parsippany, NJ.

Phytases have unique and different biochemical characteristics. This 42-day floor pen trial compared four commercial phytases with substantially different biochemical properties.

Three control phosphorus (P) trts (low, intermediate, high) were supplemented with defluorinated phosphate to provide added P, resp.: starter (1–18 d), 0.15, 0.225 and 0.3%; grower (19–34 d), 0.125, 0.2 and 0.275%; and finisher (35–42 d), 0.075, 0.15 and 0.225% P. Added P in the low control was 0.05% higher than in the 9 phytase diets.

Six replicates of 60 Cobb 500 male broilers were randomly assigned to one of the 12 trts. Body weight (BW), feed conversion (F/G), feed consumption and mortality were determined for each period. On d 18, tibia ash was determined for three random birds per pen. Phytase R (two product forms), N, O and Q were supplemented according to manufacturer recommendations. Diets were nonpelleted corn/SBM, met NRC (1996) for all nutrients except P, and phytase trts were prepared from one basal.

BW increased (P<0.0001) with added P in all periods. Starter: with the exception of Phytase N, phytases increased (P<0.05) BW over the lowest P. Grower: only Phytases N and Q underperformed (P<0.05) the intermediate control. Finisher: BW of birds fed phytases exceeded (P<0.05) the low P, but not the intermediate or high. Phytases improved (P<0.05) F/G, but were not different from intermediate or high P. Mortality of low P was higher (P<0.05) than for intermediate or high. Phytases decreased (P<0.05) mortality relative to low P in all periods. Only Phytase Q increased (P<0.05) mortality.

Low P birds had less (P<0.05) tibia ash % than intermediate or high P. At recommended levels, tibia ash across phytases was similar, with the exception of Phytase N, which underperformed (P<0.05) all phytases but was not different (P>0.05) from Phytase Q. Phytase R and Phytase O at levels higher than recommended by manufacturer outperformed (P<0.05) all other phytases. Biochemical properties of phytases differ, and depending on the commercial formulation and recommendations, could impact broiler performance.

Key Words: Phytase, P. lycii, E. coli, A. niger, Broilers


Previous research clearly demonstrates that the addition of a phytase liberates phytate-bound phosphorus in poultry diets. However discussion still remains on the effects of phytate, and ultimately a phytase, on energy and nitrogen retention. The objective of the current experiment was to evaluate the inclusion of a bacterial phytase (Quantum™, Quantum Phytase; QP) on bird performance from 1-40d and on nutrient metabolism. 1250 male, Ross broiler chicks were randomly distributed among 5 treatments. There were 10 replicates per treatment, in floor pens containing 25 chicks per pen. There were three basal diets consisting of a positive control (PC); a negative control (NC1) formulated to contain a nutrient reduction of 0.12% av. P, 0.077% Ca, 0.003% Lys, 26 kcal ME, 0.12% protein; and a negative control 2 (NC2) formulated to contain a nutrient reduction of 0.13% av. P, 0.10% Ca, 0.01% Lys, 45 kcal ME, 0.36% protein. QP was added at 100g/mt (equivalent to 250FTU/kg) to NC1 and 200g/mt (equivalent to 500FTU/kg) to NC2. Supplemental QP in NC1 and NC2 diets returned BW, FCR, and FCR in broilers to equal that of the PC-fed birds. At day 19-23 ileal samples were collected from broilers to determine nutrient digestibility values. Feeding QP significantly improved the energy values of 30 and 57 kcal DM/kg, respectively.
for the NC1 and NC2 diets. QP increased ileal digestibility of phosphorus and retained phosphorus (mg/kg). Thus, excreted phosphorus was reduced and phosphorus deposition was improved in tibia ash content, especially for birds fed NC2 containing 200g/mt QP. The inclusion of QP at 200g/mt showed the best results for nutrient digestibility, phosphorus retention, and lower phosphorus excretion compared to the positive control.

**Key Words:** Phytase, Nutrient metabolism, Broiler

**T103** Response to combined amylose-phytase-protease-xylanase supplementation when 8 week broiler males had received corn-soybean meal feeds devoid of antimicrobials with/without alfalfa meal and/or DDGS. E. T. Moran* and R. Lehman, Auburn University, Auburn, AL.

Omitting antimicrobials from broiler feed is favorable for consumer marketing. Supplemental enzymes represent a GRAS alternative. Chicks were vaccinated for coccidiosis prior to placement then reared to 8 weeks of age. Feed cordicidostat and all other antimicrobials were not employed. Males were fed corn-soybean meal feeds having nutrients at accepted levels through intervals 0-3, 3-6 and 6-8 wk, and when ME together with available P were reduced by 80kcal and 0.10% at each age. Combined enzymes guaranteed per kg of feed were amylase 8000u, protease 8000u, xylanase 600u (Avizyme 1502, 0.05%), phytase, and 500 fu (Phyzyme XP, 0.01%). Alfalfa meal (3%, Alfasfa Supreme, Toledo OH) and/or distillerâ€™s dried grains solubles (10%, Dakota Gold, Souix Falls SD) were incorporated on the basis of label composition to provide equivalent nutrition as with sole use of corn-soybean meal. Reducing ME-aP adversely affected final live weight, regardless of combinations with or without alfalfa meal and/or DDGS were employed. Recovery of weight loss occurred when the enzyme combination was supplemented to the reduced ME-aP feeds while a weight gain advantage was obtained when included at accepted nutrient levels. Advantage in BW gain from enzymes was greatest when DDGS had been used while feed conversion benefitted most with alfalfa meal inclusion. Carcass abdominal fat decreased uniformly when ME was reduced and increased with all treatments in response to enzymes. Fillets, tenders and skinless boneless thigh meat increased when enzymes had been supplemented while femurs had additional weight, length and breaking strength. Inclusion of combined amylose-phytase-protease-xylanase into broiler feeds without antimicrobials over an 8 weeks led to favorable responses in live production, skinless boneless meat yield and skeletal integrity, regardless of alfalfa meal and DDGS inclusion and whether ME with aP were sub marginal.

**Key Words:** Alfalfa meal, Antimicrobial feed additives, Broiler production, Distillers dried grains solubles, Enzyme supplementation

---

**T102** Influence of dose of a novel xylanase on performance of broilers fed a corn or corn/wheat based diet. M. R. Bedford* and H. Graham, AB-Vista Feed Ingredients, Marlborough, Wilts, United Kingdom.

Xylanases are used universally in wheat-based broiler diets and are also employed in corn-based diets, although their use is not as widespread. This is because responses obtained in corn-based diets are not as large and less frequent than that seen with wheat. The present study investigated the scale of response of variable doses of a novel, highly thermostable xylanase (Ecomase XT™) on the performance of male broilers fed energy deficient diets (NRC -100kcal/kg to 14d, -125kcal/kg 14-28d of age) where the cereal base was either corn, or 35% Wheat: 30% corn. Each diet base was supplemented with the xylanase at 0, 2000, 4000, 8000, 16000 or 32000 BXU/kg diet. A corn based positive control was included for comparison. All diets were pelleted at 85°C. Enzyme recovery from pellets was consistently 90% of that found in the mash or greater. There was a significant reduction in gain and deterioration in FCR on feeding the negative controls compared with the positive control diet at 28d (>60g and ~10 points respectively).

Addition of the xylanase lead to a dose dependent, quadratic improvement in both gain and FCR in both cereal-based diets. The rate of improvement in both parameters was almost identical for each diet base and there was no suggestion of any negative effect at the highest dose used. At 28d, gain was equilibrated with the positive control at 16,000 BXU whereas optimum FCR, achieved at approx 20,000 BXU, did not quite equilibrate with the positive control, suggesting that the 125kcal/kg downspecification was marginally excessive. The data support that this enzyme able to withstand pelleting at 85C and that it is equally able to recover energy from both wheat/corn and corn based diets, with the likelihood that it is able to recoup approx 100kcal/kg.

**Key Words:** Corn, Xylanase, Enzyme Energy


Versazyme ™(VZ) is a keratinase-based feed additive produced naturally as a fermentation product of Bacillus Licheniformis PWD-1. VZ supplementation in corn/soy broiler diets has resulted in improved growth performance and feed efficiency across a range of nutrient densities with maximal benefit in low or marginal crude protein diets. The corn/soy broiler diets supplemented with VZ were previously in the form of mash as VZ had not yet been tested in pelleted feed. This study was designed to test the efficacy and recovery of VZ pelleted under typical feed industry conditions. The pelleted diets were conditioned to 85°C for 30 sec and pelleted using a 4 mm x 3.2 mm die. The cooled pellets were crumbled and fines were included. The experimental design was a randomized complete block with a 2 x 2 factorial of 4 treatments: VZ at 0.0% (C) and 0.1% (VZ) w/w; feed form of mash (M) and pellet (P). A total of 192 male broiler chicks were randomly assigned to 24 pens and fed a corn/soy starter diet formulated at 19.3% CP to 21 d of age. There were 6 replicate cages per treatment. The birds were given ad libitum access to feed and water. Body weight and feed consumption were determined at 21 d of age. Results of growth performance showed positive effects of VZ supplementation on BWG and FCR with no interaction effects (P > 0.01). Birds fed VZ diets had significantly (P < 0.01) higher BW (798 VZM and 878 VZP) than those receiving the non-supplemented diets (743 CM and 823 CP). Birds fed diets supplemented with VZ had better overall FCR (1.57 VZM and 1.55 VZP) than those fed the corresponding diets without VZ supplementation (1.81 CM and 1.65 CP). FCR was significant (P < 0.01) for VZ supplemented
diets (1.56 vs. 1.73 for VZ vs. C, respectively) but not for pelleted diets (1.60 vs. 1.69 for P vs. M, respectively). In feed assay of keratinase confirmed the presence of the enzyme activity in VZM and VZP feeds, but not in controls. These results indicate that Versazyme™ included diets are not affected by the pelleting process and do retain the previously documented positive growth effects.

Key Words: Broiler, Pelleting, Dietary protein, Protease, Keratinase

Environment & Management III


Poultry bedding availability issues are arising rapidly in the broiler industry that may alter the type and quality of bedding available to broiler growers. In the first of a series of planned trials, eight alternative bedding sources (pine shaving (PS), pine bark (PB); ground hard-wood pallets (GP); mortar sand (MS); chopped straw (CS); ground door filler (DF); cotton-gin trash (CT); and chipped pine (CP)) were compared in side-by-side experimental pens (20 birds per pen; 48 pens total). Mixed-sex birds were reared to 42 days of age on a three-phase commercial feeding program. In addition to broiler growth performance (weight gain, feed consumption, and mortality), litter caking scores and moisture (%), the incidence and severity of pododermatitis was assessed. Significant (P<0.05) differences in live performance were detected among the sources tested. At 42 d of age, broilers reared on MS were heavier (2415 g) and consumed more feed (4054 g/brd) than those reared on GP (2143 g and 3700 g), CS (2079 and 3700 g), and GT (2170 and 3709 g), respectively. Feed conversion (Range: 1.667-1.728) and mortality (Range: 1.85 to 7.33%) were not significant among treatments. Degree of litter caking was highest for CT (87%) and CS (67%), and lowest for PB (27%). MS had the lowest litter moisture (10.5%), followed by CP and GP (29%), whereas CS had the highest (39%). Incidence of pododermatitis ranged from 24 to 55%, with birds reared on CS and CP showing the highest severity scores (21 and 23%, respectively). Overall, PB and MS ranked better than PS. Subsequent trials should provide additional information on long-term durability of each bedding source.

Key Words: Broiler chickens, Bedding sources, Pododermatitis

T106 The effects of egg shape index on incubation results of layer breeders. B. Yilmaz Dikmen1 and S. Dikmen2, 1University of Uludag Keles Vocational School, Keles,Bursa,Turkey, 2University of Uludag, Gorukle,Bursa,Turkey.

The evaluation of some egg quality characteristics has been well documented for poultry species. However, information concerning the evaluation of egg shape index and its effects on hatchability is limited. The fertile poultry eggs have the highest probability of hatching success when their physical characteristics are average. The present study was carried out to determine the effect of egg shape index on incubation results of layer breeder eggs. A total of 360 eggs were used as study material. The eggs used in this study were obtained from Super Nick white layer breeder flock at 54 weeks of age. All eggs were obtained from the same breeder flock and laid within a 24 h period. The eggs were collected, sanitized and stored at 17-18 °C and 85% relative humidity (RH) for 4 days. Eggs were marked and measured their shape index separately before setting. The eggs were allocated in to three groups according to egg shape index low shape index (LSI) (shape index<73), normal shape index (NSI) (shape index 73 to 76), high shape index (HSI) (shape index>76). The eggs were incubated in an incubator at 37.2 °C and 55% RH for 18 days. On the 18th day of incubation, all eggs were candled and fertile eggs were placed in a separate chamber in the hatchery cabinet and the temperature and humidity were maintained at 36.7 °C and 60% RH until hatching. At the end of the incubation period, all hatched chicks counted, fertility, hatchability of hatched eggs, hatchability of total eggs, embryonic mortality were recorded and measured. Egg shape index was found 71.46 ± 0.02, 75.19 ± 0.01 and 78.51 ± 0.01 for LSI, NSI and HSI groups, respectively (P<0.01). The percentage of hatchability of fertile eggs and total eggs were found 89.03 ± 2.28, 96.39 ± 1.14, 87.42 ± 2.87 and 83.33 ± 6.67, 90.00 ± 2.89, 80.00 ± 2.89, respectively (P<0.01 and P<0.05). The percentage of total embryonic mortality of fertile eggs were found 10.97 ± 2.28, 5.41 ± 0.09 and 12.24 ± 3.04, respectively (P>0.05). These results indicate that eggs with NSI have the highest hatchening result which is one of the most important point for commercial breeder enterprises and hatcheries.

Key Words: Egg shape index, Hatchability, Embryonic mortality, Layer breeder

T108 The cost of winter litter cleanout. K. S. Macklin*1 and B. R. Bock2, 1Auburn University, Auburn, AL, 2B.R. Bock Consulting, Inc, Florence, AL.

Broiler litter clean-out is typically performed in the spring, fall and occasionally over the summer. Cleaning out in the winter is generally not performed, due to concerns over heating costs required to dry and heat the new bedding. We hypothesize that in a house that has built up litter, winter cleanout may make good economic sense. Ventilation required to keep ammonia levels acceptable in a house with built up litter, may be comparable to the costs of heating a house with new bedding. To test this hypothesis two commercial broiler farms in north AL were recruited and the testing began in February 2007. On each farm, two buildings had built up litter and two buildings were cleaned to the pad and had fresh pine saw dust added. Management for the houses was done according to how the grower typically would manage their broiler houses. This management included the use of litter treatment in the brood chamber to help control the ammonia associated with built up litter, no litter treatment was added to the clean bedding. Outside temperatures were relatively cold with some daily lows around 20 °F. The results of this study showed that farm A used 6,800 ft3/house more natural gas in heating houses with new bedding than on houses that contained built up litter. Farm B used 25 gallons/house more propane heating the new bedding compared to the houses that contained built up litter. Both farms had lower ammonia levels in the houses with the new bedding (29.3ppm) compared to houses with the built up litter (50.4ppm). At the end of the trial, there was approximately 2 times more cake in the houses with the new bedding compared to the ones with the built up litter. In conclusion, the use of new bedding material in the winter did lead to slightly higher heating costs; however the lower fan run times required to control ammonia and lack of needing a litter treatment makes winter cleanout a viable alternative to traditional cleanout times.

Key Words: Ammonia, Energy, Broiler
The poultry industry has an important roll to supply food production by livestock protein in developing countries including Iran. The major sections in poultry production in Iran consists of breeder and laying production, breeder and laying breeder production, hatchery and line breeder production. Commercial productions in Iran have changed more or less during 1999-2003. The number of farms for breeder, laying and breeder productions increased 4, 13 and 49%, respectively. Meanwhile the meat production increased to 1384000 tons, but egg product decreased by 24%. Occupation trend in breeder and breeder production was 49 and 36%, whereas this trend was -4% for laying hens. Although the amount of meat was increased, but only 80% of available capacity was used. This percent for laying industry was decreased from 87% to 71% by end of 2003. Regarding to increment of breeder farms, it was expected to obtain more one-day chickens. It was observed for broiler chickens up to 12%, but it had a negative trend for egg-type chickens. Also, feed conversion and mortality rates have been improved by increasing the knowledge of producers, and controlling the diseases. According to global statistical report in 2004, Iran had the 14th and 17th rank in meat and egg production in the world, respectively. As it is obvious, egg production and its related activities are being decreased. The most important reasons could be the instability of prices to supply feed stuff, lack of a comprehensive program to regulate the price of products, low interest for investment in laying production, and tax for egg exporting.

Key Words: Broiler production, Feed conversion, Laying hens, Occupation trend, Mortality

**T106 The effects of egg shape index on incubation results of layer breeders.** B. Yilmaz Dikmen1 and S. Dikmen1,1University of Uludag Keles Vocational School, Keles,Bursa,Turkey, 2University of Uludag, Goukule,Bursa,Turkey.

The evaluation of some egg quality characteristics has been well documented for poultry species. However, information concerning the evaluation of egg shape index and it is effects on hatchability is limited. The fertile poultry eggs have the highest probability of hatching success when their physical characteristics are average. The present study was carried out to determine the effect of egg shape index on incubation results of layer breeder eggs. A total of 360 eggs were used as study material. The eggs used in this study were obtained from Super Nick white layer breeder flock at 54 weeks of age. All eggs were obtained from the same breeder flock and laid within a 24 h period. The eggs were collected, sanitized and stored at 17-18 °C and 85% relative humidity (RH) for 4 days. Eggs were marked and measured their shape index separately before setting. The eggs were allocated in to three groups according to egg shape index low shape index (LSI) (shape index<73), normal shape index (NSI) (shape index 73 to 76), high shape index (HSI) (shape index>76). The eggs were incubated in an incubator at 37.2 °C and 55% RH for 18 days. On the 18th day of incubation, all eggs were candled and fertile eggs were placed in a separate chamber in the hatchet cabinet and the temperature and humidity were maintained at 36.7 °C and 60% RH until hatching. At the end of the incubation period, all hatched chicks counted, fertility, hatchability of hatched eggs, hatchability of total eggs, embryonic mortality were recorded and measured. Egg shape index was found 71.46 ± 0.02, 75.19 ± 0.01 and 78.51 ± 0.01 for LSI, NSI and HSI groups, respectively (P<0.01). The percentage of hatchability of fertile eggs and total eggs were found 89.03 ± 2.28, 96.39 ± 1.14, 87.42 ± 2.87 and 83.33 ± 6.67, 90.00 ± 2.89, 80.00 ± 2.89, respectively (P<0.01 and P<0.05). The percentage of total embryonic mortality of fertile eggs were found 10.97 ± 2.28, 5.41 ± 0.09 and 12.24 ± 3.04, respectively (P>0.05). These results indicate that eggs with NSI have the highest hatchling result which is one of the most important point for commercial breeder enterprises and hatcheries.

Key Words: Egg shape index, Hatchability, Embryonic mortality, Layer breeder

**T107 Alternative bedding sources for rearing broiler chickens.** S. F. Bilgili*, J. B. Hess, J. P. Blake, K. S. Macklin, and J. L. Sibley, Auburn University, Auburn, AL.

Poultry bedding availability issues are arising rapidly in the broiler industry that may alter the type and quality of bedding available to broiler growers. In the first of a series of planned trials, eight alternative bedding sources [pine shaving (PS), pine bark (PB), ground hard-wood pallets (GP); mortar sand (MS); chopped straw (CS); ground door fillier (DF); cotton-gin trash (CT); and chipped pine (CP)] were compared in side-by-side experimental pens (20 birds per pen; 48 pens total). Mixed-sex birds were reared to 42 days of age on a three-phase commercial feeding program. In addition to broiler growth performance (weight gain, feed consumption, and mortality), litter caking scores and moisture (%), the incidence and severity of pododermatitis was assessed. Significant (P<0.05) differences in live performance were detected among the sources tested. At 42 d of age, broilers reared on MS were heavier (2415 g) and consumed more feed (4054 g/bird) than those reared on GP (2143 and 3700 g), CS (2079 and 3700 g), and GT (2179 and 3709 g), respectively. Feed conversion (Range: 1.667-1.728) and mortality (Range: 1.85 to 7.33%) were not significant among treatments. Degree of litter caking was highest for CT (87%) and CS (67%), and lowest for PB (27%). MS had the lowest litter moisture (10.5%), followed by CP and GP (29%), whereas MS had the highest (39%). Incidence of pododermatitis ranged from 24 to 55%, with birds reared on CS and CP showing the highest severity scores (21 and 23%, respectively). Overall, PB and MS ranked better than PS. Subsequent trials should provide additional information on long-term durability of each bedding source.

Key Words: Broiler chickens, Bedding sources, Pododermatitis

**T108 The cost of winter litter cleanout.** K. S. Macklin1 and B. R. Bock2,1Auburn University, Auburn, AL; 2B.R. Bock Consulting, Inc, Florence, AL.

Broiler litter clean-out is typically performed in the spring, fall and occasionally over the summer. Cleaning out in the winter is generally not performed due to concerns over heating costs required to dry and heat the new bedding. We hypothesize that in a house that has built up litter, winter cleanout may make good economic sense. Ventilation required to keep ammonia levels acceptable in a house with built up litter, may be comparable to the costs of heating a house with new bedding. To test this hypothesis two commercial broiler farms in north AL were recruited and the testing began in February 2007. On each farm, two buildings had built up litter and two buildings were cleaned to the pad and had fresh pine saw dust added. Management for the houses was done according to how the grower typically would manage their broiler houses. This management included the use of litter treatment in the brood chamber to help control the ammonia associated with built up litter, no litter treatment was added to the clean bedding. Outside temperatures were relatively cold with some daily lows around 20 °F.

The results of this study showed that farm A used 6,800 ft3/house more natural gas in heating houses with new bedding than on houses that contained built up litter. Farm B used 25 gallons/house more propane heating the new bedding compared to the houses that contained built up litter. Both farms had lower ammonia levels in the houses with the new bedding (29.5ppm) compared to houses with the built up litter (50-4ppm). At the end of the trial, there was approximately 2 times more cake in the houses with the new bedding compared to the ones with the built up litter. In conclusion, the use of new bedding material in the winter did lead to slightly higher heating costs; however the lower fan run times required to control ammonia and lack of needing a litter treatment makes winter cleanout a viable alternative to traditional cleanout times.

Key Words: Ammonia, Energy, Broiler
**T109** Evaluation of probiotic and phytogenetic products on the development of Necrotic enteritis in poultry. J. L. McReynolds1, J. A. Byrd1, R. Beltran2, and D. J. Nisbet1, 1USDA-ARS-SPARC-FFSRU, College Station, TX, 2Bomin USA Inc., San Antonio, TX.

In the commercial poultry industry there are many management tools used to control enteric pathogens including antibiotics, vaccines, prebiotics, and competitive exclusion cultures. The evaluation of probiotics and phytogenetic products as alternatives to antibiotics are becoming more appealing to the commercial industry because of consumer demands to remove antibiotics. Our laboratory is interested in using these products to control *Clostridium perfringens*(CP), a Gram positive organism associated with lower levels of performance and health. Controlling this organism will also help prevent the development of Necrotic enteritis NE in commercial poultry. The present investigation evaluated a probiotic culture (Bomin PoultryStarsTM) and a phytogenetic product that were administered to birds from day of hatch until termination(d 25) via the drinking water or through a wheat/corn diet respectively. Birds were administered CP (107 cfu/mL) daily via oral gavage for three consecutive days starting on d 17. The probiotic and phytogenetic treatment groups were significantly lower (P < 0.05) than the controls. The log10 values of CP were not significantly reduced in the phytogenetic treatment group. These experiments suggest that this probiotic culture and phytogenetic product could be used as a potential alternative to help control this costly disease.

**Key Words:** Necrotic enteritis, *Clostridium perfringens*, Chickens, Probiotic, Phytogenetic

---

**T110** Effect of 10% dietary DDGS on laying hen manure ammonia emissions, pH, and solids content. E. C. Hale III1, Rose Acre Farms, Seymour, IN.

120 Hy-Line W36 hens were housed in cages containing 5 hens/cage, which were further grouped into units of 20 hens/unit. 3 units were fed an industry standard diet consistent with the nutritional requirements of the bird, and the remaining 3 units were fed a nutritionally equivalent diet containing 10% DDGS. The diets were fed for a total of 6 weeks.

At the end of each week, freshly excreted manure (less than 4 hours post-excretion) was collected and analyzed for manure pH, solids content. Additionally, the amount of ammonia emitted per day was determined for a total of 4 consecutive days. Manure ammonia emissions were reduced by an average of 16.9% over the period of the study, manure pH was reduced by 0.25 SU, and manure solids content was increased by 2.36%.

**Key Words:** DDGS, Manure, Laying hen, Ammonia emissions, Diet

---

**T111** Affect of photoperiods and light intensities meeting US and European guidelines on measures of psychological stress and mobility in broilers. R. J. Lien* and J. B. Hess, Auburn University, Auburn, AL.

Broilers were subjected to photoperiods and intensities which independently meet US National Chicken Council (NCC) or proposed European Union (EU) guidelines to determine effects on psychological stress or fear responses and mobility. Seventy broilers were placed in each of 12 light controlled rooms. Six rooms were subjected to NCC photoperiods (long) (wk 1, 23L:1D: wk 2-6 20L:4D; wk 7, 23L:1D) and six to EU photoperiods (short) (d 1-3, 23L:1D; d 4-46, 14L:4D:2L:4D; d 47-49, 23L:1D). Half of the rooms of each photoperiod treatment were subjected to common US intensities (dim) (wk 1, 0.25 footcandles [FC]); wk 2-7, 0.025 FC) and half to EU intensity (bright) (wk 1-7, 2 FC). Photoperiod and intensity treatments made up a 2X2 factorial arrangement with 3 replicate rooms of each interaction treatment. TI, perching on stair-stepped perch poles, sitting or standing on 15 cm high raised platforms (decking), mobility as judged by the ability to climb onto the raised platforms to feed, and reactions to the introduction of a black chicken into the room (intrusion) were determined during wk 4 and 7.

Neither photoperiod nor intensity affected TI. The incidence of perching averaged less than 0.2%, was increased by bright intensity during wk 4, and unaffected by treatment during wk 7. Decking averaged over 6%, and was increased by bright intensity during wk 4 and 7. Mobility was increased by bright intensity during wk 4 and 7. Reactions of fear and aggression in response to intruder were greater under bright intensity during wk 4 and 7. These results indicate that psychological stress or fear responses may be increased by bright intensities specified by EU guidelines, but appear unaffected by photoperiod. Mobility also is increased by brighter intensities but unaffected by these photoperiods.

**Key Words:** Broiler chicken, Photoperiod, Light intensity, Stress, Welfare

---

**T112** Validation of a gait scoring system for field assessment of walking ability of commercial broilers. A. B. Webster*, B. D. Fairchild1, T. S. Cummings2, and P. A. Stayer1, 1University of Georgia, Athens, 2Mississippi State University, Starkville, 3Sanderson Farms, Laurel, MS.

A 3-category US gait scoring system used to evaluate broiler walking ability in welfare audits of commercial flocks was compared with the 6-category Kestin system. In two university trials, 6-wk-old broilers were gait scored by two observers for each scoring system (n=681 broilers). A sub-sample of birds was rescored and used in latency-to-lie (LTL) tests. Too few birds had significant walking difficulties to allow for comprehensive statistical comparison of the two scoring systems, but the data were encouraging despite sampling limitations. There was a significant association between the two systems and both had substantial inter-observer agreement. Both scoring systems had significant correlations with latency-to-lie but the variation of LTL was too high to give gait score or LTL much predictive value for each other. For the field observations, two teams of observers scored broilers 47 to 61 days of age on 5 commercial farms each (n=1381 broilers). Two pairs of observers scored the same birds, each pair using the US system or the Kestin system. Broilers with evident walking problems were oversampled to generate adequate numbers in each gait score category. Weighted Kappa statistics showed substantial inter-observer agreement in each system, but more so in the US system (K=0.65 vs 0.78, Kestin vs. US, respectively), suggesting that the application of the US system was more consistent between observers. Spearman correlations between US and Kestin scores for individual birds had high statistical significance (P<0.001) and indicated strong correspondence between the two systems. The simplicity of the US gait scoring system aids inter-observer agreement, making it preferable to more complex systems for use in commercial welfare audits. The strong correspondence between the US and Kestin systems validates the 3-category system in light of the well-known 6-category system.

**Key Words:** Broiler, Gait score, US gait score system, Kestin gait score system, Animal welfare

---

**T113** Fungi collected from market-age broilers under commercial conditions. J. A. Byrd*, M. B. Farnell2, M. X. Sanchez2, J. L. McReynolds1, H. M. Scott1, M. A. Davis2, D. J. Caldwell2, and D. J. Nisbet1, 1USDA-ARS-SPARC-FFSRU, College Station, TX, 2Texas A&M University, College Station.

Fungi collected from two commercial broiler houses without a history of mycotoxicosis was studied under normal production conditions. Normally, fungi are generally ignored unless clinical signs are reported. Probiotics have demonstrated that beneficial bacteria can play a role in improving productions parameters while most have ignored the impact that fungi may have on production. The goal of the present study was to record changes in fungi recovered from a commercial broiler house during production and relate these changes to foodborne pathogens. Using an automated repetitive sequence based PCR (rep-PCR) methodology to track changes fungal changes during successive grow-out flocks, different fungal and yeast genera were identified including: *Rhizopus* spp., *Aspergillus* spp., *Fusarium* spp., *Trichophyton* spp., *Coccidioides* spp, and *Curvularia*. The relationship between these fungi and environmental parameters are presented for each sampling point throughout production and within the processing plant. Generalized fungal growth patterns found in the litter and recovered from the broilers are described and the relationship between environmental factors and foodborne pathogens on these patterns are described.

**Key Words:** Fungi, Chickens, Broiler
**T114** Chick quality assessment: Visual scoring or chick length? M. Petek*, A. Orman, F. Alpay, and S. Dikmen, University of Uludag, Bursa, Turkey.

Experience and research demonstrated that the quality of the day-old chick has a big influence on the growth and final performance of the broiler. Describing and measuring chick quality is considered to be very difficult. Visual score, Tona or Pascor score, day-old chick weight and chick length are commonly used for measuring chick quality. Visual scoring include color of the chicken's, navel quality, feather development, the firmness of legs, the size of beak and eyes etc. Although visual scoring gives a good estimates on the quality of the day old chicks, it is a subjective measuring. Usually chick weight is used as an indicator for chick quality. But measuring yolk free body mass is rather laborious and has limited practical for field evaluation. One of the practical way employed to measure chick development is to determine the length of the chicken. By the present study, we planned to compare different methods in order to determine the optimal one as chick quality indicator. For this reason; 480 day old male chicks were used. Chicks were classified into two groups on the basis of feather color: deep and light yellow. Then, chicks in each group was further divided into three groups as small, middle and large according to their body length. The length of the middle group birds was varied between 18.0-18.3 cm, while that of the largest group was greater than 18.3 cm and the small group was less than 18.0 cm. A positive correlation between chick length at day 0 and chick weight at subsequent was observed. On the other hand there was no significant differences when the chicks were evaluated by taking into account their colors, except for first week. The measured body weight of chicks in deep yellow groups was greater compared to light yellow ones during the first week. Consequently; chick length was determined as an important criteria to evaluate chick quality since longer chicks exhibited better growth potential.

**Key Words:** Chick quality, Visual scoring, Chick length, Growth

**Nutrition VI**

**T115** An estimation of the energy value of B-Mannanase (Hemicell® Feed Enzyme) in turkey toms under practical conditions using varying energy levels. M. E. Jackson*1, K. R. Stephens1, M. W. Greenwood2, and G. F. Mathis3, 1ChemGen Corp., Gaithersburg, MD, 2Akey Inc., Lewisburg, OH, 3Southern Poultry Research, Athens, GA.

Five dietary treatments consisting of four energy feeding programs (Low Metabolizable Energy (LE), LE + 45, LE + 135, and LE + 180 Kcal/kg) and the LE program with a target β-mannanase added at 100 MU/ton (LE+M) were provided to 8 replicate pens with 8 Nicholas male turkeys per pen. Diets were corn-soybean meal based containing 3-7.5% animal by-product meal. All diets were assayed for proximate composition and β-mannanase activity. The feeding programs consisted of 7 diets provided from 0-3, 3-6, 6-9, 9-12, 12-15 18-18 and 18-20 weeks of age. Liquid enzyme or water was applied to all pelleted diets. Body weight was determined at 0, 3, 6, 9, 12, 15, 18, and 20 weeks of age and feed consumption was determined between these ages. The LE treatment varied from 2910 Kcal/kg from 0-3 weeks to 3329 Kcal/kg from 18-20 weeks of age. Improvements in weight gain and feed conversion were observed with each increase in energy level during all periods demonstrating that the birds consistently responded to energy density. B-Mannanase improved feed conversion from 0-20 weeks by 20.7 points, (P<0.05) and improved final weights by 5.8% (P<0.05). Weight-adjusted feed conversion at 20 weeks of age for the LE+M treatment was between the LE+135 and LE+180 Kcal/kg ME treatments suggesting that the energy uplift of the enzyme lies between these values under the practical conditions of this study.

**Key Words:** B-Mannanase, Hemicell, Body Weight, Feed Conversion, Energy Uplift


European broiler diets based on wheat and soya normally contain only xylan and β-glucanase enzymes. A very large broiler pen trial was conducted to evaluate the effect of a commercial endo-β-D-mannanase (Hemicell®) on the technical performance of broilers from 0 to 37 days of age. A one-factorial, block-designed experiment was set up with 13,680 hatched Ross 308 chicks. The trial was executed at the practical trial facilities of the Schotthorst Feed Research. Starter (0-10 days), grower (11-27 days) and finisher (28-37 days) diets were formulated with wheat as the main cereal. Narasin/nicarbazin (50/50 ppm) and salinomycin (65 ppm) were used in the starter and grower diets in order to control coccidi- osis. Aromabiotic was added as an alternative growth promoter in the starter and grower diets, and a commercial xylanase was included in all diets. The treatments were: (1) control diet and (2) control diet with 0.05% endo-β-D-mannanase added in the grower and finisher diets. Eight replicate pens per treatment were used, with 855 broilers in each pen. Mash feed and water were available for ad libitum consumption. Endo-β-D-mannanase supplementation resulted in a significantly higher body weight compared to the control diet (2173 g vs. 2138 g) (P<0.05) and a significant improvement in feed conversion (1.615 vs. 1.636) (P<0.05). The litter score, determined on day 23, was significantly better (P<0.05) for the endo-β-D-mannanase supplemented diet. These results indicate that endo-β-D-mannanase (Hemicell®) supplementation improves the technical performance and litter conditions of broilers fed wheat/soya-based diets.

**Key Words:** Enzyme supplementation, B-mannanase, Broiler, Wheat, Soyabean meal-based feeding program. E. B. Helmets, H.-Y. Hsiao1, M. E. Jackson*1, and A. Knox, 1ChemGen Corp., Gaithersburg, MD, 2Roslin Nutrition Ltd., Midlothian, Scotland.

The goal of this pen trial was to study the effects of the enzyme β-mannanase in broiler rations typical of central and northern Europe where wheat (average 64%) and soybean meal (average 27%) are the primary ingredients. Energy was reduced by 3-4% to test the hypothesis that β-mannanase compensates for lower dietary energy. To date, most studies using β-mannanase were conducted in corn-based rations. Three treatments, normal energy (NE), low energy (LE), and LE+β-mannanase (LE+M) were tested with four diets and each treatment was comprised of 16 randomly blocked pens (40 birds/pen) of Ross 308 males; measurements were taken at 3 and 6 weeks. A commercial xylanase was used in all treatment diets. Litter quality was scored at 6 weeks by visual inspection and moisture analysis of random samples. The observed results included lower weight-adjusted feed conversion (WAFC) for the LE+M group (1.685) versus the LE group (1.752) (P<0.05), and a trend to lower WAFC for LE+M group compared to the NE group (1.698). Average weight gain was similar for the LE+M group (2730 g) and NE group (2724 g); both of these groups showed significantly higher weights than the LE group (2640 g) (P<0.05). Mortality and litter quality results did not differ among the treatment groups. One may conclude that β-mannanase significantly improves broiler growth and feed conversion in reduced-energy wheat/soya bean meal-based diets containing xylanase, but has no effect on mortality or litter quality.

**Key Words:** Enzyme, Wheat, B-mannanase, Soybean meal, Broiler

Experience and research demonstrated that the quality of the day-old chick has a big influence on the growth and final performance of the broiler. Describing and measuring chick quality is considered to be very difficult. Visual score, Tona or Pascor score, day-old chick weight and chick length are commonly used for measuring chick quality. Visual scoring include color of the chickens, navel quality, feather development, the firmness of legs, the size of beak and eyes etc. Although visual scoring gives a good estimates on the quality of the day old chicks, it is a subjective measuring. Usually chick weight is used as an indicator for chick quality. But measuring yolk free body mass is ratherly laborious and has limited practical for field evaluation. One of the practical way employed to measure chick development is to determine the length of the chicken. By the present study, we planned to compare different methods in order to determine the optimal one as chick quality indicator. For this reason; 480 day old male chicks were used. Chicks were classified into two groups on the basis of feather color: deep and light yellow. Then, chicks in each group was further divided into three groups as small, middle and large according to their body length. The length of the middle group birds was varied between 18.0-18.3 cm, while that of the largest group was greater than 18.3 cm and the small group was less than 18.0 cm. A positive correlation between chick length at day 0 and chick weight at subsequent days was observed. On the other hand there was no significant differences when the chicks were evaluated by taking into account their colors, except for first week. The measured body weight of chicks in deep yellow groups was greater compared to light yellow ones during the first week. Consequently; chick length was determined as an important criteria to evaluate chick quality since longer chicks exhibited better growth potential.

Key Words: Chick quality, Visual scoring, Chick length, Growth

Nutrition VI

T115 An estimation of the energy value of B-Mannanase (Hemicell® Feed Enzyme) in turkey toms under practical conditions using varying energy levels. M. E. Jackson1*, K. R. Stephens1, M. W. Greenwood2, and G. F. Mathis3, 1ChemGen Corp., Gaithersburg, MD, 2Akey Inc., Lewisburg, OH, 3Southern Poultry Research, Athens, GA.

Five dietary treatments consisting of four energy feeding programs (Low Metabolizable Energy (LE), LE+135, LE+180 Kcal/kg) and the LE program with a target β-mannanase added at 100 MU/ton (LE+M) were provided to 8 replicate pens with 8 Nicholas male turkeys per pen. Diets were corn-soybean meal based containing 3-7.5% animal by-product meal. All diets were assayed for proximate composition and β-mannanase activity. The feeding programs consisted of 7 diets provided from 0-3, 3-6, 6-9, 9-12, 12-15 18-20 weeks of age. Liquid enzyme or water was applied to all pelleted diets. Body weight was determined at 0, 3, 6, 9, 12, 15, 18, and 20 weeks of age and feed consumption was determined between these ages. The LE treatment varied from 2910 Kcal/kg from 0-3 weeks to 3329 Kcal/kg from 18-20 weeks of age. Improvements in weight gain and feed conversion were observed with each increase in energy level during all periods demonstrating that the birds consistently responded to energy density. B-Mannanase improved feed conversion from 0-20 weeks by 20.7 points, (P<0.05) and improved final weights by 64% (P<0.05) and improved final weights by 5.8% (P<0.05). Weight-adjusted feed conversion at 20 weeks of age for the LE+M treatment was between the LE+135 and LE+180 Kcal/kg ME treatments suggesting that the energy uplift of the enzyme lies between these values under the practical conditions of this study.

Key Words: B-Mannanase, Hemicell, Body Weight, Feed Conversion, Energy Uplift


European broiler diets based on wheat and soya normally contain only xylanase and β-glucanase enzymes. A very large broiler pen trial was conducted to evaluate the effect of a commercial endo-β-D-mannanase (Hemicell®) on the technical performance of broilers from 0 to 37 days of age. A one-factorial, block-designed experiment was set up with 13,680 hatched Ross 308 chicks. The trial was executed at the practical trial facilities of the Schothorst Feed Research. Starter (0-10 days), grower (11-27 days) and finisher (28-37 days) diets were formulated with wheat as the main cereal. Narasin/nicarbasin (50/50 ppm) and salinomycin (65 ppm) were used in the starter and grower diets in order to control coccidiosis. Aromatobiotic was added as an alternative growth promoter in the starter and grower diets, and a commercial xylanase was included in all diets. The treatments were: (1) control diet and (2) control diet with 0.05% endo-β-D-mannanase added in the grower and finisher diets. Eight replicate pens per treatment were used, with 855 broilers in each pen. Mash feed and water were available for ad libitum consumption. Endo-β-D-mannanase supplementation resulted in a significantly higher body weight compared to the control diet (2173 g vs. 2138 g) (P<0.05) and a significant improvement in feed conversion (1.615 vs. 1.636) (P<0.05). The litter score, determined on day 23, was significantly better (P<0.05) for the endo-β-D-mannanase supplemented diet. These results indicate that endo-β-D-mannanase (Hemicell®) supplementation improves the technical performance and litter conditions of broilers fed wheat/soya-based diets.

Key Words: Enzyme supplementation, B-mannanase, Broiler, Wheat, Soya

T117 The effect of β-mannanase (Hemicell®) on broiler weight gain, feed conversion, mortality, and litter traits in a reduced energy, wheat-soybean meal-based feeding program. E. B. Helmes1, H.-Y. Hsiao1, M. E. Jackson1*, and A. Knox2, 1ChemGen Corp., Gaithersburg, MD, 2Roslin Nutrition Ltd., Midlothian, Scotland.

The goal of this pen trial was to study the effects of the enzyme β-mannanase in broiler rations typical of central and northern Europe where wheat (average 64%) and soybean meal (average 27%) are the primary ingredients. Energy was reduced by 3-4% to test the hypothesis that β-mannanase compensates for lower dietary energy. To date, most studies using β-mannanase were conducted in corn-based rations. Three treatments, normal energy (NE), low energy (LE), and LE+β-mannanase (LE+M) were tested with four diets and each treatment was comprised of 16 randomly blocked pens (40 birds/pen) of Ross 308 males; measurements were taken at 3 and 6 weeks. A commercial xylanase was used in all treatment diets. Litter quality was scored at 6 weeks by visual inspection and moisture analysis of random samples. The observed results included lower weight-adjusted feed conversion (WAFC) for the LE+M group (1.685) versus the LE group (1.752) (P<0.05), and a trend to lower WAFC for LE+M group compared to the NE group (1.698). Average weight gain was similar for the LE+M group (2730 g) and NE group (2724 g); both of these groups showed significantly higher weights than the LE group (2640 g) (P<0.05). Mortality and litter quality results did not differ among the treatment groups. One may conclude that β-mannanase significantly improves broiler growth and feed conversion in reduced-energy wheat/soya bean-based diets containing xylanase, but has no effect on mortality or litter quality.

Key Words: Enzyme, Wheat, B-mannanase, Soybean meal, Broiler

T118 Effects of ultraviolet light irradiation on hatchability of floor eggs from White Leghorns. C. Coufal*, J. Wells, H. Parker, and C. McDaniel, Mississippi State University, Mississippi State, MS.

Eggs laid on the floor that appear nest-clean are often collected and sent to the hatchery along with eggs laid in the nest. However, the microbial load of eggs laid on the floor can be much greater than that of eggs laid in the nest. It is generally assumed that, because floor eggs are heavily contaminated with bacteria,
T119 Effect of feeding programs during mixed-sex rearing of broiler breeders on reproductive performance and livability. J. T. Brace and N. Lekrisompong, North Carolina State University, Raleigh.

An experiment was conducted to evaluate two feeding programs during rearing on subsequent broiler breeder reproductive performance and livability. Heritage 78 males and Heritage 32 females were reared separately to 5 wk of age on a 17% dietary supplemental level of 12 ppm Zn as Bioplex Zn® in entire period; 6) control + 12 ppm Zn as Bioplex Zn® in starter phase + no Zn in grower phase; 5) control + 12 ppm Zn as Bioplex Zn® in entire period; 6) control + 12 ppm Zn as Bioplex Zn® in starter phase + 24 ppm Zn as Bioplex Zn® in grower phase. A total of 660 chicks was randomly assigned to each of six dietary treatments with five replicate pens of 22 chicks. Chicks fed dietary treatments 1), 3) and 4) showed Zn deficiency symptom with lower (P=0.01) feed intake, weight gain and tibia Zn content comparing with other treatment groups. Dietary supplementation of 40 ppm Zn as zinc sulfate had the same effects on feed intake, weight gain and tibia Zn content of chicks as dietary supplementation of 12 ppm Zn as Bioplex Zn® in entire period. Chicks fed diet supplemented with 12 ppm Zn as Bioplex Zn® in starter phase and 24 ppm Zn as Bioplex Zn® in grower phase had the same feed intake and weight gain, but higher (P<0.01) tibia Zn content comparing with chicks fed diet supplemented with 12 ppm Zn as Bioplex Zn® in entire phase. These results indicate that the supplemental level of 12 ppm Zn as Bioplex Zn® in corn-soy diet has the same effects on performance and tibia Zn content of broiler chicks as supplemental level of 40 ppm Zn as zinc sulfate.

Key Words: Broiler chick, Zinc, Organic zinc, Zinc sulfate, Requirement

T122 Organic trace minerals (Mintrex® P) in broiler breeder diets and pre-incubation conditions on bone development and leg health of broilers. E. O. Oviedo-Rondón1, L. Meija-Sanchez2, J. Small3, K. E. Brannan1, N. Lekrisompong2, A. Mitchell1, T. A. York1, and J. Brake4, 1North Carolina State University, Raleigh, 2USDA - ARS, ANRI, Beltsville, MD, 3Novus International, Inc., Chesterfield, MO.

Leg health issues and bone disorders are developmental problems that may be increased by environmental stress, inadequate nutrition, and improper incubation conditions. Organic trace minerals (OTM) as Mintrex® P were added on top (1 kg/MT) of Ross 708 broiler breeder diets from start of lay. Eggs from the flock at 35 wk of age were then pre-incubated in either NON-UNIFORM conditions at 23.9°C without forced air movement for 9 h or in UNIFORM conditions at 26.7°C with forced air movement for 11 h. All eggs were therefore incubated in a similar manner and exposed to elevated temperatures in the hatchers. Bone development was evaluated in 20 chicks per treatment at hatch. Chicks were grown to 49 d of age in 48 floor pens. Gait scores and leg disorders were observed at 40 d of age and incidence per pen was determined. Broilers were processed at 49 d and both tibias collected. Tibia mineral density (BMD) and bone mineral content (BMC) were determined with DEXA. Data was analyzed as 2x2 completely randomized factorial design with breeder diet (Control vs OTM) and egg pre-heating (NON-UNIFORM vs UNIFORM) as main effects. Results indicated that treatments did not affect chick BW or yolk utilization at hatch. However, UNIFORM pre-incubation caused lower relative weights of femur and tibia, shorter femur and tibia, and higher relative asymmetry of tibias and shanks. Chicks from breeders fed added OTM had thicker shanks and lower shank length relative asymmetry. The incidence of twisted legs at 40 d was affected by both breeder diet and egg pre-heating treatments. UNIFORM pre-incubation reduced incidence of twisted legs. Breeder diets with added OTM produced broilers with a lower incidence of gait score 2 (P≤0.01) or any gait score ≥1. BMD and BMC were not affected by treatments, but the relative asymmetry in BMD was reduced (P = 0.08) by added OTM in breeder diets. It was concluded that added OTM in breeder diets can improve bone development and gait scores in the progeny, and pre-incubation conditions may affect bone development and reduce bone disorders in broilers.

Key Words: Leg health, Organic trace minerals, Broiler breeders, Incubation, Broilers

T122 Effects of spray characteristics on application of avian vaccines. J. L. Parswell1, B. K. Fritz2, S. L. Branton1, and S. A. Leigh3, 1USDA, ARS, Poultry Research Unit, Mississippi State, MS, 2USDA, ARS, Area-Wide Pest Management Research Unit, College Station, TX.

Optimization of vaccine delivery via spray application of live Mycoplasma gallicpticum (MG) vaccine to commercial caged layer chickens is impacted by...
many factors. One of these factors is the pressure utilized to dispense the vaccine, which affects both delivery rate and droplet size. MG vaccine was applied using a self-propelled, constant speed vaccinator operated at two different pressures and using three different nozzle types, designated coarse, medium, and fine by the supplier. Droplet size and as-applied coverage and deposition were measured to determine the effects of system pressure and nozzle type on spray characteristics. Vaccine viability was also assessed to determine how viability is affected by the spray application process.

Volume median diameter (VMD) varied with nozzle type and pressure, with the fine nozzle at 310.2 kPa yielding the largest mean VMD of 192.9 µm. However, the lowest mean VMD observed was 154.2 µm for the coarse nozzle at 448.1 kPa; while statistically different, this represents a narrow range in VMD of 38.7 µm. Negligible amounts of respirable droplets (< 10 µm) were observed for any treatment. Coverage and deposition were greatest for the coarse nozzle, followed by the medium and fine nozzles. Vaccine viability appears to be unaffected by any of the treatments tested. The relative similarity of droplet sizes coupled with the disparity of coverage and deposition between nozzle types indicated that delivery rate is of greater concern than droplet size, especially given the negligible amount of respirable droplets observed.

Key Words: Vaccination, Layer, Chickens, Spray, Application


The serological response (SPA test) to F strain Mycoplasma gallisepticum (FMG) vaccine in a single strain of commercial layer chickens on a single farm was chronicled over a five year period. During the five year period, various factors were identified impacting seroconversion including spray nozzles (fine, medium and coarse), water temperature used to reconstitute and administer the vaccine, water pH, water osmolarity and pressure used to apply the vaccine. The foregoing factors were integrated into the FMG vaccine administration protocol and progressive improvement in seroconversion was evidenced ranging from an initial 55% to a present seroconversion rate of 100%.

Key Words: Layer, Poultry, Chicken, Vaccination, Egg

T124  The effect of egg storage period and turning frequency during incubation on fertile hatchability, hatching organ weights, and broiler performance.  N. Okur¹, S. U. Saryiuz², M. Turkoglu³, O. Elibol¹, and J. T. Brake*², ¹Ankara University, Ankara, Turkey; ²North Carolina State University, Raleigh.

This study investigated the effects of egg storage period and turning frequency during incubation on hatchability, hatching organ weights, and broiler performance. Hatching eggs were obtained from Ross 344 male x Ross 308 female broiler breeders at 56 wk of age. Eggs were stored for 2 or 10 d at 18 C and 75% RH prior to setting in Petersime setters in a commercial hatchery. Single-stage setters were operated at 32 C WB until E 10 of incubation with air inlets closed and from E 11 to E 19 of incubation at 29-22 C WB with air inlets open. An incubation tray of 150 eggs constituted a replicate and each treatment group had twenty replicate trays. Eggs were turned either hourly (24X) or four times hourly (96X) to E 19. Chicks were necropsied at 504 h of incubation to determine BW and weights of the heart, liver, gizzard, and yolk sac. There were 480 0-d-old male chicks assigned to floor pens in a 2 X 2 factorial design with 6 replicate pens of 20 birds each. The same feeding, management, and immunization program was used for all square meter pens. BW, feed consumption, and livability were determined at 14 and 35 d. The 10 d storage period decreased fertile hatchability and 96X turning improved fertile hatchability. Percentage yolk sac was increased but percentage liver, heart, and gizzard were decreased by the 10 d storage period. Percentage heart was significantly greater due to 96X turning. Hatchling BW was increased but broiler BW was decreased at 14 and 35 d by 10 d storage. The 96X turning frequency increased BW only at 21 d. These data showed that increased frequency of egg turning during incubation improved fertile hatchability but that 10 d of egg storage decreased fertile hatchability, changed the development of broiler chick organs, and decreased broiler growth.

Key Words: Broilers, Incubation, Egg storage, Turning
P125 A simple PCR assay for differentiation of Mycoplasma gallisepticum vaccine strains ts-11, 6/85, and F strain from commonly used Mycoplasma gallisepticum challenge strains. J. D. Evans* and S. A. Leigh, Poultry Research Unit, USDA-ARS, Mississippi State.

Mycoplasma gallisepticum (MG) is an important avian pathogen causing significant economic losses within the poultry layer industry. To limit these losses, commercially available vaccine or attenuated strains of MG are commonly used within the layer industry to control MG-induced mycoplasmosis. The route by which these attenuated strains impart protection from field strain challenge remains a subject of much debate. Further, the application of these attenuated strains can complicate MG diagnostics. In an effort to develop tools to aid in MG research and diagnostics, we have compared available MG sequences of the attenuated vaccine strains to those of the sequenced pathogenic MG strain Rlow in search of a means to easily differentiate attenuated from pathogenic strains of MG. Via gap4 sequence alignments and comparisons, we have identified and designed primers toward strain differentiation. Application of primers toward a conventional PCR assay demonstrated differentiation by production of a sole ≈220 bp product by the attenuated MG strains ts-11, 6/85, and F strain and no product from Rlow and other commonly-used laboratory challenge/pathogenic strains (S6 and R strain). Further trials demonstrated that lowering the annealing temperature from 60°C to 55°C increased product formation from the attenuated vaccine strains. The results demonstrate the suitability of these primers for real-time PCR analyses towards differentiation of attenuated and laboratory challenge strains of MG.

Key Words: Mycoplasma gallisepticum, Mycoplasmosis, Diagnostics, Attenuated Vaccine

P126 Primer sequence-independent full genome amplification and sequencing of the vg/ga strain of Newcastle disease virus. F. Perozo*,1, P. Villegas1, and C. Afonso2,1Poultry Diagnostic and Research Center, Athens, GA, 2South East poultry Research Laboratory, Athens, GA.

The Villegas-Glisson Newcastle disease virus strain from the University of Georgia (VG/GA) was isolated from the intestine of healthy turkeys and has been demonstrated to replicate in the respiratory and intestinal tract of chickens. Field experiences have shown that the VG/GA is useful in the control of velogenic-viscrotropic strains which preferentially target the intestinal tract of the birds. The differential replication pattern that diminishes the damage to the respiratory tract and an improved local immunity represented by increased IgA production in the intestinal tract are the unique features of the vaccine. In order to assess the genomic base of its tissue tropism, a modified primer sequence-independent amplification method was used to obtain the complete nucleotide sequence of the VG/GA strain. The VG/GA genome was compared to full genome Newcastle disease virus (NDV) sequences available in the Gene bank. The VG/GA strain groups within the class II, genotype II viruses that correspond to most of the respirotropic vaccine strains used in the poultry industry and differed from lentogenic enterotropic strains that belong to the class II in the genotype I. The composition of the VG/GA strain genes and proteins were compared with those of the LaSota strain, differences were observed at both the nucleotide and amino acid levels. The changes observed in proteins associated with tissue tropism may explain the differential phenotype of the VG/GA. Further studies including the generation of a reverse genetic system for the VG/GA are required to verify the significance of those changes.

Key Words: VG/GA strain, Genome, Tropism

P127 Susceptibility of five migratory aquatic birds to H5N1 highly pathogenic avian influenza virus (A/Chicken/Korea/IS/06). Y. K. Kwon* and D. E. Swayne, Southeast Poultry Research Laboratory, Athens, GA.

It is not known that which migratory aquatic species are important in spreading H5N1 highly pathogenic avian influenza (HPAI-H5N1 viruses, and the pathobiology of infections by such viruses. The objective of this investigation was to assess the susceptibility of Mute swans (Cygnus olor), Greylag goose (Anser anser), Ruddy Shelducks (Tadorna ferruginea), Mandarin Ducks (Aix galericulata) and Mallard ducks (Anas platyrhynchos) to intranasal or contact inoculation with A/Chicken/Korea/IS/06 (H5N1) virus, which was genetically very close to H5N1 HPAI viruses isolated from wild birds in Siberia and Mongolia. Mute swans and Ruddy Shelducks were the most severely affected of the five species, exhibiting depression, diarrhea, and 100% mortality within 10 days of inoculation. Grossly, moderate to multifocal to confluent pancreatic necrosis and splenomegaly were identified in these two species. Histologically, brain, pancreas, spleen, heart, oral cavity and adrenal gland were the most consistently affected, and HPAI virus was most frequently detected in the parenchyma of these organs. One dead of three inoculated Mandarin ducks developed severe necrotized pancreatitis and meningoencephalitis, and segmental necrosis of myofibers in heart. Influenza viral antigen was detected in sites with histologic lesions. Unlike these influenza virus, Greylag goose suffered moderate depression, but lacked mortality. However, the goose had severe cerebral malacia and meningoencephalitis. Viral antigen was observed in necrotized neurons and neuropil in the brain, especially hemisphere of cerebrums. Mallard ducks were resistant to the H5N1 HPAI virus, lacking gross and histologic lesions, and viral antigen. These results imply that Mute swans and Ruddy Shelducks are highly susceptible to A/Chicken/Korea/IS/06 virus, and Mandarin ducks and Greylag are intermediate susceptible, whereas Mallard ducks are more resistant.

Key Words: Aquatic birds, Avian Influenza, H5N1 virus, Susceptibility, Spreading

P128 Comparison of phosphate-buffered saline and Spray-Vac™ vaccine stabilizer for aerosol application of FVAX-MG™. S. A. Leigh*, S. L. Branton, and S. D. Collier, USDA, ARS, Mid-South Area Poultry Research Unit, Southeast Poultry Research Laboratory, Athens, GA.

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 producers 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 and well water for rehydration of lyophilized vaccines. PBS and Spray-Vac™ vaccine stabilizer were compared for their ability to protect FVAX-MG™ during vaccination. PBS powdered concentrate was added to commercial distilled water at a rate of 1 g/l. Spray-Vac™ concentrate was added to local well water at the manufacturer recommended ratio (4 oz/gal). Equal amounts of vaccine were rehydrated and diluted with either of the two solutions and used to vaccinate one half of a 75,000 bird pullet house. Approximately 6 weeks following vaccination, blood samples were drawn from equal numbers of pullets vaccinated using either PBS or Spray-Vac™ as a stabilizer. Blind random samples were tested for vaccine efficacy by serum-plate agglutination (SPA). The results showed that in both cases, 100% of tested birds were SPA positive, with an average score of 1+. These results from the field trials suggest that rehydrating FVAX-MG™ with Spray-Vac™ in well water gives equivalent results compared to using distilled water stabilized with PBS.

Key Words: Mycoplasma gallisepticum, Vaccine stabilizer, Pullet, Mycoplasmosis, SPA
**P129** Molecular characterization and phylogenetic analysis of Mexican Newcastle disease virus isolates. R. Merino*, N. Calderon*, F. Perozo, P. Villegas, and C. L. Afonso, 1Facultad de Medicina Veterinaria y Zootecnia, UNAM, Mexico DF, Mexico, 2University of Georgia, Athens, GA, 3Southeast Poultry Research Laboratory, United States Department of Agriculture, Athens, GA.

Newcastle disease virus (NDV) was isolated in Mexico for the first time in 1946 and the last report of a fowl outbreak caused by a highly virulent strain dates from year 2000, when 13.6 million birds were slaughtered and 93 farms quarantined. Mean Death Time test resulted in velogenic classification of 12 Mexican NDV strains, isolated around Mexico City between 1946 and 2006. Analysis of the deduced amino acid sequences of the F protein cleavage site from these isolates predicted that 11 were velogenic viruses, while one isolate was classified as Lentogen (like Ulster). A phylogenetic tree based on the nucleotide sequences of the F gene revealed that these Mexican NDV isolates corresponded to genotypes I, V and VIII (one, 10 and one isolates, respectively). Isolates belonging to genotype V are related to isolate Largo71 (isolates from 1946, 2004, 2005 and 2006) and Gamefowl/S/02 (isolates from 1998, 2000 and 2001). The virus classified into genotype VIII was isolated around 1947-48, and this is the first time that is analyzed by molecular biology, however, it has been used in Mexico as challenge strain. The distinctive genomic differences between the two groups of genotype V viruses (isolates from 1998 to 2001 and from 2004 to 2006) suggest that two different lineages of NDV are challenging the poultry industry in the central region of Mexico.

**Key Words:** Newcastle disease virus, Virulence, Genotype, Lineage, Mexico

**P130** Expression of recombinant H5 protein for the development of a competitive ELISA for detecting of H5 antibodies. R. Hauck* and E. Mundt, University of Georgia, Athens.

In recent years a highly pathogenic H5N1 influenza strain is circulating in Asian, European, and African countries. This strain has raised public concerns as it is seemingly able to readily cross species borders. It has been found capable to infect domestic poultry, water fowl, and birds of prey as well as several mammalian species, including humans. The aim of this study is to develop a competitive enzyme linked immunosorbent assay (c-ELISA) to detect antibodies against influenza hemagglutinin (HA) 5 in serum samples, regardless of the species investigated. The HA gene of an influenza strain (H5N2) was cloned and sequenced. Based on the sequence, a plasmid was subsequently generated for the expression of the HA in a Baculovirus system using the Baco-to-Bac approach. The generated recombinant H5-encoding Baculovirus was used to produce a His-tagged HA protein. The recombinant protein was purified by affinity chromatography and used for the establishment of an ELISA system. In an indirect approach using chicken sera with antibodies raised against H1, H2, H3, H5, H6, H7, H9, H10, H12, H13, and H15 reactivity with the recombinant protein was observed with H1, H2, H5, H6, and H10. This indicated that for a specific reactivity a c-ELISA would be valuable. For this purpose an H5 monoclonal antibody (mAb) was used. In first experiments using H5 antisera an inhibition of the binding of the H5 mAb was observed. This showed that the use of a c-ELISA for the specific detection of H5 antibodies might be possible.

**Key Words:** Influenza, Recombinant hemagglutinin, ELISA, Diagnosis

**P131** Detection of infectious laryngotracheitis virus from the darkling beetle and its larval stage (lesser mealworm) by real-time PCR. S. C. Ou*, J. J. Giambrone, and K. Macklin, Auburn University, Auburn, AL.

Infectious laryngotracheitis virus (ILTV) causes an acute respiratory disease of chickens. Severe forms of ILT cause high mortality, whereas milder forms can cause a decrease in body weights, condemnations, and poor egg shell quality and production. ILT tends to reoccur on the same farm, because this virus can persist for a long time and become latent. Mechanical transmission can occur by contaminated equipment, dust, water, feces, and litter. Since vaccine viruses can cause reactions as nearly as severe as the wild type viruses, prevention of LTV exposure in chicken farms is important. The darkling beetle, Alphitobius diaperinus, and its larvae, the lesser meal worm, commonly infest poultry litter in commercial farms. The parasites can destroy poultry building insulation, consume feed and water, and transmit infectious disease causing organisms. In addition, they may harbor such pathogens as infectious bursal disease (IBD) virus, fowl pox, avian reovirus, and Newcastle disease viruses, as well as Salmonella and E. coli bacteria. Primers were designed and procedures were developed to detect ILT by real-time PCR. Adult beetles and their larvae were collected from commercial broiler flocks, which were diagnosed as having viral ILT. The parasites were first treated with hydrogen peroxide to remove microorganisms from the external surfaces of the parasites. ILTV DNA was extracted from the beetles and larvae using a commercial kit. Results showed that most of the beetle and larvae samples were positive for ILTV DNA. Therefore, it is important to kill these common parasites on ILTV positive farms to obtain a thorough reduction in virus load in the litter.

**Key Words:** ILTV, Darkling beetles, Lesser meal worm, Real Time PCR

**P132** Variable regulation of chicken embryo fibroblasts gene expression by H5N1 avian influenza viruses. L. V. Sarmento*, C. Afonso, C. Estevez, J. Wasilenko, and M. Pantin-Jackwood, Southeast Poultry Research Laboratory, Athens, GA.

Highly pathogenic avian influenza viruses (HPAIVs) cause severe clinical disease associated with high mortality in chickens and other gallinaceous species. However, the mechanism by which different strains of AIV overcome host response is still not clear. In the present study, differences in early transcriptional host responses were evaluated by infecting chicken embryo fibroblasts (CEF) with two highly pathogenic H5N1 avian influenza viruses, CK/ HK/220/97 and Egret/HK/7572/02. A complete chicken genome microarray was used to assess differences in gene expression between cells infected with either virus. A total of 191 genes showed differential expression by two-fold or more at 4 hpi when comparing the two viruses. Gene ontology revealed that the differentially expressed genes are involved in many vital functional classes including immunity/ cytokinesis, apoptosis, transcription, cell cycle and proliferation and development. Semi-quantitive RT-PCR was used to validate the differential expression of selected genes from different categories and to investigate whether these genes and/or other genes were induced or suppressed later in the infection. It was found that CK/HK/220/97 is a stronger inducer of the innate immune response in CEF than Egret/HK/7572/02, particularly IFN-α and the Msx gene. Our data suggest that avian influenza viruses may use different mechanisms and multiple strategies to evade host response.

**Key Words:** Avian influenza virus, Microarray, RT-PCR, IFN-α, Mx1

**P133** Assessment of Clostridium perfringens and Clostridium septicum from commercial broilers with gangrenous dermatitis and asymptomatic broilers within the same houses. S. Dunham*, T. Neumann, K. Agle, T. Rehberger, D. Ritter, Agtech Products, Inc., Waukesha, WI, 2Mountaire Farms of Delaware, Inc., Millsboro, DE.

Poultry gangrenous dermatitis (GD) is an acute bacterial disease causing rapidly progressing necrosis of the skin, abdominal subcutaneous tissue, and underlying musculature. GD mortality in the U.S. can reach as high as 1% per day for up to two weeks. Clostridium species, specifically C. perfringens and C. septicum, are common causative agents isolated from skin lesions associated with GD. Herein this study assessed and compared the clostridial agents present in broilers with GD lesions and asymptomatic broilers raised in the same houses. Semi-quantitive RT-PCR was performed on each isolate. RAPD PCR was performed on toxin gene positive isolates to determine genetic diversity. From the GD symptomatic broilers 295 toxigenic Clostridium were isolated versus only 32 in asymptomatic broilers. Of the GD symptomatic bird-derived isolates 110 were identified as C.

The necessity to maintain the breeder houses free of Salmonella is very important because this way we have broiler chickens free of Salmonella too, reason why we must carry out continuous samplings to have the guarantee to maintain Salmonella free birds. The present study was carried out in a breeder open house. Material and Methods. Fifteen drag swabs, fifteen manure samples, fifteen floor eggs and fifteen broiler chickens of these same breeders were taken. The drag swabs and the manure samples were settled in a pre-enrichment broth and incubated 37°C over night and later processed according to the Mexican Official Regulation (NOM-005-ZOO-1993). The floor eggs were washed with a phosphate buffer solution for external sampling and then plated in Mac Conkey and Tricpticase soy Agar. Chicken liver, spleen, gall bladder, duodenum and egg yolk sac were collected and processed according to the Mexican Official Regulation (NOM-005-ZOO-1993). Results. There was no isolation of Salmonella enterica in this work, nevertheless, we identified other bacterial groups like Escherichia coli, Enterobacter sp, Proteus vulgaris and Proteus mirabilis. This study reinforces the importance of carrying out continuous samplings and practical of biosecurity in farms to have free Salmonella birds.

Key Words: Salmonella enteritidis, Salmonella spp, Salmonella sampling


Infectious Bursal Disease Virus (IBDV) causes a highly contagious immunosuppressive disease in young chickens. As other Birnaviridae viruses, the IBDV genome consists of two segments of double-stranded RNA. While the segment B encodes the viral protein VP1, the segment A encodes a precursor polyprotein for VP2, VP3, and VP4 and, in a second overlapped open reading frame, the protein VP5. There are classic, variant, and very virulent strains (vvIBDV) of IBDV that differ in pathogenic and antigenic traits. Among them, the vvIBDV is the most worrisome strain because of the huge productive and economic losses that is causing in its rapidly spreading throughout the world. Although the molecular basis for the increased virulence remains unclear, it seems to be associated with a co-evolution of the VP2 and VP1 genes, supporting the fact that the virulence trait requires the action of more than one single gene. Since VP5 seems to be responsible for the viral release and is discussed as a potential cellular apoptotic inducer, it has been associated with IBDV virulence. Remarkably, it has been observed that the VP5 protein of the vvIBDV have four additional aminonertimal residues as a consequence of an alternative start codon. In the present work we have amplified, cloned, and sequenced the entire VP5 gene of Uruguayan vvIBDV. The phylogenetic analysis clusters our isolates with other vvIBDV strains from around the world. The comparative nucleotide and amino acid sequence analyses showed two conserved amino acid (133R and 221W) in all very virulent viruses. It also revealed the existence of nucleotide and amino acid changes among the Uruguay isolates. Unexpectedly, the Uruguayan vvIBDV showed a point mutation in the alternative start codon of the VP5 and, as a consequence, lack the four amino acid typical of others vvIBDV. Our result indicates that the VP5 gene of vvIBDV has evolved both by the acquisition of specific amino acids as well as changing the start site of translation. This fact, together with the variability detected among our isolates, support a relevant role of this gene in IBDV evolution.

Key Words: Gumboro, IBDV, Virulence, VP5, Evolution

P136 Kinetic growth essay of an ExIEC (extraintestinal invasive Escherichia coli) strains isolated from chickens with yolk sac infection. C. C. Rosario* and C. C. Esvala, 1Facultad de Medicina Veterinaria y Zootecnia, UNAM, Circuito Exterior, 2Facultad de Medicina, UNAM, Circuito Exterior.

Escherichia coli is one of the most frequently isolated pathogenic bacteria, responsible of at least 5% of the mortality in commercial flocks. At present, pathogenic strains of E. coli) are placed within APEC group. Despite several methods have been described to determine the virulence of a given strain, control of colibacillosis is difficult since a reliable method is not currently available. In order to determine the virulence of an ipaH+ strain, a kinetic essay was used. One hundred fertile eggs from a Leghorn commercial breeder flock were randomly placed into four groups of 25 embryos each, and inoculated as follow: Group I: 100 uL of sterile PBS, Group II: 10^2 CFU/100 uL of HB101 (Negative control), Group III: 10^2 CFU/100 uL of CR-000515 (Positive control) and Group IV: 10^2 CFU/100 uL of FM-095785 (ExIEC strain). Twenty uL of allantoid fluid were collected aseptically from 5 chicks at 0, 3, 6, 9 and 12 hours post-inoculation. Ten-fold dilutions were performed to dermine CFU/mL of allantoid fluid and results were analyzed with ANOVA, differences among groups were determined by Tukey’s test. There was no growth in embryos inoculated with sterile PBS during the whole trial period. A constant growth from 3 to 12 hours among the three strains were seen, however, K-12 had the lowest growth follow by CR-000515 and FM-095785. A significant statistical difference (P<0.0001) between the PBS and K-12 group, and between the last one with CR-000515 and FM-095785, nevertheless, there was no statistical difference (P>0.05) between the last two groups. These results suggest that strain FM-095785 is a pathogenic strain since it had the highest level of growth. A pathogenic strain should pass the different virulence traits that allow them to growth and proliferate in adverse environments. In this case, virulent bacteria should be able to grow in allantoid fluid, colonize and kill embryos; that is a common feature seen in yolk sac infection cases, where ExIEC strains were found.

Key Words: Escherichia coli, APEC, Poultry, Yolk sac infection, Virulence


Intravenous cellulose microparticle (MP) injection is a patented method used to select broilers that are resistant to pulmonary hypertension syndrome (PHS, ascites). In addition to occluding pulmonary arterioles, MPs cause a localized inflammatory cell infiltrate in the perivascular region. PHS-resistant broilers (R-line) are able to resolve the vascular occlusion and inflammation, whereas PHS susceptible broilers (S-line) may progress to PHS. Previous studies showed that the inflammatory cell infiltrate was more extensive in lungs from R- versus S-line broilers. Information on pro-inflammatory cytokines involved in leukocyte recruitment (e.g., IL-8) and activation (e.g., IL-1β, IL-6, IFN-γ) was not available. The objective of this study was to examine the time course of expression of these cytokines in lungs from R- and S-line broilers before (0h, no MP) and 2, 6, 12, 24 and 48h post-MP injection. Four wk-old R- and S-line broilers (6 per line and time point) were injected i.v. with MP. At each time point, the right lung of each broiler was collected and preserved in RNA-stabilization buffer. Cytokine expression was examined by quantitative RT-PCR and the fold change in cytokine expression relative to 0h levels was computed by the ΔΔCt method. In both lines, the expression of IL-1β, IL-6, and IL-8 increased consistently from 0 to 6h, reached peak levels at 6 and 12h, and decreased thereafter, whereas IFN-γ expression increased consistently
from 0 to 48h. Lungs from R-line broilers had higher (P<0.05) IL-1β and IL-6 at 2, 6 and 12h, higher IL-8 at 6 and 12h, and higher IFN-γ expression at 6 and 48h p.i. than lungs from S-line broilers. Higher expression of pro-inflammatory cytokines in R-line compared to S-line lungs following i.v. MP injection may explain the ability of R-line broilers to effectively counteract the MP-induced pulmonary hypertension and resolve the vascular occlusion.

**Key Words:** Ascites, Broilers, Cytokines, Microparticle, RT-PCR

### P138 Egg quality and Salmonella contamination of eggs sold in super-markets from Entre Rios, Argentina

M. A. Soría1, D. J. Bueno*1, M. G. Chichi2, A. T. Costa1, I. I. C. Berniaguí1, and J. A. Trinidad1, 1Instituto Nacional de Tecnología Agropecuaria (INTA), Estación Experimental Agropecuaria Concepción del Uruguay, Entre Rios, Argentina, 2Facultad de Ciencias de la Salud, Universidad Nacional de Entre Rios, Concepción del Uruguay, Entre Rios.

A survey of egg quality and Salmonella contamination of eggs sold on super-markets was carried out in Entre Rios, a province of Argentina. A total of 216 samples (mostly boxes) of six eggs were purchased from 27 supermarkets situated in different cities from Entre Rios (2 from Villa San José, 4 from Colón, 4 from Villa Elisa, and 17 from Concordia). Egg quality was assessed by measuring egg weight, % eggshell, eggshell thickness, yolk colour and pH of the pool yolk-albumen. Eggshells, boxes, and content (yolk-albumen) were tested for the presence of Salmonella, using cultural method. Twenty-five grams of egg-shells or egg box or twenty-five ml of yolk-albumen of each sample was mixed with trypticase soy broth supplemented with ferrous sulfate. The mixture was preincubated for 24 h at 37°C. Samples were selectively enrich in tetrathionate broth, plated on Hektoen and Xylose lysine desoxycholate agar plates. Suspect colonies were picked and subjected to biochemical and serological tests. In terms of colour of the eggshell, 68% has white colour and 32% brown. The % egg per weight class was: 47.3 % extra large, 45.8% large, 6.2 % medium and 0.7% small. The average of % eggshell (eggshell weight x 100/egg weight) was 92.2 %, with the maximum of 96.0% and minimum of 72.8%.

The % eggs with black or brown yolk was 3.5% and 0.8% respectively. The % contamination from infected flocks. The small number of positive samples points towards the presence of light-intensities ranging from 0.2 to 20 lx had no direct effect on some physiological variables in broiler chickens. The experiment consisted of 3 levels of light-intensity, suggesting an absence of stress related to ammonia, light intensity

**Key Words:** Egg quality, Salmonella, Supermarket, Argentina

### P139 Protection evaluation by a spray applied inactivated vaccine against LPAIV in breeders by means of viral excretion reduction after a challenge.


Emulsified vaccine application to birds does not avoid AIV infection to field challenges, so it is necessary to help parenteral vaccination to avoid infection and spreading of virus to the environment. Our objective was to determine the capability of an inactivated spray vaccine (ISV) against LPAIV to reduce viral excretion in a controlled challenge. An ISV (H5N2 LPAIV plus bacterial toxins) was applied to a flock at the 6th week of age. Two weeks postinfection, 10 birds were sent to the laboratory and placed with 10 specific pathogen free birds in an isolation unit. Both groups were bled prior to challenge and an HI test was established to determine antibodies presence prior to the challenge. Birds were challenged with 106 DIF 50% titer H5N2 LPAIV. 10 days postchallenge, tracheal and cloacal exudates were taken form both groups. For each breeders sample, five 9 days old SPF embryos were inoculated to attempt challenge virus isolation. Afterwards a RT-PCR test was carried out in pool per group for the samples obtained. A serological follow up of the breeders flock in the farm was done weekly postvaccination. Farm birds were serologically negative to AIV induced antibodies 8 weeks postvaccination. All birds were serologically negative to AIV induced antibodies the day of the challenge. Vaccinated birds had an 8.5 Log2 antibodies level 2 weeks post challenge that lowered to a 5 Log2 level 4 weeks postvaccination. The control group reached a 7 Log2 level 2 weeks postchallenge and remained with a high 6.7 Log2 level 4 weeks postchallenge. The challenge virus reisolation failed on all vaccinated group samples, while virus reisolation was possible on all control group samples. Vaccinated group samples were negative to RT-PCR as opposed to the control birds samples which were positive in all pools. Birds immunized with an ISV do not excrete challenge virus since exudates were negative to viral isolation test and RT-PCR. Vaccinated birds antibody levels lowered at the 4th week as opposed to controls which remained with high levels up to the 4th week postchallenge.

**Key Words:** Avian Influenza, Challenge, Vaccination, Excretion
P142 Effect of deboning time and cold storage on water-holding capacity of chicken breast meat. H Zhuang* and E. M. Savage, ARS-USDA, Athens, GA.

Water-holding capacity (WHC) is a very important qualitative characteristic of meat and directly affects the yield of further processed meat and consumer acceptance of pre-packaged fresh meat. Boneless skinless chicken breast meat for further processing and consumer usage is commonly deboned at various postmortem times and preserved by cold storage before use. The objective of our study was to investigate the effect of 2 different deboning times and cold storage on water-holding capacity of chicken breast meat. Broiler breast meat (pectoralis major) was removed from carcasses early post-mortem (2h) and later post-mortem (24h). Storage treatments of samples included: 6d, 1d at 3°C, 7d at 3°C (2h deboned meat only) and 6d at -20°C plus 1d at 3°C (frozen and thawed storage, 2h deboned meat only). Water-holding capacity was estimated by cooking loss, drip loss, filter paper press and a swelling/centrifugation method. Based on the measurements of the cooking loss and filter paper press, cold storage and deboning time did not affect WHC of the 2h samples; however, based on the measurements of the swelling/centrifugation method, cold storage and deboning time significantly enhanced WHC of the 2h samples. Only the frozen and thawed storage treatment resulted in significantly increased drip loss of the 2h samples. These results suggest that the effect of cold storage on WHC of chicken breast meat depended on the methods used for WHC estimation. There is a need to develop a standard method for WHC estimation for chicken breast meat.

Key Words: Chicken Breast, Storage, Water-holding capacity, Drip loss, Cook loss

P144 Bacterial levels associated with lime as a litter amendment. K.S. Macklin*, J.P. Blake, J.B. Hess, and T.A. McCaskey, Auburn University, Auburn, AL.

Litter treatments are commonly applied to poultry litter to reduce ammonia and bacterial levels. A trial was performed in which the effects of hydrated lime (HL) on total aerobic and anaerobic counts, percent moisture and pH were measured from litter. This was performed by using clean pine shaving litter that had been placed into 16 environmental chambers (2.44 x 2.44 x 2.44 m). Chicks from a commercial hatchery were used and were placed at a density of 70/pen. In this experiment, there were four treatments, with each getting four pens. Treatments included a non-litter amended control (CON) and (HL) applied at 50, 100 and 150 lbs/1000ft2. Litter samples were collected weekly from three areas of each pen and started the day before chicks were placed and continued until birds were removed 7 weeks later. For each sample bacterial counts were determined; additionally litter pH and moisture content were elucidated. Bacterial counts (cfu/g) and percent moisture results 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 HSD.

Results indicated no statistical difference (P>0.05) in average bacterial counts or percent moisture for any of the treatments. The only statistical difference (P<0.05) demonstrated that the 100 and 150 lb application rates raised the average litter pH by 1 unit, as compared to the control.

Key Words: Lime, Litter, Bacteria

P145 Evaluation of an empirical nonlinear model to estimate feed intake in broiler breeders. L. F. Romero1, M. J. Zuidhof2, F. E. Robinson1, R. A. Renema1, and A. Naeima1, 1University of Alberta, Edmonton, AB, Canada, 2Alberta Agriculture and Food, Edmonton, AB, Canada.

The robustness of an empirical non linear model to predict metabolizable energy (ME) intake in broiler breeder hens was evaluated with respect to a linear model using metabolic BW, average daily gain (ADG) and egg mass (EM) data. Prediction equations were developed from Experiment 1 (20 to 60 wk), in which 288 Ross 708 pullets were individually caged at 16 wk and assigned to one of four feed allocation treatments: Standard (STD), HIGH (Standard+10%), LOW (Standard-10%), and Individual-bird based feed allocation (IND). Equations were evaluated on data from Experiment 2 (18 to 58 wk), which used 288 females of three strains (Hubbard Hi-Y, Ross 708 and Ross 508); four BW curves; and two photo-stimulation ages (18 and 22 wk). The non linear model included: 1) a non fixed exponential parameter of metabolic BW, 2) exponential terms to model the interaction between ADG and BW (dBW/ADG), and between EM and BW (dBW/EM), and 3) a normally distributed term associated with metabolic BW, which was linearly related to the plane of nutrition of HIGH, STD and LOW in a second regression.

In the nonlinear model, cross elasticities showed that the ADG requirement increased by 0.60% and the EM requirement decreased by 2.07% for a 1% increment in BW. Likewise, marginal ADG ME requirements increased at greater values of ADG and marginal EM ME requirements increased for greater EM production. The normally distributed term associated with maintenance had a linear relationship with ME intake (r² = 0.83). In Experiment 1, the fit of the observed vs. predicted values for the linear model was R²=0.63 and R²=0.76, and for the nonlinear model was R²=0.88 and R²=0.95 on an individual and a feed allocation treatment weekly basis respectively. Applying the equations to individual hens and strain x BW curve groups from Experiment 2, the linear model had R²=0.58 and R²=0.80 while the nonlinear model showed R²=0.84 and
P146  Egg shell color, specific gravity and hatchability, in eggs from broiler breeders. J. R. Moyle*, I. D. E. Yoho1, R. S. Harper1, A. D. Swaaffr1, R. K. Bramwell1, and D. J. Ellick2, 1University of Arkansas, Fayetteville, 2Aviagen, Huntsville, AL.

It has been suggested by hatchery managers that lighter colored eggs from broiler breeder hens don’t hatch as well as darker eggs. It has also been reported that lighter colored eggs have a lower specific gravity than dark colored eggs. Two studies were conducted to evaluate the relationship between eggshell color, specific gravity and hatchability. In both studies shell color was determined using a colorimeter to provide a numeric color value. Specific gravity of the eggs was determined by placing the eggs in salt solutions that had specific gravity ranging from 1.065 to 1.090 in increments of 0.005. In the first study, a total of 2,354 eggs were measured for color and then placed into one of five categories based on color and then checked for specific gravity. In the second study, 1,297 eggs were measured for color and specific gravity, with each egg labeled so that every egg could be followed through to hatch. Data were analyzed using JMP statistical software comparing the means from the observations. Results from the first study showed that eggs from the lightest color group had the lowest average specific gravity (1.07213) while the darkest eggs had the highest specific gravity (1.07596). This study did not show any difference in fertility, hatch, or hatch of fertile between the five different categories. In the second study, the mean color value for eggs within each specific gravity group was analyzed with the following results: 80.02±1.065, 77.12±1.070, 76.31±1.075, 75.95±1.080, 75.90±1.085, and 73.01±1.090. In the second study the lighter eggs did have poorer hatchability as compared to the dark eggs. From these two studies it was observed that there is a linear relationship between color and specific gravity in broiler breeder hens, with light colored eggs having a lower specific gravity than dark eggs. It was further observed that the extremely lightest colored eggs had a lower rate of hatch than the darker colored eggs.

Key Words: Specific gravity, Eggs, Color, Broiler breeder

P147  Ammonia release and nutrient content of laying hen manure as affected by distillers dried grains with solubles and enzyme supplementation. A. J. Pescatore*1, A. Singh1, R. S. Gates1, A. H. Cantor1, J. L. Pierce1, K. A. Dawson1, T. Ao1, and M. J. Ford1, 1Alltech/University of Kentucky Nutrition Research Alliance, Lexington, KY, 2Dept. of Biosystem and Agricultural Engineering, Lexington, KY.

The effects of using distillers dried grains with solubles (DDGS) with and without enzyme supplementation in laying hen diets on the nutrient content and ammonia release of manure was evaluated. Hens were fed one of five diets: 1) corn-soybean meal diet (16% CP, 2850 Kcal/kg ME); 2) corn-soybean meal diet with 25% DDGS (16% CP, 2850 Kcal/kg); 3) Diet 2 plus 0.1% enzyme preparation (Allzyme DDGS®); 4) low energy corn-soybean meal diet with 25% DDGS (16% CP, 2550 Kcal/kg ME); and 5) Diet 4 plus 0.1% enzyme preparation. Manure samples were collected from eight groups of six hens for each of the dietary treatments. An equilibrium flux chamber technique was used to determine ammonia gas release from the manure. Manure samples were analyzed for pH, moisture content and percent N, P and K. There was no effect of treatments on moisture content or pH. Ammonia release was highest for hens fed the corn-soybean meal diet (Diet 1) and lowest for those fed the low energy DDGS diet (Diet 4). Total ammoniacal nitrogen content for all of the DDGS diets was higher than for the corn-soybean meal diet. Manure from hens fed the DDGS diets had lower P and K content than that from hens fed the corn-soybean diet. Total nitrogen content was lowest for manure from hens fed diets supplemented with the Allzyme DDGS® enzyme preparation (Diets 3 and 5). The results indicate that inclusion of DDGS and enzymes in laying hen diets can affect ammonia release and nutrient content of the manure.

Key Words: Ammonia, DDGS, Manure content


There are many variables that affect hatchability, with hatching egg selection and quality considered among the important factors. However, to what extent egg pack quality affects hatch of fertiles is not completely known. Therefore, the purpose of this study was to determine the effect of setting poor quality hatching eggs on overall hatch and hatch of fertile. All hatching eggs were obtained from the University of Arkansas broiler breeder research farm and consisted of both quality hatching eggs and call eggs (both misshapen and dirty). In order to simulate an attempt to salvage hatching eggs, groups of eggs were subjected to different treatments prior to placing them in the incubator. These treatments included, dirty eggs wiped with a wet cloth, or sanded with an abrasive pad, and dirty unaltered eggs. Additionally, eggs were set as cracked (slightly checked); cull (misshapen), upside down, or correctly (control). Each treatment group consisted of 120 eggs with the trial replicated three times. All eggs in each group were incubated to hatch and a residue breakout of all unhatched eggs was performed following the incubation period. Results showed that there was significantly reduced percent hatch and hatch of fertile as compared to the control in all categories except cracked eggs. Cull eggs showed the greatest deviation from control. Cleaning dirty eggs resulted in no significant improvement in percent hatch compared to dirty, untouched eggs (dirty 65.3, sanded 66.2, or wiped 67.3 %, respectively). Additionally, eggs that were dirty, sanded or wiped had a higher incidence of contamination compared to controls (8.5, 4.4, and 5.1 %, respectively). In conclusion, poor egg pack will reduce overall hatchability; and attempts to improve egg pack quality by cleaning dirty eggs, did not improve hatch or hatch of fertiles as compared to dirty, untouched eggs, and did not reduce the number of contaminated eggs.

Key Words: Broiler breeders, Cull eggs, Egg pack, Egg quality, Hatchery

P149  Hatchability of eggs from young and old broiler breeders as influenced by egg position and turning during storage. J. Dowden*, D. Ingram, C. Wiggins, and G. Johnson, Louisiana Agriculture Experiment Station Louisiana State University Agricultural Center, Baton Rouge.

To determine if there are any effects of egg position and turning during storage on hatchability for today’s modern broiler breeder, two trials were conducted. In each trial, 1440 freshly laid broiler breeder eggs from two flocks (young and old) were collected from a commercial farm. In the first trial, the broiler breeders were 31 or 60 weeks of age. In the second trial the broiler breeders were 29 or 64 weeks of age. Eggs were randomized before being assigned to treatment. Treatments were arranged in a 2 x 2 x 3 factorial arrangement with two broiler breeder ages (young and old), two turning treatments (turned once daily or unturned), and three positions (large end up, on the side, or small end up). The eggs were stored for three days and placed in a Natureform incubator. On day seven of incubation, eggs were candled and the infertile and early dead embryos were removed. These eggs were broken to confirm infertility. At hatch, chicks were removed and counted. All unhatched eggs were removed and pips recorded. The unhatched eggs were then broken and the embryos classified as early, mid, or late dead. All percentages underwent arcsine conversion before analysis. The two trials were statistically tested and data were combined. Percent total hatchability, percent fertile hatchability, percent pips, percent early dead, percent mid dead, percent late dead, and percent dead were not significantly (P>0.05) affected by any of the position or turning treatments tested.

Key Words: Hatchability, Egg Storage, Broiler Breeder, Egg Position, Egg Turning
P150  
Hatchability of post-peak egg production broiler breeder eggs as influence by pre-storage warming.  
K. Homann*, D. Ingram, and C. Wiggins,  
Louisiana Agriculture Experiment Station Louisiana State University-Agricultural Center, Baton Rouge.

To determine if there are any improvements in hatchability brought about by warming end of lay broiler breeder eggs prior to storage, four trials were conducted. In each trial, freshly laid broiler breeder eggs from two flocks were used. The breeder birds were 60-64 weeks of age in all trials. Eggs were transported from a commercial farm to LSU where they were immediately randomized and prepared for treatment. In trials 1 and 2, egg were warmed for 0, 2, 4, or 6 hours pre-storage. Eggs receiving 0 hours warming were immediately placed in an egg cooler at 15.5°C and a relative humidity of 60%. Eggs receiving the pre-storage warming treatments were placed in a Naturefom setter at the same time and the appropriate eggs were removed after 2, 4, or 6 hours. These eggs were transferred to the egg cooler, stored for 3 days, and then set. A randomized block design was used for this statistical analysis. On day seven of incubation, the eggs were candled, and infertile and early dead embryos were removed. These eggs were broken to confirm infertility. At hatch, chicks were removed and counted. All unhatched eggs were removed and pips recorded. The unhatched eggs were broken and the embryos classified as early, mid, or late dead. All percentages underwent arcsine conversion before analysis. Trials 1 and 2 were statistically tested and data were combined. In trials 3 and 4, eggs were warmed for 0, 3, 6, or 9 hours pre-storage. These two trials were tested and data were combined.

In all trials, percent total hatchability, percent fertile hatchability, percent pips, percent early dead, percent mid dead, percent late dead, and percent dead were measured. Warming eggs prior to storage did not significantly (P>0.05) affect any of the variables measured in these trials.

Key Words: Hatchability, Broiler Breeder, Egg Warming, Incubation, Egg Storage

P155  
Effects of aflatoxin, curcumin, and their combination on the expression of liver antioxidant, immune and biotransformation genes in broiler chicks.  
L. P. Yarru*, R. S. Settivari, E. Antoniou, D. R. Ledoux, and G. E. Rottinghaus,  
University of Missouri, Columbia.

The objective of the present study was to evaluate the efficacy of curcumin, an antioxidant supplied by turmeric (Curcuma longa) powder, to ameliorate changes in gene expression in liver of broiler chicks fed aflatoxin (AF). Four pen replicates of five chicks each were assigned to each of four dietary treatments, which included: A) basal diet containing no aflatoxin B, aflatoxin (AFB1) or curcumin (control); B) basal diet supplemented with 1.48% curcumin; C) basal diet supplemented with 1.0 mg AFB1/kg diet; D) basal diet supplemented with 1.48% curcumin and 1.0 mg AFB1/kg diet. Aflatoxin reduced (P<0.05) feed intake and body weight gain, and increased (P<0.05) relative liver weight. Addition of curcumin to the AFB1 diet ameliorated (P<0.05) the negative effects of AF on growth performance and liver weight. At the end of the three week treatment period, livers were collected and immediately frozen to evaluate changes in the expression of genes involved in antioxidant function [catalase (CAT), super oxide dismutase (SOD), glutathione peroxidase (GPx), glutathione S-transferase (GST)], biotransformation [epoxide hydrolase (EH) cytochrome P450’s (CYP 1A1, CYP 2H1)], and the immune system [interleukins (IL-6 and IL-2)] by using the quantitative real time PCR technique. There was no statistical difference in gene expression between the four treatment groups for IL-6 and IL-2 genes. Decreased expression of SOD, GPx, GST, EH genes due to AF was alleviated by the inclusion of curcumin in the diet. Increased expression of IL-6, CYP1A1 and CYP2H1 genes due to AF diet was alleviated by curcumin. The current study demonstrates a protective effect of curcumin on gene expression in livers of chicks fed AF.

Key Words: Aflatoxin B1, Curcumin, Turmeric, Gene expression, Broilers

P151  
Persistence and level of inoculated Salmonella Typhimurium in larval and adult darkling beetles.  
A. J. Roche*1, N. A. Cox2, L. J. Richardson2, E. Rottinghaus,  
C. M. Rude, and N. C. Hinkle1, 1University of Georgia, Athens, 2Poultry Microbiological Safety Research Unit, Russell Research Center, Athens, GA, 3University of Georgia, Athens.

Salmonella diaprius is a common litter pest in broiler houses. Both adults and larvae are regularly ingested by broilers and could serve as vectors of Salmonella to the current and subsequent broiler flocks. The objectives of this study were to evaluate the persistence of a marker S. Typhimurium strain in adult and larval darkling beetles and determine the level of colonization of S. Typhimurium in the beetles. In study 1, adult and larval beetles were deprived of feed for 24 h and then provided non-medicated broiler feed for 24 h that had been sprayed with a naladixic acid resistant marker strain of Salmonellum Typhimurium at 3 inoculation levels. The beetles were then moved to a sterile container with non-inoculated feed. Individual (n=10) and pooled samples (n=1) of the adult and larval beetles, along with the feed, were sampled up to 63 d for adults and up to 36 d for larvae. In study 2, pooled adult (n=4) and larval (n=4) beetles were sampled to determine the level of Salmonella over 6 wk. After each sampling time, beetles were moved into a new container and fresh feed was added. In study 3, larvae were inoculated and allowed to pupate, then sampled. In study 1, persistence lasted 63 d (20% positive) at the high inoculation, 27 d at the medium inoculation (pooled positive), and 9 d at the low inoculation (10% positive). In the beetle larvae, the Salmonella persisted for up to 37 d (end of sampling) in the high inoculation (70%), and up to 21 d in the medium (100%) and low inoculation (80%). In study 2, the level of Salmonella for the adult beetles ranged from 10^3 to 10^4 CFU over 6 wk and averaged 10^3 at 40 d of sampling. For the larval beetles, the level ranged from 10^6 to 10^6 CFU over 6 wk and averaged 10^6 CFU at 30 d of sampling. From study 3, 45% of the larvae were positive for the marker Salmonella following pupation. These data suggest that Salmonella can persist in adult and larval darkling beetles for sufficient time to colonize subsequent broiler flocks and can be maintained though pupation.

Key Words: Alphitobius diaprius, Salmonella Typhimurium, Darkling beetles, Lesser mealworm, Broilers

P152  
Effect of corn particle size and antibiotics on intestinal strength and gizzard size.  
K. Dobblebeare*, R. S. Beyer, C. Hancock, C. M. Rude, and J. Burden, Kansas State University, Manhattan.

Healthy intestinal systems are important for fast growing poultry. Poor intestinal strength results in complications during processing, such as a decrease in line speed, due to breakage and spillage and increased carcass microbial contamination. In addition, compromised intestinal vitality leads to decreased nutrient absorption and poor feed conversion. Research has suggested that corn particle size may affect intestine and gizzard weight, while antibiotics help maintain a healthier digestive function. This study was designed to determine the effects of corn particle size and antibiotic supplements on intestinal strength and gizzard size. In this study, Cobb 500 broilers were randomly assigned to 24 battery cages, which created 4 replications of 6 experimental treatments, utilizing a 2x3 factorial. Food and water were provided ad libitum. Treatments consisted of corn soy diets formulated to meet or exceed nutrient requirements as suggested by the NRC. One factor explored was the particle size of the corn, ground to a geometric mean of 467 and 1077 microns. Each particle size consisted of three treatments, two containing different antibiotics and the third was antibiotic free. Birds were weighed at 0, 3, 6, and 7 weeks of age. At 7 weeks, birds were euthanized according to IACUC procedures. Intestine and gizzard samples were taken for analysis. Intestinal samples were harvested fresh, packed on ice and analyzed for fragility by measuring breaking force. The data showed that diets containing antibiotic supplement had higher gizzard weights. Diets containing BMD gave higher peak force of the front section of the intestine as compared to the others. Body weights were significantly higher for diets containing antibiotic supplements when compared to the treatment containing no antibiotic. Particle size and antibiotic treatment had an effect on intestinal breaking force. Further studies should be conducted to further define the effects of both particle size and antibiotics on digestive tract integrity.

Key Words: Intestine, Particle Size, Antibiotics, Feed manufacturing, Gizzard size
P154 The effects of low level laser application on hatching eggs for improvement of hatchability and survival rate. A. Tesiki*, University of Cukurova, Adana, Turkey.

The main purpose of this study is to investigate the effects of low laser application on hatchability and survival rate of broilers.

The experiments were carried out at the Experimental Poultry Farm of Cukurova University and a commercial farm in Cukurova Region of Turkey. These experiments were conducted as control and test groups. The eggs in the control groups were not irradiated, but they were kept at equal conditions together with the eggs in the test groups until being placed in an incubator.

The effect of laser treatment on the hatchability of irradiated test groups was significantly higher than the control groups in both of the experiments. Similar results were obtained for the survival rate and the body weight of broilers at the end of the fifth week of age.

As a result, a certain regimen of low laser irradiation on hatching eggs provided significant increase on the hatching of chicks, improved the survival rate, and decreased the mortality in this experiment.

Key Words: Poultry, Laser, Hatchability, Mortality, Bodyweight

P155 Dietary evaluation of Primalac and amino acid levels in commercial broilers. D. L. Everett**, A. Corzo1, W. A. Dozier, III1, R. D. Bushong3, and M. T. Kidd1, 1Mississippi State University, Mississippi State, 2USDA-ARS, Mississippi State, 3Texan Six Consulting Firm, San Angelo, TX.

One experiment with Ross x 708 broilers was conducted to evaluate various amino acid regimes in diets with and without Primalac using a factorial arrangement of treatments. Embryos and one day old chicks received standard vaccinations at a commercial hatchery (Pilgrims Pride, Russellville, AL), were transported to Mississippi State University hatchery, sexed, and placed equally sexed in experimental floor pens (48 pens; 12 birds per pen). Pens contained a pan feeder, nipple drinkers, and built-up pine shavings. The starter diet (Day 1 to 15) and subsequent diets (Day 16 to 29, Day 30 to 43, Day 44 to 48) contained two and one pounds of Primalac per ton, respectively. The control diet without Primalac contained bacitracin methylene diisalicylate in the 1 to 15 d diet and virginiamycin in the 44 to 48 d diet. Three diets varying in amino acid levels were fed in all diets except the starter diet. These diets were characterized by high amino acid density (1), reduced amino acid density (2), and further reduced amino acid density (3). No Primalac x amino acid interactions occurred. Diet 1 improved (P < 0.05) BW gain over diet 2, but diet 3 resulted in an intermediate response. Diet 1 optimized (P < 0.05) feed conversion. However, diet 3 had poorer mortality (P < 0.05) than diets 1 and 2. Contrast analyses in birds fed lower amino acids (diets 2 and 3) showed higher (P = 0.12) fillet yields when Primalac was fed. Although significant interactions did not occur, further research should be conducted on potential nutrient sparing effects of Primalac.

Key Words: Primalac, Broiler, Nutrient density, Amino acid, Breast yield

P156 Utilization of biodegraded groundnut pod with purified enzyme extracts from fungi by broilers. E. A. Lyayi*, T. E. Lawal, B. A. Adeniyi, and O. A. Aderamooye, University of Ibadan, Ibadan, Oyo State, Nigeria.

Purified enzyme extracts (PEEs) were obtained from Aspergillus niger (An), Trichoderma viride (Tv), Rhizopus stolonifer (Rs) and Mucor mucoid (Mm) and used to biodegrade groundnut pod (GNP), an agro industrial by-products containing high amounts of non starch polysaccharides (NSPs) and low crude protein. The biodegraded GNP was then fed to 252 broilers from day old to finisher (56 days) in comparison with Roxzyme G2G (a commercial feed enzyme) and the undergraded GNP as positive and negative controls, respectively. The birds were allocated to the 6 experimental diets with 3 replicates each in a completely randomized design. The crude fiber, neutral detergent fiber, acid detergent fiber, cellulose, hemicellulose, acid detergent lignin and pectin in the GNP were significantly (p<0.05) reduced when biodegraded with PEEs from the fungi. Crude protein (CP), phosphorus and metabolizable energy in the GNP were significantly (p<0.05) increased. The amounts of glucose, fructose, galactose and sucrose in the GNP were significantly (p<0.05) increased on biodegradation with the fungal PEEs. Weight gain, feed intake and feed conversion ratio were significantly (p<0.05) higher in birds fed diets containing the biodegraded GNP and were not significantly different from those fed diets containing Roxzyme G2G. Apparent digestibility of nutrients followed similar pattern. Biodegradation of GNP with PEEs and with Roxzyme G2G significantly (p<0.05) reduced the viscosity of digesta especially in the crop and gizzard of the birds. Results of the study suggest that biodegrading GNP with An, Tv, Rs and Mm was effective in enhancing its nutritional value for broilers by reducing the NSPs and viscosity and by increasing the CP and phosphorus contents as well as the digestibility of nutrients. Biodegrading GNP with the fungi before feeding to broilers produced similar results as incorporating Roxzyme G2G into the feed containing GNP thus helping to eliminate the problem of handling and storage of the commercial enzyme often experienced by poultry farmers in Nigeria.

Key Words: Groundnut pod, Fungal enzymes, Biodegradation, Performance, Broilers

P157 Effect of a symbiotic feed additive in comparison to an antibiotic growth promoter on broiler performance under field conditions. M. Mohnl1, and R. Nichol2, 1BIOMIN GmbH, Herzogenburg, Austria, 2BIOMIN Laboratory Singapore, Jalan Bukit Merah, Singapore.

Due to the growing concerns related to the use of of antibiotic growth promoters in animal production there is a need for effective alternative products that will sustain high performance in animal husbandry. The aim of the present trial was the evaluation of the efficacy of a symbiotic product in comparison to a commonly used AGP on broiler performance under field conditions in Thailand. The trial was conducted with day-old broiler chicks (AA+) with 32,600 birds per group, 4 replicates per group and 8160 birds per replicate. Birds were reared in closed houses with evaporative cooling and placed on litter consisting of rice hulls. The ration fed to broilers in both trials was a standard corn-soy ration fed in a four diet feeding program. Salinomycin was used as anti-coccidial agent in all groups. Feed and water was provided to all broilers ad libitum. Drinking water application of the product was by a medicator system in place within each pen. Experimental groups included a negative control group (NC), a group which received a synbiotic product (Biomin® Poultry5Star, Biomin GmbH) via the drinking water on day 1, 2, 3 and on three consecutive days around feed change and a positive control group (PC) which received Avilamycin (5 ppm) via the feed. The birds were kept under observation for 35 days and performance parameters were determined. Compared to the NC group and the PC group live weight and mortality could be improved in the group which received Biomin® Poultry5Star. Synbiotic group and AGP group increased body weight by 4.4% and 2.6% respectively and reduced mortality by 25.7% and 2.8% in comparison to the control. Similarly, feed conversion was improved in broilers receiving Biomin® Poultry5Star when compared to broilers in the NC group by 5.1%. In the present study the synbiotic product had a better potential to improve broiler performance as Avilamycin and might therefore be a promising alternative to the use of AGPs in broiler production.

Key Words: Symbiotic, Antibiotic growth promoter, Broiler, Performance


The increased availability of corn distiller’s dried grains with solubles (DDGS), and its use as a feedstuf for livestock diets, necessitates an improved knowledge of the nutritional composition. The non-starch polysaccharide (NSP) portion contributes to the nutritional value of DDGS and is generally associated with reduced nutrient digestibility, thus a more thorough understanding of levels and variability of the NSP components is important to gain further insight in the energy-yielding substrates in DDGS.

Thirty (30) samples of corn DDGS were randomly obtained from various commercial sources throughout the U.S. These were analyzed for percent dry matter,
acid detergent fiber, ether extract and crude protein. The soluble, insoluble and total NSP monosaccharide sugars were determined using the method of Englyst and Hudson (1987). Across the 30 samples, considerable variation existed for acid detergent fiber, ether extract and crude protein (see table). Of these, the ether extract exhibited the highest coefficient of variation of 18.7%, followed by acid detergent fiber (14.5%). With the exception of ribose and fucose, the NSP components in the insoluble fiber portion exceeded those of the soluble portion. When the two fractions were summed, the total average NSP fraction was 22.7%. Glucose, an indicator of cellulose content, was highest in concentration. This was followed by xylose and arabinose, two components of the arabinoxylan structure. The galactose and mannose levels were much lower and essentially equivalent in the total NSP. Levels of individual components were considerably lower in the soluble NSP fraction. The results suggest that considerable ranges in energy digestibility and content can be expected across batches of commercial corn DDGS, and that arabinoxylans and cellulose are the two primary NSP components in corn DDGS.

### Table 1. The determined AID and SID values for wheat and pea (mean ± SD) for some essential amino acids

<table>
<thead>
<tr>
<th>Item</th>
<th>Wheat AID</th>
<th>Wheat SID</th>
<th>Pea AID</th>
<th>Pea SID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arg</td>
<td>82.4 ± 0.28</td>
<td>85.5 ± 0.28</td>
<td>92.4 ± 0.25</td>
<td>93.8 ± 0.25</td>
</tr>
<tr>
<td>Ile</td>
<td>86.4 ± 0.19</td>
<td>90.7 ± 0.21</td>
<td>85.5 ± 0.36</td>
<td>88.0 ± 0.37</td>
</tr>
<tr>
<td>Leu</td>
<td>87.5 ± 0.19</td>
<td>90.8 ± 0.19</td>
<td>86.5 ± 0.36</td>
<td>88.9 ± 0.38</td>
</tr>
<tr>
<td>Lys</td>
<td>79.5 ± 0.31</td>
<td>84.1 ± 0.31</td>
<td>91.1 ± 0.28</td>
<td>92.3 ± 0.26</td>
</tr>
<tr>
<td>Met</td>
<td>88.5 ± 0.20</td>
<td>91.7 ± 0.19</td>
<td>84.8 ± 0.45</td>
<td>89.2 ± 0.44</td>
</tr>
<tr>
<td>Met+Cys</td>
<td>87.2 ± 0.19</td>
<td>91.3 ± 0.19</td>
<td>80.0 ± 0.38</td>
<td>85.1 ± 0.38</td>
</tr>
<tr>
<td>Thr</td>
<td>74.5 ± 0.39</td>
<td>86.0 ± 0.39</td>
<td>81.9 ± 0.32</td>
<td>88.5 ± 0.37</td>
</tr>
</tbody>
</table>

### Key Words: Apparent ileal digestibility, Standardized ileal digestibility, Wheat, Peas, Broilers

P160 The implications of a threonine deficiency on mucin dynamics in growing broiler chicks and White Pekin ducklings. N. L. Horn*, S. S. Donkin, and O. Adeola, Purdue University, West Lafayette, IN.

Mucins play a crucial role in gut health and is the major constituent of the mucus layer. Threonine is particularly relevant to the mucin structure because of the importance it serves to link carbohydrate groups to the amino acid backbone. The effects of a threonine deficiency on crude mucin excretion and mucin mRNA (MUC2) abundance were investigated in growing male broiler chickens and White Pekin ducks. Twenty-four birds of each species were fed a standard poultry starter diet from d 0 to 14 of age and then assigned to either low (3.3 g/kg) or adequate (8.2 g/kg) dietary threonine for a 14-d feeding trial. Diets were semipurified, isonitrogenous corn-soybean meal based with the addition of crystalline amino acids formulated to meet or exceed NRC recommendations for broiler chicks and ducklings. Excreta was collected from d 26 to 28 of age and analyzed for crude mucin. Mucosal contents were collected from the distal jejunum on d 28 of age, placed in Trizol® reagent, and analyzed for MUC2 mRNA abundance by RT-PCR. Data were analyzed as a completely randomized design. For broiler chicks, there was no effect (P > 0.05) of dietary threonine on crude mucin excretion or MUC2 mRNA abundance. For ducklings, there was a tendency (P = 0.06) for a decrease in crude mucin excretion, whereas there was a decrease (P = 0.03) in MUC2 mRNA abundance in response to decreasing dietary threonine. In conclusion, a threonine deficiency in broilers did not affect crude mucin excretion or MUC2 transcript abundance; although in White Pekin ducklings a threonine deficiency reduced crude mucin excretion from 37.1 to 27.9 g/100 g of excreta and MUC2 transcript abundance from 2.97 to 1.88 arbitrary units for the 14-d feeding trial. The data establish a link between dietary threonine, crude mucin excretion, and MUC2 mRNA abundance in growing White Pekin ducklings. These effects of threonine on mucin dynamics have implications for improved gut health and nutrient absorption.

### Key Words: Chick, Duckling, Mucin, MUC2, Threonine


A study was conducted to evaluate Bioplex Mn® (a chelated Mn proteinate) as an organic manganese source for broiler chicks. Corn-soybean meal diet without Mn supplementation, containing 26 mg/kg Mn, was used as a basal diet. One-day-old male broiler chicks were housed in starter cages with plastic covered feeders in an environmentally controlled room for 3 wk. Feed and water were supplied on an ad libitum basis. Treatments consisted of feeding the basal diet alone or with three supplemental levels of Mn (1000, 2000 and 3000 mg/kg) either from Bioplex Mn® or from analytical MnSO4·H2O. Eight replicate cages of six chicks were randomly assigned to each of seven dietary treatments. Manganese
supplementation from both sources linearly decreased (P<0.01) weight gain and feed intake of chicks and linearly increased (P<0.01) manganese concentration in tibia, liver and kidney. Slope-ratio analysis regressing weight gain and tissue Mn concentration on Mn intake indicated the relative bioavailability value of Bioplex Mn<sup>8</sup> compared with manganese sulfate were 200% and 139% respectively.

Key Words: Bioavailability, Chick, Manganese proteinate, Manganese sulfate, Organic manganese

P162  Effects on productive parameters and digestive mucosa of broilers caused by feed supplementation with cell walls (Saccharomyces cerevisiae), beta-glucans and mannoproteins. R. Morales<sup>1</sup>, E. Auclair<sup>2</sup>, F. Garcia<sup>3</sup>, and J. Brufani<sup>1</sup>,<sup>1</sup>IRTA-Antimal Nutrition, Constanti-Tarragona, Spain, <sup>2</sup>Lesaffre Feed Additives, Marquette-Lez-Lille, France, <sup>3</sup>Safmex S.A. de C.V., Toluca, México.

An experiment was carried out in broiler chicks (Ross 308), in order to evaluate the effect of yeast cell walls (YCW) (S. cerevisiae) or Saf-Fmannan<sup>8</sup>, and their main purified polysaccharides, beta-glucans (BG), and mannoproteins (MP) incorporated into the diet, on growth parameters and digestive mucosa. Four experimental treatments were proposed: T-1) Negative control (NC), no additives; T-2) NC + YCW (500 mg/kg feed); T-3) NC + MP (190 mg/kg) similar to MP content of YCW (500 mg) of T-2; and T-4) NC + BG (227 mg/kg) similar to the content of BG of YCW (500 mg) of T-2. Treatments were replicated 5 times and included 40 chickens each. Diets were prepared with wheat-barley-rye meal and were free of antibiotic growth promoters, anti-coccidial drugs and enzymes for cereals. The results after 42 experiment days did not show clear effects on chicken live weight by the YCW use (P>0.05) (T-1=2404; T-2=2431; T-3=2419; and T-4=2430 g), only feed conversion index was numerically better in chickens fed with YCW, MP and BG when compared to control diet fed chickens (P<0.05) (T-1=1.660; T-2=1.615; T-3=1.600; and T-4=1.584 g/g); this situation coincided with a significant increase (P<0.01) in jejunum mucosa villi height (21 days) in chickens that consumed YCW, MP and BG in the diet as compared to the use of NC diet (T-1=957b; T-2=1159a; T-3=1156a; and T-4=1109a µm).

Key Words: Yeasts cell walls, Beta-glucans, Mannoproteins, Villi height, Broiler

P163  Effect on productive parameters, by the addition of yeast cell walls (Saccharomyces cerevisiae) to broilers' feed in two different exploitation conditions. J. Arce<sup>1</sup>, E. Avila<sup>2</sup>, C. López-Coelio<sup>2</sup>, A. García<sup>3</sup>, and R. Morales<sup>3</sup>,<sup>1</sup>UMSNH, Morelia-Michoacán, México, <sup>2</sup>UNAM-FMYZ, México D.F., México, <sup>3</sup>Safmex S.A. de C.V., Toluca, México.

An experiment was carried out in broiler chickens with the purpose of evaluating productive parameters with the addition of yeast cell walls (YCW) (S. cerevisiae) or Saf-Fmannan<sup>8</sup> to feed, in two different farms; with or without technical development, working for 2 and 25 years respectively (A and B), located at 1940 masl (Mexico). A total of 5,600 one-day-old chicks were used, rearing them until they were 45 days old. They were completely randomized with a factorial arrangement of 2 x 4 with 14 replicates of 50 birds each, with the following factors: farms and treatments, which consisted of a negative control (NC) without antibiotic; positive (PC) with antibiotic (Virginiamycin); NC + YCW at 500 mg/kg of feed, and PC + YCW at 500 mg/kg of feed. Results showed significant effects (P<0.01) between treatments in body weight (2461, 2587, 2544 and 2656 g), feed consumption (4827, 4862, 4832 and 4913 g), and feed conversion (1.99, 1.91, 1.93 and 1.88 g/g) favoring treatment PC + YCW (500 mg/kg feed). Significant effects were found (P<0.01) between farms in body weight (2561 vs. 2561 g), feed consumption (4640 vs. 5098 g) and feed conversion (1.80 vs. 2.02 g/g) favoring farm A, with interaction (P<0.04) on feed conversion between the evaluated factors. Both farms showed better response to the inclusion together with antibiotic + YCW. The conclusion is that YCW at 500 mg/kg feed dose by itself is sufficient to achieve results similar to Virginiamycin, existing synergism in parameters when added jointly with YCW.

Key Words: Yeast cell walls, Saccharomyces cerevisiae, Broiler chickens, Productive parameters

P164  Production performance of single comb White Leghorns fed growing diets containing blood meal and supplemental isoleucine. S. N. Nahashon*, J. Tyus III, N. A. Adefope, and D. Wright, Institute of Agricultural and Environmental Research, Tennessee State University, Nashville, TN.

The effect of feeding blood meal supplemented with isoleucine to Single Comb White Leghorn (SCWL) chicks on their successive production performance was evaluated. In four replicates, 480 SCWL chicks were fed experimental diets containing blood meal with supplemental isoleucine from day-old to 10 weeks of age (WOA). The diets were corn-based with the protein sources being 100% soybean meal (control), 100% blood meal (BM), 50% soybean meal + 50% blood meal (SBMB), and 50% alfalfa meal + 50% blood meal (AMBM). These diets contained 2,900 Kcal ME/kg and 20% crude protein (CP). Blood meal comprised 16.8, 11.0 and 14.3% of the dietary composition in BM, SBMB, and AMBM diets, respectively. At 10-15, 15-18 and 18-46 WOA birds in all treatment groups were fed corn-soy-based diets containing 3,000, 3,080, and 2,900 Kcal ME/kg and 17.5, 16.5, and 16% CP, respectively. Experimental birds were provided a 23, 8, and 16 hr light regimen at day-old to 10 WOA, 10-16 WOA, and 16-46 WOA, respectively. Feed and water were provided at free choice and mortality was recorded as it occurred. At first egg, experimental birds were observed for age, body weight and egg weight (EW). Thereafter hen-day egg production (HEP), EW, egg mass (EM), egg grade (EG), internal egg quality (IEQ) and egg shell thickness (ST) were measured over five 28-day laying periods. Birds fed BM diets had 6.08, 5.24 and 2.63% higher HEP than those fed the control, AMBM, and SBMB diets, respectively. Mean EM of BM fed birds was 5.65, 5.49 and 2.34% higher than that of the control, AMBM, and SBMB birds, respectively. However, IEQ and ST were higher (P<0.05) in birds fed the control diet than the other treatment groups such that control > BM > SMBM > AMBM. Therefore, feeding diets containing blood meal and supplemented with isoleucine to SCWL chicks from day-old to 10 WOA significantly improved their egg production performance, but depressed their IEQ and ST.

Key Words: Single Comb White Leghorn, Blood meal, Production performance, Isoleucine

P165  Live and processing performance of broiler chickens fed diets supplemented with complexed zinc. B. Saenmahayak*, S. F. Bilgili, and J. B. Hess, Auburn University, Auburn, AL.

Influence of complexed Zinc (C-Zn) supplementation on live performance (BW, feed conversion and mortality), skin (incidence of sores, scabs and scratches) and foot pad quality, processing yields, and meat quality of broiler chickens were assessed at 49 d of age. A total of 1,440 male Ross x Ross 708 broilers were assigned to three dietary treatments (60 birds per pen; 8 pens per treatment): inorganic control (IC; 80 ppm ZnSO<sub>4</sub> and 80 ppm MnSO<sub>4</sub>), C-Zn (Availa-Zinc, Zinpro Corp., Eden Prairie, MN) replaced 40 ppm ZnSO<sub>4</sub> in control diet (IC+C-Zn) and additional 40 ppm Zn from C-Zn on top of control (IC+C-Zn). Each treatment was provided in a three-stage feeding program, which consisted of a starter (1-15 d), grower (16-41 d), and withdrawal diets (42-48 d). At 49 d of age, the incidence and severity of pododermatitis was assessed in all birds. In addition, 10 birds were randomly selected from each pen and processed to evaluate whole carcass yield, grade, skin lesions, and meat quality attributes (drip loss, cook loss, pH, water holding capacity (WHC), and color (L*, a* and b*) of breast fillet. Feed conversion was also improved (P<0.05) with IC+C-Zn as compared to IC treatment, respectively. Feed conversion was also improved (P<0.05) with IC+C-Zn as compared to IC treatment. Total mortality averaged 1.6% and did not vary among the treatments. The incidence and severity of pododermatitis was significantly reduced with both C-Zn treatments. Proportion of birds with skin lesions decreased from 42.7% (IC) to 9.6% (IC+C-Zn). No differences in carcass and component yields were detected. However, deboned fillet and total breast yields were significantly higher in IC+C-Zn than the IC treatment. Breast fillet quality attributes measured did not show any differences due to dietary treatments. Inclusion level and source of dietary Zn had a significant influence on broiler live and processing performance in this study.

Key Words: Broilers, Complexed zinc, Skin quality, Pododermatitis
P166  Performance comparison and nutrition requirement of eight commercial brown egg layer strains. P. K. Gunawardana*, M. M. Bryant, and D. A Roland, Sr., Auburn University, Auburn, AL.

Eight commercial brown egg layer strains were used to compare performance and nutrient requirements when fed diets containing three lysine levels (0.917, 0.828, and 0.747). There were eight replicates of 10 hens (21 weeks of age) for each treatment and the trial lasted 16 weeks. The results showed that there were no interactions between lysine and strain on any parameter. Lysine had significant effects on egg weight, egg mass, feed conversion, percent albumen solids, yolk color, shell color, albumen weight, egg shell and albumen components. There were significant strain effects on egg production, feed consumption, egg weight, egg mass, feed conversion, specific gravity, yolk weight, shell color, shell, albumen and yolk components, yolk albumen and whole egg solids. Strain 1 had the best overall performance. All strains peaked in production over 94% and were laying 94 to 96% at 36 weeks of age. Average egg weight (21 wk to 36 wk) was 60.3g, varying from 59.0 to 62.8g between strains. Average feed intake was 112.3g/hen/day varying from 109.6 to 116.7g/hen/day between strains. Average Egg weight of hens fed diets containing the highest lysine level was 2.04g heavier than the hens fed the diets containing the lowest lysine level. Increasing dietary lysine from 0.747 to 0.917% significantly improved feed conversion from 2.20 to 2.06 g feed/g egg and increased egg mass from 51.8 to 54.32 g/hen/day. Average yolk intake of hens fed 0.917% level was 1023mg/hen/day varying from 1005 to 1070mg/hen/day between strains. Because feed ingredient and egg price vary there can be no fixed ideal dietary lysine requirement for optimal profits.

Key Words: Brown layer Strain, Nutrient requirement, Lysine

P167  Microsoft Excel sensitivity analysis for stochastic and linear program feed formulation. W. B. Roush*, USDA-ARS Poultry Research Unit, Mississippi State, MS.

Sensitivity analysis is a basic part of a mathematical programming solution and is helpful in making nutritional and economic decisions for a given feed formulation problem. The terms shadow price and reduced cost are familiar linear program (LP) terms to feed formulators. Because of the nonlinear nature of stochastic programming (SP), a different approach is used to define shadow prices and reduced costs. The Lagrange multiplier is used instead of shadow price to describe marginal value of nutrients. Reduced Gradient is used instead of reduced cost to describe the price at which ingredients, not used in the formulation, would enter the solution. A spreadsheet feed problem was setup with 11 ingredients and 11 constraints. LP and SP solutions were determined using the Excel Solver algorithm. Two problems compared LP and SP solutions at 50% and 69% probabilities for the protein constraint. All other constraints were held at a 50% probability. Results for the 50% probability comparison showed that the feed formulations, as expected, were exactly the same for both LP and SP. Wheat was not included in the solution. The LP reduced cost and the SP reduced gradient for unused wheat were equivalent. The LP Shadow prices and the SP Lagrange multipliers were the equivalent. Results for the 69% probability problem showed a difference in the formulated rations. The LP reduced cost was $34.25 and the SP reduced cost was $34.52 showing the respective amounts that the cost of wheat would have to be reduced to enter the solution. The shadow price and the Lagrange multiplier were $2.73 and $2.71 respectively for the amount of increase in ration cost that could be expected by a unit of change in the protein requirement. Some rounding error was noted with the results.

Key Words: Sensitivity analysis, Feed formulation, Linear programming, Stochastic programming


The effect of varying levels and sources (organic vs. inorganic) of trace mineral supplements on trace mineral concentrations in manure 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 (1994) requirements in the form of inorganic salts or proteinates (Bioplex®, Altech, 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 photosimulation program was initiated. At 29 wk of age, six hens per treatment were placed in metabolism cages and manure was collected for 48 hours. Manure samples were dried, ground and analyzed for Cu, Fe, Mn and Zn by inductively coupled plasma spectrophotometry. Manure concentrations of Cu, Mn and Zn were significantly increased by the 100% level of supplementation (vs. 25 and 50%) and were unaffected by the source of minerals. Manure Fe levels were unaffected by dietary treatments. Respective concentrations of Cu, Fe, Mn and Zn in manure (DM basis) were 39, 813, 145 and 230 mg/kg for hens supplemented with the 100% level and 28, 747, 94 and 165 mg/kg for hens supplemented with the 25% level of trace minerals. The results indicate the dietary level, but not the source, of the trace minerals used with practical diets influences the concentrations of trace minerals in the manure.

Key Words: Laying hens, Trace minerals, Proteinates, Organic minerals, Manure

P169  Effect of peptides on performance, egg components, egg solids and egg shell quality of Hy-line W-36 Hens fed different protein levels in second cycle. P. K. Gunawardana*, M. M. Bryant, D. A Roland, Sr., and G. Wu, Auburn University, Auburn, AL.

A 5 × 2 factorial arrangement of five protein levels with and without Peptiva (a mixture of peptide) was used in two trials to evaluate its™ effect on performance, egg composition, egg solids, and egg quality of commercial Leghorns. Molted Hy-line W-36 hens (n=1200) were randomly divided into 10 dietary treatments (8 replicates of 15 hens per treatment). Trial one lasted 8 weeks and trial two lasted 4 weeks. In trial one, Protein had a significant effect on feed consumption, egg weight, egg production, egg mass, egg specific gravity, egg albumen solids, and percent albumen. As dietary protein increased from 13.5 to 15.6%, egg production, feed consumption and egg weight increased by 6.1%, 8.2% and 5.2% respectively. Feed consumption of hens fed the diets supplemented with Peptiva was significantly lower than that of hens fed the diets without Peptiva. Peptiva supplementation significantly increased egg production of hens during the first week with production being numerically higher in week 2, 6, 8 and overall egg production. Peptiva significantly increased egg mass and improved feed conversion during the first week but all significant effects other than the feed consumption were lost after the second week. In trial two the protein effects were similar to that observed in trial one; but peptiva had no significant effects. These results suggest Peptiva may influence protein utilization but more research is needed to fully evaluate its effects on performance and profits.

Key Words: Peptiva, Peptides, Dietary proteins, Commercial leghorns

P170  Effect of increasing dietary energy while maintaining a constant energy/lysine ratio on performance, egg components, egg solids, egg quality and profits in seven commercial leghorn strains during second cycle. P. K. Gunawardana*, M. M. Bryant, D. A Roland, Sr., and G. Wu, Auburn University, Auburn, AL.

A 3 X 7 factorial experiment of three energy levels (low, medium and high) and seven commercial Leghorn strains was conducted to determine the effect of increasing dietary energy while maintaining a constant energy/lysine ratio on performance, egg composition, egg solids, egg quality, and profits in seven commercial Leghorn strains during second cycle phase 2 (from 88 to 97 week
of age). This experiment lasted 10 weeks. Seven strain of hens of hens (n=245 of each strain) at 88 week of age were randomly divided into 21 treatments (6 replicates of 15 birds per treatment). Strain had a significant effect on feed intake, egg production, egg specific gravity, egg weight, percent whole egg solids, and haugh unit. There were no interactions between strain and dietary energy with a constant energy/lysine ratio on any parameter during second cycle. Dietary energy while maintaining a constant energy/lysine ratio had also no significant effect on any parameter. However, as dietary energy increased from 2,776 to 2,864 kcal ME/kg, egg production, final body weight of hens, egg mass, egg yolk color and egg yolk weight numerically increased; moreover, feed conversion numerically improved from 2.06 to 2.02, resulting in a 1.9% improvement of feed conversion. It is difficult to determine an ideal dietary energy level for the hens in second cycle since increasing dietary energy by addition of poultry oil had no significant effect on feed intake, egg mass or feed conversion. Because feed ingredient and egg price vary, there can be no fixed ideal dietary energy requirement for optimal profits.

Key Words: Strains, Energy/lysine ratio, Dietary energy, Lysine

P171 Testing pellet quality and pelleting efficiency in a pelleting facility in Kosova. R. I. Bakalli*, M. Thaqi2, I. Zenela2, B. Pllana1, and G. M. Pesti1, 1University of Georgia, Athens, 2USAIDKCBS, Pristina, Kosova.

It is estimated that 130,000 MT of poultry feed is produced in Kosova each year. Considerable amounts of feed are best fed as crumbles or pellets. The pelleting process is defined as the agglomeration (process of molding into a mass) of small particles into larger particles by means of a mechanical process in combination with moisture, heat, and pressure. Advantages of pelleting: improved feed efficiency, improved digestibility, decreased feed wastage, reduced selective feeding, decreased ingredient segregation, destruction of pathogenic organisms. Disadvantages of pelleting: investment in equipment, maintenance costs, risk of destruction from some vitamins, amino acids, enzymes (unstabilized forms are used). A new pelleting facility in Kosova has two pelleting presses: a flat, 6 mm diameter die press (1500 kg/h), and a ring, 3 mm diameter die press (750 kg/h). Trial 1 included testing pellet quality of common poultry feed ingredients. The durability index for: corn = 65.7, soybean meal = 41.5, sunflower meal = 97.2, wheat bran = 95.5. Trial 2 included the influence of horizontal barrel conditioner speed on pelleting efficiency and quality. If mash material speed in the conditioner was 8.19 kg/min; steam pressure was 3.3-4 bar at 81°C, capacity 438 kg/h, durability index 88.9, pelleting efficiency 150 kW/T, pelleting cost = 6 â‚¬/T; at 16.63 kg/min; steam pressure = 3.2-4 bar at 71°C, capacity = 997 kg/h, durability index = 72.3, pelleting efficiency = 71 kW/T, pelleting cost decreased to 3 â‚¬/T; at maximum speed (28.45 kg/min), steam pressure = 3.2-4 bar at 50°C, capacity = 1707 kg/h, durability index = 48, pelleting efficiency = 46 kW/T, pelleting cost decreased to 1.94 â‚¬/T. Pelletling poultry feed in Kosova will be beneficial for poultry production with possibilities to balance pellet efficiency, pellet quality and reduce the additional spending for pelleting.

Key Words: Pelleting, Pelletting Efficiency, Pellet Durability Index


Low fiber and high energy and protein diets are essential for high performance animals. This is the reason why cereals are quite important for the animal nutrition. Ensiling is an alternative of the preservation of grains. According to Berndt et al. (2002), ensiling of grains with high humidity in the animal feeding results in agronomic advantages like significantly lower field losses, more intensive use of the land (3-4 weeks according to Mader et al., 1983; Kramer und Vooruyl, 1991) and cost reduction because of the drying, thesis also supported by Silva (1997), Costa et al. (1998), Molin et al. (1999), Lemos (2006), Biagi et al. (1996) added another advantage, which is the reduction of the grain losses while maturity by earlier harvest. Other decreasing of losses was substantiated by Doggett (1988), in case of the sorghum, caused by bird damage; by Vilela et al. (1988), Santos (1992), Biagi et al. (1996), Silva (1997) as result of molds and insects infestation and the concomitant risk decreasing of mycotoxin loading when grains are ensiled (Costa et al., 2002). Lemos (2006) enumerates the control of rodents in the silo. Furthermore, the feed conversion rate was improved in the ruminant (Tonroy et al., 1974; Mader et al., 1991; Stock et al., 1991; Costa et al., 2001) and in the monogaster nutrition (Lopes et al., 2001a; Lopes et al., 2001b; Sartori et al., 2002). Jobim et al. (1999) agree that in the top layer of the silos the grain silage spoils relatively fast. The studies show that the use of biological silage additives can improve the aerobic stability of grain silages and that the tannin content can be reduced, as well as the chicken performance improved. It can be concluded that the ensiling of cereal grains is an alternative way to preserve them and to improve their nutritional value.

Key Words: Broiler, Phytase, Equivalency, Ash, Growth


An experiment was conducted to determine the relative bioavailability (RBV) of different sources of Cu for broilers. Each treatment had 8 replicate pens with 6 female Ross 708 broilers per pen in brooder batteries. Dietary treatments were: corn-soybean meal diet with no extra supplemental Cu or diets with 250, 350, or 450 ppm Cu from trisbasic copper chloride (TBCC), Mirex Cu (Mintrex), or CuPlex 100 (CuPlex). Chicks were killed on d 14 via CO2 asphyxiation, and livers were collected from each chick for Cu analysis. Increasing levels of Cu in the diet linearly decreased (P<0.03) ADG and ADFI, but this response was observed only in chicks fed CuPlex, which had decreased (P<0.01) ADG and ADFI compared to chicks fed TBCC (level × source, P<0.05), and chicks fed Mintrex were intermediate. As level of Cu increased from 250 to 350 ppm from...
TBCC, ADG and ADFI tended to increase, and then these responses decreased from 350 to 450 ppm Cu. As level of Cu from Mintrex increased, GF decreased, but as level of Cu from CuPlex increased, GF increased (level × source, P < 0.07). Liver Cu concentration linearly increased (P < 0.01) as level of Cu increased in the diet, but liver Cu concentration increased at a greater rate in chicks fed CuPlex than in those fed Mintrex or TBCC (level × source, P < 0.02). Relative bioavailability assays were conducted using liver Cu concentration and are based on calculated level of Cu added to the diets, analyzed concentrations of Cu in the diets, and total amount of Cu consumed. For calculated level of Cu added to the diets, analyzed concentrations of Cu in the diets, and total amount of Cu consumed, RBV values are 115, 106, and 109%, respectively for Mintrex and 132, 124, and 140%, respectively for CuPlex using TBCC as the standard. Based on liver Cu concentrations, CuPlex is more available than TBCC. Mintrex is just as available as, or slightly more available than TBCC, depending on the response used. More research is needed to understand the increase in ADG and ADFI in broilers fed 350 ppm Cu from TBCC.

Key Words: Broiler, Copper, Bioavailability

P175  Nucleotides in broilers diet from 1 to 21 days. R. Barbalho*1, G. A. Gomes2, and L. F. Araujo3, 1ICC Brazil, Sao Paulo, SP, Brazil, 2University of Sao Paulo, Pirassununga, SP, Brazil.

Saccharomyces cerevisiae (SC), one of the most widely commercialized types of yeast, has long been fed to animals. One of the most important aspects of yeast is its high content of nucleic acids, which through proper hydrolysis can be transformed into free nucleotides. The objective this study was to examine effects of free nucleotide from hydrolyzed yeast (Hilyses™) supplementation in vegetable diets compared to a positive control. Therefore a total of 200 male broiler chickens, 1-d-old were assigned to one of the following diets: negative control (without additives), another diet with 0.3% Hylises™/kg feed (120 g/ton of nucleotides), diet with 0.6% Hylises™/kg (240 g/ton of nucleotides) feed and other diet (positive control) with 1.0% glutamine/kg feed consisting of 5 replicates with 10 birds each. Performance parameters and gut morphology were recorded from day 1 to day 21 and at the end of the experiment 3 chickens per pen were utilized for gut morphology determination in terms of carcass percentage, breast yield, leg yield, wing yield and abdominal fat yield. Overall gut morphology did not differ between treatments with free nucleotides (Hylises™) and glutamine, but birds feeding with negative control showed worst crypt depth, villous high, villous height/crypt depth ratio and villous area. The results showed that birds feeding with 0.6% of Hylises™ (240 g/ton of nucleotides) had better performance than the others treatments and increased feed intake on first week. The glutamine decreased the performance the birds.

Key Words: Glutamine, Growth performance, Saccharomyces cerevisiae, Yeast cell component

P176  Amino acid digestibility of yeast for broilers. R. Barbalho*1 and L. F. Araujo2, 1ICC Brazil, Sao Paulo, SP, Brazil, 2University of Sao Paulo, Pirassununga, SP, Brazil.

Although evidence suggests that ileal digestibility values are better indicators of amino acid availability than excreta-based values, ileal digestibility values are limited. One assay was carried out to evaluate the apparent ileal and excreta amino acid digestibility of diets formulate with yeast obtained from different sources for broilers. The birds were raised in battery and fed commercial broiler starter from d 1 to 19. On d 20, 150 male broilers were allocated in three treatments (T1 – Autolyzed yeast; T2 – Yeast which had its residual alcohol recovered through distilling column and T3 – Yeast which had its residual alcohol recovered through washing) in five replicates of 10 broilers in each experimental unit. The animals were given a diet containing yeast as the sole source of protein. All diets contained chromic oxide (0.5%) as the indigestible marker to calculate the digestibility estimates. During the 23rd to 27th days, the excreta were collected and, in the 28th day, all broilers of each replicate were slaughtered and ileal digesta were collected from the terminal ileum by gently flushing with distilled water into plastic containers. Ileal digesta from birds within a pen were pooled and immediately stored at –20°C in airtight containers. The samples of the excreta and ileal digesta were analyzed for dry matter, nitrogen, and the digestibility coefficients and energy values, were calculated using the indigestibility factor of chromic oxide. The average the ileal and excreta digestibility were lower in yeast processed through distilling column and the best results were obtained with autolyzed yeast and yeast processed through washing. It was concluded that way that a bi product yeast is processed affects the nutrient digestibility of diets formulated with the inactive dried yeast and differences determined between ileal and excreta digestibilities demonstrate that amino acid metabolism by hindgut microflora may be substantial and that digestibilities measured in the terminal ileum are more accurate measures of amino acid availability than those measured in the excreta.

Key Words: Apparent ileal digestibility, Excreta digestibility, Protein source, Saccharomyces cerevisiae

P177  The linear correlation between phytase activity measurements determined using two assay methods in animal rations. M. E. Persia1, H. Burrows1, R. Prata1, S. S. Basu1,2, and M. Lee1, 1Syngenta Animal Nutrition, Research Triangle Park, NC, 2Syngenta Biotechnology, Research Triangle Park, NC.

Currently, different phytase assay methods have been used to quantify the enzyme activity in the feeding industry. These methods prescribe different extraction as well as assay conditions, including the assay reaction temperature, which can have significant effects on the activity data collected. In this study, experiments were conducted to build the relationship between two such assay methods that differ, among other things, in phytase assay temperature. The direct assay (DA), a higher temperature assay (50°C) was compared to the AOAC method (37°C). Each assay method was carried out on the same feed sample generated from four diet-types with phytase inclusion levels of 250, 500, 1000, 1500 and 2500 FTU of Quantum™ phytase (QP) per kg diet. Phytase activity measured with DA and AOAC methods, reported in IU and FTU respectively, were plotted. The linear correlation generated between these two sets of data, show a high correlation-coefficient (r2) of 0.965. In an attempt to measure the contribution of assay temperature to phytase activity, liquid QP was diluted to different concentrations (250, 500 and 1000 FTU/kg) in AOAC assay buffer and enzyme assays were then conducted in parallel at both 37°C and 50°C. The plotted data showed a linear co-relationship (r2 = 0.988) between the assays carried out at different temperatures. The slopes from these two linear plots, 1.52 for phytase activity measured in feed samples using the two methods and 1.63 for liquid enzyme sample measured at different assay temperatures, were similar in magnitude. This leads to the inference that difference in assay temperature was one of the major contributors to the observed differences in phytase activity measurements reported from feed analysis carried out using these two methods. In addition, based on results presented, it appears a simple linear equation can be used to convert phytase activity estimation between these two assay methods.

Key Words: Phytase, Assay, Temperature, FTU, IU

P178  Effects of trace mineral supplementation on egg production and feathering in laying hens. S. E. Scheideler*1, T. Weber1, S. Shields1, and H. Stillborn1, 1University of Nebraska, Lincoln, 2Altech Inc., Nicholasville, KY.

Five experimental diets ranging in zinc (Zn) and selenium (Se) levels and Zn and Se sources were fed to laying hens from 24 to 110 weeks of age. A non-fasting molt was induced at 65 weeks of age. The diets included a basal diet with 0 ppm supplemental Se and Zn (Diet A); 30 mg/kg Se from Na Selenite combined with 100 ppm Zn from Zn Sulfate (Diet B); 30 mg/kg Se from Selplex (Altech, Inc.) and 100 ppm Zn from Zn Sulfate (Diet C); .30 mg/kg Se from Na Selenite and 100 ppm Zn from Altech Bioplex Zn (Diet D); or .30 mg/kg Se from Selplex and 100 ppm Zn from Altech Bioplex Zn (Diet E). Each diet was fed to 6 replicate cages with 4 Bovan White hens per cage. Feather scores (FS) were conducted every 2 weeks during the trial using 2 scoring systems â€” Tauson and Webster and Hurnik. Trace mineral treatment had no significant effect on feed intake, hen weights, egg weights or egg specific gravity during all phases both pre and
post molt during this trial. Egg production showed a significant dietary effect during Phase 2 of production with hens fed diet D having improved EP d-1 of 87.4 compared to hens fed the other experimental diets. That is the only time period that there was a significant effect of treatment on EP parameters. As hens aged, feather scores by both scales showed a rapid deterioration during Phases 2 and 3 of the study with rejuvenation of feather cover following molt. By the Webster and Humik scale, diet significantly affected feather score during Phase 3 and 5 of the study. Hens on the basal diet (0 supplementation of Se and Zn) had the poorest feather cover; while hens on Diet D (Se from Na-Seleinite and Zn from Bioplex) had the best feather scores during Phase 3 and Diet E (Se from Selplex and Zn from Bioplex) had the best scores during phase 5 (post molt).

Key Words: Feather Cover, Zinc, Selenium, Laying Hens, Trace Mineral

P179 The effect of glycine in diets for broilers fed corn-soybean meal diets. A. Waguespack*, S. Powell, A. Donsbrough, D. Dean, T. Bishnoi, L. Southern, R. L. Payne², ¹LSU Agricultural Center, Baton Rouge, ²Degussa Corporation, Kennessaw, GA.

The purpose of this report is to summarize the effect of added Gly to corn-soybean meal (C-SBM) diets. Eleven experiments (Exp.) were conducted that included C-SBM, which were thought to be adequate in all nutrients, and then that diet with added Gly. All Exp. were conducted from 0 to 14 or 18 d of age. In some of these Exp., there was a significant response to added Gly in gain (ADG), feed intake (ADFI), or gain:feed (GF). Where the effect was not significant, often with added Gly. All Exp. were conducted from 0 to 14 or 18 d of age. In some C-SBM, which were thought to be adequate in all nutrients, and then that diet meal (C-SBM) diets. Eleven experiments (Exp.) were conducted that included

P180 Effects of low crude protein diets with amino acid supplementation on broiler performance in the starter period. E. R. McGill, J. D. Firman, and A. Kamyab, University of Missouri, Columbia.

Previous research conducted by this laboratory indicated that dietary crude protein can be as low as 15% and achieve similar broiler performance as a 23% CP diet. Two recent experiments were conducted with the objective of testing the effects of feeding a 15% CP diet with crystalline amino acid supplementation on the performance of broilers from 1-3 weeks of age. In both experiments, commercial broilers were fed a diet formulated to meet NRC requirements for the first seven days. The diet contained 23% CP and 3200 kcal/kg ME, and also served as the positive control diet (A). At day 7 birds were sorted by weight into battery pens with 5 birds per pen. Both experiments contained the same six dietary treatments with eight replicates per treatment for a total of 48 pens. The remaining treatments consisted of: a 15% CP negative control diet with crystalline amino acids added back to meet required levels (B), a NC diet + .1% cystine (C), a NC diet + .1% threonine (D), a NC diet + .1% glycine (E), and a NC diet + .1% cystine, threonine, and glycine (F). Glutamic acid was added to all diets to maintain a 20% protein equivalent. All diets were formulated on a digestible basis, and were designed to be isocaloric. At the conclusion of the experiments, body weight gain (BWG), feed intake (FI), and feed efficiency (FE) were measured. In Experiment 1, significant differences (P < 0.05) were found in BWG between treatments A and F, although no significant differences in FI or FE were observed. There were no significant differences (P > 0.05) in BWG, FI, or FE between any of the other treatments. In Experiment 2, treatments had no effect (P > 0.05) on performance. Overall, these results suggest that feeding a 15% CP diet + crystalline amino acids to broilers in the starter period may yield similar performance as a 23% CP diet.

Key Words: Low crude protein, Broilers, Crystalline amino acids, Performance, Starter period

P181 Comparison of dietary bacitracin methylene disalicylate (25 g/ton) vs bacitracin methylene disalicylate (25 g/ton) plus Bacillus subtilis C3102 spores (CALSPORIN®) for broiler chickens in litter pens over 3 cycles with Salmonella challenge at 10 days in 1st cycle. M. D. Sims1, T. Lohrmann2, N. Otomo3, D. M. Hooge4, and J. D. Firman5, 1Virginia Diversified Research Corp., Harrisonburg, 2Quality Technology International, Inc., Elgin, IL, 3Calpis Co. Ltd., Tokyo, Japan, 4Hooze Consulting Service, Inc., Eagle Mountain, UT, 5University of Missouri, Columbia.

Three cycles of Ross x Cobb broilers were placed on clean litter in cycle 1 (January 11) and on re-used litter in cycles 2 (March 1) and 3 (April 19). Chicks were challenged with Salmonella typhimurium Copenhagen (1x10⁹/g feed) at 10 d in cycle 1 only. There were 8 replicate pens with 30 chicks each per treatment, and each trial lasted 42 d. Diets included a negative control (nCON; not supplemented with antibiotic or microbial), bacitracin methylene salicylate (BMD®, Alpharma) at 50 g/ton, or BMD® 25 g/ton + Bacillus subtilis C3102 (Bs C3102; CALSPORIN®, 3 x 105 cfu/g feed). Data were analyzed statistically by cycle and 3 cycles combined. The BW and FCR results were consistent over 3 cycles (nCON poorest results in cycles 2 and 3; P < 0.05). Overall, BMD® 50 g/ton gave best FCR (1.843 vs 1.857 for BMD® 25 g/ton + Bs C3102 spores vs 1.953 for nCON (P < 0.06). The 42-d BW was 2.270 kg for BMD® 25 g/ton + Bs C3102 spores and 2.255 kg for BMD® 50 g/ton vs 2.163 kg for nCON (P = 0.13). Mortality did not differ significantly (2.36, 2.36, and 1.90% with BMD® 25 g/ton + Bs C3102 spores treatment lowest). Clostridium perfringens counts at 35 d were lower (0.30 and 0.30 CFU/g feces) in birds fed BMD® 50 g/ton and BMD® 25 g/ton + Bs C3102 spores vs nCON (1.56 CFU/g feces; P < 0.001; less than 2.30 CFU/g were “none detected” and considered “0”). Whole carcasses rinses found Salmonella counts unaffected by treatment but lower by cycles 1 to 3. The BMD® 25 g/ton + Bs C3102 spores treatment was favored economically and therefore recommended for commercial use.

Key Words: Bacillus subtilis C3102, Bacitracin, Broiler chicken, Calsporin, Direct-fed microbial

P182 Molting 16 white and brown egg laying strains without feed withdrawal. M. M. Bryant and D. A. Roland, Auburn University, Auburn, AL.

Animal welfare concerns have made it evident that feed withdrawal is no longer an acceptable method for force molting hens. Producers are now faced with finding an alternative method that is as effective. To this end two trials were conducted to evaluate the effectiveness of three diets intended to induce molt. Trial one was an eight by two factorial study where eight strains of 66 week old white leghorns were fed one of two diets. One diet used corn to replace soy bean oil meal (SBOM) and omitted salt (CN). The other diet substituted wheat midds and soy hulls for corn and SBOM and also omitted salt(WM). The second trial was conducted using four strains of White Leghorns and four strains of Brown Leghorns that were also 66 weeks old. Each strain was fed one of two diets. One diet was the same as the CN diet in the first study and the other diet substituted SBOM for corn and omitted salt (SB). Hens were fed these molt diets for 28 days and were then fed an appropriate post molt layer feed. Performance was evaluated for sixteen weeks for both trials. The criteria used to evaluate perfor-
mance were egg production (EP), egg weights (EW), feed consumption (FC), egg specific gravity, hen mortality and interior egg qualities. In the first trial, EP and EW were higher for hens fed the WM diet early but by peak production and for the overall average (wk1-16) there were no differences. Average FC after egg production resumed was higher for hens fed the WM diet by 6%. Some strains had EP higher than 90% at 86 weeks of age. In the second trial FC was higher for hens molted with the SB diet than those molted with the CN diet. There were no differences between hens fed the different molt diets in any of the other criteria measured. The average EP of brown egg layers at 65 weeks of age (prior to molt) was higher than white egg layers. After molting this reversed. At 16 weeks post molt (86 weeks of age) brown egg layer EP was 85% and white egg layers EP was 88%. Although all three diets were satisfactory, the method of choice would depend on ingredient prices of molt feeds.

Key Words: Molt, Hen, Strain

P183 Effect of exogenous enzymes supplementation on apparent metabolizable energy of corn. L. R. B. Dourado1, N. K. Sakomura*1, N. A. A. Barboza1, M. Hruby2, and E. Pierson3, 1FCAV-UNESP, Jaboticabal, São Paulo, Brazil, 2Danisco Animal Nutrition, St. Louis, MO.

The use of enzymes has been shown to improve digestibility of nutrients in corn-soybean diets. However, few studies have been conducted to determine the effect of enzymes specifically on corn. The aim of this work was to evaluate the apparent metabolizable energy (AMEn) of corn supplemented with exogenous enzymes (Danisco Animal Nutrition). A digestibility trial was conducted using a total collection of excreta method from 7 to 14 days of age: 280 7-day old Cobb * male chickens were distributed into seven dietary treatments, five replicates of 8 chicks each. A basal diet containing corn, dicalcium phosphate, limestone, salt, mineral and vitamin mixture was supplemented with enzymes evaluated. The treatments consisted of corn (without enzymes) and corn supplemented with one of the following enzymes: amylase (g min 400 u/kg feed), xylanase (g min 150 u/kg feed), phytase (g min 500FTU/kg feed), Avizyme® 1502 (amylase, xylanase and protease) at 500 g/tonne and Grindzym® (xylanase, pectinase and β-glucanase, 500g/tonne) and combination of Avizyme® 1502 and Phyzyme XP (all enzymes supplied by Danisco Animal Nutrition). Diets and excreta were analyzed for dry matter, nitrogen and energy. The supplementation of Avizyme 1502 + Phyzyme XP provided greatest improvement (p=0.08) in AMEn of corn (3578±31) compared to corn without enzymes (3504±55). The improvements for individual enzymes were from highest to lowest for Avizyme 1502, xylanase or Phyzyme XP and amylase. Supplementation with Grindzym did not improve corn AME.

Key Words: Corn, Enzymes, Apparent metabolizable energy, Broilers

P184 Feeding full fat oil seeds to laying hens: Effect on production parameters, egg quality and yolk fatty acids. Z. Hayat1, T. N. Pasha1, F.M. Khattak1, G. Cheriass2, and M. A. Jabbar1, 1University of Veterinary and Animal Sciences, Lahore, Pakistan, 2Oregon State University, Corvallis.

An experiment was carried out with three hundred, 53-week-old white leghorn hens to examine the effect of dietary full fat oil seeds (sunflower, canola, flax) at three different levels (5, 10, 15%) on egg production, egg weight, feed consumption and yolk fatty acids. The inclusion of oil seeds did not alter the egg production or egg weight when compared with eggs from hens fed the corn-soy-based control diet (P>0.05). Feeding flax (10,15%) and canola (5,10,15%) led to reduction in the total saturated fatty acids (P<0.05). The deposition of α-linolenic acid (18:3n-3), eicosapentaenoic (20:5n-3) and total long chain n-3 fatty acids was highest with flax 15% (P<0.05). The total n-3 fatty acids was 32, 26 and 15 mg/g yolk in eggs from hens fed flax (15,10, and 5%) when compared to 6 mg/g yolk in eggs from the control diet (P<0.05). The content of n-6 fatty acids and total polyunsaturates (n-6+n-3) was highest in eggs from hens fed 15% sunflower diet (P<0.05). The feed intake was less for hens fed 10% flax diet when compared to those consuming the control diet (P<0.05). These results suggest that full fat oil seeds could be incorporated into laying hen diets without affecting production performance and egg quality. In addition, inclusion of oils seeds could also provide different n-6 and n-3 essential fatty acids to humans upon consumption of these eggs.

Key Words: Eggs, Fatty acids, Full fat oilseeds, Egg quality

P185 Growth performance, white meat yield and litter mineral concentration with organic trace minerals supplementation in Cobb 700 and Ross 708 broilers. J. Zhao1, R. B. Shirley1, J. D. Richards1, J. Dibner1, K. D. Christensen1, J. P. Allard2, C. D. Knight1, and A. F. Giesen1, 1Novus International Inc., St. Charles; MO, 2OK Foods, Inc., Fort Smith, AR.

Two consecutive studies were conducted using four grow-out houses with 15,600 birds per house to investigate the benefits of organic trace minerals (OTM: Mintrex® a chelate of one metal atom bound by two molecules of 2-hydroxy-4-methylthiobutanoic acid) on performance, carcass yield, and tissue and litter mineral concentration in Cobb 700 (Trial 1) and Ross 708 (Trial 2) birds. Control birds were raised under a standard grow-out program using 100 % ITMs to provide 80 ppm Zn, 120 ppm Mn, and 8 ppm Cu from sulfates. The OTM treatment contained half of the level of Zn and Mn as control (40 ppm Zn, 60 ppm Mn, and 8 ppm Cu), with 50 % of Zn, Mn, and Cu from Mintrex. There was no negative effect of the reduced OTM program on weight gain, feed efficiency, or tissue storage of minerals (tibia Zn, Mn and liver Cu) in either trial. In addition, in Trial 1 OTM improved final body weight (3.48 vs. 3.60 kg for the Control and OTM, respectively, P = 0.04), white breast meat yield in males (22.4 % vs. 23.0 %, P = 0.09), and tender percentage in both male (3.77 % vs. 5.92 %, P = 0.02) and female (4.10 % vs. 4.20 %, P = 0.02). No treatment differences were observed in growth performance and meat yield in Trial 2. Analysis of the built up litter revealed an average of 2.3 % Ca; 1.7 % P; 150 ppm Cu; 350 ppm Fe; 420 ppm Mn; and 350 ppm Zn, levels that are substantially in excess of NRC recommendations for broilers at any stage of growth and could be a source of minerals that could antagonize ITM utilization. In summary, the OTMs used in these studies can meet the requirements of rapidly growing broilers; while allowing for a reduction in dietary ITM inclusion rates, and therefore a lower excretion of trace minerals into the environment.

Key Words: Beast meat yield, Broiler, Environment, Organic Trace Minerals, Tissue

P186 Broiler breeder mineral and vitamin nutrition on chick quality and biometrical characteristics. L. F. Araujo1,2, C. S. S. Araujo1,2, D. Zumwalt1, A. Corzo2, C. D. McDaniel1, and M. T. Kidd1, 1Mississippi State University, Starkville; 2University of Sao Paulo, Pirassununga, SP, Brazil.

The developing embryo and the hatched chick are completely dependent for their growth and development on nutrients deposited in the egg. This experiment was conducted to evaluate chick quality and biometrical measures of organs of progeny from broiler breeders fed diets containing different sources of vitamins and minerals. Ross 708 breeders received a control diet (containing a vitamin and mineral premix devoid of Se) or diets containing supplemental vitamin B (vitamin B12, 60 µg/kg; d-biotin, 500 µg/kg; folic acid, 4 mg/kg; niacin, 80 mg/kg; d-pantothenic acid, 25 mg/kg; vitamin B6, 10 mg/kg; riboflavin, 25 mg/kg), vitamin D (1 kg of HyD/ton), and vitamin E (120 IU/kg), the combination of the three vitamins, Se (0.3 mg/kg), Zn (30 mg/kg), Mn (40 mg/kg) from organic sources, the combination of the three minerals, and an additional diet containing the combination of all vitamins and minerals. All ten dietary treatments were supplied in mash form. Breeders were housed in a floor pen facility with 80 pens (8 replications/treatment). Each pen was equipped with 1 feeder, nipple drinkers and 1 nest. Each pen contained 3 females which were inseminated before eggs were collected. A total of 450 eggs (45 eggs per treatment) were obtained and set at 26 wk of age. Chick quality characteristics included BW, chick length, hydration, navel condition, wet chicks, wicks, dried yolk, red hocks, mechanical trauma and culls. Biometrical characteristics included liver, gut, gizzard, bursa and yolk weight relative to BW. Feeding broiler breeders supplemental Zn and the combination of Se, Zn and Mn improved chick length and BW of progeny. Relative gut weight was higher for chicks from broiler breeders fed with supplemental combination of vitamins B, D, and E, and Se. No effects were
observed for the other biometrical characteristics. It was concluded that chick quality and biometrical characteristics of chicks 1 d posthatch can be affected by broiler breeder nutrition.

Key Words: Broiler breeders, Minerals, Vitamins

P187 Improved growth performance and bone health with organic trace mineral supplementation in broilers. J. Zhao1, J. D. Richards 1, J. J. Dibner 1, K. D. Christensen 2, J. P. Allard 2, C. D. Knight 1, and A. F. Giesen 1, 1Novus International Inc., St. Charles, MO, 2OK Foods, Inc., Fort Smith, AR.

Four grow-out houses each with 15,600 birds were used to investigate the impact of Mintrex® organic trace minerals (OTM) on growth performance, bone development and gastrointestinal health status in Ross 708 broilers. An inorganic trace mineral (ITM) program with 80 ppm Zn, 120 ppm Mn, and 8 ppm Cu from sulfates served as the control. OTM was added to the control ITM levels to provide an additional 40 ppm Zn and Mn and 20 ppm Cu in the starter feed. In grower and finisher diets OTM replaced 50% of the Zn, Mn and Cu to provide mineral levels comparable to the ITM control. Running and stunting syndrome (RSS) was diagnosed on day 7 in all houses, but by design was untreated. Histopathological examination of 14-d intestinal samples confirmed that RSS was present in both treatments. Birds receiving the OTM were heavier than Controls at each measurement throughout the study. Final 52 day body weight was 3.136 vs. 3.068 kg for the OTM and Controls, respectively (P<0.04). Feed efficiency and mortality were not significantly affected with 1.958 and 5.06% vs. 2.008 and 5.54% for the OTM and Control (P>0.25). The severity of foot pad lesions, and hence the percentage of damaged foot pads, was reduced in the OTM group versus the Control group (3.0% vs. 5.5%, P =0.04). Comparing healthy and unhealthy 14 day-old birds, RSS reduced femur weight, femur hydroxyproline content and tibia breaking strength (P<0.05); however, there was no difference in these criteria between the two treatments. Birds fed OTM had higher femur deoxypyridinoline crosslink concentration with 41.12 and 25.07 nmol/L for the OTM and Control (P>0.25). The severity of foot pad lesions, and mortality were not significantly affected with 1.958 and 5.06% vs. 2.008 and 5.06% respectively, with the increase on Ca in the diet. Based on results from first egg-production cycle (E1), recommend the 14:1 ratio (4.2% Ca:0.30% aP) without PU and 12:1 ratio (3.5% Ca:0.30% aP) with 600 PU. During the second cycle (E2), recommend 4.2% Ca and 0.38% aP. Supplementation of deficient diets in aP with 600 PU improves EW during the second egg-production cycle.

Key Words: Additive, Brown-egg hens, Egg-production, Enzyme, Phytate


Two experiments were carried out to evaluate available phosphorus (aP) requirement on brown-egg laying hens. In experiments 1 (E1) and 2 (E2) 240 and 288 birds, 40 and 44 week-old, were used, respectively, distributed in a completely randomized design. In E1, a factorial design 5x2 (0.094; 0.194; 0.294; 0.394 and 0.494% aP x 0 and 300 phytase unities – PU) was used. In E2, a factorial design 3x4 (0.094; 0.294 and 0.494% aP x 0; 300; 600 and 1200 PU). Data collection was performed after six periods of 28 days each. In E1, there was no interaction between aP and PU levels. aP influenced in a quadratic fashion egg production (EP), egg mass (EM), plasmatic phosphorus (pP) and feed:egg mass ratio (FEMR) with the requirements estimated, respectively, in 0.29; 0.29; 0.49 and 0.31% aP. aP levels also stimulated linearly tibia ash amounts (TA) and bone resistance (BR). Phytase addition elevated pP (from 4.034 to 4.784 mg/dL), TA (from 41.55 to 42.90%) and BR (from 9.678 to 11.135 kgf·mm-1). In E2, EP and TA increased linearly following the increase in aP on diet. Phytase addition up to 1200 PU increased linearly aP, while TA presented a quadratic effect with max level estimated with 567 PU on diet. There was interaction between aP and PU for EM, FEMR, feed:egg ratio (FEDR) and BR. BR increased linearly when basal diet was supply with 1200 PU max, and in the phytase-free diet, when aP levels were elevated up to 0.494%. In diets using 600 PU, the increase of aP improved linearly EM, FEMR and FEDR. Results suggest levels of 0.31% or 332mg of aP in diets without phytase for laying hens. Laying hens fed on diet with low aP improve their egg production by adding up to 1200 PU.

Key Words: Additive, Bone resistance, Egg production, Enzyme, Phytate


Two experiments were carried out aiming to determine sodium and chloride requirements for laying Japanese quails, based on birdsâ€™ performance evaluation. In each experiment, 120 quails 65 day-old were used, distributed in a completely randomized design, with four treatments, six replicates of six birds each. A basal diet was formulated for both experiments, with the proper nutritional requirements for laying quails, except for Na and Cl. For the first experiment, basal diet was supplemented with sodium bicarbonate in order to provide the levels of 0.05, 0.15, 0.25 and 0.35% of Na. It was also added to every diet 0.225% of ammonium bicarbonate to provide 0.20% of Na. There was a quadratic effect of Na levels on egg production, feed consumption, egg mass and feed:egg mass ratio, with the estimated requirements of 0.27; 0.22; 0.24 and 0.23% of Na, respectively, whilst specific gravity decreased linearly as Na levels increased. As for Cl levels, there was a quadratic effect on egg production, feed consumption, egg mass and feed:egg mass ratio and specific gravity. Estimated requirements for these parameters were 0.25; 0.26 and 0.21% of Cl, respectively. No significant effects were found on remaining parameters. It is recommended, therefore, based on productive performance, 0.23% of sodium and 0.24% of chloride in diets for laying quails.

Key Words: Coturnix coturnix, Egg-production, Minerals, Requirements, Egg-shell quality

Amino acids methionine (Met) and cystine (Cys) are used by poultry in elevated amounts during body growth and frequently are the first limiting in diets for broiler chickens. According to Rostagno et al. (2005), the recommendation of digestible Met+Cys for broilers during pre-initial phase is of 0.944%, and its digestible lysine (Lys) ratio is 71%. The aim of this research was to estimate the requirements of digestible Met+Cys for male broiler chickens during pre-initial phase (1 to 7 days). The assay was performed at the Poultry Experimental Facilities of Animal Science Department of UFPB, in Areia, PB, Brazil, using 900 male broiler chicks Cobb, with initial weight of 44.9±0.6 g, distributed in a completely randomized design, with six treatments and six replicates of 25 birds each. Treatments consisted in a basal diet, formulated according to Rostagno et al. (2005) recommendations, supplemented with DL-methionine in order to reach six levels of digestible met+cys (0.734; 0.794; 0.854; 0.914; 0.974 and 1.034%).

Digestible Lys level used was previously determined (1.234%). The evaluated parameters were: feed consumption (FC), weight gain (WG) and feed:gain ratio (FGR). Results were submitted to variance analysis and polynomial regression using the computational program SAS. A linear effect was verified of digestible Met+Cys levels, and at each 0.06% a reduction of 19.1 g on FC was estimated. WG and FGR presented a quadratic effect, with the highest WG (770.5 g/bird) and the best FGR (1.402) estimated for the digestible met+cys levels of 0.706 and 0.755%, respectively, through the equation $Y = -280.63 + 977.2x - 559.44x^2$ ($r^2 = 0.99$). Considering the levels that provided the best FGR, digestible Lys ratio was 71%, the same ratio established by Rostagno et al. (2005). It is recommended 0.873% of digestible Met+Cys for male broiler chickens during pre-initial phase.

Key Words: Aviculture, Ideal protein, Requirement, Sulfur amino acids

P192 The impact of phytase source, wheat middlings, and citric acid on broiler growth performance during the grower phase. T. O’Connor-Dennie*, V. Brewer, and J. L. Emmert, University of Arkansas, Fayetteville.

Emerging research shows that the inclusion of microbial phytase, in conjunction with citric acid (CA) may improve the nutritive value of wheat by-products; this coupled with the increase in ethanol production has made wheat by-products viable carbohydrate sources that can be supplemented to a corn-soybean meal diet. In the present experiment the effect of phytase source (E. coli, EP; or fungal, FP), wheat middlings (WM), and CA, were investigated during the grower phase of male broilers. Broilers were fed a P-adequate diet from d 0 to 20; on d 20 to 25 birds were weighed and allotted to 13 treatments with five replicates containing 20 male chicks. Treatments were: 1 to 4) corn-soybean diet (0.8% Ca and 0.13 % nPP) supplemented with 0, 0.04, 0.08, or 0.12% inorganic P (iP); 5 to 6) as diet 1 with 500 FTU/kg phytase (EP or FP); 7 and 8) as diets 5 and 6 with 3% CA; 9) corn-soybean diet with 10% WM (0.8% Ca and 0.13 % nPP); 10 to 13) as diet 9 with 500 FTU/kg phytase (EP or FP), and 3% CA, alone or in combination. At the termination of the grower phase daily gain (g/c), daily feed intake (g/c), feed efficiency, and feed conversion were calculated. Increasing iP and EP increased gain and feed intake (P < 0.05), whereas the inclusion of the FP had no effect on growth performance (P < 0.05). Broilers fed EP diets had better gain and feed efficiency compared to broilers fed FP diets (P < 0.05). Increasing the level of CA increase feed efficiency, while growth performance was not affected by WM (P < 0.05), combining the EP with WM or WM and CA increased gain and feed efficiency in broilers compared those fed diets 1 to 4, and diet 9 and 11 (P < 0.05). In conclusion, EP was more efficacious than FP and the inclusion of WM had no deleterious effects on growth performance.

Key Words: Phytase, Citric acid, Wheat middlings, Phosphorus


With the genetic advances of broiler chicken strains, amino acids nutritional requirements available in the NRC (1994) seem to be under estimated and Bra-zilian Tables of Nutritional Requirements (Rostagno et al., 2005) are currently used on poultry diets formulation in Brazil. In Rostagno et al. (2005) one can find the recommendation of 0.814% of digestible methionine+cystine (Met+Cys) during the initial phase and the digestible lysine (Lys) ratio is 71%. This research aimed to estimate digestible met+cys requirements for male broiler chickens during initial phase (8 to 21 days) considering its digestible lysine ratio. The assay was performed at the Poultry Experimental Facilities of Animal Science Department of UFPB, in Areia, PB, Brazil, using 720 male broiler chicks Cobb, with initial weight of 196.1±2.5 g, distributed in a completely randomized design, with six treatments and six replicates of 20 birds each. Treatments consisted in a basal diet, formulated according to Rostagno et al. (2005) recommendations, supplemented with DL-methionine in order to reach six levels of digestible Met+Cys (0.604; 0.664; 0.724; 0.784; 0.844 and 0.904%). Digestible Lys level used was previously determined (1.084%). The evaluated variables were: feed consumption (FC), weight gain (WG) and feed:gain ratio (FGR). Results were submitted to variance analysis and polynomial regression using the computational program SAS. A linear effect was verified of digestible Met+Cys levels, and at each 0.06% a reduction of 19.1g on FC was estimated. WG and FGR presented a quadratic effect, with the highest WG (770.5 g/bird) and the best FGR (1.402) estimated for the digestible met+cys levels of 0.706 and 0.755%, respectively, through the equations $Y = -465.2 + 3478.3 - 2447.7x + (3.94)x^2$ ($r^2 = 0.94$) and $Y = 3.6582 - 0.9757x + 3.9571x^2$ ($r^2 = 0.99$). Considering the levels that provided the best FGR, digestible Lys ratio was 70%. Therefore, it is recommended for male broiler chickens 0.755% of digestible Met+Cys during the initial phase.

Key Words: Amino acids, Aviculture, Ideal protein, Requirement, Performance, Requirement


Methionine (Met), lysine (Lys) and threonine (Thr) are the three first limiting amino acids on poultry diets. There is a wide range of information on Met and Lys requirement for broiler chickens, but Thr is less explored. According to NRC (1994), total Thr requirement for broiler chickens during initial phase is 0.800% of digestible Thr, while Rostagno et al. (2005) recommend 0.865% for pre-initial phase. The aim of this research was to estimate the requirements of digestible Thr for male broiler chickens during pre-initial phase (1 to 7 days). The assay was performed at the Poultry Experimental Facilities of Animal Science Department of UFPB, in Areia, PB, Brazil, using 720 male broiler chicks Cobb, with initial weight of 49.7 ± 0.6 g, distributed in a completely randomized design, with six treatments and six replicates of 20 birds each. Treatments consisted in a basal diet, formulated according to Rostagno et al. (2005) recommendations, supplemented with L-threonine order to reach six levels of digestible Thr (0.655; 0.715; 0.775; 0.835; 0.895 and 0.955%). Digestible Qty and Met+Cys level estimated for the digestible met+cys levels of 0.706 and 0.755%, respectively, through the equations $Y = -465.2 + 3478.3 - 2447.7x + (3.94)x^2$ ($r^2 = 0.94$) and $Y = 3.6582 - 0.9757x + 3.9571x^2$ ($r^2 = 0.99$). Considering the levels that provided the best FGR, digestible Lys ratio was 70%. Therefore, it is recommended for male broiler chickens 0.755% of digestible Met+Cys during the initial phase.

Key Words: Amino acids, Aviculture, Ideal protein, Nutritional requirement, Performance


Recently, a new phytase (Quantum™ Phytase; OP) has been selected and evolved using molecular techniques to reach a desired thermo-tolerance range through the feed processing system without the use of coating while maintaining high
enzymatic activity at the animals optimal body temperature. There are several factors within the conditioning and pelleting process of animal feed manufacturing that can negatively impact enzyme stability and these differences are present across different feed mill locations. It is also critical to have a robust and reliable technique to measure phytase activity in the feed to determine levels and potential limits in temperature tolerance. Thus the objective of the current research was to evaluate the thermo-tolerance range of QP using a new modified assay to accurately determine QP activity in complete feed. Several studies were conducted at different feed mill locations using the same range of pellet temperatures. The phytase was included in feed at commercial levels (200g/mt, equivalent to 500FTU/kg) and pelleted at temperatures ranging from 80-92°C at the pellet die. The feeds were assayed for phytase activity using a new procedure for the optimal reaction conditions for QP. The use of this optimal reaction conditions improved the sensitivity (signal-to-noise) of the phytase activity measurement compared to standard assay conditions. Results demonstrate that the non-coated thermo-tolerant QP can survive the rigors of normal feed pelleting conditions; however, variation between manufacturing locations were observed. The optimized assay method provides a reliable extraction and assay procedure for phytase activity in pelleted and mash animal feed, and can be used with confidence for quality control of feed supplemented with QP.

**Key Words:** Phytase, Thermo-tolerant, Assay, Pelleting
AUTHOR INDEX

Numbers following names are abstract numbers for oral presentations, abstract numbers preceded by MP are Monday poster presentations, abstract numbers preceded by TP are Tuesday poster presentations, and abstract numbers preceded by WP are Wednesday poster presentations.

A

Abbas, A. O., 65
Abbas, H., MP276
Abdel-Maksoud, A., TP353
Abdul-Careem, M. F., 57, 61
Abe-Kitani, D., MP254
Adenike, N., MP333, TP383
Adela, O., 89
Adelizzi, A., 66, 67, 194
Afi, Y. K., 80
Aghdam Shahriar, H., MP287
Ahmadi, A., MP278
Ahmadi, F., TP405
AICAP Network, 1
Amizu, O., 21, 28
Akbari, M. R., MP255
Akins, E. D., MP321
Akrami Moghaddam, M. A., MP405
Al-Atri, T., TP384
Alexander, D. J., 2
Al-Hooti, S. N., TP384
Aljariali, H., MP278
Aljamaal, A., 157
Allen, D. L., 53, 54
Al-Mazedi, H. M., TP384
Alomirah, H. F., TP384
Alp, M., TP374
Alphin, R., MP327, 144, 189
Alvarado, C. Z., TP393, TP394, 240, 244, 247
Al-Zenki, S. F., TP384
Amalaradjou, M. A. R., TP384
Almaric, R., TP344
Anderson, J. L., 214
Anderson, K. E., 14, 183
Anderson, P., TP391, 145
Anderson, S. W., 112
Andree, R. M., 44
Anderson, S. W., 112
Andree, R. M., 44
Andrew, C., 4
Angel, C., 66, 67
Angelo, M. L., TP379, 29
Amnett, C., 210
Anthony, N. B., 42, 58, 221
Anu, S. C., TP397
Anup, K. J., TP373
Ao, T., TP358, TP361, TP381
Applegate, T. J., 86
Arango, J., TP415, 218
Araujo, C. S. S., TP371, TP373, TP375, TP377, 165
Araujo, L. F., TP371, TP373, TP375, TP377, 165
Araujo, X., MP382
Arguelles-Ramos, M., 141
Arora, K. L., MP262, MP263, TP420
Arthur, J. A., 218
Ashghar, G., MP288
Ashwell, C. M., 97
Atencio, J. L., MP316
Atkins, H. M., 194
Attene-Ramos, M., 229
Atwell, C. A., 163
Ault, A., 4
Austic, R. E., MP267, MP268
Avila, E., MP310
Azuma, T., MP412

B

Bailey, C. A., 99, 132, 169
Bailey, J. L., MP272
Balalaia, R., 230
Balander, R. J., 153, 154
Baldizan, G., MP291
Balodano, F. J., 94
Bandegan, A., MP302, TP357
Bao, H., MP252
Barbato, G., MP271, MP274
Barbut, S., 246
Barri, A., MP328, 147, 148
Barros, R., 32, 164
Barta, J. R., MP250, TP406, 176
Bastiani, M., MP249, MP281
Batal, A. B., 88
Bateman, K. D., 60
Bates, R. M., 194
Bauermeister, L. J., TP392
Bautista-Ortega, J., TP392
Beach, E., 56
Beam, K. R., 26, 167
Beavers, J., 149
Beck, M. M., 187
Bédrécarats, G. Y., 116, 118
Belser, J., 7
Beltran, R., MP326, TP345
Bennett, L. W., 50, 109
Benoit, J., TP373
Benson, E., MP327, 144, 189
Bento, H., 238
Bentz, D., 243
Berezowski, J., 210, 239
Bergaoui, R., TP344
Bergeron, N., MP324
Berghman, L. R., MP254, 6, 59
Bermudez, A. J., 236
Bernard, R. S., TP404
Bernardeau, M., MP300
Berrang, M., TP393, TP394, 120, 127
Berres, J., 32
Bertechini, A. G., 202, 207, 208
Betti, M., TP400, TP401
Bianchi, M., 123, 248
Biladeau, A., TP388, TP390
Bilgili, S. F., MP322, MP325, 240
Birrenkott, G. P. J., TP269, TP404
Biswas, B. K., MP262, TP420
Blake, J. P., MP320, MP322, TP403, 74, 75, 76, 77, 172
Blankenship, E., 187
Block, S. S., 56
Bolthas, N. A., 186
Bottje, W. J., 6, 59
Bouzaienne, T., TP344
Bowers, J., 150
Bowers, J. W. J., TP392
Braasch, D. A., 109
Bradley, F. A., 39
Braga, H. B., 207
Brake, J., 46, 136, 141, 142
Bramwell, R. K., 138, 139
Branon, J., MP314
Brant, G., TP368
Branton, S., 112
Brashears, M. M., TP393, TP394
Brashears, M. T., TP344
Bravo, B., TP354
Bravo, J. A., 29
Bray, J., 68, 70, 71
Bregendahl, K., TP368, TP369, 27, 83
Brèque, C., MP272
Brewer, R. L., 178
Brewer, V. B., TP378
Brina, N. P., MP319
Brubin, J. T., MP253
Brito, J. A. G., 202
Brooks, B. W., 78
Brousseau, C., MP326
Brown, A. J., MP332, 191
Bruggeman, V., 233, 235
Brule-Babel, A. L., 82
Brunano, G., 107
Buchanan, N. P., TP331
Buchanan, H., TP332, 207
Caldwell, D., MP326, TP391, 69, 145
Calvo, M. C. C., MP310
Canterbury, J. L., 187
Cantor, A. H., TP358, TP361, TP381
Capua, U., 2
Carey, J., 11, 68, 69, 70, 134, 145
Carranco, M. E., MP310
Carrillo, S., MP310
Carvalho, J. C., 202, 207, 208
Cason, J. A., 121, 126, 133
Castillejos, L., MP293
Castro, O., TP336
Cavani, C., 123
Cerrate, S., TP355, TP355, TP359, TP360, TP364, 33
Chaisara, S., MP270
Chamani, M., MP287
Chambres, J. R., MP255
Chan, M., 78
Charbonneau, M. A., 217
Checer, K. M., TP340
Chen, C. H., MP254
Cheng, H. W., TP411, 137
Cheng, K., MP266, 216
Cherian, G., 90, 91, 102, 156, 224
Cherry, T., 68, 70, 71
Chiang, H., 213
Chouinard, Y., MP272
Christensen, K., 131, 151
Christensen, V. L., MP331
Clark, F. D., TP408, 100
Classen, H. L., 110, 190
Coca-Sinova, A., MP296
Cogburn, L. A., 49
Cole, K., 6, 171
Collazos, H., TP336
Compton, M. M., 223
Conner, D. E., 122
Cook, M. E., TP380
Coon, C. N., MP312, 100
Corchero, F. J., 107
Corchero, J., MP294
Corrett, L. E., 114
Corzo, A., MP298, TP373, 25, 30, 31, 87, 165
Cos, C., MP272
Costa, A., 125
Costa, A. A. G., TP365
Costa, F. G., TP364, TP370, TP376, 33
Costa, V. A., 202
Coto, C., TP353, TP355, TP359, TP360, TP364, 33
AUTHOR INDEX

Swaggerty, C., 213
Tabatabaei, M. M., MP278
Tagoyama, T., TP338
Taira, H., 187
Takahashi, M., MP299
Tanaka, T., TP412
Tang, D. C., 5
Taylor, C., 68, 70
Taylor, M. L., MP301
Taylor, R. L., Jr., 214
Tellez, G., MP250, MP251, TP389, 59, 171, 178, 180
Tercero, A., 181
Thanthrige-Don, N., 61
Thaxton, J. P., 112
Thogerson, C. M., 184
Thompson, L. D., TP393, TP394
Tillman, P., 20, 30, 31
Toghyani, M., 79
Toler, J. E., MP269, 212
Topper, P. A., 196
Toro, H., 5
Tounouvi, K. M., MP280
Townsend, J. C., TP392
Trabue, S. K., 129, 135
Trakooljul, N., 49
Trampel, D., MP307, 83
Trava, C. N., MP313
Treese, S. T., 44
Triana, S., TP336
Troche, C., 86
Tvrtkovic, C. T., 60
Tsirtsiskos, P., TP345
Tumpey, T. M., 7
Tuys, J., II, MP333, TP383

U

Uetake, K., TP412
Ullah, Z., 108

Uni, Z., 97
Upton, R., 101
Urgnani, F., 203
Utterback, C. W., 84
Utterback, P. L., TP362, 84, 96

V

Vaillancourt, J. P., 10
Vakili, R., TP339
Valaja, J., TP342
Valdivia, P., 181
Valencia, D. G., MP282, MP294, MP295, TP341, 92, 107
Valkonen, E., TP342
van der Hoef, H., 179
Van der Klis, J., MP293, 231, 233
Van Hoeven, N., 7
Van Kessel, A., TP382
Van Wyhe, R. C., MP328
Vandenberg, G., MP272
Vargas, E. A., 93
Vargas, F., 94
Vargas, R. E., MP290, MP291
Vazquez-Anon, M., 161, 162
Veguilla, V., 7
Venkitanarayanan, K., TP397, 48
Venue, D., MP272
Vieira, S. L., 32, 164
Viscarra, M. G., 94
Vizzier-Thaxton, Y., 112, 131

W

Waghela, S., MP254
Waldroup, P., TP353, TP355, TP359, TP360, TP364, 33
Walk, C. L., MP328, 101
Wang, C. Y., 115, 117
Wang, J. J., TP356
Wang, Y., 115, 117, 174, 213
Wang, Z., TP353, TP355, TP359, TP360, TP364, 33
Ward, N. E., MP286, TP350, TP362
Warlick, A., 112
Watkins, S., TP359
Webb, K. E., Jr., MP297, MP309, 19
Weber, P., 85
Webster, A. B., MP332, 191
Wehmeyer, M. E., 163
Wei, C.-J., 4
Wells, J., 146
Westmoreland, S. L., 55
Wetstein, M. E., 20
Wheeler, E. F., 196
Whitmarsh, S. K., 50, 109
Wideman, R., MP261, 58
Widjaratne, G. P., TP382, 24
Wiermansz, C., TP355
Wiggins, C. B., MP329
Wilkie, D. C., 78
Williams, S., TP350
Williams, S. K., 124, 125
Willis, W. L., MP317
Wilson, C. A., 74, 75, 76
Wilson, D. A., TP415
Wilson, J., TP350
Wilson, J. L., 143
Wineland, M., MP331, 72, 147, 149
Winkelbauer, P., 161, 163
Wittenberg, K. M., 81, 82
Wolanski, N. J., 152
Wolfenden, A., MP250, MP251, TP389, 171, 178, 180
Wolfenden, R., MP251, 171, 178
Wong, E. A., MP297, MP309, 19
Wood, B. J., 179
Wood, D., MP264
Wooming, A., TP409

Worley, J. W., 192, 193
Worrall, S. P., TP380
Wright, D., MP333, TP383
Wu, J., TP395, TP401
Wuelling, C. W., 163
Wyatt, C., 101
X

Xie, J., 53, 54
Xin, H., 83
Y

Yahav, S., 46
Yakout, H. M., MP276
Yan, F., TP353, TP355, TP359, TP360, TP364, 33
Yang, H., 228
Yang, Z. Z., 4
Yaqoob, M., MP279, 198
Yeh, E., MP264
Yoho, D. E., 138, 139
Yoon, J., MP293, MP307
Yousaf, M., MP279, 198
Yu, H., 174
Z

Zavarize, K. C., 236
Zeinali, A., MP249, MP281
Zhang, Y., MP252
Zhao, J., 161, 162
Zhou, H., 174, 213
Zhuang, H., 120
Ziaei, H., MP279, MP281
Zimova, O., 201
Zuidhof, M., TP400, TP401, 140, 195, 210, 211, 239
SUBJECT INDEX

Numbers following key words are abstract numbers for oral presentations, abstract numbers preceded by MP are Monday poster presentations, abstract numbers preceded by TP are Tuesday poster presentations, and abstract numbers preceded by WP are Wednesday poster presentations.

A
absorption, 105
acid-insoluble ash, MP296
activation-induced cytidine deaminase, 158
active learning, 153, 242
acute phase response, 22
3-O-acetyltransferase, TP407
ad libitum feeding, 239
additive, MP303, MP304
additivity, TP337
adenovirus vector, 5
administration, 38
age at sexual maturity, TP417
air chilling, 120
all natural, 13
alternate and classic complement pathways, 63
alternative, TP411
alternative feed, TP365
alternative to antibiotics, 104
aluminum sulfate, 73
AMEn, MP318, TP367
amino acid, MP288, MP298, TP349, 30, 31, 96, 205
amino acid balance, TP364
amino acid digestibility, TP337, TP346, 86, 199
amino acid digestibility in broilers, MP294, MP295
amino acid transporter, MP297
amino acid, wheat, broilers, TP357
ammonia, 74, 75, 76, 196
AMPK, 119
anaerobe, TP396
analysis of variance, MP315
animal welfare, 34, 151
antibiogram, TP389
antibiotic, TP389
antibody, MP260
antibody titer, MP320, 79
antimicrobial, TP389, TP392, 17, 125
antimicrobial activity, TP344
antimicrobial peptide, MP252, MP255
antioxidant, TP400, 91
Apicomplexa, MP250
APN, MP297
apoptosis, 158
apparent ileal digestibility, MP302, TP357
apparent metabolizable energy, TP372
applied physiology, TP404
arabinobioxylan, MP286
artificial turf, TP416
ascites, MP275, 58
ascorbic acid, MP269, 212
Aspergillus niger, TP343
astaxanthin, MP308, TP340
atherosclerosis, 214
audit, 151
autoinducer-2, 99
avian, 1, 2
avian bile, MP273
avian influenza, 3, 4, 5, 6, 7, 10, 11, 144
Azomite, 225

B
Bacillus licheniformis, 175
bacitracyn, TP379
bacteria, MP320, 16, 77, 121
bacterin, MP251, 178
bacteriocin, 124
barley, MP302
Bayesian estimation, TP416
beak trim, 137
bedding source, MP322
behavior, TP413, 191
Bifidobacterium, MP317
bilingual, 245
bioactive peptide, TP395
bioavailability, 163
bioethics, 34, 35
biofilm, 127
Biolys, 27
Bio-Mos, 172, 173
biosecurity, 10, 145
bird, MP270
blood, MP321
blood meal, TP383
blood parameter, 235
BMD, 172
body temperature, 239
body weight, 136, 197
bone density, MP313, TP373, TP377
bone development, TP355, 181
bone mineral density, TP415
bone strength, TP377, 182
Bordetella avium, 180
breast meat quality, 123
breast meat yield, 225
breeder, 51
broiler breeder, MP272, MP287, MP312, MP329, TP371, TP381, 93, 138, 139, 141, 142, 146, 164, 195
broiler breeder flock age, 143
broiler breeder male, 136
broiler carcass, 128
broiler chick, MP279, TP362, 109
broiler chicken, MP322, TP343, TP344, TP345, 123, 210
broiler embryo, 50
broiler, lipopolysaccharide, light, 65
broiler performance, MP301, 95, 143, 149, 206
brooding temperature, 72
brown egg, TP402
brown egg color, 227
brown egg layer, 218, 220
Brown laying hen, MP282
brown pullet performance, TP341
bursa of Fabricius, TP405
carbohydrase, TP350
carcass, 21, 28
carcass bacteria recovery, 126
carcass microbiology, TP386
carcass weight, 66
carcass yield, MP301, TP363, TP376
catecholamine, 47
calculator, 8
cell proliferation, MP258
cellulitis, 178
challenge, 213
chemical and physical composition, TP335
chemical composition, 81, 82, 92
cytokine, 113
cock, TP358
cock growth, 140
cock navel, 52
cock performance, 66
cock, TP397, TP411, 5, 14, 119, 188, 228
cock breast, 120
cock CD40, MP254
cock embryo, TP267, MP268
cock embryo cell, TP409
cock intestine, MP309
cock prostaglandin E₂, 115
cloacal gland, 115
Clostridium butyricum Miyairi, 588, MP299
Clostridium perfringens, 59, 174, 175, 231, 233
clined down, 217
Coban, MP328
coccidia, MP328
coccidiosis, 71, 176
coccidiosis vaccination, MP326, 101
cold stress, 190
coliform, 128
compost, 78
concentration, 193
conjugated linoleic acid (CLA), TP342, TP380
conjugated linoleic acid, ericosapentaenoic acid, docosaheaxenoic acid, 132
cooling, TP329
copper, 161, 162
copper source, TP374
calcium level, MP282
calcium source, MP282
calcium-to-phosphorus ratio, TP355
calculator, 8
CPSR, 8
cell proliferation, MP258
cellulitis, 178
challenge, 213
chemical and physical composition, TP335
chemical composition, 81, 82, 92
cytokine, 113
cock, TP358
cock growth, 140
cock navel, 52
cock performance, 66
cock, TP397, TP411, 5, 14, 119, 188, 228
cock breast, 120
cock CD40, MP254
cock embryo, TP267, MP268
cock embryo cell, TP409
cock intestine, MP309
cock prostaglandin E₂, 115
cloacal gland, 115
Clostridium butyricum Miyairi, 588, MP299
Clostridium perfringens, 59, 174, 175, 231, 233
clined down, 217
Coban, MP328
coccidia, MP328
coccidiosis, 71, 176
coccidiosis vaccination, MP326, 101
cold stress, 190
coliform, 128
compost, 78
concentration, 193
conjugated linoleic acid (CLA), TP342, TP380
conjugated linoleic acid, ericosapentaenoic acid, docosaheaxenoic acid, 132
control, 2
cooling, TP329
copper, 161, 162
copper source, TP374
egg production, TP381, 137, 138, 139, 157, 165
egg quality, MP278, MP310, TP342, TP375, TP416, 134
egg sanitation, 146
egg weight, TP420, 197
egg yolk granule, MP267
eggshell, 55, 80
eicosanoid, 224
Eimeria, MP250, TP354, 232, 234, 235
Eimeria acervulina, TP348
Eimeria maxima, 231, 233
Eimeria tenella, 71
electron spin resonance, TP366
Elusieve, 87
embryo, TP380, 150
embryo edema, 215
embryo weight, 103
embryogenesis, 46
embryonic development, 64
embryonic heat production, 103
embryonic weight, TP420
emissions, 193
endogenous loss, 200
endoxylanase, MP280
energy, MP284, MP289
energy and protein, 197
energy and protein analysis, TP335
energy digestibility, TP351, TP352
energy formulation, TP353
energy-reduced diet, 206
enriched broiler meat, TP400
enzyme, MP275
enzyme activity, MP275
enzyme supplementation, 82
erythrocyte agglutination, lysis, immunity, 63
Escherichia coli, 83, 128, 133
essential oil, TP344, 104, 238
estrogen, 55
Europe, 248
expectation, 38
expression profile, MP309
extension, 36, 37, 38, 40, 41
fasting, 49
fat type, MP287
fatty acid, MP264
n-3 fatty acid, TP398, 90, 91, 102, 134, 224
n-6 fatty acid, 102
fatty acid profile, MP272
fear of humans, 186
feather meal, TP356
feather pecking, TP412
feathering, TP419
fecal, MP331
feed additive, TP338, TP345
feed behavior, TP370
feed form, 107
feed manufacture, 166, 167, 168
feed restriction, 239
feed safety, TP547
feed space, 142
feed-to-gain ratio, TP365
feed withdrawal, TP368
feeder space, 184
feedstuff, TP367
femoral head disarticulation, 100
fermentation, MP307
fertility, MP263, 136
fertility and hatchability, 143
fiber source, MP292
fishy taint, 220
flC, 171
floor density, MP333
fluorescence in situ hybridization, 219
FMO3, 218, 220
food intake, 119
food safety, MP323, 135
food science, 243
foodborne pathogen, 17
Fos, 54
fractal pattern, TP410
frame size, 195
French guinea broiler, MP333
full-fat oilseed, 90
fungi, TP347
furnished cage, TP412, TP416
Fusarium mycotoxin, MP285, TP406
G
gait, 182
GalliPro, 206
Gallus gallus, 187
game fowl, 39
garlic, TP336
gas stunning, 123
gelatin, 122
gene-based vaccine, 4
gene expression, MP277, TP383, 43
genetic selection, TP410, TP414
genetic variability, 216
genetically modified corn, MP301
genotyping, MP321
GHRH, 117
GHRH-L, PHI, VIP, 117
GHRH-related peptide, 117
gizzard erosion, TP340
β-glucan, MP256
glucose, MP259
graduate course, 244
grass pea, MP283
growth efficiency, MP330
growth performance, MP333
growth-promoting antibiotics, 70
guanidino acetic acid, 226
guar meal, 169
guar saponin, 99
l-gulonolactone oxidase, 212
gut development, 97
H
hanging, 131
hatch weight, 165
hatchability, MP329, 146
hatchery, 149
HD-11, TP407
health risk, 64
heat shock protein, 148
heat stress, MP306, 46
hemagglutination, TP339
hemicell, 204
hemorrhage, MP264
hemostasis, MP264
hen-day egg production, 88
hen performance, MP284
heritability, TP418
HI test, MP252
Poult. Sci. 87 (Suppl. 1)
hidden Markov, 185
high-protein distillers dried grain (HP-DDG), 88
high-protein distillers grain, 86
histamine, TP340
history, 41
host response, 61
hull, 98
human-animal interaction, 186
humidity, TP335
husbandry, 183
hydrolysate, 19
5-hydroxytryptamine, MP285
hypothalamus, MP265, 49

I
ideal protein, 33
ileal digestibility, 96
image analysis, 54
immersion chilling, 126
immune maturation, 64
immune-related gene, 216
immune response, MP253, MP279, MP281
immunity, TP339, 56
immunomodulation, 62
in ovo feeding, 97, 156
in ovo injection, 109
in vivo passage, 170
inactivation, 144
incubation, 147, 148, 149, 150
incubational egg weight loss, 165
indigenous chicken, TP417
induction, MP325
industry, 40
infectious bronchitis virus, 194
infectious laryngotracheitis virus (ILTV), TP409
inflammation, 58
influenza, 1, 2, 8, 9
infrared, 137
inheritance, 215, 217
inhibition, 99
instruction, 240
integrated poultry operation, TP391
interassay variability, TP357
international trade, 11
intestinal health, MP293
intestinal microbiota, 229
intestinal villi, 52
intestine, TP406
iPod, 244
Iranian indigenous chicken, TP418
Iranian Ross broiler, MP249
isoleucine, 32

J
Japanese quail, MP262, MP263, MP266, TP420, 44, 45, 111, 221, 223

K
keratinase, TP356
keto acid, 66, 67
keyhole limpet hemocyanin, MP260
kidney lesion, 236

L
laboratory exercise, TP404
Lactobacillius, MP300, 229
layer performance, MP278
laying hen, MP293, MP308, MP310, TP368, TP369, TP374, 27, 83, 84, 85, 88, 157, 160, 184, 196
learning, 152
learning by teaching, 153
leg abnormality, TP355
leg problem, 181, 182
lesion scoring, 71
linatine, 134
lipid, TP363, TP380
lipid oxidation, 132
lipopolysaccharide, MP261
liquid aluminum sulfate, 75, 77
liquid by-product, TP338
Listeria monocytogenes, TP393, TP394, TP399, 124, 127
litter, MP316, MP320, 68, 69, 77
litter material, 79
litter moisture, 141
litter treatment, MP320, 74, 75, 76
live performance, 211
liver and brain, MP268
lysine, 28
l-lysine HCl, 27
low temperature, 108
luminescence, TP396
lymphocyte, MP258, MP259, 62
lysine, TP364, 22, 23, 25, 30, 31, 33

M
M2e, MP251
macronutrient, MP313
macrophage, MP257, 62
macrophage-conditioned media, MP258
male fertility, MP262
management, MP323
mannanoligosaccharide, MP306, MP334, 70, 228
manure nitrogen, 67
Marek’s disease, 57, 222
Marek’s disease virus, 61
marker association, 218
marker, MP331
market research, 13
Master 4-H Volunteer, 39
maternal effect, 140
matrix metalloproteinase, MP273
Mattersen, 208
meat, 246, 247
meat and bone meal, 89
meat quality, TP385, 18
meat safety, 18
medicinal plant, MP276
melamine, 236
melatonin, immunity, 65
meta-analysis, 237
metabolic disorder, 224
metabolic stimulant, 109
metabolism, MP277
metabolizable energy, TP362, 29, 89, 211
methionine, 15, 26
methionine deficiency, 212
methionine hydroxy analog, TP347, 105
microarray, 49, 174, 222
microbial ecology, 110
microflora, 232
micronization, MP294
microwave, TP399
mineral, TP371, TP373, TP376
mineral litter composition, MP324
Mintrex, 163
Mintrex Zn, 161
molt, TP368
molting, TP411, 84, 112
monitoring, 11
monoclonal antibody, MP254
month, year, and farm interaction, MP315
morphology, 55
morphometry, MP305
mortality, 142
molting, 118
mucin, 122, 148
mucosal immune system, MP261
muscle growth, TP338
mushroom, MP317
Mycoplasma, 179
mycotoxin, MP307
nanosilver, TP405
native Thai chicken, MP270
natural, 12
natural source vitamin E, 56
NatuStat, 173
near-infrared spectroscopy, TP346
necropsy, TP408
necrotic enteritis, MP334, 173, 174, 175
net energy, 29
network, 1
Newcastle disease virus, MP327, 194
nicarbazin, MP271, MP274
nitrogen, 73
nitrogen balance, TP369
nitrogen mass balance, 68
nonfeed withdrawal, 112
nonphytate phosphorus, MP312
nonstarch polysaccharide, MP286, 89
nonstarch polysaccharide-enzyme, TP351, TP352, 209
NOR, MHC-Y, MHC-B, 219
nutrient digestibility, 98
nutrient efficiency, TP359
nutrient profile, 50
nutrient requirement, TP359
nutritional quality, MP315
nutritional value, MP311
nutritive value, MP290

omega-3, TP398
online teaching, 243
online training, 245
organ morphology, TP336
organic, 12, 13, 15, 26, 106
organic acid, TP393, 229
organic mineral, 155
organic poultry, 18
organic trace mineral, 159
organic zinc, MP278
osteoporosis, TP415
outreach, 241
oxidative stress, TP366, 163

PAACO, 151
pandemic, 7, 9
Passiflora alata, TP413
paternal effect, 213
pathogen, 16
pathology, TP405, 177
pattern recognition receptor, MP256
pea protein concentrate, MP295
peach palm oil, MP291
pellet, MP292, TP360
pellet quality, TP353, 166, 167, 168
penetration, 215
PepT1, 19
peracetic acid, TP392
performance, MP276, MP283, MP305, MP312, MP332, TP354, TP363, TP370, 70, 79, 107, 203, 234, 238
phase feeding, TP378
phosphorus, MP331, TP374, 201
phosphorus bioavailability, canola meal, 198
phosphorus deficiency, MP304
photoperiod, MP332, 110, 188, 191
photostimulation, 116
physiology, 112
phytase, MP324, TP375, TP377, 101, 141, 198, 200, 201, 209
phytase enzyme, TP408
phytate, 200
phytogenic additive, TP366, 104
pigment, TP402
pipping muscle, 50
pituitary, MP265, 114
plant extract, TP354, 231, 232, 233, 234, 235, 237
plasma lipoprotein, MP291
point of inflection, 221
pollutant, 177
polyunsaturated fatty acid, 156
n-3 polyunsaturated fatty acid, TP400
poultry, MP291, TP384, TP403, 4, 15, 130, 145, 246, 248
poultry processing, TP386, 240, 242
poultry production, 17
poultry scientist, 35
poultry waste, TP403
prebiotic, MP249, MP303
precision feeding, 96
prednisolone, 100
restarter diet, TP360
probiotic, MP249, MP255, MP281, MP299, MP300, MP326, TP345, 16, 176
processing, 41, 106, 131
processing-line speed, TP386
production cost, 203
product parameter, MP280
professional society, 35
program delivery, 37
program development, 37
PronTech, 125
prostaglandin receptor, 115
protein, TP382, 24
protein metabolism, 22
protein nutrition, TP356
protein quality, MP309
proteinase, TP361
proteomics, 61, 214
PSE, 246, 247, 248
pullet, TP361, TP406
pullet growth curve, 139
pullet lighting program, TP415
pullet maturity, MP284
pulse electric field, 130

quality control, 92

range production, 14
ready-to-eat, TP399
ready-to-eat product, 124
real-time RT-PCR, 3, 57
receptor, MP259
S

Saccharomyces cerevisiae, MP306
safety, TP384
salicylic acid, 121
Salmonella, MP251, MP255, TP391, 6, 59, 69, 122, 130, 133, 230
Salmonella Enteritidis, TP397, 170
Salmonella Typhimurium, 125
Salmonella vaccine, 171
Salmonella vector, 171
sand, MP316
sanitation, 183
sanitizer, 129, 135
scanning electron microscopy, 80
selection, 21
selenium, MP313, TP381, 164
SelPlex, 157
sensory, 120
septal-hypothalamic region, 53
serotonin, 47
serum chemistry, 100
serum protein, liver enzyme, 95
sex, TP419
sexual maturation, 116
shea nut meal, TP343
shear force, TP398
shelf life, TP392
shell egg, 135
shell quality, 155
shell surface, 129
shittake, TP348
shrink, 190
Sibbald, 202, 207
silver ion, 127
simulated digestion, TP395
Single Comb White Leghorn, TP383
single nucleotide polymorphism, 216
slow-growing, TP385
smooth muscle cell, 214
Smyth chicken, 60
sociality, TP414
sodium, 108
sorghum, 94
sous vide, 132
soy-, canola-, and corn-based ingredients, TP372
soybean meal, 92, 93, 205
soybean product, MP294, MP295
sperm motility, MP272
sperm viability, 48
spermatogenesis, MP266, 51
spleen, 102
sponge, TP387
spot, TP402
squid, MP310
standardized ileal digestibility, MP302
stocking density, MP319
storage, MP311
stress, 54, 114, 147, 185

T

T-2 toxin, TP407, 111
T-cell subset, 57
teaching, 152, 241
technology, 241
testes, MP269
testicular tissue, MP266
texture profile, TP398
thermal fog, MP327
thermoregulation, 72
thermotolerance, 46
threonine, MP288, 20, 23, 25, 31
thymosin β4, MP257
thyroid, MP277
thyroxin, 118
TMEc, TP367
Toll-like receptor, MP257
total antioxidant capacity, MP269
trace mineral, TP361, 155
traceability, MP323
transport, 105
transport stress, 42
TRAP, MP250
trypsin inhibitor, 93
turkey, MP285, MP314, MP318, MP319, MP330, TP372, TP385, TP394, 21,
23, 42, 118, 178, 179, 180, 181, 186, 204, 247
turkey embryo, 97
turkey tom, 28

U

ultrastructure, 80
ultra-trace mineral, 225
uniformity, TP378
USDA challenge grant, 242

V

vaccine, 180
vaccine response, 177
vaccine vector, 59
valine, MP298, 32
vasoactive intestinal peptide, MP270
vasotocin, 53
vectored vaccine, 6
vegetative buffer, 194
ventilation, 192
Fibrio fischeri, TP396
video, 152
virginiamycin, MP253
virus, 78
visfatin, 51
vitamin, TP371, TP373, 160
vitamin A, MP260, 158
vitamin E, MP279, MP287, TP339, 156
vitamin U, 172
vitiligo, 60
vocalization, 185, 187

W

waste management, TP403
water intake of broiler, MP292
SUBJECT INDEX

weight, TP417
weight gain, TP365
weight gain, FCR, 198
welfare, MP319, 184, 188, 190
well-being, 187
wheat, MP311, TP358
wheat DDGS, 81, 82
whey, MP297, 19
White egg, TP370
wild aquatic bird, 3

Y

yeast, 228
yeast β-glucan, MP334

yeast cell wall component, TP379
yeast whole cell, TP379
yolk cholesterol, MP268
yolk replacement, MP267
yolk sac, 52

Z

zinc, TP375, 159, 162
zona pellucida, MP271
zoonosis, 9
ZP3, MP274
zymography, MP273