**ABSTRACTS**
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**1. An Analysis of the Nonlinear Dynamics of Daily Broiler Growth and Feed Intake.**

Studies have demonstrated that daily growth velocity (i.e., BW (d_{n+1}) - BW (d_n)) of individual birds resulted in an oscillatory response. In experiment 1, the hypotheses were examined that the feed intake velocity (FIV) was oscillatory and that there was a positive relationship between bodyweight velocity (BWV) and FIV. Forty-eight Ross x Arbor Acre male broiler chicks were individually caged in brooder batteries at 1 d of age and moved to individual grower cages at 20 d. A crumbled commercial starter feed and water were provided ad libitum for 49 d. Birds were housed with 24 h lighting in a temperature-controlled (27.2 C) environment. BW, and FI were measured at 11:00 for each of 49 d. Results indicated that the FIV was oscillatory and that a moderate positive relationship existed between BWV and FIV (r^2 =0.61). A Kohonen neural network (KNN) clustered BWV and FIV into 3 phases with decreasing r^2 values over the phases. The decrease in the r^2 appeared to be related to the starter ration fed throughout the 49 d. Experiment 2 examined the effect of starter, grower, and finisher rations on cumulative BW and FI (r^2 =0.61). A Kohonen neural network (KNN) clustered BWV and FIV into 3 phases with decreasing r^2 values over the phases. The decrease in the r^2 appeared to be related to the starter ration fed throughout the 49 d. Experiment 2 examined the effect of starter, grower, and finisher rations on cumulative BW and FI, BWV, FIV, carcass characteristics, and KNN phases. It was hypothesized that the correlation between BWV and FIV would strengthen with the feeding of the appropriate feed during the appropriate phase and that the KNN phases provided biologically rational times of ration change (TORC). There were 5 feeding programs with 9 birds in each treatment. The first 3 treatments were fed crumbled commercial starter, grower, or finisher, respectively for 49 d. The other 2 feeding treatments were based on the KNN derived TORC and an industry recommended TORC. No significant (P>0.05) differences were found for BW, FI, or any carcass characteristics. The KNN TORC group demonstrated reduced variability of BW and FI as compared to the industry TORC group. The reduced variability was also noted in carcass characteristics, which reflected improved uniformity for the KNN versus industry groups.

**Key Words:** Growth, Feed Intake, Artificial Neural Network, Kohonen, Time of Ration Change

**2. Evaluation of a Commercial Broiler Growth Model for Predicting Nutrient Requirements for Broilers.**
E. O. Oviedo-Rondon*, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

This study was conducted to evaluate the use of a commercial growth model (OmniPro, Novus Inc., St. Louis, MO) to estimate protein and amino acid needs for broilers. The model was used to estimate protein and amino acid needs for males and females using the typical growth chart provided by the breeder (Cobb 500). Feeding periods were defined as 0-14 d for starter, 14-35 d for grower, and 35-49 d for finisher. Diets were formulated to provide 90, 100, and 110% of these estimates. In addition, diets formulated to NRC (1994) standards and fed 0-21, 21-42, and 42-49 d served as a positive control. Eight pens of 60 birds of appropriate sex were assigned to each dietary treatment. At 49 d samples of birds were processed to determine dressing percentage and carcass yield. At 49 d, BW of males fed the 100% OmniPro diets did not differ significantly from that of males fed the NRC diets and was not improved by increasing to 110%; however birds fed the 90% OmniPro weighed significantly less than those fed 110% OmniPro. The 49 d BW of females fed 100% OmniPro or NRC was significantly greater than those fed the 90% OmniPro diets but less than that of females fed 110% OmniPro diets. At 49 d, the feed conversion ratio (FCR) of males fed the 100% OmniPro diets was significantly better than those fed NRC and was not improved by the 110% OmniPro diets. The FCR of females fed 100 or 110% OmniPro diets did not differ from that of those fed NRC and was superior to that of females fed 90% OmniPro diets. No difference in BY was noted among females fed the various treatments. These data suggest that the nutrient estimates generated by the OmniPro program support performance equal to that of NRC nutrient recommendations.

**Key Words:** Broilers, Growth models, Amino acids
Three modeling the digestible amino acid requirements of female turkey 0 to 18 weeks of age. E.C. Blair, J.D. Firmann, K Thompson, University of Missouri-Columbia.

The purpose of this study was to create a model that would accurately predict the digestible amino acid requirements (daar) for female turkey from 0 to 18 weeks of age. It was found that a model previously created to predict the daar for male turkey was not able to function as a predictor in female turkey. Data previously collected from our lab was used to create a set of equations that would predict a female turkey’s intake (g/day) of feed and the birds lysine requirement. The predicted lysine requirement was then used to provide an ideal protein ratio for a female turkey on a digestible basis. The model uses a birds weight (g) to predict both its intake and the ideal protein ratio. With the equations in place the models predicted requirements were tested against data previously collected and was found to not be significantly (p > 0.05) different.

Key Words: Turkey, Modeling, Ideal Protein Ratio

4 Amino acid absorptive capacity of wild and domestic turkey poults. O.T. Foye, B.L. Black, P.R. Ferken, North Carolina State University, Dept. of Poultry Science, North Carolina State University, Dept. of Zoology.

Unlike wild turkeys, domestic turkeys are genetically selected for growth performance and meat yield, but no information exists on how digestive function has been altered. This study evaluated the amino acid absorptive capacity of wild and domestic turkeys fed different levels of dietary protein and carbohydrate. Day-old Eastern wild and Nicholas turkey poults were randomly assigned to battery cages containing 10 poults and fed experimental diets for 72 h prior to enteric tissue sampling. Two dietary treatments per strain were replicated three times in each experiment. In experiment 1, the poults were fed iso-nitrogenous diets containing either high (52.4%) or low (17.7%) carbohydrate (CHO). In experiment 2, the poults were fed iso-caloric diets containing either high (49.0%) or low (24.0%) crude protein (CP) diet. Bodyweights, gross jejunal morphology, alanine transport and leucine aminopeptidase (LAP) activities were measured before and after 72 h of feeding. In both experiments, Nicholas poults had 26.2%, 16.8%, and 9.2% significantly greater bodyweights (P < 0.001), jejunal mass (P < 0.001), and lengths (P < 0.001) than wild poults at hatch, respectively. Nicholas poults had significantly greater jejunal lengths and bodyweights than wild poults (P < 0.05) after 72 h of feeding, which was correlated with the amount of food intake rather than diet composition. In experiment 1, jejunal alanine transport rates were negatively correlated to CHO consumption in Nicholas poults (R2 = 0.40, P < 0.05), but in wild poults: high CHO intake had a suppressive effect on alanine transport activity in the jejunum in Nicholas poults. In experiment 2, alanine transport and LAP activity was suppressed 41.5% (P < 0.01) and 20.8% (P < 0.05), respectively, in Nicholas poults fed the low CP diet, but not in wild poults. Although amino acid absorption rate in domestic turkeys may be reduced by high CHO or low CP diets, total absorptive capacity is more than compensated by increased gut size and thus able to fuel aggressive posthatch growth.

Key Words: amino acid transport, aminopeptidase activity, dietary carbohydrate, and protein, turkeys

5 Sulfur amino acids (SSA) requirement of slow- and fast-feathering male broilers from 21 to 42 days of age. A. Kalinowski* and E.T. Moran, Jr., Auburn University, Auburn, AL.

Two experiments were conducted to separately determine methionine (MET) (Exp. 1) and cystine (CYS) (Exp. 2) needs of broilers from 21 to 42 days of age and whether differences existed between slow (Ross x Ross 308) and fast (37% FE) feathering males. Birds in each experiment were reared in 32 floor pens (25 birds/pen) and fed a common diet from 0-3 wks. From 21 to 42 days, experimental corn-soybean meal based diets (20.0 % CP; 3150 kcal ME/kg) having either four MET or four CYS levels were offered. In Exp. 1 dietary MET was 0.32%, 0.38%, 0.44% and 0.50% with surfeit CYS (0.40%). Interactions between the main factors of FE and age were not significant. The extent of feathering rate has minimal influence on MET needs. Although F/G responded linearly to MET (P < 0.004) as did weight gain (P < 0.05), these data together with chilled carcass wt and abdominal fat wt (linear, P < 0.04) suggest a plateau at 0.44% MET. In agreement with this suggestion, breast weight yield increased up to a MET level of 0.44% (quadratic: P < 0.01; r2 = 0.64). The second experiment measured CYS (0.32%, 0.34%, 0.38%, and 0.46%) response with MET fixed at a marginal level of 0.38% to avoid sparing and to improve acuity. Contrary to Exp. 1, most measurements indicated a significant interaction between CYS and feathering (P < 0.05). Increasing dietary CYS had no effect on either WG or F/G of slow feathering birds, while WG of fast feathering birds reached a plateau at 0.34% CYS (quadratic: P < 0.01) with F/G exhibiting a similar trend (P < 0.11). Chilled carcass wt (quadratic: P < 0.05; r2 = 0.92) and breast fillet wt (quadratic: P < 0.06; r2 = 0.92) of fast-feathering birds also maximized at 0.34% CYS; however, abdominal fat was not influenced by either feathering rate or CYS supplementation. Results suggest that MET requirements to maximize growth and processing yields approximate 0.44% and marginally higher than the 0.38% advocated by NRC (1994). Although a greater need for CYS appears to exist for fast than slow feathering male broilers, the NRC recommendation of 0.34% seems to be suitable for both.

Key Words: Broilers, Sulfur amino acids, Requirement

6 Evaluation of Lysine, Methionine, and Threonine Needs of Broilers Three to Six Weeks of Age Under Moderate Temperature Stress. C. P. Ojano-Dirain*, C. A. Fritts, and P. W. Walldrop, University of Arkansas, Fayetteville, AR.

Two studies of identical design were conducted to evaluate the needs for Lys, Met, and Thr in broiler diets fed from 3 to 6 wks of age when raised under moderate heat stress (27 C). Male chicks of a commercial strain (Cobb 500) were grown in electrically heated battery brooders from 1 to 21 d and fed a nutritionally adequate (24% CP) diet. At 21 d six birds were randomly assigned to each of 96 compartments in unheated grower batteries maintained in a room at 27 C and fed the test diets from 21 to 42 d. A basal diet containing by analysis 1.03% Lys, 0.38% Met, and 0.78% Thr was supplemented with Lysine HCl, DL-Methionine, and L-Threonine in a 4 x 3 x 2 factorial arrangement with Lys levels of 1.03, 1.08, 1.12, and 1.16%, Met levels of 0.38, 0.44, and 0.50%, and Thr levels of 0.78 and 0.88%. Four pens of chicks in each of two trials were fed each of the experimental diets. Feed conversion and BW gain were measured with 21 d BW used as a covariate for BW gain analysis. At the conclusion of the study all birds were processed following a 12 hr fast to determine dressing percentage and parts yield. Dietary Lys levels had no significant effect on 21-42 d BW gain, feed conversion ratio (FCR), or dressing percentage (DP). Breast yield (BY) was significantly improved and abdominal fat (AF) reduced by increasing Lys levels to 1.12%. No significant Lys x Met interactions were observed. Increasing Met to 0.44% resulted in significant improvements in BW gain, FCR, DP, and BY, and a numerical (P = 0.08) reduction in AF. Threonine levels had no significant effect on any parameter. There was a significant interaction of Lys and Thr on breast meat yield; however it followed no consistent trend with the higher level of Thr significantly improving BY at some levels of Lys and significantly decreasing BY at other levels of Lys. These results suggest that under conditions of moderate heat stress the present levels of Lys and Met suggested by NRC (1994) may be inadequate; levels of Thr appear to be adequate for this age bird.

Key Words: Broilers, Amino Acids, Heat Stress

7 Arginine need of broiler males from 42 to 56 days of age under terms of an ideal amino acid pattern. A. Corzo, E. T. Moran, Jr., and D. Hoehlert, Auburn University, Auburn, AL.

An “ideal” relationship of amino acids one to the other optimizes utilization of associated crude protein. Little research has been done to evaluate arginine need for broilers from 42 to 56 days of age under a favorable amino acid balance. An experiment was conducted to measure arginine response by broilers to a feed having crude protein approximating an ideal amino acid pattern (Mack, 1999). A total of 1120 Ross x Ross 308 male broilers were randomly distributed into 32 floor pens of an open-sided house and provided common diets from placement until 6 weeks of age. From 6 to 8 weeks birds were fed a corn-soybean meal diet (17% CP, 3250 Kcal/kg ME and 0.85% lysine) having four arginine levels (0.80 to 1.22% arginine) and had continuous access to water and light. Data were analyzed as orthogonal polynomials, and regression analysis estimated the arginine requirements. At an arginine level of 0.98% of the diet, body weight, body weight gain, and feed/gain (42-56d) were estimated to be adequate (P < 0.01). Birds were processed and chilled carcass weight optimized at 1.00% arginine (P < 0.01). Further arginine supplementation was necessary in order at 42-56d to achieve similar performance. An ideal arginine level of 1.00% has been suggested by NRC (1994). The relationship between dietary arginine content, feed efficiency and growth response is a complex function that may be influenced by the presence or absence of other criteria and the amino acid profile of the test diet.
to maximize recovery of breast meat (fillets, 1.05% arginine; P < 0.05; tenders, 1.18% arginine; P < 0.05). An arginine requirement approximating 1.00% as advocated by NRC (1994) is in general agreement with present results.

**Key Words:** arginine, broiler, protein

8 Expression of Chicken Hepatic Histidase mRNA is Regulated by Dietary Protein Concentrations. T. P. Chandrimada* and A. J. Davis, University of Georgia.

Histidase catalyzes the deamination of L-histidine to trans-uroconic acid. This reaction is the first step of the major catabolic pathway of histidine. A portion of the coding sequence for chicken hepatic histidase has been determined. PCR primers were generated using sequence information from conserved regions of the known mammalian nucleotide sequences. Using RT-PCR methodology, a 711 bp segment of the coding region of chicken hepatic histidase was obtained. The partial chicken histidase coding sequence has the following percent nucleotide identity and deduced amino acid identity (in parenthesis) with the corresponding region from mouse 81% (95%), rat 80% (96%) and human 81% (95%). In a series of four experiments, broiler chicks were allowed free access for 1.5, 3, 6, and 24 hours to a low (13 g/100 g diet), basal (22 g/100 g diet) or a high (40 g/100 g diet) protein diet. The diets were isocaloric and had equal concentrations of dietary fat. Hepatic histidase mRNA expression was examined for each experimental period by Northern Analysis. There were no differences in the expression of the mRNA for histidase at 1.5 hours for the chicks fed the three protein levels. At 3 hours the mRNA expression of histidase was significantly (P < 0.05, n=6) reduced in chicks fed the low protein diet when compared to chicks fed the high protein diet. Expression of histidase mRNA at 6 and 24 hours was significantly reduced in chicks fed the low protein diet and significantly enhanced in chicks fed the high protein diet compared with chicks fed the basal diet. The results suggest that hepatic histidase mRNA expression is rapidly altered in response to dietary protein intake and that previously seen increases in chicken hepatic histidase activity when feeding increased protein levels was mediated by corresponding changes in hepatic histidase mRNA expression.

**Key Words:** Histidase, Dietary protein, Chicken

9 Feed manufacturing and pellet quality effects of corn-soybean based broiler diets with graded levels of added moisture formulated to different energy densities. G. H. Moritz*, K. R. Cramer, K. J. Wilson, R. S. Beyer, and W. B. Cavalcanti, Department of Animal Science and Industry - Kansas State University.

The addition of moisture to corn-soybean based broiler diets has been shown to significantly improve pellet mill throughput as well as pellet quality. Past research has suggested that pellets of high quality can contribute to reducing broiler maintenance expenditure, creating the potential to reduce dietary ME while maintaining performance. The objective of the current study was to add graded levels of moisture to create diets that differ in energy density and pellet those formulations in order to assess feed manufacturing parameters and resultant pellet qualities. Treatments consisted of three levels of added moisture (0, 2.5, and 5%), which were used to create formulations that varied in energy density (NRC recommended levels (NRC) and 5% less NRC recommended levels (low energy)). Low energy diets were established primarily by decreasing the oil inclusion, although all diets utilized the same ingredient profile. Each of the six treatments were applied to four 1,000 lb (454 kg) replicates of birds. NRC diets demonstrated increased production rates (P = 0.0001), decreased pellet starch gelatinization (P = 0.0299) and decreased pellet durabilities (P = 0.0001) compared to low energy diets. Moisture addition, despite dietary energy density, increased production rates (P = 0.0001), decreased relative electrical energy values (P = 0.0001), decreased pellet starch gelatinizations (P = 0.0304) and increased pellet durabilities (P = 0.0440). Linear regression equations were derived to estimate processing trends. Concerning NRC diets, for every 1% increase in moisture addition, pellet mill production rates increased on average by 0.21 MT/hr. Concerning low energy diets, for every 1% increase in moisture addition, relative electrical energy of the pellet mill decreased on average by 0.13 kWh/MT. These results conclude that moisture addition to broiler diets may increase economic returns of pellet manufacturing while simultaneously increasing pellet quality. Furthermore, low energy diets containing added moisture can provide statistically similar pellet mill production rates and energy usage as NRC basal formulations with the added benefit of significantly improved pellet quality.

**Key Words:** Feed manufacturing, Energy density, Moisture, Pellet quality

10 The Effects of Spray Dried Egg as an Alternative Fat Source on Physiological and Growth Performance Traits in Broilers. Sarah Norberg*, Bud Harmon*, and Mickey Latour1, Purdue University.

Two experiments were conducted to investigate the changes in physiology and growth performance in broilers fed different fat sources. In both experiments, broilers were randomly assigned to one of three dietary treatments containing either animal vegetable blend plus spray dried egg (AVSDE), full spray dried egg (FSDE) or standard control diet (CON). In Experiment 1, livers and yolk sac weights were obtained at 0, 1, 3, and 7 days post hatch. In Experiment 2, broilers were assessed for differences in feed conversion rates and body weight gains at 0, 18, 35, and 42 days of age. At Day 42, the broilers were processed and evaluated for total carcass yield and yield of breast and thighs. In Experiment 1, the FSDE had lower relative liver weights compared to CON with AVSDE being intermediate. In Experiment 2, no differences were observed in body weight, average daily gain, feed conversion, or carcass yield. There was an increase in mortality for broilers fed AVSDE. In conclusion, broilers fed a combination of spray dried egg with a conventional fat source achieved optimal physiological and growth performance traits as those fed a standard starter diet.

**Key Words:** Conventional fat, Spray dried egg

11 Effects of Guar Meal on Growth and Feed Conversion of Broilers. S. Conner-Appleton*, J. T. Lee, A. L. Cartwright, and C. A. Bailey, Texas A&M University System College Station, TX / USA.

Guar meal has been shown to negatively affect broiler growth, consumption, and feed conversion when excessive amounts are added to the diets. Two studies were conducted to evaluate the effect of three distinct fractions of guar meal on broiler performance. The purpose of the first study was to determine the percentage of the different guar meal fractions that could be added before growth and consumption were affected. The second study was conducted to determine if Hemicell(β)-mannanase addition could alleviate some of the negative effects of feeding guar meal to broilers. The three fractions of guar meal studied were the germ fraction, the seed coat or hull fraction, and a combined fraction of the two, which was approximately a 25:75 germ to seed coat. The diets in first experiment contained each of the three fractions at 0, 2.5, 5, 7.5, and 10 percent in basal industry type corn: soy diets. A three phase feeding experiment contained each of the three fractions at 0, 2.5, 5, 7.5, and 10 percent in basal industry type corn: soy diets. A three phase feeding program was utilized over a six weeks feeding period. The results of this study indicated the germ fraction could be fed at up to 5% of the diet while the hull and combined fractions could only be fed at 2.5% of the diet. The second study diets contained 5% of each of the three fractions with and without enzyme addition. No difference in body weight between the germ gum fraction and the control was observed. The addition of enzyme improved cumulative feed conversion but had no effect on body weight.

**Key Words:** Broilers, Guar Meal, β-mannanase, Feed Conversion

12 Hemicell(β) Enzyme Decreases In Vitro Viscosity of Guar Meal Feeds. J. T. Lee*, S. Conner-Appleton, C. A. Bailey, and A. L. Cartwright, Texas A&M University System College Station TX / USA.

Guar meal is a high protein by-product of guar gum production. Guar meal constituting over 5% of the diet depresses growth and performance of broilers presumptively due to a residual gum, galactomannan polysaccharide. The gum increases intestinal viscosity while decreasing nutrient absorption. Hemicell(β), a β-Mannanase, was added to commercial standard corn/soy diets containing 2.5, 5, 7.5, 10% guar meal, respectively. Hemicell(β) was added at ten different concentrations ranging from 1/32 to 100 times the recommended dose. A procedure was established to measure the effect of the enzyme concentration on the viscosity of the supernatant of each sample. Viscosity was determined using a Brookfield LVDV-II cone and plate viscometer with a CPE-40 spindle. Feed samples
were mixed with water and enzyme solution at a 1:5 ratio. Samples were incubated at 40 °C for an hour after addition of enzyme. After incubation, the samples were placed in a 4 °C water bath for 15 min. to reduce enzymatic activity. The samples were then centrifuged for 10 min. in a Fisher Clinical centrifuge. The supernatant was placed in the viscometer to acquire the viscosity reading. Hemicell® significantly reduced the viscosity of all diets. A linear relationship between enzyme concentration and sample viscosity was observed between 0 and the enzyme level recommended by the manufacturer. This reduction in viscosity of the feed could offer a hypothesized method to decrease the intestinal viscosity of guar meal diets in vivo thereby improving performance of broilers.

Key Words: Guar, Hemicell®, Viscosity, Gum

13 Increasing the Level of Dispensible and Indispensable Amino Acids Does Not Overcome the Performance Reduction in Low Crude Protein Diets. P. W. Walldroup*, Q. Jiang, and C. A. Fritts, University of Arkansas, Fayetteville, AR.

The objective of this study was to determine if providing levels of indispensible amino acids (IAA) equal to that of higher CP diets would improve performance of chicks fed low CP diets. Diets were formulated to meet NRC (1994) IAA using corn and soybean meal of known composition. Diets contained 16, 18, 20, 22, and 24% CP with 3200 ME kcal/kg. In addition, diets with 16, 18, and 20% were supplemented with additional IAA to a level equal to that found in the 22% CP diets. To determine if a possible response to the additional IAA was due to specific AA needs or to addition of N, additional diets with 16, 18, and 20% CP were supplemented with a mix of dispensible AA (DAA; equal parts Ala, Glu, and Gln) to provide levels of N equal to that provided by the IAA supplements. For the first 7 d posthatch all chicks were fed the 24% CP diet and fed the test diets from 7 to 21 d posthatch. Each diet was fed to 12 pens of 5 male chicks of a commercial strain. Body weight by pen was taken at 7 and 21 d and feed consumption determined. At 18 d a 24 hr fecal sample was taken, quickly frozen, lyophilized, and analyzed for N content. Body weight gain was significantly reduced in chicks fed diets with less than 22% CP. Addition of IAA to match those found in 22% CP improved performance of chicks fed diets with 16, 18, and 20% but did not match that of chicks fed 22 or 24% CP. Addition of the DAA mix significantly improved performance of chicks fed 16% CP but not those fed 18 or 20% and not to the level attained on 22 or 24% CP diets. Feed conversion was significantly impaired by feeding diets with 16 and 18% CP but was improved by addition of the IAA. Addition of the DAA mix had variable effects on feed conversion. Results of this study suggest that reduced performance on diets low in CP is not totally related to a deficiency in essential AA or N pool.

Key Words: Broilers, Protein, Amino Acids

14 Effects of varying dietary ideal amino acid profile levels on broiler performance in different periods. D. Hoehler1, P.J.A. Wijtten2, D.J. Langhout2, A. Lemme1, and A. Petri1.


Previous studies have shown that the crude protein (CP) and amino acid (AA) response of broilers to a truly optimized essential AA profile is significantly higher than that reported in the literature. In the present study, possible interactions among different AA and CP levels between the starter, grower and finisher phase were investigated. All diets were formulated according to the apparent fecal digestible AA profile reported by Mack et al. (1999), expressed as ratio to lysine in all diets being: Lys (100), Met + Cys (75), Thr (63), Trp (19), Arg (112), Val (81) and Ile (71). A complete block design with two AA levels in the starter (100 and 120%), day 1-14, two AA levels in the grower (100 and 120%, day 15-30), and three AA levels in the finisher period (90, 100 and 110%), day 31-37 were fed to male Ross 308 birds. The corresponding 100% AA levels for the starter/grower/finisher phases represent total (apparent fecal) dietary lysine contents of 1.22 (1.05/1.18 (1.02)/1.16/0.99)%, respectively, being the CVB-standard. This design resulted in a total of 12 treatments using 6 replicates with 20 broilers each. Diets based on corn, wheat, soybean meal, fish meal and potato protein were formulated to be isocaloric. Increasing the dietary AA+CP level from 100 to 120% significantly improved weight gain (+30g/+35g) and feed conversion ratio (+7.5%/-3.4%) in the starter/grower phases. In addition, breast yield was increased and abdominal fat pad weight was decreased due to the enhanced AA+CP level in the grower period. Increasing the dietary AA+CP level from 90 to 110% in the finisher period significantly improved weight gain (+31g) and FCR (-5.3%). Final body weights increased consistently from 2267g to 2367g from dietary treatment 1 (100/100/90% AA+CP levels) to 12 (120/120/110% AA+CP levels), respectively. The results confirm previous experiments. The effect of increased AA+CP levels on weight gain was more pronounced in the starter phase compared to the grower and finisher phases. Additionally, the results indicate that the effects on weight gain of AA+CP increments in the different phases might be affected by the AA+CP levels fed in previous or consecutive phases.

Key Words: Broiler, Amino Acid, Ideal Protein

15 Effects of Intestinal Modification on Utilization of Methionine Sources by Broilers. C. A. Fritts*, M. A. Motl, and P. W. Walldroup, University of Arkansas, Fayetteville, AR.

Studies with germfree versus conventional broilers have suggested that the intestinal microbial status of the chick might influence the absorption of DL-Methionine (DLM) and its hydroxy analogue (HMB). The objective of this study was to evaluate the response of broilers to the two sources of MET in diets with and without high levels of antimicrobials to determine if intestinal microbial status would influence the response to the sources of MET. A corn-soybean meal diet was prepared that was calculated to provide 110% of all suggested amino acid needs (NRC, 1994) other than Met. It was analyzed to contain 0.34% Met and 0.75% TSAA. A large batch was prepared and divided into two aliquots. One was supplemented with a combination of antibiotics (200 g/ton Bacitracin MD; 100 g/ton Penicillin; 200 g/ton chlortetracycline) and sulfathiazole (100 g/ton) in an attempt to modify the intestinal microflora. The other aliquot received no additives. Both the unmedicated and medicated diets were divided into two aliquots each and supplemented with graded levels of either DLM or HMB in amounts calculated to provide 0, 0.08, 0.12, 0.16, and 0.20% Met, based on 99% activity for DLM and 88% activity for HMB. This resulted in a 2 x 2 x 6 factorial with 2 diet types, 2 methionine sources, and 6 levels of supplemental Met for a total of 24 treatments. Each was fed to six replicate pens of six chicks in wire-floored batteries from 0 to 21 d. Mean body weight and feed consumption by pen were determined at 21 d. Increasing levels of Met significantly improved BW and feed conversion (FCR). There was no significant difference in either BW or FCR associated with Met sources. Chicks fed the medicated diets had significantly higher BW and better FCR than chicks fed the unmedicated diets. However, there were no significant interactions between Met source and level, Met source and medication, or the three-way interaction of Met source, level, and medication were observed.

Key Words: Methionine, Broilers, Hydroxy analogue

16 Broiler Arginine and Methionine Requirements at Two Temperatures. M. Chamrunpollert, G.M. Pesti*, and R.I. Bakalli, University of Georgia, Athens GA.

Two experiments were conducted with straight-run Ross x Ross broiler chicks in battery brooders from 7 to 21 d to determine the arginine (Arg) and methionine (Met) requirements of young broiler chicks at control (25 C) and warm (35 C) temperatures. In both experiments, one-day-old broiler chicks were fed a corn and soybean meal based starter diet for 7 d. Six replications (2 replicates in each of 3 rooms per temperature) with eight chicks each were used for each treatment. In Experiment 1, the basal diet was based on corn (34.52%), wheat (26.96%), corn gluten meal (16.53%), soybean meal (11.74%) and poultry fat (23% of CP and 3.20 kcal/g of ME). Six levels of Arg (0.95, 1.05, 1.15, 1.25, 1.35, or 1.45% in the diet) were the dietary treatments. The broken-line linear model was used to estimate the chicks' Arg requirement. Based on body weight and FCR data, respectively, the Arg requirements of young Ross x Ross broiler chicks raised at 35 C were 1.15±0.03% and 1.13±0.02% while those of chicks at 25 C were 1.26±0.03% and 1.27±0.02% in Experiment 1. In Experiment 2, the influence of temperature and dietary Arg on the Met requirements of young broiler chicks was investigated. The basal diet was based on corn (53.45%), soybean meal (37.72%), and poultry fat (23% of CP and 3.20 kcal/g of ME). Experiment 2 had a 6 x 2 factorial arrangement, with six levels of dietary Met (0.35, 0.40, 0.45, 0.50, 0.55, or 0.65%) and two levels of dietary Arg (1.52 or 2.52%). When chicks were fed a corn-soybean meal basal diet containing 1.52% Arg, the Met requirement of young Ross x Ross broiler chicks raised at 35 C was 0.430±0.02% and 0.430±0.05% while those of chicks at 25 C was 0.430±0.01% and 0.480±0.03%, based on body gain.
and FCR data, respectively. When Arg levels were increased to 2.52%, the Met requirement of young Ross x Ross broiler chicks was higher at both temperatures. The requirements of chicks raised at 35°C were 0.500.02% and 2.499.92%, and at 25°C were 0.590.03% and 2.579.92%, based on body gain and FCR data, respectively. Temperature and amino acid balance may both affect the amino acid requirements of broilers.

**Key Words:** Arginine requirement, methionine requirement, broilers, temperature

### 17 Arginine Responses in Broilers: Live Performance

M. T. Kidd*, M. P. Thaxton*, J. B. Yeatman1, S. J. Barber1, and W. S. Virden1, Mississippi State University, Mississippi State, MS.

Two experiments were conducted to evaluate Arg needs of broilers. Experiment 1 estimated Arg needs of chicks in a clean environment and Experiment 2 evaluated Arg responses in broilers during a coccidial challenge. In Experiment 1, a test diet deficient in Arg (0.95% total Arg) was created by blending the protein ingredients corn, corn gluten meal, wheat middlings, soybean meal, and amino acids. Graduations of total Arg (as achieved by adding L-Arg in place of a filler) increased in 0.12% increments up to 1.55% of diet (6 treatments and 6 replications/treatment). Treatment diets were administered from Days 1 to 18. The test facility was a tunnel house (thermoneutral conditions) with nipple drinkers and new shavings. Arg needs (95% of the asymptote in the quadratic response) for BW gain, feed:gain, and corrected feed:gain were 1.15, 1.26, and 1.27% of diet, respectively. Experiment 2 was a factorial design of dietary Arg and monensin sodium. Broilers were fed dietary total Arg:Lys ratios of 0.90, 1.10, and 1.30 with or without 90g of monensin. The starter and grower diets were fed from Days 1 to 21 and 22 to 42, respectively. At Day 28, broilers received an Eimeria tenella challenge (60,000 oocysts/bird) via feed administration. An additional group of birds were fed the 1.10 Arg:Lys ratio and did not receive monensin sodium or a coccidial challenge. Hence, there were seven dietary treatments (3 Arg x 2 monensin and a control) replicated six times (40 birds/replicate). No interactions occurred. Day 21 BW and feed:gain were improved (P < 0.05) in birds fed the Arg:Lys ratio of 1.30 over birds fed the 0.90 ratio. Differences in lesion scores did not occur. Birds fed diets containing monensin had decreased BW and increased feed:gain (P < 0.05) for the 1 to 42 d period. Feed:gain, but not BW, was improved (P < 0.05) in broilers fed the 1.30 Arg:Lys ratio over birds fed the 0.90% Arg:Lys ratio for the 1 to 42 d period. The 1.30 Arg:Lys ratio improved (P < 0.05) overall livability.

**Key Words:** Arginine, Broiler, Coccidiosis

### 18 Arginine Responses in Broilers: Coccidiosis and Stress

J. P. Thaxton*, M. T. Kidd1, J. B. Yeatman1, S. J. Barber1, and W. S. Virden1, Mississippi State University, Mississippi State, MS.

An experiment was conducted to delineate interactive effects of dietary Arg, coccidiosis infection, and physiological stress. At Day 21, broilers were fed one of three dietary Arg:Lys ratios: 0.90, 1.18, and 1.45. These Arg:Lys ratios were achieved by the addition of L-Arg to a corn and corn gluten meal basal diet containing 0.95% total Arg. Each diet was fed to 8 pens of 40 male broilers from Days 21 to 38. On Day 22, six birds in each pen received subcutaneous implants of osmotic pumps in the interscapular space between the wings. A like number of non-implanted controls were maintained in each pen. The remainder of birds in each pen were extras. Also, on Day 22, fresh pine shavings litter to which litter birds were exposed. L-Arg was added to the diet to contain sporulated Eimeria tenella, E. acervulina, and E. maxima oocysts (ratio of clean to dirty litter was 3:1) was added to each pen. Osmotic pumps released ACTH (8IU/kg BW/d at 1uL/h for 7 d) continuously. Three ACTH- birds and three Controls were removed from each pen on Days 30 and 38, bled within 20 sec after removal, killed, weighed and the liver, spleen, bursa of Fabricius and the third lobe of the thymus on the left side were removed and weighed. Results indicated that all birds experienced clinical coccidiosis as evidenced by lesion scores from birds killed on Day 30. Arg:Lys at 0.9 did not reduce incidence of coccidial lesion scores, but higher levels did. Birds that received ACTH plus the higher Arg levels exhibited lower lesion scores than ACTH-treated birds on the low level of Arg. Total relative immunohistochemical tissue (spleen, bursa and thymus) content was reduced by ACTH, while relative liver weight was increased . Arg levels had no effect on these latter two parameters. Arg may be antagonist to physiological stress responses during infection with coccidiosis.

**Key Words:** Arginine, Broiler, Coccidiosis, Stress

### 19 Impact of graded levels of dietary lysine on economic criteria in turkeys of different age periods.

A. Lemme1, A. Petri1, and D. Hoehler1, Degussa AG, FA-AT, Hanau, Germany.

The results of four dose-response trials conducted to investigate the effects of dietary lysine on performance of BUT Big 6 turkey toms in different phases were used to examine the impact of graded lysine levels on profitability. The two criteria “feed cost per kg gain” and “gross margin (income over feed cost) per phase” were compared. Exponential regression equations revealed optimum dietary lysine levels of 1.50, 1.37, 1.24, >0.96%, and 1.37, 1.18, 0.94, >0.96 % for maximising weight gain and minimising feed conversion ratio at 5-8 (P1), 9-12 (P2), 13-16 (P3), and 17-20 (P4) weeks of age, respectively. Basal feed prices determined by least cost formulation generally increased with lysine supplementation. According to the economic scenario assumed, optimum dietary lysine levels were found to be 1.32 (P1), 1.10 (P2), 0.87 (P3), and 0.82 % (P4) for minimising feed cost per kg gain. The respective figures for maximising gross margin were 1.51, 1.34, 1.05, and 1.04%, respectively. It could be shown that feed cost per kg gain varied only within marginal ranges due to the fact that the lysine effects on feed cost were compensated by the effects on weight gain. In contrast, gross margin was clearly affected by dietary lysine. Particularly suboptimum lysine supply reduced profitability. Thus, gross margin was regarded as the more relevant economical parameter for the producer than minimum feed cost per kg gain. Maximum gross margins were found at lysine levels substantially higher than those deemed optimum for lowest feed cost per kg gain. This indicates that under the conditions tested, maximum growth rate is much more important for optimising gross margin. It can be assumed that optimum lysine levels were even higher, if breast meat percentage would be considered as additional economical parameter. It is therefore recommended to formulate dietary lysine levels assuring high growth rates (or breast meat percentage) for maximising profitability.

**Key Words:** Turkey, Lysine, Dose-response, Feed cost, Profitability

### 20 Threonine Needs of Cobb Female Broilers from Days 42 to 56

M. T. Kidd1, W. A. Dozier, III2, S. J. Barber3, W. S. Virden1, D. W. Chambless1, and C. Wiernusz4, Mississippi State University, Mississippi State, MS; 2 University of Georgia, Tifton, GA; 3 United States Department of Agriculture, Mississippi State, MS; 4 Cobb-Vantress, Siloam Springs, AR.

Limited published information is available concerning threonine (Thr) needs of mature female broilers. Five hundred female Cobb broilers were fed common diets and housed in floor pens until Day 41. At Day 41, 126 broilers were randomly allocated to 42 cage units (3 birds/cage). Broilers were fed six dietary Thr levels (0.45 to 0.80% of diet in 0.07% increments). Treatments in the Thr dose response experiment were replicated between five and eight times. A floor pen experiment was conducted to compare the test diet containing surfeit Thr (0.66%) to a corn and soybean meal diet containing equal Thr (0.66%) for the 42 to 56 d period. All birds in the dose titration experiment were processed at Day 56 and breast meat was cone deboned. Live performance responses were replicated between five and eight times. A floor pen experiment was conducted to compare the test diet containing surfeit Thr (0.66%) to a corn and soybean meal diet containing equal Thr (0.66%) for the 42 to 56 d period. All birds in the dose titration experiment were processed at Day 56 and breast meat was cone deboned. Live performance responses in broilers fed diets containing equal Thr in a corn and soybean meal diet. A quadratic response occurred for BW gain, but not other live performance or carcass measurements. The Cobb female broilers need (95% of the asymptote) for BW gain was 0.60% Thr (0.53% digestible) for the 42 to 56 d period.

**Key Words:** Threonine, Broiler, Amino Acid

### 21 Threonine Needs of Cobb Male Broilers from Days 42 to 56

M. T. Kidd*, W. A. Dozier, III*, S. J. Barber*, W. S. Virden*, D. W. Chambless*, and C. Wiernusz*, Mississippi State University, Mississippi State, MS; 2 University of Georgia, Tifton, GA; 3 United States Department of Agriculture, Mississippi State, MS; 4 Cobb-Vantress, Siloam Springs, AR.

Three floor pen experiments (1 test diet validation experiment and 2 dose response experiments) were conducted to evaluate threonine (Thr) needs of mature male broilers.
needs in Cobb male broilers from Days 42 to 56. The test diet was primarily based on corn and peanut meal and contained 0.45% Thr (0.40% digestible Thr). The dose response consisted of graduations of Thr (as added by adding L-Thr in place of sand) to the test diets in 0.07% increments. The test diet containing 0.66% Thr was compared to a corn and soybean meal diet containing 0.66% Thr (5 replications/treatment; 25 birds/replicate). Test diets varying in Thr were fed to broilers in a clean (new shavings, nipple drinkers, tunnel ventilation) or dirty (old shavings, bell drinkers, conventional open sided house) environment. Test diets were replicated between 4 and 7 times (16 birds/replicate). Live performance and carcass attributes were measured for the 42 to 56 day period. Treatment differences (P < 0.05) in the test diet validation experiment did not occur indicating that the test diets containing surfeit Thr supported growth responses as well as the “typical” corn and soybean meal diet. Quadratic responses (P < 0.05) for broilers in the clean environment occurred for BW gain, corrected feed/gain, carcass weight, and breast weight resulting in total dietary Thr levels (95% of the asymptote) of 0.67, 0.68, 0.65, and 0.63% of diet, respectively. Quadratic responses for growth and carcass attributes for broiler raised in a dirty environment did not occur. However, gain, feed/gain, corrected feed/gain, carcass weight, breast weight, and breast yield in broilers raised in the dirty environment responded to increased dietary Thr in a linear manner (P < 0.05). Thr needs of Cobb male broilers are near NRC (1994) recommendations, but environmental conditions may affect Thr needs.

Key Words: Threonine, Broiler, Amino Acid

22 Effect Of Threonine Supplementation Of Low Protein Diets On Broiler Growth. A. J. Pescatore1, A. H. Cantor1, D. J. Burnham2, M. J. Ford1, and R. S. Gates1, 1University of Kentucky, Lexington, KY, 2 Ajinomoto Heartland, Inc., Chicago, IL.

Three experiments were conducted to determine the effect of L-threonine supplementation of low protein diets on broiler growth. In Experiments 1 and 2, male broiler chicks were used, while female broiler chicks were used in Experiment 3. The strain of bird was the same for Experiments 2 and 3 and a different strain was used in Experiment 1. Birds were housed in cages (61 cm wide x 51 cm deep x 36 cm high), 10 birds per cage. In each study, six replicate groups of 10 birds were assigned to each of six treatments in a randomized complete block design. Within each experiment, birds were distributed among cages so that average starting BW for each of the 36 replicates was within a range of 1g/bird. Birds were fed the experimental diets for 14 days beginning at 7 d of age in Experiment 1 and at 8 d of age in Experiments 2 and 3. Treatments consisted of feeding low protein (17.7%) diets with the following levels of digestible threonine: 1) 0.58%, 2) 0.61%, 3) 0.64%, 4) 0.67%, 5) 0.70%, and 6) 0.73%. In Experiment 1, there were linear effects of dietary threonine on final BW and on BW gain and feed conversion. In Experiments 2 and 3, a different strain was used in Experiment 1. Birds were housed in cages (61 cm wide x 51 cm deep x 36 cm high), 10 birds per cage. In each study, six replicate groups of 10 birds were assigned to each of six treatments in a randomized complete block design. Within each experiment, birds were distributed among cages so that average starting BW for each of the 36 replicates was within a range of 1g/bird. Birds were fed the experimental diets for 14 days beginning at 7 d of age in Experiment 1 and at 8 d of age in Experiments 2 and 3. Treatments consisted of feeding low protein (17.7%) diets with the following levels of digestible threonine: 1) 0.58%, 2) 0.61%, 3) 0.64%, 4) 0.67%, 5) 0.70%, and 6) 0.73%. In Experiment 1, there were linear effects of dietary threonine on final BW and on BW gain and feed ratio for the 14-d period. Maximum values for BW (832 g), BW gain (672 g), and gain to feed ratio (7.70) were obtained with the two highest levels of digestible threonine. In Experiment 3, there was a significant increase in BW gain for the female broilers during Days 8-15. Maximum gain was achieved with the 0.67% digestible threonine level. By Day 22, this trend was no longer significant. There were no effects on feed intake or feed conversion. In Experiment 2, there were no effects of dietary threonine level on the parameters studied. The results of these studies indicate that growth response of broilers to marginal dietary levels of threonine may vary due to genetic strain and sex of the bird.

Key Words: Threonine, Amino acids, Broilers

23 Response of fast and slow feathering broiler males reared under summer conditions to high and low dietary levels versus increased proportions of balanced essential amino acids. A. J. Zarate1, E. T. Moran, Jr.1, and D. J. Burnham2, 1 Auburn University, Auburn, AL, USA, 2 Heartland Lysine Inc. Chicago, IL, USA.

The extent of feathering is expected to influence broiler response to a hot environment. Broilers fed for performance in the experiment was conducted using a commercial type feeding regimen to compare high and low levels of CP (1% difference for 1-16, 16-32, 32-41, and 41-47 days of age) having balanced EAA at either 100 or 110% of expected needs using either fast (Ross 308) or slow (Ross 308) feathering male broilers. Birds were grown in floors pens under summer conditions to 47 days of age. Data were statistically evaluated as factorial arrangements of CP level (high versus low), EAA level (100% versus 110%), and feathering (fast versus slow).

In total, existing environmental conditions adversely affected final bird performance to a marginal extent (2880 g BW, F/G 1.73) to enable feed treatments to elicit potential effects. No significant interactions (P > 0.05) were found among main factors with live performance, and only CP was influential. The high CP level fostered increased gain over low CP but adversely affected feed conversion. Carcasses from birds receiving either high CP or EAA at 110% of need had additional abdominal fat. Independently, fast feathering birds fed high CP level had less abdominal fat while slow feathering birds had additional fat. Birds that had received high CP also had the advantage in carcass weight and relative yield as did fillet and tender weights and percentages. Under terms of present experimentation, increasing dietary CP was the most effective manner of improving broiler production under summer conditions.

Key Words: Broilers, Carcass yields, Dietary protein, Essential amino acids, Feathering, Heat stress


There are concerns by consumers and government health officials regarding the use of growth promotion antibiotics in food producing animals and potential transfer of antibiotic resistance to human pathogens. As a result many countries around the world are limiting or eliminating the use of antibiotic growth promotants in food producing animals. The European Union has prohibited the use of antibacterial feed additives that have most successfully controlled the incidence of both clinical and sub-clinical Necrotic Enteritis in broilers. Since this action many countries have experienced near epidemic proportions, 25 to 40% of all flocks breaking with Necrotic Enteritis and Necrotic Dermatitis. As a result lot of efforts are being made to look for newer, natural (nutricine) products as substitutes for growth promotion antibiotics. Immustim®, a highly purified naturally occurring beta-1,3/1,6-glucan molecule with known chemical structure and with proven mode of action isolated from Bakers yeast, Saccharomyces cerevisiae was evaluated as a replacement for growth promotion and antibiotic additives and ionophores. This study involved approximately 500,000 Immustim® fed broilers, without growth promotion antibiotics and/or ionophores compared with 1,500,000 broilers fed regular medicated feeds (with ionophores and growth promotion antibiotics). Compared field data includes livability, feed conversion, average daily gain, incidence of clinical Necrotic Enteritis, condemnations and uniformity. Almost identical livability, weight for age and feed conversions were obtained. Slightly improved plant condemnations and improved skin lesions were observed in Immustim® fed broilers. Above data and probable mode of action will be presented.

Key Words: Immustim, Nutricine Biomodulator


Poultry producers face the possibility of reduced access to growth-promoting antibiotics in broiler diets. Use of enzymes to enhance digestibility of nonstarch polysaccharides in feedstuffs has been proposed as a means of improving performance in diets without antibiotics. In this study, broiler diets were fed with or without antibiotic supplements [50 g/ton BMD and 45.4 g/ton roxarsone in starter (0-14 d) and grower (14-35 d) diets and 15 g/ton virginiamycin in finisher (35-42 d) diets]. Three types of diets were compared. The first contained 5% meat and bone meal and amino acid levels typical of commercial diets. The second was formulated to be identical in ME and amino acids but with no animal protein. The third diet type also contained no animal protein, but had reduced ME (2, 3, and 4% reduction in starter, grower, and finisher diets respectively). These diets, with and without the antibiotics, were then fed with or without the addition of 0.1% Avizyme 1502 (Finnfeeds, St. Louis, MO). Four pens of 50 male chicks (Cobb 500) were fed each diet in mash form. Mean BW and feed consumption were obtained at 14, 35, and 42 d. At 42 d five birds per pen were processed to determine dressing percentage and breast yield. Addition of Avizyme significantly improved BW at 14 and 42 d and numerically (P = 0.08) at 35 d with no significant effect on feed conversion (FCR), mortality, dressing percentage (DP), breast yield (BY), or abdominal fat (AF). Birds fed diets with the antibiotic program had significantly improved BW at all ages.
26 Graded Levels of Phytase Past Industry Standards Improves Broiler Performance. R. B. Shirley* and H. M. Edwards, Jr., University of Georgia.

This experiment determined the effect of a log-titrated dose of phytase on phytate phosphorous utilization in zero to sixteen-day-old Cobb X Cobb mixed-sex broiler chicks. The corn-soybean meal basal diet used contained 22.5% CP, a ME of 3.130 kcal/g diet, and a deficient available phosphorous (aP) level of 0.204% (total phosphorous (tP) = 0.45%). In addition, to a positive control diet (0.45 aP; 0.70% tP), the phytase levels evaluated were: 0, 93.75, 187.5, 350, 750, 1,500, 3,000, 6,000, 12,000 FTU/kg diet. Regression analysis of log-transformed phytase levels revealed a quadratic response for body weight gain (BWG), feed intake (FI), plasma calcium and phosphorous (Phosphorus Ca and phosphorous P), phosphorous rickets (P rickets), bone ash, and tibia ash, with an R² of .93, .88, .26, .85, .94, .96, and .98, respectively. Using Dunnett’s t-Test (α = 0.05) to compare the control and any given phytase level, phytase addition from 0 to 750 significantly increased BWG from 287 to 424 g and FI from 381 to 505 g/chick. Compared to the control’s BWG of 501 g/chick and FI of 594 g/chick, further increments of phytase from 1,500 to 12,000 numerically increased BWG (459 to 515 g/chick) and FI (547 to 595 g/chick). Plasma Ca numerically decreased as phytase supplementation increased, however, plasma P significantly increased from 2.5 to 3.8 mg/dl (0 to 6,000), and numerically to 7.1 mg/dl (12,000), but was no different than the control’s plasma P of 6.9 mg/dl. Compared to the control’s P risks of 0%, increasing phytase significantly decreased P risks from 80 to 40% (0 to 3,000), and numerically from 13.3 to 3.3% (6,000 to 12,000). Compared to the control’s bone ash (40%), increasing phytase significantly increased bone ash from 26 to 36% (0 to 3,000), and was numerically increased further to 37 and 41% (6,000 and 12,000). Likewise, when compared to the control’s tibia ash (.568 g), tibia phos- phorous was significantly increased from .260 to .469 g (0 to 3,000), and was numerically increased further from .544 to .601 g (6,000 to 12,000). These data show that with each additional phytase supplementation to 12,000 FTU/kg, bird performance is maximized in an aP deficient diet, and that current industry recommendations for levels of phytase supplementation need to be reevaluated.

Key Words: Broiler performance, Phytase supplementation

28 The Interactive Effects of Eimeria acervulina Infection and Phytase in Broiler Chicks. B. C. Watson*, J. O. Matthews¹ and L. L. Southern¹, ¹LSU Agricultural Center.

Three experiments (Exp.) were conducted to determine the interactive effects of Eimeria acervulina infection and phytase in male broiler chicks. Chicks were pretested from 0 to 4 or 6 d posthatching, and the assay periods were 12 to 14 d. Treatments were replicated with 6 (Exp. 1) or 12 (Exp. 2 and 3) pens of five chicks each. Initial BW were 67, 98, or 79 g and final BW were 363, 371, or 369 g in Exp. 1 to 3, respectively. All diets were corn-SBM (C-SBM) formulated to provide 1.26% total lysine and 3,200 kcal/kg ME, and were adequate in all other nutrients except Ca and aP where appropriate. In Exp. 1, the treatments were: 1) C-SBM, 1.0% Ca and 0.45% aP; 2) C-SBM, 0.80% Ca and 0.25% aP; 3) Diet 1 + 500 FTU phytase 4) Diet 2 + 500 FTU phytase; 5 to 8) Diets 1 to 4 but infected with 400,000 E. acervulina oocysts on d 0, 3 and 6 of the Exp. Daily gain, ADFI, and gain:feed were reduced (P<0.01) by the coccidial infection and the reduction in Ca and aP. Phytase increased (P<0.02) ADG and ADFI regardless of the Ca and aP adequacy of the diet or the presence of coccidia. Gain:feed was reduced (P<0.01) by the coccidial infection and by the reduction in Ca and aP. Gain:feed was increased by phytase but only in the uninfected chicks (phytase x coc, P<0.02). Toe and tibia ash were decreased (P<0.01) in chicks fed diets deficient in Ca and aP. Phytase increased toe and tibia ash, but only in diets deficient in Ca and aP (phytase x Ca and aP, P<0.01). Also, phy- tase was less effective in increasing tibia ash in coccidia-infected chicks than in control chicks (phytase x coc, P<0.02). Experiments 2 and 3 included treatments 1 to 4 of Exp. 1 (no coccidial infection). In both Exp. 2 and 3 the reduction in Ca and aP (P<0.01) ADG, ADFI and gain:feed. Phytase addition increased (P<0.01) ADG and ADFI in diets deficient in Ca and aP, but not in the control diet. These data indicate that phytase is effective in the presence of a coccidial infection, but based on gain:feed and tibia ash, it may not be as effective as in uninfected chicks. Furthermore, phytase increased ADG and ADFI in diets formulated to be adequate (or excess) in all nutrients for male broiler chicks.

Key Words: Broiler, Phytase, Coccidia

29 Effect of Source and Level of Vitamin D in Broiler Diets Designed to Minimize Phosphorus Excretion. C. A. Fritts*, and P. W. Waldroup, University of Arkansas, Fayetteville AR.

A study was conducted to compare two sources of vitamin D in conjunction with phytase-supplemented diets with reduced P levels. A positive control diet was formulated to NRC recommendations for Ca and nonphytate P (NPP). By adjusting the level of dicalcium phosphate, limestone and sand a second series of diets (Early Modified) was prepared that provided for early skeletal development followed by markedly reduced levels of NPP in grower and finisher diets (0.4, 0.2, and 0.1% NPP). All diets in this series were supplemented with 1000 FTU/kg of phytase. Within each NPP series diets were supplemented with 1000, 2000, or 4000 ICU/kg of cholecalciferol (VIT-D3) or equivalent amounts of 25-OH-cholecalciferol (25-OH). The combination of 2 NPP regimes, 2 vitamin D sources, fed at 3 levels resulted in a 2 x 2 x 3 factorial arrangement for a total of 12 treatments fed to 4 replicate pens of 25 male broilers. At 21, 42 and 49 d, birds were weighed and feed consumption determined. At 49 d, all remaining birds were processed in a pilot processing plant with automatic evisceration to determine incidence of broken legs, wings and rib cage. Five birds per pen were also evaluated for tibia ash and tibia dyschondroplasia (TD). Source of vitamin D had no effect on BW, feed consumption and mortality. However, vitamin D increased (P<0.01) ADG, ADFI and gain:feed. 25-OH diets had a higher severity of TD compared to chicks fed VIT-D3. Increasing the level of vitamin D from 1000 to 4000 ICU/kg significantly improved BW at 42 and 49 d. Level of vitamin D had no significant effect on any other live production parameter, incidence or severity of TD, or number of broken bones during processing. Chicks fed the reduced NPP program did not differ from those fed the NRC program for any live production or bone development parameter.
Although fecal P excretion was not determined, previous studies in our lab have shown approximately 50% P reduction.

Key Words: Vitamin D, Phosphorus, Broilers

30 Effect of dietary phosphorus and enzyme levels on reproduction in turkey breeder hens. J. L. Godwin*, J. L. Grimes, and V. L. Christensen, NC State University, Raleigh, NC, USA.

The objective of this research was to examine the effect of dietary phosphorus (P) and phytase (E) levels on the reproductive performance of turkey breeder hens. Large White turkey breeder hens were housed in a curtain-sided house with 48 pens (10 birds per pen) and photostimulated with 15.5 hr of light per day at 31 wk of age (WOA). Hens were fed a breeder ration with treatments as follows: high P (HP), total P=0.7%, HP + enzyme (HP+E), medium P (MP), total P=0.5%, MP + enzyme (MP+E), low P (LP), total P=0.3%, LP + enzyme (LP+E). This provided for a 3 x 2 factorial with three levels of P and two levels of E. At 20 wk of lay all inorganic P was removed from the LP+E and LP diets. Feed and water were provided ad libitum for a 28 wk reproductive period. Diets were fed in mash form. Data were recorded on a pen basis. Individual bird BW and feed consumption, by pen, were determined at monthly intervals from 31 WOA to 62 WOA. Hens were inseminated weekly with pooled semen from same strain breeder males. Hens were observed for biweekly reproductive performance for 28 wk of egg production. The following parameters were measured: hen housed and hen day egg production (EP), fertility, hatchability, hatch of fertile, feed consumption, settable and total settable eggs, egg weight, shell thickness, broodiness, and mortality. All settable eggs were incubated by pen in a common incubator for each week. Data were analyzed using General Linear Model Procedures of SAS, 1989. There were no consistent differences for any of the parameters observed due to dietary P. Addition of enzyme to turkey breeder hen diets resulted in a significantly lower percentage of birds going out of production and transitory improvements to hatchability of all fertile eggs. There were no P x E interactions. In conclusion, decreasing dietary P resulted in no major reproductive problems for turkey hens.

Key Words: phosphorus, phytase, turkey breeders, hatchability, egg production


Our objective was to determine if high available phosphorus corn would provide sufficient available phosphorus (P) to laying hens fed corn-soybean meal diets from 57-69 weeks of age. Six replications of twelve Dekalb Sigma White Leghorn hens were fed a normal yellow dent corn-soybean meal diet from 57-69 weeks of age. Six replications of twelve Dekalb Sigma White Leghorn hens were fed a normal yellow dent corn-soybean meal diet (YD) diet or high available phosphorus corn-soybean meal diet (HAP) diet without and with 0.04% supplemental inorganic nonphytate P. The YD diet was formulated to contain 2.55% CP, 3.8% Ca, and 0.10% nonphytate P and the HAP diet contained 2.78% CP, 3.8% Ca, and 0.07% nonphytate P. Hens on the HAP diet were fed for 8 wk. In addition, a positive control, YD diet (17% CP, 3.8% Ca, 0.45% nonphytate P) was also fed. The HAP corn was directly substituted for YD and the amount of soybean meal was kept constant in all diets. Egg production, hen body weight, egg weight, egg mass, feed consumption and feed efficiency were measured. The YD and the YD + 0.04% P treatments were terminated at 61 and 65 weeks of age, respectively, due to severe depressions in egg production. Egg production and egg mass for hens fed HAP diets were not significantly different (P>0.05) from those of hens fed the 0.45% nonphytate P diet; however, hens fed the unsupplemented HAP diet did have significantly lower hen body weights and feed intake (P<0.05) compared to hens fed the positive control diet. Our results indicate that high available phosphorus corn contains more available P than normal yellow dent corn and that hens can be fed high available phosphorus corn-soybean meal diets with little or no P supplementation with only minimal effects on production performance.

Key Words: High available phosphorus corn, Laying hens, Nonphytate phosphorus


An experiment was conducted to determine the bioavailability of calcium in a product derived from calcified seaweed (Marigro). Ross X Ross male chicks were pretested from 0 to 7 d posthatching. On d 8, chicks were allotted to six treatments: 1) Corn-soybean meal basal diet (B), 0.5% calcium (Ca), 2) B + 0.075% Ca from limestone, 3) B + 0.15% Ca from limestone 4) B + 0.225% Ca from limestone, 5) B + 0.075% Ca from Marigro, or 6) B + 0.15% Ca from Marigro. Each treatment was replicated with eight pens of six chicks each. Initial and final BW were 122 and 658 g. The diets were formulated to provide 1.20% total lys, 0.91% TSAA, and 3,200 kcal/kg ME. Chicks were allowed ad libitum access to feed and water throughout the experiment. Limestone or Marigro was added at the expense of sand. Daily gain and ADFI were linearly increased (P<0.01) by the Ca from both limestone and Marigro. Gain:feed was increased (P<0.01) by Ca from Marigro but not from limestone. Toe ash tended to be increased by Ca from limestone (P<0.07) and by Ca from Marigro (P<0.10). The means for treatments 1 to 6 were the following (ADG, 38.6, 40.9, 41.5, 43.6, 41.1, 42.4, Pooling SED = 0.9; ADFI, 51.3, 53.4, 54.2, 56.9, 53.1, 54.1, Pooling SED = 0.9; gain:feed 0.753, 0.766, 0.766, 0.767, 0.772, 0.784, Pooling SED = 0.007). Multiple linear regression analysis using the analyzed levels of Ca in the diets indicated that the Ca in Marigro was 97, 104, 131, and 99% available using ADG, ADFI, gain:feed, and toe ash, respectively, as response variables. Biological availability estimates, using the calculated levels of dietary Ca, were 115, 84, 119, and 112% using ADG, ADFI, gain:feed, and toe ash, respectively. These data indicate that the Ca in a product derived from calcified seaweed (Marigro) is as available as the Ca in limestone.

Key Words: Chicks, Bioavailability, Lime, Seaweed

33 Effects of heat stress and phosphorus deficiency on egg production and mortality of laying hens. M.E. Persia*, P.E. Biggs, K.W. Koelkebeck, and C.M. Parsons, University of Illinois, Urbana, IL USA.

Two experiments were conducted in environmentally controlled chambers to determine if there were any interactive effects of heat stress and phosphorus deficiency on laying hen egg production and mortality. Hens were fed either P-deficient or P-adequate corn-soybean meal diets for several weeks prior to the start of the experiment. The first experiment was a 2x2 factorial, where the P-deficient hens were fed a marginally P-deficient diet (0.16% available P, AP) and the P-adequate hens were fed a control diet (0.45% AP) and placed in either a thermoneutral (TN) or a heat stress (HS) chamber for the two wk experiment. The TN chamber was kept constant at 21°C, while the HS chamber was cycled daily between 35°C for 12 h and 26°C for 12 h. Hens on the 0.16 and 0.45% AP diets and housed in the TN chamber were pair-fed with the respective hens housed in the HS chamber so that AP intakes were similar. The second experiment was similar to the first, except that the dietary treatments were 0.10 and 0.45% AP, and the cyclic HS was maintained at 35°C for 12 h and 29°C for 8 h daily. In both experiments, significant diet effects (AP) were noted for feed intake and egg production, but HS did not affect egg production or mortality. In Experiment 1, feed intakes and egg production for the 0.16% and 0.45% AP treatments were 84 and 90 g/hen/d and 67 and 81% hen-day egg production, respectively. In Experiment 2, feed intakes and egg production for the 0.10 and 0.45% AP treatments were 61 and 87 g/hen/d and 44 and 76% hen-day egg production, respectively. Hen-day egg production between TN and HS group were similar in both experiments (71 and 70% for Experiment 1 and 60 and 59% for Experiment 2). There were no significant interactions between AP level and environmental temperature in either experiment. Thus, under pair- or equal-feeding conditions, any adverse effects of HS were not exacerbated by P deficiency.

Key Words: Laying hens, Phosphorus, Heat stress, Egg production, Mortality
34 Nutrient requirements of Dekalb White, Dekalb Sigma and Bovans White hens for optimum profits in a cool environment during phase I. A. M. Bateman1, M. M. Bryant1, and D. A. Roland1, 1Poultry Science Department, Auburn University.

A study was conducted to compare performance and nutrient requirements of Bovans White, Dekalb Sigma and Dekalb White hens when housed under cool environmental conditions (68 ± 3°F average) during weeks 21–36 of age. Three diets, which contained 18.7, 17.3 or 16.2% protein, were fed to each of the three strains in a 3 x 3 factorial arrangement. The criteria used were egg production, feed consumption, egg weight and egg specific gravity. Strain of bird significantly affected (p<0.05) egg production, feed consumption, egg weight, egg specific gravity and feed conversion (lbs./doca.). The Dekalb White hens had the highest feed consumption, egg weight and egg specific gravity, but the Bovans White hens had the highest egg production and the lowest feed conversion (lbs./doca.). The 16 week average egg production of the Bovans White, Dekalb Sigma and Dekalb White was 94, 88 and 92% respectively. Diet had a significant effect on egg weight and egg specific gravity. Hens fed the highest protein diet had the highest egg production, followed by the moderate and lowest protein diets. Egg specific gravity followed the reverse order. Feed conversion (g feed/g egg laid) was significantly affected by diet, but not by strain. The birds fed the highest protein diet had the lowest feed conversion. Based partly on the results from this study, the Dekalb Sigma hens are no longer available. As a result, requirements were calculated for only the Dekalb White and Bovans White hens. Both strains optimized profits when fed the highest protein diet. For optimum profits during phase I, Dekalb White hens required 1,093 mg lysine, 782 mg TSAA, 20.00 g protein and 308 Kcal ME/hen/day, while the Bovans White hens required 1,052 mg lysine, 753 mg TSAA, 19.3 g protein and 296 Kcal ME/hen/day. The Dekalb White hens required 20 mg lysine, 14.3 mg TSAA, 0.37 g protein and 5.52 Kcal ME/g egg, while the Bovans White hens required 19.8 mg lysine, 14.2 mg TSAA, 0.36 g protein and 5.58 Kcal ME/g egg for optimum profits.

Key Words: protein, Bovans White, Dekalb White, egg production, profits

35 Nutrient requirements of Dekalb Whites and Bovans Whites hens for optimum profits during phase II. A. M. Bateman1, M. M. Bryant1, and D. A. Roland1, 1Poultry Science Department, Auburn University.

A study was conducted to compare performance and nutrient requirements of Bovans White hens and Dekalb White hens when kept under warm temperatures (78 javascript:degeree(F) average) during weeks 40-52 of age. Three diets were used in each of the two strains for a 2 x 3 factorial arrangement. These diets contained 18.7, 17.3 or 16.2% protein. The criteria used were egg production, feed consumption, egg weight and egg specific gravity. Strain of bird significantly affected (p<0.05) egg production, egg weight and egg specific gravity. The Dekalb White hens had higher egg weight and egg specific gravity, but lower egg production than the Bovans White hens. Diet had a significant effect on egg production. Hens fed the highest protein diet had the highest egg production, followed by the moderate and lowest protein diets. Feed conversion was significantly affected by diet, but not by strain of bird. Hens fed the moderate protein diet had the lowest feed consumption. Feed conversion was not significantly affected by strain or diet. Optimum profits were obtained in both strains using the moderate protein diet. For optimum profits during phase II, Dekalb White hens required 966 mg lysine, 788 mg TSAA, 18.21 g protein and 298 Kcal ME/hen per day. The Bovans White hens required 987 mg lysine, 804 mg TSAA, 18.60 g protein and 304 Kcal ME/hen per day. The Dekalb White hens required 17.6 mg lysine, 14.4 mg TSAA, 0.33 g protein and 5.44 Kcal ME/g egg, while the Bovans White hens required 17.8 mg lysine, 14.4 mg TSAA, 0.33 g protein and 5.47 Kcal ME/g egg for optimum profits.

Key Words: protein, Bovans White, Dekalb White, egg production, profits

36 Broiler breeder reproductive performance was unaffected by Avaïla® Zinc and Avaïla® Manganese. S. J. Barber1, W. S. Virden1, T. L. Ward2, T. M. Falkner2, and M. T. Kidd1, 1Mississippi State University, Mississippi State, MS, 2Zinpro Corporation, Eden Prairie, MN.

Research has shown that trace elements such as zinc (Zn) and manganese (Mn) are reproductive functions. Studies, research has shown that trace element-amino acid complexes, such as Avaïla®Zn (ZnAA) and Avaïla®Mn (MnAA), have greater bioavailability than inorganic sources of minerals. The aim of this study was to evaluate reproductive performance of broiler breeders fed diets differing in Zn and Mn level and source. At 21 wk of age, three hundred sixty hens and 48 males (Cobb) were placed in floor pens (15 hens and 2 males per pen) under cool, well-ventilated, 21-36 of age. Three diets, which contained 18.7, 17.3 or 16.2% protein, were fed to each of the three strains in a 3 x 2 factorial arrangement. The criteria used were egg production, feed consumption, egg weight and egg specific gravity. Strain of bird significantly affected (p<0.05) egg production, feed consumption, egg weight, egg specific gravity and feed conversion (lbs./doca.). The Dekalb White hens had the highest feed consumption, egg weight and egg specific gravity, but the Bovans White hens had the highest egg production and the lowest feed conversion (lbs./doca.). The 16 week average egg production of the Bovans White, Dekalb Sigma and Dekalb White was 94, 88 and 92% respectively. Diet had a significant effect on egg weight and egg specific gravity. Hens fed the highest protein diet had the highest egg production, followed by the moderate and lowest protein diets. Egg specific gravity followed the reverse order. Feed conversion (g feed/g egg laid) was significantly affected by diet, but not by strain. The birds fed the highest protein diet had the lowest feed conversion. Based partly on the results from this study, the Dekalb Sigma hens are no longer available. As a result, requirements were calculated for only the Dekalb White and Bovans White hens. Both strains optimized profits when fed the highest protein diet. For optimum profits during phase I, Dekalb White hens required 1,093 mg lysine, 782 mg TSAA, 20.00 g protein and 308 Kcal ME/hen/day, while the Bovans White hens required 1,052 mg lysine, 753 mg TSAA, 19.3 g protein and 296 Kcal ME/hen/day. The Dekalb White hens required 20 mg lysine, 14.3 mg TSAA, 0.37 g protein and 5.52 Kcal ME/g egg, while the Bovans White hens required 19.8 mg lysine, 14.2 mg TSAA, 0.36 g protein and 5.58 Kcal ME/g egg for optimum profits.

Key Words: protein, Bovans White, Dekalb White, egg production, profits

37 Responses of Chicks from Broiler Breeders fed Supplemental Zinc and Manganese from Sulfate or Amino Acid Complexed Sources: Live Performance and Processing. W. S. Virden1, J. B. Yeatman1, S. J. Barber1, C. D. Zumwalt1, T. L. Ward2, A. B. Johnson2, and M. T. Kidd1, 1Mississippi State University, Mississippi State, MS, 2Zinpro Corporation, Eden Prairie, MN.

Live performance and carcass characteristics were evaluated in the progeny of broiler breeders that received diets supplemented with zinc (Zn) and manganese (Mn) from sulfate or amino acid complexed sources. Broiler breeders received one of four diets (6 replications per treatment): a control diet containing 75 ppm Zn and 83 ppm Mn diet from the premix in sulfate forms, control diet plus 75 ppm Zn from ZnSO4 and 80 ppm Mn from MnSO4, control diet plus 75 ppm Zn from Avaïla® Zn (ZnAA) and 80 ppm Mn from MnSO4, or control diet plus 75 ppm Zn from ZnAA and 80 ppm Mn from Avaïla®Mn (MnAA). Broiler breeder eggs were set and hatched by pen. Broiler treatments were dietary broiler breeder treatments. Broilers were placed in 24 floor pens with 40 birds per pen using a randomized complete block design. Progeny received a common starter diet from Days 0-17, a common grower diet from Days 18-34, and a common finisher diet from Days 35-42. All diets met or exceeded NRC (1994) nutrient specifications. Body weight gain, feed intake, feed conversion in g, and percentage livability were evaluated for the starter, grower, and finisher periods. On Day 42, five males and five females from each pen were processed. Carcass yield, breast yield, and percentage fat pad were then calculated for each bird. Treatment differences did not occur (P>0.05) for body weight gain, feed intake, feed conversion ratio, carcass weight, breast weight, fat pad weight, carcass yield, breast yield, or percentage fat. However, progeny of breeders fed the control diet supplemented with ZnAA and MnAA had higher percentage livability from Days 0-17 (P<0.04) and Days 0-34 (P<0.04). Feeding broiler breeders supplemental Zn and Mn from amino acid complexed improved livability (as potentially mediated by enhanced immunity) of progeny without affecting growth or carcass characteristics.

Key Words: Zinc, Manganese, Broiler, Livability

38 Responses of Chicks from Broiler Breeders fed Supplemental Zinc and Manganese: Cellular Immunity. W. S. Virden1, J. B. Yeatman1, S. J. Barber1, K. O. Willeford1, T. L. Ward2, T. M. Falkner2, and M. T. Kidd1, 1Mississippi State University, Mississippi State, MS, 2Zinpro Corporation, Eden Prairie, MN.

Broiler breeders received one of four different diets (4 treatments with 6 replications per treatment): a control diet containing 75 ppm zinc (Zn) and 83 ppm manganese (Mn) from the premix in sulfate forms, control diet plus 75 ppm Zn from ZnSO4 and 80 ppm Mn from MnSO4, control diet plus 75 ppm Zn from Avaïla® Zn (ZnAA) and 80 ppm Mn from MnSO4, or control diet plus 75 ppm Zn from ZnAA and 80 ppm Mn from Avaïla®Mn (MnAA). Broiler breeder eggs were identified, set, and hatched by pen. Progeny were evaluated for immunity at hatch or after being placed in...
battery chambers and fed common diets from eggs set on 29 (Experiment 1), 33 (Experiment 2), and 43 (Experiment 3) wk of production. In Experiment 1, immune organ weights were obtained at hatch and Day 15 and white blood cell populations were counted at hatch. Chicks from breeders fed supplemental inorganic Zn and Mn had higher (P < 0.01) percentage bursa weight than birds fed the treatments containing ZnAA. All treatments containing supplemental Zn and Mn had higher (P < 0.03) percentage thymus weights over the control. White blood cell populations and organ weights at hatch did not differ between treatments. A cutaneous basophil hypersensitivity test to phytohaemagglutinin-P was measured on Days 9 and 10 and a primary antibody response to SRBC was measured on Days 7 and 14 in Experiment 2. Chicks from breeders fed control diet supplemented with ZnAA and MnAA had an increased (P < 0.03) hypersensitivity response over chicks from the control diet. Antibody responses to SRBC did not differ between treatments. At hatch, CD4+ and CD8+ receptor levels were identified on T lymphocytes. Differences in the ratio of these receptors between treatments did not occur. Birds were bled in Experiment 3 to collect serum and evaluate antibody titer levels for vaccinations given to the breeders. Titer levels did not differ between treatments.

Key Words: Zinc, Manganese, Broiler Breeder, Chick, Immunity


While much is known about the detrimental effect of vanadium (V) on egg albumen quality no data have been reported on the influence that V has on shell pigmentation of commercial brown egg-type layers. An experiment was conducted with Hy-Line brown layers to determine what effect V would have on shell pigmentation of brown shelled eggs. A corn-soybean meal basal diet served as the control (0 ppm added V). Two other diets were supplemented with sodium metavanadate at 30 or 40 ppm of Zn/Mn. Eggshells were fed for 14 consecutive days and then all hens were switched to the control diet and fed for 14 consecutive days. Initial (base line) egg shell pigmentation was determined for each egg. Eggshell pigmentation was determined for each egg laid on days 1, 2, 3, 6, 9, 12 and 14 after initiation of feeding the experimental diets. Vanadium had a negative effect on egg albumen quality. A significant increase in eggshell luminosity (less pigmentation) was observed for eggs collected from birds fed V compared to control eggs. Switching the birds to the diets containing no vanadium resulted in restoration of egg shell pigmentation. These data confirm that V, a common contaminant of poor quality feed-grade phosphate sources, does have a bleaching effect on brown eggshells.

Key Words: Vanadium, Pigmentation, Eggshells

40 Economics of using fat and protein on egg size under summer conditions in commercial Leghorns (Phase 1). S. S. Sohail, M. M. Bryant, and D. A. Roland Sr., Auburn University

Although the beneficial effect of fat and protein on egg size has been well recognized, it is still a common practice to increase dietary protein without supplementing fat to increase egg size during summer, but the relationship of using high protein with and without fat has not been fully elucidated. To explore the relationship, Hyline W36 hens (n = 960, 21-wk-old) were randomly assigned to two levels of fat (with and without) and three levels of protein (17.4, 18.7, and 19.8%) in a 2 x 3 factorial arrangement of treatments for 16 weeks. Hens were caged in an environmentally controlled house where average house temperature was maintained at 26°C. Egg weight (EW), egg production (EP), feed consumption (FC), egg mass (EM), feed efficiency (FE), egg specific gravity (SG), body weight (BW), and mortality were determined. Increasing fat or protein in corn-soy diets increased EW (P < 0.05). Fat increased EW 2.5 times more in hens fed the lowest protein (17.4%) than that of hens fed the highest protein (19.8%; P < 0.01). Inclusion of fat to lowest protein diet improved egg size equal to the highest protein diet without fat. Fat decreased FC and improved FE at higher protein levels of 18.7 and 19.8% but not at the lowest level (17.4%; fat x protein, P < 0.01). Fat and protein had no effect on EP, EM, SG or mortality. Inclusion of fat increased BW of hens (P < 0.001). Adding fat to the highest protein (19.8%) diet produced maximum profits with the current fat and egg prices. Hens fed the lowest protein diet with fat produced more profits than hens fed the highest protein diet without fat. These results can help producers calculate losses incurred by not using fat, and the importance of increased dietary protein under summer conditions.

Key Words: Egg size, Fat, Protein, Summer

41 Effect of dietary supplementation of micro-minerals, phytase and cage density on molted hens. M. M. Bryant*, D. A. Roland, Sr., and S. Sohail, Auburn University, Auburn, AL/USA.

A study was conducted to investigate the effect of removing or decreasing micro-mineral premix in a commercial layer diet with and without phytase. Two diets were formulated to be iso-caloric and iso-nitrogenous and to contain either 0.4% available Phosphorus (aP) or 0.3% aP plus phytase (300 FTU). Diets were mixed with one of four levels of added micro-mineral premix (MMP: 0, 30, 60 and 100%) yielding a 2 x 4 factorial arrangement of treatments. The effects of cage density were also studied by housing 1120 birds at either three or four hens per cage. The study was replicated four times for each cage density for a total of eight replicates and 140 hens per treatment. Hens were molting at 65 weeks of age and fed a post molt feed without MMP for two weeks prior to the start of the study. Study diets were fed for 14 weeks. Egg production (EP), egg weights (EW), egg specific gravity (SG), feed consumption (FC) and hen mortality (HM) were determined to evaluate performance. Increasing MMP had no effect on EW, FC, or HM, but increased SG as MMP levels increased (P<0.05). Hens housed four per cage consumed 4.2 g/hen/d less feed (P<0.001) and laid 2% fewer eggs (P<0.01) than hens housed three per cage. Egg weights for hens housed three per cage were higher than hens housed four per cage (62.4g vs 61.7g, p<0.05). Hens fed diets with 0 MMP and no phytase laid 3% fewer eggs (P<0.05) than hens fed diets with 0% MMP with phytase. Results indicate that MMP improved shell quality and phytase improved EP when all MMP was removed from the diet.

Key Words: Micro-minerals, Phytase, Layer

42 Effect of zinc and manganese amino acid complexes (Availa® Z/M) on layer production and egg quality. J. Khajarem1, S. Khajarem1, C. J. Rapp2, T. L. Ward2, A. B. Johnson2, and T. M. Fakler2, 1Department of Animal Science, Khon Kaen University, Thailand, 2Zinpro Corporation, Eden Prairie, MN.

One hundred sixty-eight brown layers (Arbor Acres, 16 wk of age) were used to determine the effect of the complexed Zn and Mn on layer production and egg quality. Layers were allocated randomly to one of four dietary treatments, with six replicates of seven hens per treatment. Diets were fed from 18 to 65 wk of age. Treatments included a control diet (corn-soybean-fish meal) with 60 ppm Zn from ZnO and 60 ppm Mn from MnO and three diets containing added levels (20/20, 30/30 and 40/40 ppm, Zn/Mn) of complexed Zn and Mn from metal amino acid complexes. Data were recorded and summarized for two production phases, 18 to 37 wk and 38 to 65 wk and for the overall 47 wk experiment. Addition of 30 ppm Zn/Mn improved (P < 0.05) hen-day egg production during Phase 2 and for the overall experiment. Feed conversion to egg mass was not affected by treatment. Egg weights during Phase 2 were larger (P < 0.05) when hens were fed diets with 30 ppm of Zn/Mn. Shell weight and shell thickness were improved (P < 0.05) at all levels of additional complexed Zn/Mn during Phase 2. For the overall experiment, specific gravity increased (P < 0.05) with the addition of 20 ppm Zn/Mn. Haugh Units during Phase 2 measure on fresh eggs did not differ due to treatment, but were improved at all levels of additional complexed Zn/Mn after storage at replicated summer temperature for three months. The overall effects in a lay down production period, egg quality and shell quality were observed mainly in Phase II (38-65 wk) and overall period (18-65 wk). These data indicate that addition of complexed Zn and Mn to the layer diet improved both layer performance and egg quality.

Key Words: Laying Hens, Egg Production, Zinc, Manganese, Eggshell Quality
One hundred thirty-five thousand pullets (Isa White) were used to determine the effect of complexed Zn on layer production and egg quality. Pullets were allocated arbitrarily to one of two paired houses at one day of age. Each house was randomly assigned to one of two treatment diets. Treatments included a series of standard commercial diets containing 66 ppm supplemental Zn as ZnO and same commercial diets with 40 ppm added Zn from Availa-Zn zinc amino acid complex. At 18 wk of age, birds were transferred to three layer houses (average of 34,312 layers per house) keeping integrity of treatments within two houses and the third house containing a combination of the two treatment groups. Egg production, feed intake and mortality were monitored and recorded weekly. Egg quality measurements were recorded from 60 to 64 wk of age. Hens were molting at 65 wk of age. Hen-housed egg production was increased by adding complexed Zn to layer diets (234.5 vs. 243.1 for control vs complexed Zn, respectively). Accumulated mortality was lower for layers fed complexed Zn compared to controls (13.4 vs. 13.7%, respectively). Accumulated feed intake per dozen eggs was improved with addition of complexed Zn (1.38 vs. 1.46 kg per dozen eggs). For all response criteria, the mixed house group of layers had intermediate responses. Egg quality was measured by determining the percentage of undergrade eggs. Feeding complexed Zn reduced undergrade eggs from 9.2 to 8.4%. These data indicate that addition of complexed Zn to layer diets improved both layer performance and egg quality. Economic estimates using these improvements resulted in an increase in net profit per hen over the control group.

**Key Words:** Laying Hens, Egg Production, Zinc, Eggshell Quality

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**44 Effect of corn-soybean based broiler diets with graded levels of added moisture formulated to different energy densities on 3 to 6 week performance and energy metabolism.** J. S. Moritz*, K. R. Cramer, K. J. Wilson, R. S. Beyer, and W. B. Cavalcanti, Department of Animal Science and Industry - Kansas State University.

Moisture addition to broiler grower diets has been shown to increase pellet quality and consequently improve broiler performance. It has been speculated that moisture-induced high quality pellets may best improve performance when formulations account for moisture inclusions and broilers are reared under conditions that dictate high maintenance expenditures. The feeding of high quality pellets has been suggested to reduce broiler maintenance expenditure, creating the potential to reduce dietary ME while maintaining performance. The objective of the current study was to add graded levels of moisture to create pelleted diets that differ in energy density and feed those formulations in order to assess broiler performance and energy metabolism. Treatments were prepared by using three different levels of added moisture (0, 2.5 and 5%), to create diets that varied in energy density (NRC recommended levels (NRC) and 5% less NRC recommended levels (low energy)). Performance was assessed by each of the six diets being fed to ten replicate pens of 45 male broilers during the 3 to 6 week grower period. Energy metabolism was assessed by timed ad libitum feeding and fecal collections of individually caged 4.5 week old male broilers. Broiler live weight gain was not significantly affected due to any treatment combination. NRC diets demonstrated increased feed intakes (P = 0.0093) and feed efficiencies (P = 0.0001) compared to low energy diets. Moisture additions demonstrated slight improvements in feed efficiencies compared to formulations without added moisture, however, differences were not significant (P = 0.5129). Low energy formulations that included moisture additions demonstrated statistically similar feed efficiencies to NRC formulations without added moisture. Energy density approached significance (P = 0.1127) for broiler TME values; although, the moisture level effect (P = 0.3195) and interaction effect (P = 0.9587) failed to illustrate differences. These findings conclude that incorporating moisture in low energy broiler formulations can produce feed efficiencies equivalent to typical corn-soybean NRC formulations; most likely due to improvements in pellet quality and not increases in metabolizable energy.

**Key Words:** Broiler performance, Energy density, Moisture, Pellet quality, True metabolizable energy

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Broiler chicken starter diets contain high amounts of crude proteins. Supplementing the starter feed with a protease enzyme could improve the utilization of starter feed. The objective of this study was to determine the efficacy of a broad-spectrum protease enzyme, PWD-1 keratinase, upon supplementation to corn-soy diets on growth performance. Three experiments of similar design were conducted. In each of the experiments, broiler chicks were randomly assigned to 24 cage pens of 8 birds per pen in a CRD arrangement of 5 experimental treatments and raised from 1 to 21 or 26 d of age. Treatments in experiments 1 and 2 were control (C, 21% CP), low protein (LP, 17% CP), and LP diet supplemented with 0.5%, 1%, or 1.5% of the enzyme (w/w). The enzyme preparation was a crude keratinase produced by fermentation of Bacillus licheniformis PWD-1. Treatments in experiment 3 were: control (C), C + 1% enzyme (C+E), LP, and LP +1.5% enzyme (LP+E). Feeding the LP+E diet resulted in significant improvements in body weight gain (880 and 873 vs. 812 gm for 1% and 1.5% vs. LP, respectively) and FCR (1.53 and 1.49 vs. 1.71 for 1% and 1.5% vs. LP, respectively). Results of experiment 3 confirmed the positive effect of the enzyme and further demonstrated that supplementing diets with higher protein content (21% CP) with 1% enzyme resulted in significant (P<0.05) improvements in body weight gain (724 vs. 654 gm) and FCR (1.42 vs. 1.49). Feeding the LP +1.5% enzyme diet also improved the body weight gain of birds to the level of the 21% CP diet in experiments 1 and 3. Furthermore, diets containing the enzyme at 1%, or 1.5% level resulted in the reduction of intestinal viscosity at 22 and 27 days of age. Results of these experiments indicate that the growth performance of broiler chickens can significantly be improved by dietary supplementation with PWD-1 keratinase.

**Key Words:** Broilers, Protease, Keratinase, Growth Performance, Starter Feed

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**46 Separation of the effects of xylanase and β-glucanase addition on performance of broiler chicks fed barley based diets.** M. J. Azain*, X. -L. Li2, A. K. Shah1,2, and T. E. Davies1,2, 1 University of Georgia, 2Aureozyne.

The growth performance benefits of enzyme addition to barley based diets are well established. Commercially available enzyme preparations contain multiple enzyme activities in addition to what is claimed on the label. The objective of this work was to demonstrate the role of xylanase and β-glucanase preparations free of other fibrolytic enzyme activities. The genes coding for the hydrolases are originally isolated from an anaerobic fungus and over-expressed in a fibrolytic enzyme negative host. Performance of broiler chicks (6 birds/pen, 6 pens/diet) housed in Petersime battery brooders was monitored for 10 days. The barley diet used contained 23% crude protein, 1.3% lysine and 3000 kcal ME/kg. The reference diets were corn soy (CS) based diets with similar lysine and protein contents, but with 3000 and 3100 kcal ME/kg. Birds fed the CS diet with 3000 kcal grew 14% slower than birds fed the 3100 kcal CS diet. Birds fed the basal barley diet with no enzyme addition demonstrated a 23% reduction in growth rate relative to the 3000 kcal CS diet and 34% reduction relative to the 3100 kcal CS diet. Addition of β-glucanase alone at 3000 U/kg increased gain 25% to a rate similar to that in the 3000 kcal CS diet. Addition of xylanase alone (1000 U/kg) increased gain 19%. The combination of β-glucanase and xylanase increased gain 41% to a level that was not significantly different from that in the 3100 kcal CS diet. A commercial preparation resulted in a similar increase in growth rate. Measures of digesta viscosity obtained after 12 days of feeding demonstrated that both β-glucanase and xylanase reduced viscosity and that their effects were additive. The viscosity measured with both enzymes was similar to that seen in the CS diets and with that obtained with a commercial enzyme preparation. These results document the additive effects of xylanase and β-glucanase enzymes tested in the absence of other catalytic activities.

**Key Words:** Barley, Fibrolytic enzymes, Starter diet
47 Beta-glucan stimulates +AFw-italicize is vein- nitrite production in broiler chicken macrophages. Yuming Gua1, R. A. Ali2, and M. A. Qureshi3, 1North Carolina State University.

Glucans with beta-1,3 and beta-1,6 glycosidic linkages, so called beta-glucan, are primary structural components of cell walls of yeast and fungi. In the present work, a water soluble and chemically defined and naturally occurring beta-1,3/1,6-glucan isolated from Bakers yeast, Saccharomyces cerevisiae was used to investigate its effect in vitro on macrophages. The MQ-NCSU cells, a transformed chicken macrophage cell line of myeloid lineage cell source, were collected in their log phase of growth and seeded in a 24-well culture plate at a cell concentration of 0.5 x 10⁵/mL of RPMI 1640 medium. Beta-Glucan was added at six different concentrations of 0, 5, 50, 100 µg/mL, and 1 and 5 mg/mL, with or without 1µg/mL lipopolysaccharide (LPS) from E. coli, respectively, and then incubated at 41C and 5%CO₂ for 24h. The culture supernatants were collected and nitrite production were measured by mixing the macrophage culture supernatant with an equal volume of Griess reagent. The cells cultured with only beta-glucan at concentrations of 0, 5, 50, 100µg/mL, and 1 and 5 mg/mL produced nitrite of 0.85, 1.67, 1.09, 2.18, 27.03 and 38.82µM, respectively. When cultured with both beta-glucan and LPS, the nitrite levels were 48.94, 48.00, 49.94, 41.85, 44.76 and 39.18µM respectively. These results show that LPS is a potent macrophage activator and produced the highest amount of nitrite. Beta-Glucan at concentrations of 1mg/mL and beyond also significantly stimulated macrophages to produce nitrite(p<0.01). No synergistic effect was found between beta-glucan and LPS, but it seems that the effect of LPS was blocked by beta-glucan at concentrations 1mg/mL and higher, as the nitrite levels declined significantly (p<0.01) when beta-glucan was added into cultures with LPS. Macrophages play critical roles in nonspecific and acquired immune responses. This work suggests that beta-glucan may function similar to bacterial LPS by inducing nitric oxide synthase expression and activity, thereby possibly improving macrophage functions in chickens. Studies are in progress to explore possible immune enhancement effects of dietary beta-glucan in chicken.

Key Words: Beta-glucan, Macrophages, Chickens.


Two 21-d experiments were conducted to evaluate the efficacy of water-soluble serum (WSS) on broiler performance under different environments. Day old Ross X Ross broilers (n = 400 per experiment) were randomly assigned (10 pens/treatment, 10 birds/pen) to receive 0% WSS, 0.25% WSS, 0.50% WSS, 0.75% WSS, 1.00% WSS, or 1.25% WSS from d 0-7, 0-14, and 0-21. Average daily feed intake, gain to feed ratio, and weight were increased (P<0.01) when beta-glucan was added into cultures with LPS. ADG was increased (P<0.01) when beta-glucan was added into cultures with LPS. Macrophages play critical roles in nonspecific and acquired immune responses. This work suggests that beta-glucan may function similar to bacterial LPS by inducing nitric oxide synthase expression and activity, thereby possibly improving macrophage functions in chickens. Studies are in progress to explore possible immune enhancement effects of dietary beta-glucan in chicken.

Key Words: Water-soluble serum, broiler growth, breast meat yield, nitrogen excretion

49 Evaluation of water-soluble serum in the drinking water of broilers. T. N. Chambles1, M. T. Kidd1, J. B. Yeatman2, C. D. Schultz3, and J. M. Campbell2, 1Mississippi State University, Miss. State, MS, 2APC, Inc., Ames, IA.

Spray-dried plasma protein is a high protein feed ingredient commonly used in weanling pig diets and calf milk replacement diets, but not chick diets. A 42d battery study was conducted to evaluate the effect of providing water-soluble serum (WSS) in the drinking water of broiler chickens on broiler growth, breast meat yield and nitrogen excretion. A total of 252 Ross X Cobb male chicks were utilized in the study. The chicks were housed in brooder batteries in a thermoneutral environment for the first 21d of the study. The birds were then transferred to grower batteries in a thermoneutral environment for the remainder of the study. Water soluble serum (WSS) was added to the drinking water to obtain six concentrations: 0%, 0.25%, 0.50%, 0.75%, 1.00%, and 1.25%. Drinking water was mixed daily, and each treatment was provided fresh drinking water each day. Body weights, feed consumption, water consumption and evaporative water loss were determined on days 0, 3, 7, 14, and 21. Fecal samples were collected on days 7, 21 and 24 for determination of total fecal nitrogen. At the end of the trial, all birds were processed and breast meat yield was determined. The addition of WSS had no effect on body weight, feed consumption, or water consumption at any of the measurement periods. Meas yield was not affected by the addition of WSS to the drinking water provided to broiler chickens. Additionally, total fecal nitrogen was not affected by the addition of WSS to the drinking water. This experiment indicates that birds reared in battery cages in a thermoneutral environment do not benefit from the addition of WSS to the drinking water.

Key Words: Water-soluble serum, broiler growth, breast meat yield, nitrogen excretion

50 Mating Behaviour and Reproductive Performance of Male Broiler Breeders. R. H. McGovern1, J. L. Wilson2, and F. E. Robinson2, 1The University of Georgia, 2The University of Alberta.

Mating behaviour and reproductive performance was compared among broiler breeder males of intrinsically low, average, or high BW. Males were selected by BW at 20 wk of age from a flock of 600 Cobb broiler breeder males: low (2133 g), average (2624 g), and high (3100 g). Body weight treatments were imposed on 21 males per treatment at 24 wk of age for the low rapid (LR), average rapid (AR), average standard (AS). Males on the rapid treatment underwent a rapid increase in BW from 24 to 26 wk of age. At 28 wk of age the high BW males were subjected to a constant BW increase (high constant, HC), standard BW increase (high standard, HD), or minimal weekly gains (high slow, HW). Cockerels were full-fed for the first 3 weeks and skip-a-day fed until 21 weeks of age. All birds consumed corn and soybean meal based commercial broiler breeder diets. A 24-hour day was provided for the first 3 days. From 3 days to 3 weeks of age the birds were on a 12L:12D schedule. All birds were on an 8-hour day length until 21 weeks of age. The number of females in the scratch area was correlated to male BW at 26, 27, and 28 wk of age (r=0.54, 0.49, 0.45, respectively). Low BW males had greater percent completed mating compared to the average or high BW males at 26 wk (43.5%, 24.4%, and 21.8%, respectively). Higher male BW was associated with a greater percentage of negative mating behaviour (aggression and mating interference) in early production. The number of females in the scratch area positively correlated to the percentage positive mating behaviour at 26 wk of age (r=0.50). A greater percentage of aggression and mating interference occurred when there were low BW males in the scratch area (r=0.50). There were no differences in fertility or hatchability due to male BW. In a commercial flock, a normal distribution of male BW has implications for mating behaviour and reproductive performance.

Key Words: Broiler breeder males, mating behaviour, fertility, hatchability, body weight

51 Effects of Dietary Menhaden Oil on Fertility and Sperm Quality of Broiler Breeder Males. B.P. Hudson* and J.L. Wilson, The University of Georgia, Department of Poultry Science.

In order to assess the effects of dietary fat source on semen quality, either poultry fat (PF) or Menhaden oil (MO) was included in broiler breeder male diets. All birds were reared under commercial conditions, then housed in cages at 21 weeks in a solid side-walled, climate-controlled facility. Half of the males received PF, while the remaining half received MO as the primary dietary fat source in all diets. Inclusion rate of either PF or MO in starter and developer diets was 3%, yielding 5.58 and 5.77% total fat, respectively. For males, starter and developer diets were provided from 0 to 4 weeks and from 5 to 24 weeks, respectively. A breeder diet containing 2% added fat (PF or MO) and 4.58% total dietary fat was provided after 24 weeks. All males were individually weighed biweekly to determine feed allotments. From 47 to 65 weeks of age, hens were inseminated every third week with a marginal dose of
52 Measuring Testicular Size in Broiler Breeder Roosters by Ultrasound Technology. L.J. Richardson1,*, J.L. Wilson1, A.B. Caudle2, and K.C. Powell3, 1The University of Georgia, Department of Poultry Science, 2Department of Veterinary Medicine, 3Roche Animal Nutrition and Health.

An ultrasound (Aloka SSD-900V) machine fitted with a linear surgical probe (UST-5526L-7.5 Laproscopic transducer) was used to access testicular size in broiler breeder males by inserting the 1cm probe through the cloaca to a depth of 12 cm. This position puts the reading face of the probe in close proximity to the testes. The objective of the study was to obtain repeatable measures of the testes without injuring the roosters. A 5ml saline enema and lubricant (J-Lube) was used to ease probe insertion, decrease the possibility of intestinal tract damage, while increasing ultrasound image quality.

The trial was completed with 102-45 wk old broiler breeder males that were individually caged. Four semen collections were attempted with roosters over a three-week period prior to the initial ultrasound procedure and a total semen collection at the termination of the study. Thirty-six percent of the males ejaculated semen at each attempted collection, 17% of the males never ejaculated semen, and 83% of the males ejaculated at least once prior to the ultrasound procedures. Six ultrasound images were attempted of the right and left testes of each rooster over the next 3 weeks. Testicular height averaged 1.64 cm (Aloka Image Processing Software). Right and left testis differed slightly in width (0.046 cm), and left testis width proved to be more repeatable than right testis height over the six attempted measurements, suggesting right testicular asymmetry. At the termination of the study, 80% of the roosters ejaculated semen indicating no negative effect of repeated probe insertion. These data prove that ultrasound images can be used to access testicular size in adult roosters with little physical damage to intestine or cloaca.

Key Words: broiler breeder males, Fertility, Hatchability, Sperrn quality

54 Effect of flock age, length of egg storage, and frequency of turning during storage on hatchability of broiler hatching eggs. O. Elibol1, B. A. Lenfesty1,*, and J. Brake2, 1University of Ankara, Ankara, Turkey, 2North Carolina State University, Raleigh, NC USA.

Hatching eggs from two young (30 and 31 wk) or two old (52 and 53 wk) Ross x Ross 308 broiler breeder flocks were stored for 3, 7, or 14 d at 18 C and 75% RH while being turned 0, 4, or 24 times per day in two experiments. Fertility and hatchability decreased with increased flock age in Experiment 1 but not in Experiment 2. Fertile hatchability declined with length of storage period in both experiments due to an increase in both percentage early and late embryonic mortality with length of storage period. Fertile hatchability was increased by turning hatching eggs either 4 or 24 times per day during storage in Experiment 1 or by 4 times per day in Experiment 2. Turning eggs 24 times per day produced an intermediate result in Experiment 2. A significant interaction of flock age x turning in storage for fertile hatchability in Experiment 1 suggested that eggs from an older broiler breeder flock benefited more from turning when stored for 14 d than did similarly stored eggs from a young broiler breeder flock. A similar numerical trend was observed in Experiment 2. It is suggested that differences in egg quality between young and old flocks may account for much of the observed effects.

Key Words: Turning, Egg Storage, Hatchability, Embryonic Mortality, Broiler Hatching Eggs


Proper sampling for risk analysis of food safety hazards within farm production environments is challenging. The sensitivity, specificity, and repeatability of sampling techniques for foodborne pathogens are not well documented. Consequently, three different methods of Salmonella isolation were compared, Tetrahionate broth, Rappaport-Vassiliadis R10 broth, and Dynabeads anti-Salmonella methods were tested using pure culture, inoculated and uninoculated litter, crops, cecal, and drag swab samples. Variation in sensitivity of the different methods was observed. However, the Dynabeads anti-Salmonella method may offer an advantage over the traditional methods in time saved. More fully characterized sampling and isolation techniques need to be developed to investigate the ecology of the pathogens on the farm so that effective food safety risk management strategies can be developed and assessed.

Key Words: Salmonella, Dynabeads anti-Salmonella, Sampling

56 Bacteriophage concentration influences Salmonella host specificity. K.L. Guenther1,*, J.P. Higgins2, S.E. Higgins1, L.A. Newberry1, W.E. Huff2, and B.M. Hargis1, 1University of Arkansas, Fayetteville AR, 2PFP/PSRU, ARS, USDA, Fayetteville AR.

Bacteriophage are small viruses with no potential to infect animals or plants. These viruses have been previously demonstrated to effectively treat enteric and respiratory bacterial infections. Host-specificity of most bacteriophages offers a potential advantage in that beneficial normal flora need not be destroyed. However, extreme host specificity implies obligatory custom selection of bacteriophage for each field application. Preliminary studies in our laboratories, using low-titer bacteriophage derived from plaques, indicated that host-specificity varied from experiment to experiment, suggesting that high concentrations of bacteriophage might actually reduce host specificity. Presently, we selected two wild-type bacteriophages against Salmonella enteritidis PT 13A. One isolate (PHL-5) caused large clear plaques and the other caused plaques that contained surviving bacteriogenic colonies (PHL-4). Each were amplified to high titer (PHL-5: 1 x 10⁹ pfu/ml; PHL-4: 1 x 10⁸), separated from host bacteria by 0.2 um filtration, serially diluted, and applied to 11 different Salmonella isolates representing 8 different serovars. PHL-5 caused lysis in 5 of 11 isolates tested while PHL-4 caused lysis in 7 of 11 isolates. However, much higher numbers of phage (10x to 10⁷ x higher) were required for freshness of the eggs when set such that the poorer albumen quality of the older flocks did not become a factor.

Key Words: Turning Frequency, Hatchability, Embryonic Mortality, Broiler Hatching Eggs
heterologous lysis than for the original host bacterium (control). Furthermore, heterologous lysis was different with respect to plaque morphology (generally less complete lysis). These data confirm previous reports of bacteriophage-host specificity but suggest that host specificity may be related to the bacteriophage:host ratio. Knowledge of bacteriophage numbers (pfu) is clearly essential for accurate characterization and selection of bacteriophage as potential therapeutic agents.

Key Words: Salmonella, Bacteriophage, Host Specificity

57 Simplicity and undefined competitive exclusion culture development and effect of culture pH on efficacy in poult. A.L. Elwood1, L.R. Bielke1, L.A. Newberry1, N.K. Neighbor2, D.J. Donoghue1, A.M. Donoghue2, and B.M. Hargis3,
1University of Arkansas, Fayetteville AR, 2PP&PSRU, ARS,USDA, Fayetteville AR.

Ceca were obtained from 3 healthy turkeys (4-8 weeks) from each of 3 sources, aseptically removed, and placed into a 100% CO2 chamber at 40C. Ceca were inverted and placed in BHI supplemented with 0.3 mL/L of thioglycolic acid, 0.25g/L of L-cystine, and 0.002g/L of Methylene blue and incubated for 48 hrs. The resulting culture was diluted (30% glycerol), dispensed in 1 mL aliquots, and frozen in liquid N2. A single aliquot was then thawed, amplified in 1 liter of medium (as above), and inoculated at 1mL original culture in liquid N2.

The culture process was repeated at either pH 7.0 or 5.5 (cecal pH) and dilutions of the culture were tested for prophylaxis against Mycoplasma gallisepticum in poult. As in previous studies as compared to pH 7.0, with reduced SE recovery by 50%.

Furthermore, heterologous lysis was different with respect to plaque morphology (generally less complete lysis). These data confirm previous report of bacteriophage-host specificity but suggest that host specificity may be related to the bacteriophage:host ratio. Knowledge of bacteriophage numbers (pfu) is clearly essential for accurate characterization and selection of bacteriophage as potential therapeutic agents.

Key Words: Salmonella, Bacteriophage, Host Specificity

58 Influences of Various Dietary Factors on Egg Quality Responses to Age of Inoculation with F-Strain Mycoplasma Gallisepticum in Commercial Egg Laying Hens. M. R. Burnham1, E. D. Peebles1, S. L. Branton2, and P. D. Gerard1,
1Mississippi State University, Mississippi State, Mississippi, United States of America, 2United States Department of Agriculture, Mississippi State, Mississippi, United States of America.

Influences of dietary factors on internal and external egg constituents of commercial egg laying hens inoculated at different ages with F-strain Mycoplasma gallisepticum (FMG) were determined. Determinations were made at 24, 34, 44, 50, and 58 wk of age. At 12 and 22 wk of age, one hundred and twenty layer hens were randomly assigned to individual cages in each of two enclosed ends of a temperature regulated cage layer facility and were either sham (control) or FMG inoculated (treated). Four different supplemented layer diets were randomly provided to birds within each treatment group at 20 wk of age. Diets included: 1) normal basal diet (NB); 2) NB with 1.5% additional poultry fat (PF); 3) NB with 1.5% additional PF and supplemental phytase (F) and 25- hydroxyvitamin D3 (D3); and 4) NB with supplemental P and D3. Treatment-inoculation age-diet combinations were thrice replicated, with ten hens in each replication. Variables investigated were egg weight (EW), and percentages of shell (PSW), albumen (PAW), and yolk (PYW) weight, along with percentages of yolk moisture (PYM) and lipid (PLY). FMG-treatment increased overall EW. The addition of all three supplements increased PSW at 34, 44, and 50 wk in comparison to controls. Furthermore, at 24 wk PAW was increased by sham or FMG inoculation at 22 wk compared to that at 12 wk, but at 50 wk was decreased by sham or FMG inoculation at 22 wk compared to that at 12 wk. In birds fed added PF, PYW at 24 and 50 wk was depressed by FMG inoculation at 12 wk. In birds inoculated with FMG at either time period, PYM was increased at 34 and 58 wk of age. At 24 wk in birds fed Diet 1 and inoculated at 22 wk of age, PYM was increased in comparison to those inoculated at 12 wk.

The 22 wk inoculation also increased PYM at 58 wk in birds fed Diet 3 or 4. At 24 wk of age, FMG-treated birds inoculated at either period exhibited an elevated PYL when fed any of the four diets. In association with a delay in initiation of lay by FMG-inoculation, as has been shown in previous studies, EW may be increased over the complete laying cycle due to FMG inoculation. Age dependent effects of PF, P, and D3 can modify responses in PYW and PYM to FMG inoculation at 12 or 22 wk in commercial layers.

Key Words: albumen, D3, inoculation, layer, Mycoplasma gallisepticum, phytase, shell, yolk.


A study was conducted to evaluate the effect of aluminum (as the sul- fate) as a molting agent when used in laying hens without phytase. Using 720 commercial laying hens (Hy-Line W-36), 72 wk of age, 12 replicate groups of 10 hens were each assigned to one of the following treatments: 1) basal diet fed on an ad libitum basis during Days 1-14, restricted to 40 g/hen/d during Days 15-21; 2) complete feed withdrawal during Days 1-7, basal diet restricted to 40 g/hen/d during Days 15-21; 3) basal diet + 0.3% Al; 4) basal diet + 0.3% Al + phytase (11,500 ptu/kg diet); 5) basal diet + 0.3% Al + phytase (11,500 ptu/kg diet) and 6) basal diet + 0.45% Al + phytase). The low-P basal layer diet used in the molting period was formulated to contain 0.17% available P. The Al-supplemented diets (Treatments 3-6) were fed on an ad libitum basis during Days 1-21. Light was restricted to 8 hr during Days 1-21, increased to 13 hr on Day 22 and then gradually increased (1 hr per week) to 16 hr/d for all treatments. A layer diet (0.30% available P) was fed on an ad libitum basis to all treatment groups starting on Day 22. Feed intake was approximately 83 g/hen/d for hens in Treatment 1 during Days 1-14 and 45 g/hen/d for hens in Treatments 3-6. Egg production ceased by Day 6 for hens in Treatment 2, decreased to <10% by Day 15 for hens in Treatments 3 and 4, and was <2% by Day 16 for hens in Treatment 5. During Weeks 5-24 following the molting period, hens from Treatments 2, 5, and 6 had higher egg production than hens from Treatment 1. However, there were no significant treatment effects on the total 24-wk post-molt egg production period. Feeding 0.45% Al improved post-molt eggshell breaking strength, while per cent shell was increased by use of 0.45% Al or complete feed restriction. The results indicate that the use of dietary Al as a molting agent produced results similar to the use of a conventional feed-restriction molting procedure and that the presence of phytase did not alter the response to dietary aluminum.

Key Words: Aluminum, Force molting, Phytase

60 Production parameters and fearfulness levels affected by beak and claw reduction in two strains of Leghorn hens. C. N. Honaker*, P. L. Ruszler, and C. L. Novak, Virginia Tech, Blacksburg, VA USA.

A total of 768 pullets representing strains B & H which were maturing at 20 weeks of age were housed 4 birds per cage at 348 sq cm. The claws were reduced (RT) at hatch using microwave energy on one-half of the pullets and compared with the other half of normal toed (NC) birds. The beaks of one-half of each of these treatments were reduced at 1 day of age (B1) using infra-red energy and one-half precision trimmed at 7 days (B7) with a hot blade debeaker to measure the effect of these treatments upon adult production parameters. Egg production and livability were recorded daily and analyzed each 28 day period. Body weight, feed intake, feed efficiency, mortality, and egg number were recorded each 28 days. Fearfulness activity was observed on a daily basis. A commercial management regimen was followed with feed and water fed ad libitum. The RC hens laid 2.2 more eggs per hen housed (HH) than which were maturing at 20 weeks of age to the NC hens. The B7 treatment allowed 1.2 more eggs per HH than the B1 treatment while strain B laid 6.2 more eggs per HH than strain H did. The RC treatment in the B strain produced 3 more eggs per HH than the NC treatment while only 1.4 more eggs were produced in the same comparison in the H strain. Overall feed efficiencies ranged from 1511g to 1567g/dozen eggs following the same pattern changes as rate of production at 48 weeks. The body weight of B1 birds at 1800g was only 5g more than the B7 treatment while strain H weighed 1912g versus 1682 for strain B at 48 weeks of age. The normal toed birds weighed 1817g at 48 weeks or 39g more than the claw reduced treatment. The
beak reduction treatment had no effect on body weight with B1 weighing 1800g versus 1795g for B2. Liveability was not affected by any treatment. The normal level of fearfulness is very low during egg production. The RC layers displayed a lower level than the NC layers. Claw reduction can have a positive affect on egg production and fearfulness. The small loss in egg production experienced by beak reduction at 1 day of age is more than offset by the labor not needed at 7 days.

Key Words: Claw, Beak, Egg production, Fearfulness, Body wt

61 Investigation of antibiotic transfer into eggs: biologically active enrofloxacin detected in albumen and yolk. Melissa Davidson*, Hari Bhaskaran, Heather Nichols, and Dan Donoghue, University of Arkansas Center of Excellence.

Our laboratory has been investigating the pharmacokinetics of antibiotic transfer into egg components. Antibiotics, including enrofloxacin, are used to treat breeder hens for various illnesses. Recently, McReynolds and co-workers reported reduced ability of competitive exclusion (CE) bacteria to prevent Salmonella colonization when enrofloxacin was detected in the yolk sac of chicks from treated hens. Because of the unusual kinetics of drug transfer into developing egg yolks, it is possible that enrofloxacin residues will persist in preovulatory egg yolks even days after antibiotic withdrawal. Therefore, the purpose of this study was to determine the duration of enrofloxacin residue in eggs after withdrawal from the antibiotic. Four groups of 10 hens were dosed following label directions with either 25 or 50 ppm in water for 3 or 7 days (n=40 total). A quantitative bioassay method was developed to detect enrofloxacin residues in egg components. Briefly, bioassay plates were prepared using 8ml of Mueller Hinton agar with 109 Klebsiella pneumoniae per mL of agar. Standards and samples were incubated on the agar at 37°C for at least 14 hours. Enrofloxacin was detected within 1 day of dosing and up to 3 or 7 days after drug withdrawal in the albumen and yolk, respectively. These results support the possibility that residues may be present and adversely affect CE in chicks up to 7 days after treatment of hens. Additional research is being conducted to determine the actual residue concentrations in neonatal chicks. This information is necessary to advise poultry producers when CE can effectively be used in neonatal chicks produced from treated hens.

Key Words: Enrofloxacin, Residues, Yolk, Eggs, Competitive Exclusion


Sand is being evaluated in broiler houses as a potential bedding material. A concern for the temperature of sand has arisen as a possible brooding problem. This study was designed to measure the temperature of masonry-grade sand placed in broiler pens as bedding. Temperatures were evaluated for new and used Sand compared to new and used Pine Shavings. Sand and Pine Shavings were placed into 2’X 2’ plastic trays 3 inches deep. Electric brooders were placed 18 inches above the litter surface. Maximum temperature and time to reach maximum temperature were measured. Temperature measurements were taken on the surface and 3 inches below the surface with an electronic meter/logger. Results showed a significant maximum surface temperature difference (P<0.05) only when new sand and new pine shavings were compared (38°C vs. 43.5°C). There were no significant differences in maximum temperature at 3 inches below surface (33°C vs. 32.67°C) time to reach maximum temperature for both surface (9.12 hr. vs. 7.6 hr.) and 3 inches below surface (11.6 hr. vs. 9.68 hr.) in new litter. No significant differences were found when comparing maximum temperature and time to maximum temperature between used sand and pine shavings at surface or 3 inches deep. In conclusion, new sand does not require extra heating time before chick placement in warm weather. Due to a lower maximum temperature (5.5°C less than pine shavings), new sand should be placed 3 inches deep. In conclusion, new sand does not require extra heating time before chick placement in warm weather. Due to a lower maximum temperature (11.6 hr. vs. 9.68 hr.) in new litter. No significant differences were measured. Temperature measurements were taken on the surface.

Key Words: Litter Temperature, Sand, Pine Shavings, Brooding


The most commonly reported microorganisms in poultry litter include Staphylococci, coliforms, molds and yeasts along with a variety of other groups. In contrast, reports of fecal microflora seldom include significant numbers of molds, yeast or Staphylococci. In addition, the bursa of Fabricius has been reported to contain populations similar to that of the intestine. In this study the microflora of the bursa was examined. Bursae were excised aseptically from E18-E21 day embryos and chicks from days 1-7, 14, 21, 28 and 35. Chicks were reared on litter. The interior surface of the bursae was swabbed. Serial dilutions were made and samples grown on appropriate media for enumeration. Results show the bursal flora was similar to that of the litter on which chicks were reared.

Key Words: Litter, microflora, broiler, bursa of Fabricius

64 Presence of salmonella as an index of effective cleaning between broiler flocks. J. A. deGraft-Hanson1, R. Forecca*, L. B. Parker, D. Stevens1, K. Williams1, and S. Camer1, 1University of Maryland, Princess Anne, Md.

543 samples from 2 broiler houses were collected over a period of 24 months prior to placement of chicks and tested for the presence of Salmonella to determine the efficacy of cleaning between flocks. Multiple samples of drag swabs, water, feed, litter, insects, and swabs from fans and walls were aseptically collected into whirl paks and transported to the lab on ice. Within 24 hours they were analyzed by pre-enrichment in BPW at 35 C, selectively enriched in TTH (42 C) and RV (35 C) broth and plated unto XLT-4, MLLA and BGSA (37 C 24-48 hours). Presumptive colonies were biochemically screened for confirmation. 54 (9.9%) samples were positive. The most consistently negative samples were wall swabs. Most of the other samples were periodically positive. Litter, crawling insects and feeders were the most positive samples at 23.5% (24/102), 11.8% (8/68) and 14.7% (5/34) respectively. On a few occasions no samples were positive before placement. This indicated not only that Salmonella was not firmly entrenched in these houses (since samplings followed the presence of positive flocks) but also that at times, cleaning between broiler flocks was thorough and effective.

Key Words: Litter, microflora, cleaning, Salmonella

65 Malpositions induced by the absence of turning during early incubation can be reduced by turning eggs four times hourly thereafter. O. Elbol1, M. Turkoglu2, S. D. Peak1, and J. Brake2, 1University of Ankara, Ankara, Turkey, 2North Carolina State University, Raleigh, NC USA.

The effect of turning frequency following a period of no turning (NT) during early incubation was studied in two experiments. Experiment 1 compared turning frequencies of 24 or 96 times per day from 8-16 d of incubation following a period of NT from 5-7 d of incubation. Experiment 2 compared turning frequencies of 24 or 96 times per day from 3-16 d of incubation following a period of NT from 0-2 d of incubation. In both experiments eggs were incubated or hatched within the same machine except when subjected to the specific turning treatments. In both experiments there were only numerical improvements in fertile hatchability but there was a significant reduction in the incidence of Malposition II (head in small end of egg) embryos associated with the greater frequency of turning following the period of NT. These experiments suggest that the deleterious effects, with respect to an increased incidence of Malposition II, of NT during early incubation can be ameliorated by subsequently turning eggs 96 times per day versus the standard 24 times.

Key Words: Turning, Malpositions, Hatchability, Embryonic Mortality

66 Effect of experimental chlorate compound (ECP) and competitive exclusion product (CE) Salmonella contamination of broilers. J.A. Byrd1, M. Turkoglu1, K.D. Knapke2, R.C. Anderson1, L.F. Kubena3, and D.J. Nisbet3, 1USDA-ARS-SPARC, Food and Feed Safety Research Unit, 2Department of Veterinary Pathobiology, Texas A&M University.

Previously, we evaluated chlorate in the drinking water during a simulated pre-transport feed withdrawal (FW) and reported the experimental chlorate compound (ECP) significantly (P < 0.05) reduced the number of Salmonella recovered in market-age broiler crops and ceca. This study was performed to investigate the effect of concentration of the ECP and a commercial competitive exclusion product (CE) on cecal Salmonella typhimurium (ST) recovery. Immediately upon arrival, chicks were challenged with 103 ST and provided distilled water, a commercial CE and/or a 0.125X, 0.25X, 0.5X or 1X ECP (1X ECP is equivalent to a 15 mM chlorate ion concentration) in the drinking water 4 d post ST challenge. Ten
The effect of an experimental chlorate compound on *Salmonella* recovery of turkeys when administered prior to feed and water withdrawal. R.W. Moore*1, J.A. Byrd2, K.D. Knape3, R.C. Anderson1, T.R. Callaway1, T.S. Edrington1, L.F. Kubena1, and D.J. Nisbet1, USDA-ARS-SPARC, Food and Feed Safety Research Unit, 2Department of Veterinary Pathobiology, Texas A&M University.

Previously, chlorate compounds have been observed to reduce *E. coli* and *Salmonella* infections in swine and broilers. The following studies were performed to investigate the effects of an experimental chlorate compound on *Salmonella typhimurium* (ST) infections of turkeys. Two experiments were performed to investigate the effect of concentration and duration of the experimental product on crop and ceca *Salmonella* recovery. In all trials for Experiment 1, 15-week-old turkey toms were challenged with not less than 6.5*10^6 cfu of ST and administered either 0 or 1X, 2X, 3X, or 4X of the chlorate product (a 1X concentration is equivalent to a 7.5 mM chlorate ion concentration) in the drinking water for 38 h. Treatment was followed by a 10 h water withdrawal and an 8 h feed withdrawal prior to organ sampling. For all treatment concentrations, turkeys provided with the experimental chlorate product had significantly (P<0.05) lower populations and incidences of crop (>1.5 log reduction) and ceca (>0.6 log reduction) ST as compared to control birds (2.1 and 0.94 log ST average for all trials, respectively). In all trials for Experiment 2, 15-week-old turkey toms were challenged with not less than 5.0*10^6 cfu of ST and administered a 3X concentration of the chlorate product in the drinking water for either 38 h, 26 h, 14 h, or 0 h prior to water withdrawal. Treatment was followed by a 10 h water withdrawal and an 8 h feed withdrawal prior to organ sampling. For all treatment durations, turkeys provided with the experimental chlorate product had significantly (P<0.05) lower populations and incidences of crop (>2.2 log reduction) and ceca (>1.5 log reduction) ST as compared to control birds (3.1 and 1.8 log ST average for all trials, respectively). These experiments suggest that the experimental chlorate compound significantly reduces *Salmonella* colonization in commercial turkeys when administered prior to feed and water withdrawal.

Key Words: *Salmonella* typhimurium, chlorate, turkey, feed withdrawal


Subtyping and identifying bacterial pathogens throughout food processing and production chains is key to the new HACCP based food safety plans. A reduction in these areas remains the primary means of subtyping *Salmonella* isolates. Molecular biology techniques however, offer the promise of more rapid and sensitive subtyping of *Salmonella*. This study evaluates the potential of restriction enzyme *PvuII* followed by probing with the rRNA operon from *E. coli* to generate serotype specific DNA fingerprints. There was a total of 32 identified serotypes with an overall agreement of 208 of 259 (80%) isolates tested between USDA serotype identification and ribotype serotype identification. Most of the isolates that did not correlate were serotype identified as *S. Montevideo* which indicates that for this serotype there are multiple ribotypes. When *S. Montevideo* isolates were not included, the Ribotype identification agreed with serotyping in 207 of the 231 (90%) isolates. The primary outcome of any ribotyping procedure is to give distinct ribotype patterns. This extensive poultry epidemiological study demonstrates that in addition to ribotype patterns, the identification of isolates to known serotypes provides the investigator with additional information which can be useful in comparison to traditional epidemiology and isolate identification studies.

Key Words: *Salmonella*, Serotyping, Ribotyping, Epidemiology

An on-farm demonstration of planting trees around poultry houses. G. Malone* and D. Abbott-Donnelly, 1University of Delaware.

Increasing urban encroachment and issues relating to emissions from houses are challenges facing the poultry industry. Neighbor-relations concerns are exacerbated when residential homes are in close proximity and downwind of tunnel ventilation fans. With rapid adoption of tunnel and windowless-type housing, planting trees around the perimeter of poultry farms may offer potential environmental, neighbor-relations and production benefits. Following several poultry industry meetings with other stakeholders, guidelines for a tree program on Delmarva have been established. Cost-share opportunities for the practice have also been identified. In the Spring of 2001, a tree program was designed and implemented on a three-house tunnel-ventilated poultry farm in Delaware. Rows of red cedar and red cedar, plus white pine, were planted around the poultry houses to achieve the following long-term objectives; a visual screen to block the view of the houses by neighbors, a vegetative filter to capture emissions from houses and a windbreak to conserve energy. An update on this proactive, industry-lead initiative will be discussed.

Key Words: poultry houses, neighbor-relations, emissions, trees

Histopathologic Characterization In The Encephalic Regions In Specific Pathogen Free Chickens Experimentally Infected With The Chimalhuacan Velogenic Viscerotropic Newcastle Disease Virus Strain. Adriana Barri1, Nestor Ledesma1, David Caldwell2, and Guillermo Tellez1, 1Departamento de Produccion Animal!, Aves, Facultad de Medicina Veterinaria y Zootecnia, Universidad N, 2Department of Veterinary Pathobiology, Texas A&M University. College Station, Texas 77845

The Newcastle disease is one of the most contagious of all viral diseases, spreading rapidly among susceptible birds. As threatening as most strains of the virus are, the threat of exotic velogenic (viscerotropic) strains represents another order of magnitude of risk. The purpose of this study was to identify the histopathologic characterization in the encephalic regions in specific-pathogen-free chickens experimentally infected with the chimalhuacan velogenic viscerotropic Newcastle disease virus strain (V V-NDV). Ninety four weeks old specific-pathogen-free chickens were divided in two groups: Group 1) 45 birds were inoculated I.M. with 10^6 IDCE 50% V V-NDV. Group 2) 45 birds were inoculated I.M. with PBS and were used as control not inoculated chickens. From 24 to 72 hours P.I., every 4 hours, and from 73 to 80 hours P.I., every 30 minutes, 2 birds from each group were killed and the whole encephalon was collected and conventionally processed for histopathological examination. Each encephalon was cut, and the frequency and histologic lesions in each anatomical region (telencephalon, diencephalon, mesencephalon, and cerebellum) were determined. Respiratory (sneezes, nasal secretion, tracheal sounds), digestive (diarrhea), and nervous (incoordination, wryneck, head spasms, tics) symptoms caused by V V-NDV were observed from 36 hours P.I. Mortality started at 72 hours P.I. About 80% of the chickens showed nervous symptoms. The most important and constant anatomic regions with histopathological changes were: Telencephalon (particularly its Neostriatum and Hiperestriatum sub-regions); Mesencephalon (particularly its optic quiasm sub-region); and cerebellum. In all these regions, 95% of gliosis; 95% of necrosis; 80% of neuronophagia; 30% of demyelination; 5% of hemorrhages and 5% of non suppressive meningitis, were observed. This is the first report describing the lesions produced by a V V-NDV in the different regions of the encephalon. Further comparative studies among other neurotropic NDV strains would be of interest.

Key Words: Velogenic Viscerotropic Newcastle Disease, histopathology, anatomic regions, SPF chickens.
Age of inoculation with F-strain Mycoplasma gallisepticum (FMG) and its subsequent effects on performance and eggshell characteristics in commercial egg laying hens were investigated during a 60 wk trial. At 12 wk of age, one hundred and twenty layer hens were randomly assigned to individual cages in each of two enclosed ends of a temperature regulated cage layer facility and were either FMG (treated) or sham inoculated (control). At 22 wk of age an additional one hundred and twenty layer hens were randomly assigned to individual cages in each enclosed end of the same facility and were likewise sham (control) or FMG inoculated (treated). Each treatment group and inoculation period combination were replicated 12 times, with ten hens in each replication. Variables investigated were BW, egg production (EP), egg weight (EW), eggshell strength (ESS), and percentage undersized (US), peewee (PS), small (SS), medium (MS), large (LS), extra-large (XLS), and jumbo sized egg classifications. Onset of lay was delayed ten days in treated birds inoculated with FMG at 12 wk of age when compared to 12 wk sham inoculated controls. These data suggest that inoculation with MG S6 at 10 rather than at 22 wk of age depresses egg production in commercial layers through peak egg production.

**Key Words:** egg production, inoculation, layers, Mycoplasma gallisepticum

### 73 Transfection of Cultured Avian T Cells with Vector Plasmids Associated with Protein Kinase C and Calcium

H Horick*, M Owens, and T Scott, Clemson University, Clemson, SC.

Protein kinase C (PKC) has been shown to be involved in the control of cell growth. In addition, signal transduction interruptions of PKC can lead to hyperproliferation of cells. The objective of this study was to transfet cultured avian T cells with vectors carrying eukaryotic genes (i.e., enhancer elements) for signal transduction. The transfected avian cells were analyzed for specific activation of NFAT, NFkB, and AP1 vectors by chemiluminescence via Clonetch Luciferase Reporter Assay Kit. Several experiments illustrated the expression by these vectors for the luciferase gene. The cell line was Con A-C1-Vick cells (Kogut et al., 1999; U.S. Patent No. 5,891,443) purchased from ATCC, which are T lymphocytes derived from avian spleen and transformed with avian reticuloendotheliosis virus. The vectors were components of the Mercury Pathway Profiling Luciferase System from Clontech. Initially, transfections were unsuccessful using the Clontech system procedure, however significant improvements were made by using a liposome based transfection (TransIT-2020, Promega) and Opti-MEM I reduced serum medium from GIBCO. Stimulation by phorbol myristate acetate (10 ng/ml) and calcium ionophore (0.5 g/ml) following transfection effectively activates PKC and calcium-dependent pathways that in turn activate the signal transduction elements of interest. Further treatment of the transfected cells verified that PKC activity was disrupted by using the PKC inhibitor chelaphos-C (2mM). The use of these transfected cells could become a model for future studies involving, but not limited to, animal health, biomedical applications, and cancer research.

**Key Words:** T cells, PKC, Chicken

### 74 B Cell Proliferation Mediated by Apparent Soluble Factor from Harderian Gland of Chickens

N Noble*, M Owens, and T Scott, Clemson University, Clemson, SC.

The Harderian gland in avian species is functionally unique from other vertebrate phylogenic groups in its ability, as a lymphoid tissue, to produce a humoral response to antigenic challenge. Proliferating plasma cells are the most abundant cell type in the interstitial spaces of this gland, and secrete predominantly the IgA isotype that bathe the nasal and respiratory passages of chickens. Previous studies in our laboratory indicated that a soluble factor is responsible for the observed proliferation of plasma cells from Single Comb White Leghorn chickens to elicit a proliferative response in B cells from the bursa of Fabricius. Tritiated thymidine uptake, added during the final 6 hrs of 24 hr incubation, revealed greater levels of DNA synthesis and thus cell proliferation in groups treated with serial dilutions of the HG-SPNT than groups treated with just the phorbol dibutyrate or cells incubated with media alone. SDS-PAGE using 10-20% gradient gels revealed strong protein bands of moderate molecular weight (MW) in the range of most interleukins. Chromatography, a type of ion-exchange chromatography, was performed on the HG-SPNT to isolate the proteins at their unique isoelectric point (PI). Results of bioassays using samples obtained following column separation indicate that the low MW proteins (13-14.5 kDa with an apparent PI equal to 7.7) could be responsible for plasma cell proliferation in the Harderian gland. Our laboratory continues steps to isolate and characterize these soluble factors, with the intention of determining their role in the immune response of the Harderian gland.

**Key Words:** B cells, Proliferation, Harderian gland, Cytokine, Phorbol dibutyrate

1University of Arkansas, Fayetteville, AR, 2PP&PSRU, ARS, USDA, Fayetteville, AR.

Intentional early colonization of the intestinal tract with beneficial microflora, known as Competitive Exclusion (CE), has been shown to successfully protect poultry from selected enteric pathogens. While effective cultures have been produced and are commercially available, an inexpensive, air tolerant and completely defined culture is needed. Presently, we developed an in vitro competition assay to select for individual facultative anaerobes, of poultry enteric origin, that exclude Salmonella. Using this assay, 24 isolates were selected and stored individually. These 24 isolates were amplified in batch culture using modified aerobic conditions (Tryptic Soy Broth, 4hrs at 40°C) and administered at final doses of 10, 100, or 1000 cfu to day-of-hatch poults. Two days later, poults were challenged with 100-1000 cfu antibiotic-resistant-marked Salmonella enteritidis PT13A by oral gavage. Five days later, all poults were killed and cecal tonsils were aseptically removed for tetrathionate enrichment (24 hr at 37°C) followed by selective plating with marker antibiotics. Selected lactose-negative, antibiotic-resistant colonies typical of Salmonella were further confirmed by serogrouping. Treatment related protection (p < 0.05) ranged from 25% to 95% in 3 experiments. Interestingly, greatest protection was related to the lowest doses of the protective microflora administered in each experiment. These data suggest that effective combinations of competitive enteric microflora can be identified by appropriate in vitro selection methods.

Key Words: Competitive exclusion, Salmonella


Attempts to use bacteriophage against enteric bacterial disease have failed, possibly due to in vitro selection of inappropriate phage. Presently, 4 wild-type phages isolated in our laboratory (PHL 4, 5, 16, and 24) against Salmonella enteritidis PT13A (SE) were subjected to potentially adverse environmental conditions expected to be present in the chicken gut. Conditions for phage isolation were: pH 7, 300 m osM, and 37°C. When PHL 4 or 24 were incubated with SE in Tryptic Soy Broth at either pH 5.5 or 6.2, representing normal cecal pH, little differences in the ability of these phages to delay SE growth were detected as compared to appropriate controls (detected spectrophotometrically in all experiments). Similarly, little effect of simulated chicken body temperature (41.5°C) was noted as compared to the original isolation temperature (37°C). In exp. 2, PHL 4, 5, 16, and 24 were subjected to pH 5.5, 6.2, and 7.0 at either 41.5°C or 37°C in the presence of SE in suspension culture. Only subtle effects of temperature or pH alterations were noted in the delay of SE growth. Similarly, osmotic pressures of 150 m osM, 300 m osM or 450 m osM at either 41.5°C or 37°C had little effect on phage function. In exp. 3, these 4 phages were either individually subjected to a brief (30 min) drop in pH to a simulated proventricular environment (pH 2) or maintained at pH 7.0 (controls). Brief exposure to pH 2 reduced phage recovery (PHL 5, 16 log; PHL 4, 20 log). When each of the 4 phages were individually orally administered, in combination with florescein dye, to day-of-hatch chicks (exp. 4), PHL 16 & 20 were not recovered from dye associated gut, and recovery of PHL 4 & 5 were reduced by 6 log. These results suggest that low pH tolerance may be important for therapeutic or prophylactic phage candidate selection.

Key Words: bacteriophage, Salmonella, therapeutic


1Auburn University, AL, 2Elanco Animal Health, Indianapolis, IN.

Coccidiosis control programs in broilers based on live vaccines have received renewed interest in recent years. In this study, live immunization in male broilers via day-old vaccination (Coccivac B®- Schering-Plough Animal Health), administered either with or without medicated feed (Treatment (Trt) 1) or feeds containing non-nutritive feed additives (Trt 2), was comparatively evaluated with an anticoccidial program (nasarin - Monteban®, Elanco Animal Health), administered either alone (Trt 3) or in combination with non-nutritive feed additives (Trt 4). In Trt 2, 3, and 4, non-nutritive feed additives were selected based on their typical use in the industry. Male broilers (total 1440, RossxCobb) were reared in replicate pens (8 pens/trt; 45 birds/pen) to 42 d of age on litter seeded (via spraying) with three species (E. acervulina, E. maxima, E. tenella) of coccidia. Live weight, feed efficiency, livability, whole carcass (hot, chilled, lean) and parts yield (abdominal fat, wing, thigh, drumstick and breast), and total saleable product yield were determined. In the live phage evaluation, significantly (p<0.05) improved body weight (BW) feed efficiency when compared to other trt. There were no significant differences in livability among treatments. Contrast analysis indicated that Trt 3 significantly (p<0.05) improved hot carcass, chilled carcass, lean carcass, breast fillet and total breast yield when compared to Trt 1. Likewise, Trt 3 and 4, both of which contained an anticoccidial, significantly improved hot carcass, chilled carcass, and lean carcass yield when compared to the vaccine trt (Trt 1 and 2). In this study, anticoccidial programs utilizing feed additives were more effective than those programs involving live vaccination in terms of live performance and total saleable product yield.

Key Words: Coccidia, Immunization, Feed Additives, Broiler, Yield


The objective was to evaluate the anticlostridial efficacy of the three most commonly used feed additive antibiotics when applied in conjunction with the coccidial vaccine, Coccivac-B®. In the floor pens the initial stocking density was 0.66 square ft/bird. The Ross X Ross chicks were sprayed vaccinated at the hatchery with Coccivac-B. Bird weights and feed consumption were measured on Days 21, 35, and 49. The treatments were non-medicated, BMD1, 50, virginiamycin 15, and Flavomycin 2 grams per ton. The four treatments were randomized within forty-eight blocks. On Days 17, 18, and 19 all birds were dosed with a C. perfringens at 1.0 X 106−9. On Days 21 and 27, pre-selected birds were examined for the degree of Necrotic Enteritis lesions. Few very classical lesions were seen, possibly due to a fast developing infection and toxins being released. Differences were noted between treatments in regard to Necrotic Enteritis mortality. Twenty-one percent of the nonmedicated birds died from Necrotic Enteritis while only nine percent died in the Flavomycin pens, six percent in the BMD pens and five percent in the virginiamycin pens. Little difference was noted between all treatment groups in regard to average total lesion scores from Necrotic Enteritis. All three feed additives moderated the Necrotic Enteritis challenge, as seen by an at least a 5 point improvement in feed conversions and 0.12 lbs heavier bird on Day 49 with BMD. Maximum performance improvement was attained with Flavomycin with a 7.3 point improvement in feed conversion and 0.21 lbs heavier bird at Day 49, compared to the non-medicated control treatment. The feeding of feed additive antibiotics during the grow-out phase of broiler production in this study provided significantly improved performance and anticlostridial protection over non-medicated controls.

Key Words: Flavomycin, BMD, Virginiamycin, Necrotic Enteritis, Chickens

79 Use of a live attenuated Salmonella vaccine to protect hens against Salmonella Enteritidis infection during molt. P.S. Holt1, S. Kelly-Ahele2, and R.K. Gast1. 1USDA/ARS Southeast Poultry Research Laboratory, Athens, GA, 2Megan Health, Inc, St. Louis, MO.

Induced molting is an important layer industry tool used to achieve a second egg lay from aging hens. We previously showed that inducing a molt in hens exacerbated an infection by Salmonella Enteritidis (SE) including increased SE shedding, higher susceptibility, and more rapid horizontal transmission of the organism to uninfected but exposed hens. In the current study we examined whether immunization of hens with Megan Vac1, a commercially-available live attenuated S. Typhimurium vaccine prior to molt would provide any protection for hens as indicated by reduced or no horizontal transmission of SE during this high stress period. Vaccinated (one dose of vaccine administered by aerosol two weeks prior to molt) or unvaccinated hens were placed into 3 rows of layer cages each, 11 hens per row, and molt was induced via feed withdrawal for 14 days. On day 4 of molt, the center hen in each row received 1 X 107 SE and shedding of SE was examined on days 3, 9, 17, and 24 post...
challenge. Day 3 post challenge 26/30 (87%) unvaccinated exposed hens were shedding SE compared with 3/30 (10%) of the vaccinated hens. By day 9, 26/20 (87%) unvaccinated vs 7/30 (23%) vaccinated hens were shedding SE. Levels of SE in gut samples from vaccinated hens were low, requiring broth enrichment for detection, while many of the gut samples from unvaccinated hens contained 10^7 SE/ml. In organ samples taken from both groups on day 10, 100% of ceca and ovaries were SE+ in unvaccinated hens vs 10% of ceca and 0% of ovaries from vaccinated hens. These results provide evidence that immunization of hens with a live Salmonella vaccine prior to the induction of molt may be a possible intervention strategy for reducing SE problems during this potentially high-stress period.

**Key Words:** Eczema, Antibodies, Candida

### 83 Breast Muscle Development in Commercial Lines of Broiler Chickens.

G. N. Scheuermann*, S. F. Bilgili, J. B. Hess, and D. R. Mulvane, *Auburn University, Auburn, AL.*

Genetic and gender-related variations in breast muscle yield of broiler chickens may be attributed to differences in number and size of muscle cells (myofibers). In this study, day-old, sexed chicks from eight commercial strain-crosses (SC) were reared to 56 d of age in replicate pens (4 pens/SC; 25 males and females/pen). A common, four stage commercial broiler feeding program, consisting of a starter (1-21 d), grower (22-35 d), finisher (36-49 d), and a withdrawal (50-57 d) was utilized. Feed and water were provided *ad libitum* and lighting continuously throughout the study. Live performance [average weight (BW), feed conversion (FC), and mortality (MORT)] was assessed at Days 21, 35, 49, and 56. At Day 8, 16 chicks/SC (eight/sex) were weighed, breast muscles excised, weighed, frozen, sectioned, and stained for estimation of myofiber density (myofiber number/area; MFD). In addition, breast muscles from 16 birds/SC (eight/sex) were harvested at 15, 22, 29, 36, 42, 49, and 57, to establish breast yield curves and correlations. Breast fillet dimensions (length, width, and depth) were also measured for each SC at 57 d of age. Statistical analysis of the live performance data showed differences (P<0.05) among the SC for BW, FC, breast weight and yield. MORT did not vary between the SC, but increased linearly with age. Males were superior to females (P<0.001) for BW and breast weight. There was an age effect (P<0.001) for all variables. Significant interactions were detected for SC*age for breast weight (P<0.01) and sex*age for BW and breast weight (P<0.001). Breast yield increased with age. Breast fillet dimensions were significant for SC and sex effects. No differences (P>0.05) in MFD were observed among the SC. However, males had 16% greater MFD compared to females (P<0.001), suggesting an advantage in myofiber numbers. Embryo weight at 19 d of incubation, as well as measurements taken at 8 d of age (BW, breast weight and yield) was consistently and positively correlated with breast weight and yield at each age through 57 d. MFD measured at 8 d of age did not explain observed differences in breast yield at market age. Breast yield potential of broiler chickens, determined during embryonic development, appears to be fully expressed through the early post-hatch period.

**Key Words:** Broilers, Breast yield, Myofiber

### 84 Possible involvement of ryanodine receptors in pale, soft, and exudative meat in broilers.

D.I. Petkov*, G. García 1, J. Killefer 2, C.M. Owens 1, L.A. Newberry 1, and B.M. Hargis, 1University of Arkansas, Fayetteville, AR, 2 West Virginia University, University,Morgantown, WV.

An emerging problem in the poultry industry referred to as pale, soft, and exudative meat (PSE) closely parallels a similar syndrome in swine, selected for fast growth and lean meat. This defect in chicken breast meat at processing results in low water holding capacity and poor binding characteristics of processed meat products and is estimated to cost the industry 1.5 million dollars per year. In both species PSE meat results from protein denaturation caused the rapid onset of rigor mortis, accelerated glycolysis, pH decline with an associated buildup of lactic acid and depletion of ATP. Sensitivity to halothane and other non-depolarizing muscle relaxants or stress agents in swine indicated that PSE has a genetic basis. The "halothane gene" (HAL) is an inherited disorder mapped to the 6p11-q22 region of swine chromosome 6. Further analysis linked genetic basis. The "halothane gene" (HAL) is an inherited disorder mapped to the 6p11-q22 region of swine chromosome 6. Further analysis linked the malignant hyperthermia (MH) in swine and MH in humans with the Ryonadone receptor 1 (RyR1) in skeletal muscle. A mutation at Arg14-Cys and Arg14-Cys found in cDNA coding for RyR1 are associated with PSE-positive swine and MH susceptibility in humans, respectively. Elimination of the Arg14-Cys mutation in swine by Mendelian selection has largely eliminated this condition. To explore the possibility of similar involvement of RyR1 (RyR1) in the PSE condition described for chickens, we are determining the structural organization of the gene coding for the Ryonadone receptor 1 expressed in chicken breast muscle. PCR Primers were designed utilizing conserved regions of published cDNA sequences for RyR1 in humans, swine, and other species. Total RNA was isolated from Pectoralis Major muscle of one-day-of-hatch broiler and amplified

**Key Words:** Molting, Salmonella, Vaccination, Food Safety
using RT-PCR. The resulting PCR product (900 bp.) was cloned into a phage vector and utilized as a probe for screening the chicken genomic library for the presence of HyR1. To date we have screened approximately 1,400,000 phage plaques and have identified twelve clones that contain potential RyR1 sequences. Genomic library screening as well as sequence analysis of positive clones is still in progress.

**Key Words:** PSE, Ryanodine, Malignant hyperthermia, Chicken

### 85 Incidence of Salmonella on whole broiler carcasses obtained from retail outlets in Northeast Georgia.

M. Simmons\(^1\), D. L. Fletcher\(^1\), M. E. Berrang\(^2\), and J. A. Cason\(^2\).

\(^1\)University of Georgia, Athens, GA, \(^2\)USDA, ARS, Athens, GA.

Whole, fresh broiler carcasses were purchased from grocery stores in the Northeastern United States during a 20-24-week period. Carcasses were selected based on intact packages, processing establishments (USDA plant number), and sell-by-dates, so that each bird came from a sealed package and represented a single plant and processing day combination. All carcasses were purchased on a Monday or Tuesday morning to ensure that birds were at least two to three days post-processing. Carcasses were aseptically removed from packages, giblets removed, the carcasses placed in sterile bags containing 500 ml of buffered peptone, shaken, and then the carcass and rinse together incubated for 24 h at 37 °C. After 24 hours, 0.5 ml of the incubated rinse solution was placed into 10 ml each of Rappaport-Vassiliadis and tetrahionate (Hajna) (TT) broth and incubated at 42 °C for 24 h. Each broth was then streaked onto brilliant green sulfa (BGS) and modified lysine iron agar (MLIA) media, and incubated for 24 h at 35 °C. Suspect Salmonella colonies were inoculated on triple sugar iron (TSI) and lysine iron agar (LIA) slants and incubated at 35 °C for 24 h. Presumptive positives were confirmed using Poly O and Poly H agglutination tests. Based on the number of unique establishments, expiration dates, and weekend sales, the number of birds available each week ranged from 6 to 17. Over the 20 week period, 251 independent carcasses from 14 establishments were evaluated. Salmonella-positive carcasses ranged from 0 (for one week) to over 60% (for three weeks). Only four of the 20 weeks had an incidence of less than 20% positive carcasses. For the entire 20-week study, 85 of the 251 total carcasses tested, or 33.9%, were found to be Salmonella positive.

**Key Words:** Salmonella, Whole broilers, Salmonella incidence, Retail incidence

### 86 Evaluation of bacteriophage treatment as a method to reduce culturable Salmonella in poultry carcass rinse water.

J.P. Higgins\(^1\), S.E. Higgins\(^1\), K.L. Guenter\(^1\), W.E. Huff\(^1\), and M.M. Huff\(^1\).

\(^1\)University of Arkansas, 2PP&PSRU, ARS, USDA, Fayetteville, AR 72701.

Bacteriophages (phages) represent a group of viruses that specifically infect and replicate in bacteria. Phage research, with respect to therapeutics, has recently gained momentum with the documented successful treatment of bacterial infections in several animal species. The phage used in these experiments (PH1 4) was isolated and cloned from waste water in the presence of Salmonella enteritidis PT 13A (SE). Presently, we hypothesized that treating broiler carcasses with phage would reduce the recovery of SE from carcass rinse. In these preliminary experiments, processed 8-wk-broiler carcasses (n=9) were individually rinsed with 100 ml of sterile distilled water. All rinse water was pooled and divided into four 4 ml aliquots. Each sample was inoculated with SE to achieve final concentrations of 0.92 x 10\(^{6}\), 10\(^{5}\), 10\(^{4}\), or 10\(^{3}\)cfu/ml (n = 30/treatment). Cloned phage was simultaneously inoculated to achieve an estimated final concentration of 0, 10\(^{5}\), or 10\(^{6}\) phu/ml (n = 40/treatment). The addition of 10\(^{6}\)phu/ml of phage at all selected concentrations of SE reduced (p<.05) frequency of SE recovered as compared to controls. Reducing the phage inoculum to 10\(^{5}\)phu/ml with 92 cfu/ml of SE reduced (p<.05) frequency of SE recovered (50-60%) as compared to controls, with no effect at higher concentrations of SE. Data suggest that sufficient concentrations of an appropriate phage, or phage mixtures, could greatly reduce recoverable SE from carcass rinses. Experiments are in progress to further evaluate the effect of pre-treating carcasses (or live poultry pre-slaughter) with bacteriophages on SE recovered from carcass rinses. While the regulatory acceptability of such treatment has not been determined, the ubiquitous nature of phages and the inability of these viruses to infect higher organisms, would leave little argument regarding the safety of such applications.

**Key Words:** Salmonella, bacteriophage, carcass rinse

### 87 Effect of broiler feed withdrawal and transportation on levels of Campylobacter, Salmonella and E. coli on carcasses before and after immersion chilling.

J. K. Northcutt\(^{1,2}\), M. E. Berrang\(^1\), J. A. Dickens\(^1\), D. L. Fletcher\(^2\), and N. A. Cox\(^1\).

\(^1\)USDA, Agricultural Research Service, \(^2\)The University of Georgia.

A study was conducted to determine effect of broiler feed withdrawal and transportation on carcass Campylobacter, Salmonella and E. coli levels before and after immersion chilling. Four week old Campylobacter positive broilers were transferred to the research facility and placed into floor pens on litter with 18 birds in each of 12 pens. Full feed broilers (FF) and broilers held without feed for 12 hours (FW) were processed at 6, 7 and 8 weeks of age. One week prior to slaughter, broilers were gavaged with Salmo nella (1 ml per bird containing 1 x 10\(^{10}\) organisms/mL). The day before processing, feed but not water was removed from FW broilers for 4 hours. These birds were then caught, cooled, transported for 1 hour, and held for an additional 7 hours before processing. FF broilers were caught and cooled less than 10 min before processing. All broilers were stunned (14 volts, 500 Hz) for 30 sec, bled for 120 sec, scalded for 2 min at 52 C, defeathered, mechanically eviscerated and rinsed. Twelve pre-chill carcasses were subjected to a whole carcass rinse (WCR), while the remaining carcasses were tumble chilled in ice water containing 20 PPM chlorine. When carcass temperature reached 4 C, carcasses were removed from chillers, allowed to drip for 5 min, and subjected to a post-chill rinse (PCR). No free chlorine was found in chill water after carcasses reached 4 C. Feed withdrawal and transportation had no practical effect on pre-chill and post-chill Campylobacter, Salmonella and E. coli numbers recovered from carcasses. For both FF and FW treatments, bacterial populations were approximately 1.5 log units lower on chilled carcasses than on pre-chilled carcasses for each of the tested organisms. These data suggest that for contaminated broilers, feed withdrawal and transportation will not significantly influence the presence of human food borne enteropathogens on carcasses.

**Key Words:** Broiler Feed Withdrawal, Broiler Processing, Carcass Microbiological Counts


N.J. Stern\(^1\) and M.C. Robach\(^2\).

\(^1\)US. Dept of Agriculture, ARS, Richard B. Russell Research Center, Athens, Georgia, \(^2\)Wayne Poultry, Inc., Oakwood, Georgia.

Within the United States Campylobacter spp. is the most frequently reported bacterial agent of gastroenteritis. Transmission from poultry to humans is suggested as a significant source of infection. The Center for Food Safety and Control and the Centers for Disease Control and Prevention calculated an incidence of human disease between 1996 and 1999 was reduced from 23.5/100,000 to 17.5/100,000, suggesting a reduction in human exposure. We sampled 20 commercial flocks in 1995 and 10 flocks in 2001. Fifty random fecal droppings were assayed per flock the day before processing. Fifty random carcass rinses were taken from the same flocks, which were the first group of birds processed the next day. Serial dilutions of these samples were plated onto Campy-Celex media and enumerated as previously described. We provide data indicating that levels of Campylobacter spp. were reduced from an average of greater than 10\(^{4}\) cfu per carcass in 1995 to slightly more than 10\(^{3}\) cfu per carcass rinse in 2001, in North Georgia, while the corresponding frequency of carcass contamination remained consistently high during these periods. During broiler production, the levels found in fully grown broilers remained constant (10\(^{3}\)-10\(^{4}\) cfu per gram of feces) in 1995 and 2001. This reduction in levels of the organisms on processed carcasses may be more important than the continued high frequency of carcass contamination.

**Key Words:** Campylobacter, Poultry, Broiler, carcasses

### 89 Molecular characterization of Listeria monocytogenes isolated from a poultry further processing facility and from fully cooked product.

M. E. Berrang\(^1\), R. J. Meinersmann\(^1\), J.K. Northcutt, and D.P. Smith, USDA-ARS-Russell Research Center.

Presence of Listeria monocytogenes on fully cooked product suggests either post cook contamination or undercooking. This study was conducted to explore environmental sources of L. monocytogenes in a commercial further processing facility and compare those isolates found to others detected on fully cooked product. A survey was conducted in which forty
environmental samples from raw and cooked product areas of two production lines were cultured for L. monocytogenes. The resulting isolates were subjected to molecular subtyping by ribotyping and pulsed field gel electrophoresis (PFGE) and compared to twenty-five live isolates collected by plant personnel from product contact surfaces and fully cooked product suspected of being contaminated with L. monocytogenes. Eighty-nine environmental and product isolates were divided into fourteen distinct ribogroups. Two ribogroups included isolates from fully cooked product; the members of these two ribogroups were subjected to further analysis by PFGE resulting in PFGE clusters. Common ribotypes of fully cooked product produced on line A was found to be indistinguishable from isolates collected from: 1) the spiral freezer exit conveyor on line A; 2) raw product contact surfaces on line B; and 3) drains in the cooked area of line B. L. monocytogenes from fully cooked product produced on line B was not found to be indistinguishable from isolates collected from: 1) an isolate detected in the raw product side of line B; and 2) the floor in the cooked product area of line B. Furthermore, common ribotypes of L. monocytogenes were detected in raw product collected in the slaughter facility supplying the cook plant and apparently surviving in the cook plant environment for as long as six months. These data show that fully cooked product can become contaminated with L. monocytogenes that resides on many surfaces within the further processing facility. The presence of the same strain of L. monocytogenes at different sites will make it more difficult to pinpoint the direct source of contamination.

**Key Words:** Listeria monocytogenes, further processing, ribotype, PFGE, cooked poultry meat

90 Risk Analysis of Salmonella and Campylobacter Levels in the Broiler Production Continuum. R. Bailey1, R. Wills1, A. Byrd2, T. Doler2, and M. Rybolt1. 1Mississippi State University; Mississippi State, MS. 2Food and Feed Safety Research Center, College Station, TX.

Current methods for producing and processing poultry can lead to the introduction and spreading of pathogens from hatchery to the processing plant. As poultry companies continue to provide a safe, wholesome product to consumers, they must also comply with federal regulations addressing L. monocytogenes in processed broilers. Additionally, the Food Safety Inspection Service (FSIS) has announced its interest in implementing similar type regulations for Campylobacter. Although many risk factors that potentially contribute to Salmonella and Campylobacter levels in broiler flocks have been identified, identification of the most effective sites for intervention have not been established. The objective of this work was to investigate the relationship of the prevalence of Salmonella and Campylobacter in broiler flocks in the production house and at different points in the processing line. Ten broiler houses on 10 different farms with six consecutive flocks per house were studied. Whole body rinses were collected on 20 euthanized birds from each of the flock’s dressing (Pre-chill - PR). Twenty different carcass rinses were collected on the processing line as the birds left the pickers (Post-picking - PoP), just prior to entry into the immersion chilling tank (Pre-chill - P1P), and as the birds left the immersion chilling tank (Post-chill - PoC). Broilers from 35 flocks were sampled in the processing plant. All samples were evaluated for Salmonella and Campylobacter. Odds ratios for comparing pathogen levels at the four sample collection sites were calculated. Results of this study showed that odds of recovering Salmonella and Campylobacter were significantly higher, 5.5 and 1.5 times respectively, at PR I when compared to PoC. It was also shown that the presence of both of the organisms behaved differently through processing. This study points out the difficulty that may be encountered in making risk management decisions relative to meeting FSIS Salmonella performance standards and controlling Campylobacter during processing.

**Key Words:** Salmonella, Risk analysis, Campylobacter

91 Microbial shelf-life of L. monocytogenes carcasses following continuous on-line processing using acidified sodium chlorite. D. E. Conne1, G. K. Kemp2, C. C. Warf2, and D. Klein2. 1Auburn University, Alabama. 2Alicde Corporation, Redmond, Washington.

Acidified sodium chlorite (ASC), antimicrobial intervention used in poultry processing, was evaluated to determine effect on populations of spoilage bacteria on commercially processed carcasses. Broilers (38-44 d) were processed in a commercial facility during one shift by one of three methods (ASC treatments): typical commercial procedures (control); continuous on-line processing (COP), in which ASC (1000 ppm) was sprayed (15 s) on to carcasses immediately prior to chilling (1x ASC); or COP with an added application of ASC (1000 ppm, 15 s) after chilling (2x ASC). Carcasses (20/treatment group) were sampled at pre-ASC, post-ASC and post-chill using the whole carcass rinse method and analyzed for populations of aerobic (APC), psychrotrophic, and pseudomonad bacteria. Additional chilled carcasses (36/ASC treatment), were sealed in plastic bags with an absorbent pad, and stored at 4 C for 16 d. At 3 d intervals, 6 carcasses/ASC treatment were analyzed to enumerate populations of APC, psychrotrophic, and pseudomonad bacteria. Populations of all bacterial types on carcasses at pre- and post-chill were 0.14-0.52 log cfu/mL lower (p<0.05) on ASC treated carcasses vs control carcasses. Although transfer of carcasses from post-chill to the evisceration line that was done to achieve the 2x ASC treatment resulted in recontamination of carcasses, the second ASC application reduced (p<0.05) this contamination to original post-chill populations. On stored carcasses, there were significant differences in bacterial populations between the 3 ASC treatment groups. At <13 days, bacterial populations were 1-2 log cfu/mL lower on 1x and 2x ASC treated carcasses vs control carcasses. The time required for bacteria to reach 6.0 log cfu/mL was 6, 8, and 9 days on control, 1x ASC, and 2x ASC treated carcasses, respectively. Whereas, time required for bacteria to reach 7.0 log cfu/mL was 7, 9, and >11 days on control, 1x ASC, and 2x ASC treated carcasses, respectively. Therefore, ASC treatments significantly increased the microbial shelf-life of stored broiler carcasses, and shelf-life extension was greater when a second post-chill ASC spray was applied. Use of ASC in continuous on-line processing can provide a means for commercial poultry processors to increase the shelf-life of their refrigerated products.

**Key Words:** Acidified Sodium Chlorite, Processing, Shelf-life, Bacteria

92 A Comparison of AVATEC, Bacitracin, and Yeast Culture Residue on the Performance of Broiler Chickens Reared on Recycled Litter. V.G. Stanley1, M. Daley1, and A.E. Setton2. 1Prairie View A&M University. 2Altech, Guelph, Canada.

Three trials were conducted to evaluate the effects of AVATEC, an anticoagulant (90.7 g/ton); Bacitracin Zn, a growth-promoter (50 g/ton); and Yeast Culture Residue (YCR) (416 g/ton) on the growth of broiler chicks reared on recycled litter. A total of 720 Cornish Rock male chicks, (240 birds/trial) were separated into four treatment groups each replicated three times. Recycled litter consisted of pine wood shavings infected with three selected strains of coccidia (/italicized E. tenella, /italicized E. maxima, and /italicized E. acervulina). The diets consisted mainly of corn-soy supplemented with necessary vitamins and minerals to satisfy NRC (1994) requirements. Parameters measured were broiler body weight, total coliforms of the intestinal tract, ceca, and liver relative weights. Body weight of chicks fed diet supplemented with YCR was significantly higher than the control (P<0.05) and was comparable to Bacitracin and the anticoagulant in all three trials. In all trials, the body weights of chicks in all treatments decreased with each cycle of the reused litter. The coliform count from YCR-treated chicks was significantly lower (P<0.05) than controls and was comparable to that of chicks given Bacitracin. Coliform counts of the control and AVATEC-treated birds did not differ whereas Bacitracin treated birds were intermediate and did not differ from any of the other treatments. Cecal and liver relative weights calculated from the chicks in the last trial showed that only the liver was significantly affected by treatments. In conclusion, YCR appeared to be a viable alternative to Bacitracin in enhancing growth, and was comparable to AVATEC in performance of chickens reared on recycled litter.

**Key Words:** Broilers, Recycled , Litter

93 Comparative Effects of Monensin, Salinomycin, and Yeast Culture Residue on the Performance of Broiler Chicks Infected with Three Selected Eimeria spp. V.G. Stanley1, M. Daley1, and A.E. Setton2. 1Prairie View A&M University. 2Altech, Guelph, Canada.

Three separate trials with 360 day-old Cornish Rock male broiler chicks were conducted to investigate the effects of three medicated feeds on the suppression of three selected species of Eimeria. Day-old chicks were fed diets containing either monensin (60 g/kg), salinomycin (60 mg/kg) or Yeast Culture Residue ([YCR] 1 kg/ton). The four treatment groups
were control (unmedicated-uninfected), monensin-infected, salinomycin-infected, and YCR-infected. At 14 d of age, chicks were infected orally by gavage, with one of three species of Eimeria. In Trial 1, chicks were infected with /italicized E. tenella (50,000 oocysts/bird), whereas in Tri- als 2 and 3, chicks were infected with /italicized E. maxima (50,000 oocysts/bird) and /italicized E. acervulina (500,000 oocysts/bird), respec- tively. The response variables measured included bi-weekly body weight gain,ecal scores, relative cecal and liver weights, blood chemistry val- ues, and serum enzyme activities. The duration of each trial was 28 d. Data showed that /italicized E. tenella and /italicized E. acervulina infection did not affect body weight gain as much as /italicized E. max- ima infection. Both monensin and YCR treatments significantly reversed the effects of /italicized E. maxima infection. /italicized E. maxima sig- nificantly increased relative liver weight whereas /italicized E. tenella infection did not. Both monensin and YCR treatments significantly re- duced cecal lesions caused by /italicized E. tenella and mid-intestinal lesions caused by /italicized E. maxima. /italicized E. tenella infection significantly reduced uric acid, an effect reversed by YCR, but not by mo- nensin. YCR and monensin treatments exacerbated the glucose lowering effect of /italicized E. maxima infection but not the reduction of total protein. YCR interacted with /italicized E. maxima infection to increase GGT and AST activities above the control. In Trial 3, chicks fed diet treated with YCR and infected with /italicized E. acervulina had body weight gain significantly higher than the control (599 vs 533 g) 2 weeks post-infection and was comparable to salinomycin treatment. In conclu- sion, YCR appeared to be a viable alternative to some anticoccidials in controlling coccidiosis.

Key Words: Yeast culture residue, Monensin, Salinomycin

94 Growth and Fertility of Breeder Males Reared on Skip-a-Day and Every Day Feeding. C.A. Pietsch1, W.D. Berry1, and S.S. Oates1, 1Auburn University Department of Poultry Science.

Fertility of broiler breeder males depends on continuous growth during rearing. Allowing periods of static or declining body weight during rearing results in impaired fertility. Skip-a-day feeding schedules, commonly used in the rearing of broiler breeders, may present a case of very short- term growth inhibition with subsequent reduction in fertility. A study was conducted to determine whether the use of a daily feeding schedule would promote better fertility than skip-a-day feeding. Four pens with 10 Ross broiler breeder males were set up in a closed environment. Start- ing at 4 weeks of age, two of the pens received feedings every day and the other two were fed twice the daily allotment every other day. A control corn-soy diet was used for both groups. Body weights were measured every week from 4 weeks to 22 weeks of age. At 21 weeks of age, the average body weights for the pens receiving feed daily were 3.04 kg, and the average weights for the birds on skip-a-day were 3.13 kg. Shank and breast weights were 5.8% higher in the birds fed every other day compared to the control pens. Shanks for the birds fed daily averaged 10.8 cm, with keel lengths of 20.8 cm, respectively. Thanks for the birds fed every other day averaged 10.8 cm, with keel lengths of 20.6 cm, respectively. Results demonstrate that no significant differences existed between the body weights, shank lengths, or keel lengths for the birds fed daily compared to the birds fed every other day during rearing. Five birds from each pen will be killed for measurement of testes weight and tissues taken for histological analysis. Sperm quality can be analyzed by sperm morphology, count, and motil- ity. Fertility of the remaining males will be assessed by matings with breeder hens.

Key Words: Broiler breeder, Fertility, Growth, Rearing, Feeding

95 Phytase Supplementation for Rearing and Production of Heavy Strain Broiler Breeders. H. Li1, W.D. Berry1, and S.S. Oates1, 1Auburn University Department of Poultry Science.

Little information is available about whether phytase can be used to re- place phosphorus in broiler rations and production diets of heavy-strain breeder replacement pullets and hens. The objective of this study was to quantify the effects of dietary phytase on growth and livability of pullets during the rearing phase and their subsequent production performance during the entire breeder period. 1000-day-old female breeder chicks were placed in 4 pens with 250 birds each receiving 2 dietary treatments with 2 pens each treatment in a litter floored light proof pullet house. Male chicks were reared separately. Control pullets received a diet with 0.35% AP added inorganic phosphorus. Phytase treated pullets received a diet with 0.25% AP, supplemented with 300 U/kg phytase. At 22 weeks of age, 800 pullets were allocated to 8 pens in a curtain sided, slat litter breeder house. There were 100 hens per pen. Four pens each received either a control diet containing 0.3% AP without phytase or a phytase diet contain- ing 0.1% AP supplemented with 300U/kg phytase. In the first 22 weeks, there was no significant difference in mortality, body weight or weight uniformity between control and phytase treatment groups. Ev- ery 4 weeks, 40 birds from each treatment were measured for shank and keel length and 4 birds from each treatment were killed for measurement of digestive tract length including large intestine & ceca, small intes- tine, pancreas and gizzard. Blood samples were taken from 40 hens in each treatment to determination of plasma total protein, calcium and phosphorous. Litter samples were taken for determination of litter phos- phorus. From 25 to 65 weeks, egg production, egg weight, shell weight, egg specific gravity, fertility and hatchability will be determined.

Key Words: Breeder, Rearing, Phytase

96 Evaluation of Luminescence in Salmonella Enteri- tis as a Real-Time Measurement of the Effects of Commer- cial Litter Treatments on Pathogen Survivability. T Pansky*, M Rybolt, T Doler, and H Bailey, Mississippi State University, Missis- sippi State, MS.

The food animal industry is facing increased regulatory pressure con- cerning the presence of foodborne pathogens in pre-harvest production environments. For the industry to make logical risk management deci- sions pertaining to pre-harvest microbial control, scientifically sound risk factor information must be available. Appropriate methods to do risk fac- tor analysis in the production environment are lacking. The objectives of this work are to 1) develop luminescent strains of Salmonella and 2) utilize a luminescent strain of Salmonella as a real time measurement of pathogen viability in poultry litter containing different commercial treatments. Thirteen different serotypes of Salmonella, including wild types isolated from production, environments were utilized. Sources of the or- ganisms included porcine, reptile, bovine, marsupial, avian, and poultry litter. A plasmid (pCGLS-2) containing genes for penicillinase and lu- ciferase expression was successfully electroporated into all Salmonella isolates except one. Growth curves were determined using absorbance and luminescence levels. S. anatum (bovine intestine isolate) and S. ru- bislaw (opossum isolate) showed the highest levels of luminescence. S. cholerasuis spp. arizonae (reptile isolate) displayed the lowest lumines- cence. S. Kentucky, a poultry litter isolate displaying mid-range lumi- nescence, was selected for use in the litter treatment study. Optimum litter moisture level based on Salmonella survivability was determined. Three different commercial litter treatments, Poultry Litter Treatment 1, Poultry Guard2, and All Clear3 were used. Luminescence levels, as a real time expression of S. Kentucky cellular activity and survivability using the at the time positive results in- dicated that utilizing Salmonella containing a luminescent gene may be an appropriate method for evaluating the effects of different poultry litter treatments on the survivability of the pathogen.

Key Words: Salmonella, Luminescence, Real-time

97 The Effect of Electrostatic Space Charge in Red-ucing Dust and Microorganisms During the Rearing of Broiler Breeder Pullets. L.J. Richardson1, B.W. Mitchell2, J.L. Wilson1, and C.L. Hofacre3, 1The University of Georgia, Department of Poultry Science, 2Department of Avian Medicine, 3Department of Animal Science, Mississippi State University, Missis- sippi State Research Laboratory, Athens, GA.

High levels of dust and microorganisms are known to be associated with confinement rearing facilities. Broiler breeder pullets are grown on litter floors to 20-22 weeks before they are moved to laying houses. During this time, airborne dust accumulates on walls and equipment and airborne dust levels increase. Since, microorganisms in general are carried by dust particles, this provides an excellent vector for horizontal disease transmission between birds. Airborne dust has also been closely cor- related to ammonia levels, by reducing the levels of dust; this should reduce the possibility of disease transmission from this vector. Two e- nvironmentally controlled broiler breeder pullet rooms containing female broiler breeder pullets (n=300) were used to evaluate the effectiveness of an electrostatic space charge system (ESCS) in reducing airborne dust and gram-negative microorganism levels over an eight-week period (start- ing when the birds were 10 weeks old). Two configurations of the negative

Zearalenone (ZEA), a mycotoxin with estrogenic activity, is produced by Fusarium graminearum growth in corn, sorghum, wheat, barley and other grains. ZEA has potential adverse effects in chickens and may be an indicator of other mycotoxins that are formed concurrently. This study was conducted to examine the ability of some strains of lactic acid bacteria (LAB) to remove ZEA from contaminated media and some involved factors. Pellet and supernatant, from overnight 42 different bacteria cultures at 37°C (belonged to Bifidobacterium sp., Lactobacillus sp. and Entrococcus sp. which were isolated from human health, NCFB collection, poultry and yogurt) were used to ZEA (25 μg/1.5 ml PBS or LAFT/g/LAFT/1) binding assay, 1 hour at 37°C. Also, some bacteria were killed by heat (121°C, 15#) and supernatants from different bi-fidobacteria were treated with heat (121°C, 15#) or neutralized with NaOH (1N) before the binding assay. Reverse-phase HPLC was used to quantify ZEA remaining in the supernatant of bacterial pellet incubated with ZEA or when bacterial supernatants were incubated with this toxin, the ZEA was extracted with chloroform, which then was evaporated and the residue was dissolved in mobile phase for HPLC analysis. The percentage of ZEA disappearance depended on the strains. The best bacteria (cells) that removed ZEA were Bifidobacterium strains. The removal of this toxin was greater in heat treated cells than in viable cells, showing that the autoclaved could produce some changes in the surface binding more toxin. All the supernatants reduce ZEA, between 26 and 50%, but this effect was reduced when the supernatants were submitted to heat or neutralization treatment, suggesting that the pH and sterilization by hummid heat could play an important role in ZEA disappearance. The data indicate that LAB appear like an interesting alternative to reduce the bioavailability of ZEA in the poultry foods.

Key Words: Lactic acid bacteria, Zearalenone, Binding, Supernatant, HPLC


Alternate-day feed restriction is known to reduce adult gonadal function and increase ingestion of litter and feces, thereby increasing horizontal transmission of Salmonella. Similarly, pre slaughter feed withdrawal increases crop contamination with Salmonella. We hypothesized that dietary Al₂SO₄ would reduce voluntary consumption of feed, providing an alternative method of restriction (or pre slaughter feed withdrawal). When Al₂SO₄ was fed at 10% of the broiler starter diet of day-of-hatch broiler chicks, 11-day body weights were reduced by 67% with a 60% reduction in feed consumption (exp. 1). In vitro, 292 mg Al₂SO₄ (10% wt:v) caused a 3.5 log reduction in Salmonella enteritidis (SE) recovery as compared to controls (exp. 2). To investigate the effects of Al₂SO₄ on pre slaughter feed withdrawal and SE recovery from crops, 5/15 in 7-wk-broilers in each of 10 pens were challenged with 10⁶ cfu SE (exp. 3). Seven days post-challenge, all pens were subjected to simulated 8 hr feed withdrawal (n=5) or incorporation of dietary (10%) Al₂SO₄, Al₂SO₄ had no effect on recovery of SE from crop or cecal tonsils. To simulate feed restriction in broilerized breeders, 5/15 7-wk-broilers in each of 6 pens were challenged with 10⁶ cfu SE (exp. 4). Two days post-challenge, randomly-selected pens were either ad libitum fed with control feed, fed + 10% Al₂SO₄, or pair fed control diets (n=2/treatment).

Dietary Al₂SO₄ significantly increased SE recovery from cecal tonsils as compared to either pair fed broilers or controls. Al₂SO₄ similarly increased SE recovery from cecal tonsils in exp. 5, and caused significantly increased circulating heterophil to lymphocyte ratios by 14 days of treatment as compared to controls, suggesting that these levels of dietary Al₂SO₄ cause a toxic or physical stressor. In conclusion, these data indicate that dietary Al₂SO₄ causes increased stress as compared to daily dietary restriction, does not reduce horizontal transmission of SE, and is not a useful alternative to physical feed restriction.

Key Words: Aluminum sulfate, feed restriction

100 New value-added process for poultry skimming sludge from dissolved air flotation units. John Lee*, Rigel Technology Corporation, Shawnee, KS, USA.

DAF (dissolved air flotation) skimming sludge is a major waste sludge from poultry processing and waste water treatment plants. Land application, lagoon, blend and further centrifugation process are used for the skimming sludge. All these process not economic. DAF skimming sludge has good nutritional value of fat, protein and minerals. A simple process technique has been developed to convert the waste sludge into a value-added NutriValue product at low process cost. A typical dry form product has crude protein 50%, fat 38%, ash 2.5%, moisture 6%, phosphorus 0.59%, calcium 0.34%, fiber 0.99%, alanine 3.9%, aspartic acid 4.8%, glutamic acid 6.4%, glycine 2.4%, leucine 5.9%, lysine 4.3%, valine 3.7% and very low micro counts. The pepsin digestible protein is 94%. The fat oxidation can be prevented by a fat antioxidant. This simple process can cover the nutrients in DAF skimming sludge. The dry process cost can be reduced significantly because the solid level can be increased. Also the value-added product can be used as wet basis ingredient for liquid feed applications at extremely low process cost. The products have no any free fat on the product surface and no any oily feeling even at higher fat level. The product can be used as a general protein/fat ingredient for different feed and fertilizer applications. If the product is used for dairy animals, the product has the by-pass function for dairy animals to produce more milk at low cost. The land application and fee problems from DAF skimming sludge can be resolved by this new simple process technique. For a mid-size poultry processing plant, the final product has a value about one million dollars per year.

Key Words: Waste treatment, Protein and fat, Dissolve air flotation, Skimming sludge, Value-added process

101 Does selection for reduced adrenocortical responsiveness in Japanese quail have a positive impact on male sexual behavior? R. H. Marin*,1,2 and D. G. Satterlee1, 1Louisiana State University Agricultural Center, Baton Rouge, LA, 2CONICET, Argentina.

Genetic selection of Japanese quail for a reduced (low stress, LS) rather than exaggerated (high stress, HS) adrenocortical response to brief restraint is associated with a non-specific reduction in stress responsiveness, decreased fearfulness, greater sociality, and enhanced male reproductive performance (augmented cloacal gland and testes size). Because sexual behavior has components that are affected by all of these traits, herein, the copulatory behavior of male LS and HS adults was compared. In Exp. 1, males from each line were individually tested in an experimental chamber (novel environment) in two consecutive steps. First, the approach (social proximity) of a test male (LS or HS) to a compartment containing two females (1LS + 1HS) that he could see but not reach was examined. Second, after allowing the test male and both females to co-mingle, the male’s latency to first grab (LATGRB) and the numbers of mounting attempts (MTS) and copulatory acts (CA) were recorded. LS males spent longer (P = 0.08) near the females before the sexes were co-mingled. When the birds were allowed contact, LS males showed a significantly higher (P < 0.04) number of CC and greater (P < 0.04) copulatory efficiency (CC/GRB) than HS males. No line differences were observed in LATGRB, GRBS, and MNTS. In Exp. 2, individually-caged males from each line were observed when one female (LS or HS) was introduced into their home cages as a sexual partner. The LS males...
showed a lower LATGRB and greater CC and CC/GRB than HS quail (all P < 0.03). The present findings suggest that genetic selection for reduced adrenocortical stress responsiveness prior to the attainment of puberty has a positive impact on adult sexual behavior.

**Key Words**: Corticosterone, Japanese quail, Sexual behavior


Sand, as poultry litter, can be used as an alternative to pine shaving litter in areas in which obtaining it is relatively easy such as along the Alabama Gulf Coast. It is reusable and over the long term offers a viable alternative to the ever increasing costs of pine shavings. The purpose of this study was to determine the bacterial load associated with both sand and pine shavings when used as litter, in a 7 week broiler growout trial. The trial consisted of a total of 16 pens in which 8 pens containing pine shavings and 8 pens containing sand. Litter was collected from several random locations within each pen. They were collected weekly for a total of 10 weeks, this included 1 week pre-bird placement, 7 weeks with birds in the pens, and 2 weeks post-bird removal. Samples were diluted and plated in triplicate on MacConkey Agar (MA), Plate Count Agar (PCA), and Reduced Blood Agar (RBA). MA and PCA were incubated aerobically at 37°C, while RBA was incubated anaerobically at 37°C. Plates were incubated for 18 and 36 hours and at those times bacterial counts were taken. For each week sand samples exhibited lower overall bacterial counts on all three media types than did pine shaving samples. This work shows that bacteriologically sand can be a viable litter alternative to pine shavings if it is locally available.

**Key Words**: Litter, Bacterial, Pine shavings, Sand


A challenge trial using broiler chicks was conducted to test the effects of a yeast cell wall preparation on an infection of *Eimeria acervulina* and *Clostridium perfringens*. Two hundred day-old chicks were housed in ten isolation chambers. At 15 d of age, 150 were randomly allocated into the treatment chambers in ten isolation chambers. At 15 d of age, 150 were randomly allocated, those in the treatment chambers received the same ration to which 0.1% yeast cell wall preparation was added. Body weight and feed intake were monitored weekly from d15-36. A second set of daily doses (4.5 X 10^8 CFU of C. perfringens) on d26, 27 and 29 (9.67 x 10^7) was provided. Feed efficiency. Fecal oocysts counts of treated birds, were lower (P ≤ 0.05) with the T4 treatment yielding results 2 days sooner.

**Key Words**: Coccidiosis, *Eimeria acervulina*, Yeast, Broilers, *Clostridium perfringens*


This experiment was conducted in a complete randomized block design and included 600 mixed sex broiler chicks, which were divided into four groups with five replicates per group. The four (T1 to T4) dietary treatments were isocaloric and isonitrogenous. The birds received 0, 800, 1000, and 1200 g probiotic / ton of feed in the starter (0-21d). For the grower period (22-42d) the Probiotic level was reduced by a factor of 2.5 for all the treatments. Evaluated variables were included: weight gain, feed intake, feed efficiency, mortality, carcass quality, plasma cholesterol, blood hemoglobin, and white blood cells. Results showed that only weight gain of starter period was significantly affected by dietary treatments (P<0.05) with the T4 being heaviest and the T1 being lowest. At the end of the study, no significant differences were detected among dietary treatments for weight gain, even though the T4 group was heaviest and the T1 group lowest. At the same age other factors such as feed intake, mortality, and carcass characteristics were not statistically significant (P>0.05). On the other hand, abdominal fat was highest (9%) in T1 and lowest (2.48%) in group 4 (P<0.05). Analysis of variance showed no significant differences between treatments for plasma cholesterol and blood hemoglobin content, but significant difference was seen in the number of white blood cells, with T1 group having the lowest cells. Keywords: broiler, probiotic, performance, blood characteristics

**Key Words**: broiler, probiotic, performance, mortality, blood characteristics

## 105 Comparison of the PATHIGEN® Salmonella Test versus standard microbiological plating methods for the detection of Salmonella in drag swabs from poultry houses. T. Farrell1, M. B. Weisner1, R. Nash1, A. Parkinson1, J. White2, and C. Young2*, 1Animal Disease Diagnostic Laboratory, Division of Animal Industry, Ohio Department of Agriculture, 2IGN International Inc.

Thirty-three commercial chicken houses were sampled for the presence of Salmonella using drag swabs and tested using the PATHIGEN Salmonella Test and standard plating methods. Drag swabs were enriched overnight in Buffered Peptone Water followed by overnight selective enrichment in Mueller-Kauffmann Tetrathionate Broth or Rappaport-Vassiliadis Broth (RV). After selective enrichment, a 100 µL volume of the RV enrichment culture was tested using the PATHIGEN Salmonella Test. Both the RV and Tetrathionate enrichement broths were sampled for isolation of Salmonella on Brilliant Green plus Novobiocin and XLT4 plates. Salmonella isolates detected by plating were further evaluated for the presence of O, B, and D antigens. Of the 33 chicken houses tested, 27 were determined to be positive for the presence of Salmonella by both plating and the PATHIGEN Salmonella Test, 5 houses tested negative by both methods, and 1 house was positive using the PATHIGEN Salmonella Test but was negative by plating. Of the houses that were confirmed positive for Salmonella by plating methods, 50 of 145 samples (35%) were positive using Tetrathionate broth selective enrichment and plating, 81 of 166 (48.2%) were positive using RV broth selective enrichment and plating, and 90 of 166 (54.2%) were positive by one of the two plating methods. Eighty-nine of 166 (53.6%) were positive using RV broth selective enrichment and testing using the PATHGEN Salmonella Test, of which 75 (84.2%) were confirmed by culture. Five Salmonella enteritidis positive houses were detected and confirmed by both plating and the PATHGEN Salmonella Test. Based on this study, the PATHGEN Salmonella Test was an effective screening tool for the detection of Salmonella, and particularly Salmonella enteritidis, from commercial chicken houses using a drag swab sampling method, while yielding results 2 days sooner.

**Key Words**: PATHIGEN, Salmonella, Drag, Swabs, Poultry

## 106 Hatchability of eggs sanitized with increasing concentrations of BioSentry 904 or Bio-Phene. D. V. Bourassa2*, R. J. Buh1, and J. L. Wilson2, 1USDA-ARS Russell Research Center, 2University of Georgia.

A series of experiments was conducted to determine the relative safety of two hatching egg sanitizing chemicals on embryo viability. On each of four consecutive days, broiler breeder hatching eggs were gathered and separated into ten groups of 88 eggs. Eight of the groups were then sanitized with BioSentry 904 or Bio-Phene at 1, 2, 6, or 12 times the recommended concentration. One rack of eggs per day was sprayed with 8 oz (240 mL) of solution containing , 1, 3, or 6 oz/gal concentration of either chemical. Two racks per day were controls, one sprayed with water and the other not sprayed at all. Following treatment, eggs were held in a 66F egg cooler and on the morning of the fifth day all eggs were set in incubators operating at 99.5F and 55% RH. The only significant depression in hatchability was found with the BioSentry 904 at a concentration of 6 oz/gal, which was 12 times the recommended concentration. Hatchability of all other treatments were not significantly different when compared to the nonsprayed and water sprayed controls.

Temperate bacteriophages (phages) incorporate viral DNA into bacte- rial DNA to induce lysogenesis. While lysogeny confers bacterial resis- tance to reinfection, truly lytic phages reportedly do not cause lysogeny. Lytic phages theoretically thus represent superior therapeutic candidates. Presently, we cloned 22 wild-type phages against *Salmonella enteri- tidis* PT 13A (SE) and evaluated these for ability to induce resistance. Three 10x dilutions of each of these 22 phages, obtained from single agar plaques from single plaques, were incubated with three concentrations of SE (10<sup>2</sup>, 10<sup>3</sup>, 10<sup>6</sup>) in tryptic soy broth (TSB). While each phage delayed SE growth (2 to 12 hrs vs. control), no phage prevented eventual growth. In exp. 2, phage were isolated from 3 waste water samples by inocu- lating source+TSB+SE for enrichment. This culture was 0.2 m filtered for titering and incubated overnight. Three 10x dilutions each of these 22 phages, obtained from soft agar plugs were coincubated with three concentrations of SE (10<sup>1</sup>, 10<sup>2</sup>, 10<sup>3</sup>). Efficacy of Marigro in Supporting Growth, Car- cass Yield and Meat Quality of Broilers. M.A. Juarez1, N. Ledesma1, L.M. Charles1, R. Merino1, E. Morales1, L. Sutton2, M. Silva3, and G. Tellez1, 1Departamento de Produccion Animal: aves, FMVZ, UNAM, Mexico, 2Productos Quimicos Agropecuarios S.A. Mexico, 3PetAg Inc. Hampshir, IL 60140 USA, 4Propollo SA de CV Mexico.

The effect of an enzymatic complex (EC= amylase, xylanase, and pro- tease) on the intestinal microflora using a high- wheat-based diet (HW) and a coccidia challenge (CC) in broilers was determined. Three di- ets were tested (n=300): 1) Negative: HW without CC; 2) Experimen- tal: HW plus 0.1% EC; and 3) Positive: HW with CC. On day 13, groups 2 and 3 were coccidia challenged with 10<sup>4</sup> 1, E. acervulina; 10<sup>3</sup> E. maxima; and 10<sup>3</sup> of *E. tenella*/bird. At 20 and 26 days, ileum content (IC) was analyzed for coliforms (Co), molds-yeasts (MY), and enterobacteriaciae (En) and *Clostridium* sp. (Csp). On day 26, blood samples were taken for total and differential cells count (TDDC). Gross lesions (GL) were registered for mortality. Bacterial count on day 20 was: Co: 35.2±38.8, 124.0±216.8, 24.0±21.4, MY: 82.4±144.2, 112.0±173.4, 16.8±137.7; En: 44.8±63.1, 70.0±123.8, 10.8±8.67; Csp: 80.5±26.6, 65.5±40.8, 90.6±101.3. CFU/g for groups 1, 2 and 3, respectively (P>0.05). At day 26 there was a significant increase (P<0.05) in Csp CFU/g in group 2: 3780.0±4847.4, 8890.0±1411.5, 320.0±16.7; (P<0.05). There were also significant dietary effects (P<0.05) due to the EC addition on the TDDC: heterophil: 31.0±5.25, 32.25±16.37, 18.001±9.29; monocytes: 1.66±1.63, 14.50±16.59, 7.33±5.20; and leukocyte lysis: 2.66±0.81, 27.75±14.95, 9.35±15.6 mg% for groups 1, 2 and 3, respectively. Mortality in this study were 3 chicks from group 2 that died at day 20. They all showed severe lesions of necrotic enteritis (NE). The significant increase in the total number of Csp in the group that received the EC, was associated with NE lesions and hematological changes, as previously reported in NE cases. These results suggest that the addition of an EC to a HW diet with CC may induce the occurrence of NE in broiler chicks.

**Key Words**: Enzymes, *Clostridium*-Coccidia, Intestinal microflora, Necrotic enteritis, Broilers chicks

110 *Aspergillus* sp. meal improves development of intestinal digestion, absorption and body weight uniform- ity, in neonatal broiler chickens. G. Nava4, MA Juarer1, N Ledesma1, R Merino1, A Prieiro2, L Sutton3, E Morales1, JL Davalos1, M Silva3, and G Tellez1, 1Departamento de Produccion Animal: Aves, FMVZ UNAM, 2Quimicos Agropecuarios SA de CV Mexico, 3PetAg Inc, Hampshir, IL USA, 4Propollo SA de CV Mexico.

A trial was conducted to determine the effects of adding 0.2% *Aspergillus* meal (AM), on body weight uniformity (BWU), percentage of protein (PP) and energy calories (EC)/g of dry matter in the ileum content (IC), and coccidia deposition in the tibia and chemical proximal analysis of IC. BWU-CV was calculated the BWU among the body weight coefficient variation (BW- CV). At 10, 20 and 30 day tenchick of each group werekilled to determine mortality. Bacterial count on day 20 was: Co: 9.81±0.20<sup>a</sup>, 6.94±3.89<sup>b</sup>; at day 16: 9.61±1.22<sup>a</sup> and 6.11±2.61<sup>b</sup>; at day 27: 12.06±2.08<sup>a</sup> and 7.08±0.07<sup>b</sup> for diets 1 and 2, respectively (p<0.05). Percentage of mineral deposition in tibia was at day 10: AS 13.00±0.61<sup>a</sup> and 14.64±1.99<sup>b</sup>; CA 4.63±0.29<sup>a</sup> and 5.40±0.74<sup>b</sup>; P 3.23±0.63<sup>a</sup> and 2.64±0.34<sup>b</sup>; at 20 day: AS 13.70±0.99<sup>a</sup> and 13.24±1.10<sup>b</sup>; CA 5.14±1.30<sup>a</sup> and 4.63±0.74<sup>b</sup>; P 3.46±0.15<sup>a</sup> and 2.94±0.10<sup>b</sup>; at day 30: AS 17.0±2.02<sup>a</sup> and 14.98±0.55<sup>b</sup>; CA 6.22±0.76<sup>a</sup> and 5.40±0.22<sup>b</sup>; P 3.08±0.36<sup>a</sup> and 2.68±0.13<sup>b</sup> for diets 1 and 2, respectively (p<0.05). PR digestibility was at day 10: 38.2% and 27.1%; at day 20: 19.8% and 20.6%; at day 30: 21.7% and 20.8% for diets 1 and 2, respectively. EC was at day 10: 4479 and 3222; at day 20: 3936 and 3493; at day 30: 3791 and 3469 for diets 1 and 2, respectively. Addition of AM in the diet improved the digestibility of protein and energy calories (EC)/g of dry mater in the ileum content of neonate broiler chickens. These intestinal changes had a tremendous impact on BWU.

**Key Words**: Neonate broilers, Absorption, Aspergillus meal, Uniformity
111 The addition of *Aspergillus* sp. meal does not induce the occurrence of necrotic enteritis in broiler chicks fed a high-wheat-based diet and coccidia challenge. B. Grace1, G. Nava2, M.A. Juarez2, N. Ledesma2, L.M. Charles2, A. Priego3, L. Sutton3, M. Silva4, and G. Tellez2. 1 Prairie View A&M University, Prairie View, TX 77446, 2 Departamento de Produccion Animal: Aves, FMVZ, UNAM, Mexico, 3 Productos Químicos-Agropecuarios SA, Mexico, 4 PetAg Inc, Hampshire, IL 60140 USA, 5 Propollo SA, Mexico.

The design of this study was to determine the effect of *Aspergillus* sp. meal (AM) on the incidence of necrotic enteritis (NE) in 1 to 26 day old broiler chickens using a high-wheat-based diet (HW) and a coccidia challenge (CC). This experiment consisted of 3 diets with 2 replicates of 50 birds each (n=300). The diets were: 1) Negative: HW without CC; 2) Experimental: HW plus 0.2% AM; and 3) Positive: HW with CC. On day 13, groups 2 and 3 were coccidia challenged with 10^7 E. acervulina; 10^3 E. maxima; and 10^3 of E. tenella/bird. At 20 and 26 days, ileum content (IC) was analyzed for coliforms (Co), molds-yeasts (MY), and enterobacteriaceae (En) by incubating under aerobic conditions for 24 hr at 37°C. *Clostridium* sp. (Csp) specific medium was incubated under anaerobic conditions for 48 hr at 37°C. On day 26, blood samples were taken for total and differential cells count (TDCC). Bacterial evaluation on day 20 was: Co: 35.2±38.8, 848.0±1109.4, 24.0±24.1; MY: 82.4±144.2, 675.2±876.7, 16.8±13.7; En: 44.8±63.1, 692.8±901.2, 10.8±8.67; Csp: 80.5±26.6, 114.0±91.8, 90.6±103.3 CFU/g for groups 1, 2 and 3, respectively (P<0.05). At day 26 no significant differences in aerobic or anaerobic bacteria were showed between groups (P<0.05). No significant changes were seen on TDCC (lym-phocytes, heterophils, monocytes, eosinophils, and basophils) between groups (P<0.05). Leukocyte lysis demonstrated numerical differences due to CC: 2.66±0.81, 10.8±5.71, 9.33±5.16 mg% for groups 1, 2 and 3, respectively. No mortality was registered in any group during the experiment. These results suggest that the addition of 0.2% *Aspergillus* sp. meal does not induce the occurrence of necrotic enteritis in broiler chicks fed with a high-wheat-based diet plus coccidia challenge.

**Key Words:** *Aspergillus* sp. meal, Intestinal microflora, *Clostridium*, Coccidia

112 Dietary supplementation of endoxylanases and phospholipase for turkeys fed wheat-based rations. A. A. Santos, Jr.1, P. R. Ferket, and J. L. Grimes, NC State University, Raleigh, NC, USA.

The adverse effects of non-starch polysaccharides (NSP) on turkeys fed wheat-based diets may be alleviated by dietary supplementation of enzymes. In comparison to controls, the enzymes increased d body weight (15.29 Vs 15.77 kg, P<0.05) and 126 d feed/gain (2.45 Vs 2.37, P<0.05). No significant changes were seen on TDCC (lymphocytes, heterophils, monocytes, eosinophils, and basophils) between groups (P<0.05). At day 26 no significant differences in aerobic or anaerobic bacteria were showed between groups (P<0.05). No significant changes were seen on TDCC (lymphocytes, heterophils, monocytes, eosinophils, and basophils) between groups (P<0.05). Leukocyte lysis demonstrated numerical differences due to CC: 2.66±0.81, 10.8±5.70, 9.33±5.16 mg% for groups 1, 2 and 3, respectively. No mortality was registered in any group during the experiment. These results suggest that the addition of 0.2% *Aspergillus* sp. meal does not induce the occurrence of necrotic enteritis in broiler chicks fed with a high-wheat-based diet plus coccidia challenge.

**Key Words:** *Aspergillus* sp. meal, Intestinal microflora, *Clostridium*, Coccidia

113 Effect of Dietary Phosphorus and Calcium on Performance of Broilers from 3 to 7 Weeks of Age. A. Abudabos*, S. F. Lightsey, W. C. Bridges, and D. Maurice, Clemson University, Clemson, SC.

We have shown that dietary P could be lowered to 0.5-0.6% from 3-6 weeks of age and removed from the finisher diet without loss in performance or mechanical properties of long bones. In this experiment we tested the effects of total dietary P (TP) and Ca on growth, feed conversion, breast muscle yield, serum P, and bone measurements. The experiment was designed as a complete factorial arrangement from 3 to 7 weeks of age. Determined TP and Ca values were used in diet formulation. From 3-6 weeks, four levels of TP (0.45, 0.5, 0.55, and 0.6%) and two levels of Ca (0.7 and 0.9%) provided 8 treatments; each diet was fed to 6 pens. From 6-7 weeks, diets with two levels of TP (0.45 and 0.55%) and three levels of Ca (0.6, 0.7, and 0.8%) were used and each diet was fed to 6 pens of birds. Diets with 0.45% TP did not contain a source of inorganic P. At 6 weeks of age interactions were detected (P<0.05) for feed intake, weight gain, and serum P. Birds fed 0.5, 0.55, and 0.6% TP with 0.9% Ca consumed more feed and gained more weight as compared to the other groups. Feed conversion of birds fed the 0.9% Ca diet was lower than those fed diets with 0.7% Ca. Serum P was increased (P<0.05) at the lowest level of TP when dietary Ca was lowered. Lowering the Ca level in general raised (P<0.05) serum P. Significant interactions were not detected for breast muscle yield or bone measurements. Significant (P<0.05) main effects were observed for bone ash. Ash was a function of the amounts of TP and Ca in the diets; Ca and P contents of the bones were not affected by the dietary treatments (P>0.05). Interactions or main effects for TP and Ca were not detected for body weight gain, feed consumption, feed conversion, breast muscle yield, serum P, and bone measurements at 7 weeks of age. In summary, our findings demonstrate that from 3-6 weeks of age, dietary total P can be lowered to 0.5-0.55% while it can be removed totally from the finisher diets without loss in performance or bone integrity.

**Key Words:** Chicken, Phosphorus, Calcium

114 Nutritional evaluation of low phytic acid barley mutants and demonstration of improved P availability that is independent of endogenous phytase activity. L. B. Linarese1, D. R. Ledoux1, T. L. Veu1, J. N. Broomhead2, V. Rabob2, and K. Zyla3. 1 University of Missouri, Columbia, MO. 2 USDA-ARS, Aberdeen, ID. 3 University of Agriculture, Krakow, Poland.

Two experiments were conducted to determine true metabolizable energy (TME) and digestible amino acids (AAD) in five low phytic acid barley (Hordeum vulgare L.) mutants, and demonstrate that improved P availability in barley mutants is independent of endogenous phytase activity. In Exp. 1. 48 cecectomized roosters (6 roosters/barley plus 6 roosters for determination of endogenous excreta) were used to determine TME and AAD in two wild type ( Hull-less (HWT) and Harrington Check (HC)) and five low phytic acid barley mutants (HM422, M422, M635, M955 and M1070). The TME values for HWT, HC, HM422, M422, M635, M955, and M1070 were 3249, 3137, 3181, 2977, 3040, 3170, and 2995 kcal/kg, respectively. Essential amino acid digestibility for HWT, HC, M422, M22, M635, M955, and M1070 averaged 86.5, 85.8, 83.7, 81.3, 86.2, and 82.9%, respectively. In Exp. 2, an in vitro digestion procedure, designed to simulate the physiological conditions in different parts of poultry gastrointestinal tract, was used to determine P release from barley cultivars containing endogenous phytase activity (non-autoclaved) or barley cultivars autoclaved (121 C, 20 kg/cm^2, 20 minutes) to destroy endogenous phytase activity. Analyzed endogenous phytase activities ranged from 183 U/kg for HC to 266 U/kg for HM422. Autoclaving reduced P release by 57% from wild-type barley cultivars and by 39% from mutant barley cultivars. In autoclaved barley cultivars, P release from mutant barleys averaged 58% compared with 28% for wild-type barleys. These results indicate that P in mutant barley cultivars is more available than P from wild type barley cultivars and this increase in availability is independent of endogenous phytase activity.

**Key Words:** Barley, TME, AAD, Calcium, Digestible, Phytase

Poult. Sci. 81 (Suppl. 1)
115 Energy and amino acid utilization in spray-dried egg determined with ducks. S.E. Norberg1, H. Dong1, M. Latour1, and O. Adeola1, 1Purdue University.

A study was conducted utilizing 24 White Pekin ducks to determine nitrogen-corrected apparent metabolizable energy (AMEn), true metabolizable energy (TMEn), and apparent amino acid digestibility (AAD) of spray-dried egg, a by-product of the egg industry. Soybean meal and plasma protein were also evaluated for energy and amino acid digestibility. Ducks were sorted by weight and divided into six blocks of four. Each block was randomized to spray-dried egg (SDE), plasma protein (PP), soybean meal (SBM) and dextrose. Ducks on the dextrose treatment served as a source of fasting energy, nitrogen and amino acid losses for calculating true energy and amino acid utilization values. The experiment consisted of an initial 48-h period and a 54-h excreta collection period. At 8 and 32 h after feed withdrawal, ducks were tube-fed dextrose (30 g/150 mL of water). At 48 and 54 h after feed withdrawal, ducks were tube-fed (30 g/150 mL of water) of each feed ingredient or dextrose. Excreta was collected at 54, 60, 72, 84, 96, and 102 h after feed withdrawal into whirl pak bags screwed onto caps sutured around the vent of each bird. The AMEn and TMEn values for ducks fed SDE were higher (P < 0.001) than PP, which was also higher (P < 0.001) than SBM. The AMEn values were 5.048, 3.230 and 2.605 kcal/g for SDE, PP, and SBM. The AAD of all of the indispensable amino acids except methionine, histidine and valine were similar for SDE, PP and SBM. Methionine digestibility in SDE was 89.5% higher (P < 0.001) than PP (88.3%) or SBM (91.3%). There was no difference in methionine digestibility between PP and SBM. Dispensable AAD except proline and alanine were similar for SDE, PP and SBM. Alanine digestibility in SDE was 89.9% higher (P < 0.005) than SBM (85.6%). There was no difference in alanine digestibility between SDE and PP. The study showed that the energy value of spray-dried egg is superior to that of plasma protein or soybean meal. Furthermore, digestibility of methionine is higher but valine, histidine and proline are lower in spray-dried egg as compared to plasma protein and soybean meal. Thus, spray-dried egg has a great potential as an energy and amino acid ingredient for non-ruminant diets.

Key Words: Spray-dried egg, Plasma protein, Metabolizable energy, Apparent amino acid digestibility, Ducks


The bio-availability of phytate from plant origin to poultry is very low. As a result the enzyme phytase is sometimes added to the feed to improve the availability of phytate phosphorus. There is enough evidence suggesting that there is a genetic component to bio-availability of phytate phosphorus to poultry. A 40 sire pedigree population was established using the Athens-Canadian random-bred population. The 102 hens were fed on .35 % phytate diet. At weeks of age, birds were put in individual metabolism cages for a 3 day acclimatization period. The amount of phytate phosphorus utilized by each hen was determined by analyzing the amount of phytate phosphorus in the total feed consumed and the feces produced. Six hundred and fifteen hens were used in this study. The data was subject to variance component analysis. The heritability estimate for phytate phosphorus utilization was 0.33. The result of this study suggests that phytate phosphorus utilization by hens is heritable, and selection can be successful.

Key Words: Phytate, Phosphorus, Heritability


Growth data from three Japanese quail populations were compared to ascertain the effect of long term selection on early and late growth, and the overall growth trajectory. Two of the populations have been divergently selected for week 2 body weight for 120 generations and the third is an unselected random control population. The Laird form of the Gompertz model, the Richards model and the spline regression models were fitted to the weekly body weights collected on the 3 populations. The results of this study suggest that selecting on juvenile body weight did result in changes in initial growth rate, the exponential decay rate and the shape of the curve. Thus, appropriate selection pressure can be applied to modified the trajectory of growth. The selection also resulted in a differential early mortality rate among the 3 populations.

Key Words: Growth, Selection, Trajectory


An experiment was conducted to investigate the influence of dietary supplemental betaine on performance, egg quality, liver betaine and AntiDiuretic Hormone (ADH) of laying hens. Two hundred eighty eight of seventy eight weeks old laying hens were fed basal diets containing 0, 500, 1,000, 2,000 ppm betaine during the environmentally high temperature stress. Basal diets contained 16% CP and 2,800 ME. Egg production, feed intake, feed conversion were examined for eight weeks. Egg qualities, liver betaine, blood osmolarity, AntiDiuretic Hormone (ADH) were measured at the end of experiment. Egg production of hens fed 500, 2,000 ppm of betaine was 75.06, 75.02% and tended to increase compared to that of control, but was not significant different. Feed conversion (FC) of those treatments was significantly lower than control (P < 0.05). Eggshell breaking strength of hens fed betaine was significantly higher than control (P < 0.05). However, betaine supplements showed no influence to increase the albumen height and Haugh unit. Liver betaine was linearly increased up to 2,000 ppm betaine diet. It showed significance between control and 2,000 ppm betaine treatment (P < 0.05). ADH of birds fed betaine supplemental diets tended to increase relative to that of control, but was not statistically different between them. As the results of this experiments, dietary supplemental betaine may have the potential to improve the performance, eggshell breaking strength, liver betaine.

Key Words: Betaine, laying hens, egg production, heat stress, egg quality

119 Tolerance of White Leghorn hens to iron in drinking water. B. L. Damron* and A. R. Eldred, University of Florida, Gainesville, Florida / USA.

Although a number of extension publications and magazine articles state tolerance levels for iron in poultry water supplies, there appears to be a paucity of scientific literature containing supporting data. The standard of 0.3 ppm is often recommended and is based on preventing taste and staining problems for humans. At the other end of the spectrum is a publication that says there is no evidence that iron will cause problems for poultry. There are limited data showing that iron was toxic to laying hens, and no data on the specific gravity of water that might affect iron toxicity. This study was designed to determine if iron toxicity could be a real problem. Drinking water treatments consisted of reagent grade ferrous sulfate added to deionized water in amounts sufficient to provide iron levels of 0, 0.5, 1, 2, 4, or 8 ppm iron in Experiment 1; 0, 4, 8, 16, or 24 ppm for Experiment 2; and 0, 100, 200, 300, 400, or 500 ppm during Experiment 3. Water treatments were prepared weekly and each provided ad libitum to six replicate pens of five hens in Experiment 1 and 3, and to five replicate pens for Experiment 2. Treatments were provided to each cage in a commercial trigger-operated watering cup mounted in a five-cage manifold and connected by plastic tubing to a collapsible 10-L container placed overhead for gravity flow. In all experiments egg production was recorded daily for individual birds. Personal egg weights and specific gravity were determined on five eggs per treatment each week. Feed consumption of each pen was measured over the 28-day period for calculation of daily feed intake and feed conversion. Body weight change was determined from individual weights taken at the beginning and end of each experiment. It appears from these studies that the laying hen’s tolerance for iron in drinking water was somewhere between 24 and 100 ppm, and that performance should not be adversely affected by the practical iron levels found in poultry water supplies.

Key Words: Drinking water, Iron tolerance, Laying hens

Fructooligosaccharides have the potential to substitute for dietary antibiotics, due to their beneficial roles and safety to animals and human beings. An experiment was conducted to evaluate the effect of dietary supplementation of fructooligosaccharides (FOS) on the performance and cecal microbial populations of broilers, compared to biogen and zinc bacitracin. One hundred and ninety-two 3-day-old male broiler chicks (Avian) were randomly assigned to four groups with four replications of 12 birds each. The control group was only fed a corn-soybean basal diet, FOS (33% fructooligosaccharides, 30% water, and 37% sucrose, glucose and fructose), biogen (a live bacillus-preparation) and zinc bacitracin (10% zinc bacitracin) were added to the basal diet at the level of 1.5%, 800mg/kg and 300mg/kg, respectively, to form the experimental diets. The feeding trial lasted for 21 days. Compared to control, dietary FOS increased cecal bifidobacterium number by 1.75-fold ($P<0.05$) at 14 of age and 1.45-fold ($P<0.05$) at 21 of age, but there was no effect of FOS on cecal E. coli number or pH ($P>0.05$). Zinc bacitracin-fed broilers were the least in cecal bifidobacteria numbers. Cecal bifidobacteria number of the biogen-fed group was slightly, but not significantly, more than that of the control ($P>0.05$). FOS-fed chicks did not show any improvement in daily weight gain, feed intake and feed efficiency. Zinc bacitracin improved weight gain by 6.10% ($P<0.05$) at day 7, and 1.71% ($P>0.05$) at day 14, compared to the control; and by 7.37% ($P<0.01$) at day 7, and 5.49% ($P<0.05$) at day 14, compared to FOS group. The results showed that dietary supplementation of FOS contributed to improvement of the intestinal microbial population, but growth promotion was not detectable in this experiment. The reason may be that dietary supplementation of FOS was higher than that it should be.

**Key Words:** Fluctooligosaccharides, Biogen, Zinc bacitracin, Microbial, Broiler chicks

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An experiment was conducted to investigate the effects of dietary supplementation of microbial phytase and cellulase and their interactions on performance, utilization of nutrients, and tibia quality index of layers fed corn-soybean meal basal diets. 192 Hixsec layers (18 weeks old) were randomly arranged into 8 groups with 4 replicates of 6 birds each. A 2x2x2 factorial design of treatments was used with two levels of non-phytate P (0.16% and 0.38%), two levels of phytase (0 and 300U/kg), and two levels of cellulase (0 and 0.1%). Dicalcium phosphate and ground limestone (0.16% and 0.38%), two levels of phytase (0 and 300U/kg), and two levels of cellulase (0 and 0.1%) were added to the basal diet at the level of 1.5%, 800mg/kg and 300mg/kg, respectively, to form the experimental diets. The feeding trial lasted for 31 weeks. Dietary 0.1% cellulase significantly decreased feed intake ($P<0.05$) at day 14, compared to the control; and by 7.37% ($P<0.01$) at day 7, and 5.49% ($P<0.05$) at day 14, compared to FOS group. The results showed that dietary supplementation of FOS contributed to improvement of the intestinal microbial population, but growth promotion was not detectable in this experiment. The reason may be that dietary supplementation of FOS was higher than that it should be.

**Key Words:** Phytase, Cellulase, Performance, Nutrient utilization, Layers

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**122 The Effect of Betaine on Performance of Layers Fed Corn-Based Diets Reduced in Choline Chloride and Methionine.** J Castaing1, P Larroude1, B Messager2, and M. Hruby3, 1ADSO, France, 2CEVA Nutrition Animale, France, 3Finnfeeds International, UK.

A trial was conducted to establish whether the part of methionine and choline, which is used to cover layer’s requirement for methyl groups could be replaced by a more efficient methyl donor betaine and in essence reduce the requirement by layers for methionine and choline. 144 ISA Brown 44-week old layers were assigned into two treatments, one bird per cage. Corn/wheat-based diet with a metabolizable energy of 2760 kcal ME/kg, 17% crude protein, lysine 0.78%, methionine 0.37% and choline chloride (100%) at 375 g was reduced in methionine (0.315%), all added choline chloride, and supplemented with 610 g of betaine (Betafin® S1) per tonne of feed. The replacement ratios used between DL-methionine and choline chloride (100%) with betaine product were 1.3 and 2.08 : 1. Performance characteristics were observed during a 12-week long trial. Between the control and betaine treatment there was observed no significant ($P>0.05$) effect on feed intake (105.4g vs. 105.7g), egg production (85.5% vs. 86.9%) and feed conversion (1.93 vs. 1.93). Egg weight (64.7g vs. 63.6g) was also not affected significantly but there was a tendency for the betaine treatment to have a lower percentage of heavier eggs above 63 g (64% vs. 55%). The result of this trial suggested that a significant amount of methyl donor choline and methionine can be replaced by betaine without reduction in performance.

**Key Words:** Layer, Methyl Donor, Betaine, Choline, Methionine

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**123 Pearl Millet as an Alternative Feed Ingredient in Broiler Production.** A. J. Davis*, M. E. Freeman, and N. M. Dale, University of Georgia.

Widespread cultivation of pearl millet for grain production has been limited due to its susceptibility to rust disease and its inability to compete economically with the production of corn and soybeans. Pearl millet’s tolerance to heat, drought and acidic soils, however, may make it an ideal crop in the Southeastern US. Grain from a rust resistant strain of pearl millet developed at the Coastal Plain Experiment Station at Tifton, GA was evaluated in a 6-wk broiler experiment. The grain from this hybrid had a TMEN of 3372 Kcal/kg (90.4% DM) and contained 12.3g/100g protein with a favorable amino acid profile. Ground pearl millet was incorporated into broiler starter and finisher diets at 33.3g/100g diet at the expense of corn and soybean meal. Performance of chicks fed the millet diets was compared to those fed standard corn/soybean starter and finisher diets. All diets were isocaloric and isonitrogenous. Day-old CobbxCobb mixed-sex chicks were randomly assigned to 20 floor pens in an environmentally controlled broiler house. Each pen contained 30 birds. Half of the pens were fed the millet based diets while the others were fed standard corn/soy diets. At 3 wks of age there were no differences in weight gain and feed conversions. At 6 wks of age, chicks fed the pearl millet based diets had an average body weight gain of 2.172g/bird and a feed conversion of 1.689, while the control chicks had a feed conversion of 1.652 and a significantly ($P<0.05$) lower body weight gain of 2.069g/bird. Further examination of body weight gains revealed that millet-fed males and females had average gains of 2,409 and 2,048g, respectively, while the control males and females had average gains of 2,320 and 1,932g, respectively. The difference in weight gain between the females fed the millet and those fed the control diet was significant ($P=0.014$) while the difference in the gain of the male birds was not ($P=0.127$). Ten birds (5 male and 5 female) were randomly selected from each pen and processed. The average carcass weight of the female birds fed millet was significantly greater than controls, while comparable weights between the males was not different. The results suggest that pearl millet could be an effective alternative grain for poultry production.

**Key Words:** Pearl millet, Chicks, Carcass

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**124 Lysine Addition to Commercially Overprocessed Soybean Meal.** N. M. Dale* and A. J. Davis, University of Georgia.

Previous research from this laboratory has indicated that lysine supplementation to diets containing overprocessed soybean meal (SBM) largely overcomes the associated depression in chick performance. In those studies, SBM was overprocessed in a laboratory autoclave so as to closely control the process. While lysine supplementation largely overcame the negative effects of overprocessing, it was not clear whether this response,
observed with autoclaved SBM, would also be observed with samples inadvertently overprocessed under commercial conditions. A corn-soy formula, slightly deficient in total lysine (1.06%) was employed in three basal treatments containing either: 1) normal SBM, 2) SBM overprocessed in an autoclave, or 3) SBM received at a local feed mill with a KOH protein solubility of 63% (indicative of overprocessing). To a portion of each of these diets 1.25% lysine (from lysine HCl) was added. Six replicates of six mixed-sex broiler chicks received each of the six test diets for a 14-day period. No significant differences were observed in growth rate between any of the treatments. Addition of 0.375% of lysine to all test diets significantly improved feed conversion. The degree of improvement from lysine supplementation was far greater in those treatments based on either autoclaved or commercially overprocessed SBM in which lysine was presumed more deficient due to the effects of the Mailard reaction. Improvements in feed conversion associated with lysine supplementation were 5.33%, 8.97% and 8.55% with the control soy, autoclaved soy and commercially overprocessed soy diets, respectively. These results confirm that previous observations on the use of lysine to overcome the negative effects of SBM overprocessing, which had been conducted with autoclaved samples, can be extended in their application to soybean meal overprocessed under commercial conditions.

Key Words: Overprocessed soybean meal, Lysine, Chicks

125 Effect of processing and birds age on metabolizable energy of full fat soybean. Nilva Sakomura*, Eduardo Freitas1, Rafael Neme1, and Andrea Santos1, 1Faculdade de Ciências Agrárias e Veterinárias, UNESP, Jaboticabal - SP - Brasil.

Full fat soybean can be processed by steam or extrusion in order to inactivate antinutritional factors. This study was conducted to determine the metabolizable energy (MEₙ) of full fat soybean heated (HFS), full fat soybean extruded (EFS) compared to a mixture of soybean meal solvent extracted (80%) and oil (20%) (SM+O) for chicks and roosters. Two digestibility trials were conducted by total collection of excreta methodology. In the first trial 240 12 old chicks were distributed in 4 treatments with 6 replicates of 10 birds and in the second one 56 roosters were used in 4 treatments with 7 replicates of 2 birds. Full fat soybean was removed 40% of control diet (2900 kcal/kg and 20.5% CP). The results were analysed as a factorial arrangement of two bird age (chicks and roosters) and three soybean meal types (HFS, EFS and SM+O). MEₙ (kcal/kg DM) values of HFS, EFS and SM+O determined on chicks and roosters were: 3.359, 3.503, 3.648 and 3.586, 3.818, 3.976, respectively. The MEₙ values of HFS, EFS and SM+O determined on chicks and roosters were: 3.359, 3.503, 3.648 and 3.586, 3.818, 3.976, respectively. The MEₙ values of soybeans determined on chicks were lower than rooster because the fat digestion is smaller in young than older birds. MEₙ of full fat soybean heated was lower than full fat soybean extruded and mixture of SM+O in function of heat processing of HFS does not liberate oil of the cells.

Key Words: Chick, Full fat soybean, Metabolizable energy, Processing, Rooster

126 The Effect of an Endo-Xylanase and Beta-Glucanase Complex on Nutrient Digestibility in Animal-By-Product Free Broiler Diets With Significant Inclusions of Canola Meal. R. Stilborn1, R. Salmon2, H. Burrows3, and M. Hruby4, 1Lakeside Research, Alberta, Canada, 2Walbee Consulting, Saskatchewan, Canada, 3Finnefeds Int. Ltd., Marlborough, UK.

Two studies were conducted with Arbor Acre x Peterson male broilers to determine the effect of canola meal inclusion in animal-by-product free wheat/soy-based diets on broiler performance and the effect of an endo-xylanase and beta-glucanase mixture on nutrient digestibility at the ileal and fecal levels. 2016 male broilers were assigned to four treatments: 1. 6% canola meal inclusion; 2. as 1. plus enzyme (Grindzym 5.33% GP 15000); 3. 12% canola meal; 4. as 3. plus enzyme. In the second experiment, male broilers were assigned to two treatments and fed pelleted diets from treatment 3 and 4 of the previous experiment. At 20 days of age, 24 birds per treatment were slaughtered, ileal digesta collected and analyzed for crude protein, energy, Ca, P and amino acids using the chronic oxide marker technique. Fecal samples from each pen were also collected and analyzed for crude protein and energy content. In the present study, increasing canola inclusion from 6% to 12% significantly reduced weight gain (P<0.001) and feed intake up to 40 days of age and feed conversion (P<0.001) up to 21 days of age. The main effect of enzyme addition was a significantly reduced feed intake (P<0.001) and improved feed conversion (P<0.001) at 40 days of age. The results of the digestibility study supported the growth trial data with a significant (P<0.05) improvement in ileal digestibility of energy, crude protein, phosphorus and 16 essential and non-essential amino acids. Fecal digestibility values showed a significant improvement (P<0.05) for energy and crude protein in the enzyme treatment. In the animal-by-product free diets, the need to incorporate different types of EXS or higher inclusions of vegetable protein sources in order to maintain a diet cost without affecting broiler growth rate is a significant advantage of the enzyme mixture. This research suggests that a xylanase and beta-glucanase complex could allow relaxation of the limits on inclusion of alternative vegetable protein sources.

Key Words: Xylanase, Beta-Glucanase, Canola, Animal-by-Product Free Diet
129 Impact of Liquid *Saccharopolyspora* Solubles Concentrate on Pellet Mill Throughput and Broiler Performance. M. T. Kidd*, 2 D. J. Fidler, K. B. Koch, B. J. Traxler, 3 and C. L. Quarles 4. 1Mississippi State University, Mississippi State, MS, 2Abbott Laboratories, North Chicago, IL, 3North Dakota State University, Fargo, ND, 4Colorado Quality Research, Wellington, CO.

Three experiments were conducted to evaluate the impact of liquid *Saccharopolyspora* Solubles Concentrate (SynerMaxSM) on pellet mill throughput and broiler performance. Pellet mill energy consumption, pellet mill throughput, and pellet durability index were measured in diets containing 0.0, 0.5, 1.0, 2.0, and 4.0% SynerMax of diet (3 replications/treatment). Quadratic regression equations indicated that optimal (P < 0.05) pellet mill energy consumption, pellet mill throughput, and pellet durability index occurred when diets contained 1.6% SynerMax of diet, respectively. Female broilers (1,440) were allocated to 140 battery cages (10 birds/cage) and fed one of five treatment diets (0.0, 0.5, 1.0, 2.0, or 4.0% SynerMax of diet; 28 replications/treatment) from Days 1 to 28. Body weight was improved (P < 0.05) as SynerMax was increased to 1.7% of diet (95% of the asymptote). Male and female broilers (1,092) were placed separately in 78 floor pens. Birds received dietary treatments of 0.0, 0.5, or 1.0% SynerMax of diet (13 replications/treatment) from Days 1 to 50. Performance responses were measured by pen and all male broilers from 11 pens per treatment were processed. Male broilers had better (P < 0.05) Day 50 BW and feed:gain corrected for mortality than female broilers. Female broilers and broilers fed diets containing 0.5% SynerMax of diet had higher (P < 0.05) livability than male or control fed broilers, respectively. Feed:gain did not differ (P > 0.05) for female broilers, but male broilers had improved feed:gain and breast meat yield (P < 0.05) when fed diets containing 0.5% SynerMax over control fed male broilers. Diets containing SynerMax had improved pellet mill performance, and improved live performance and breast meat responses.

Key Words: SynerMax, Broiler, Pellet Mill, Breast Meat

130 Effect of Dietary Liquid *Saccharopolyspora* Solubles Concentrate on Broiler Performance and Carcass Traits. D. J. Fidler*, 1 B. George, 2 C. L. Quarles, 3 and M. T. Kidd 4. 1Abbott Laboratories, North Chicago, IL, 2Colorado Quality Research, Wellington, CO, 3Mississippi State University, Mississippi State, MS.

Male broilers (936) in Experiments 1 and 2 were randomized across 78 floor pens. In Experiment 1, treatments (3 x 2 x 13 replications) consisted of three dietary levels of liquid *Saccharopolyspora* solubles concentrate (SynerMaxSM): 0.0, 0.5, and 1.0% of diet) and two dietary levels of Primalac (0.5 and 1.0% of diet). Treatments (3 x 2 x 13 replications) consisted of three dietary levels of SynerMax (0.0, 0.5, and 1.0% of diet) with and without an antibiotic (25 g/ton of BMD®-50 in the starter and grower and 15 g/ton of virginiamycin in the finisher) in Experiment 2. Experiments 1 and 2 were completed at Day 48 and 49, respectively. Growth performance, intestinal strength, and carcass characteristics were measured. In Experiment 2, intestinal bacterial populations were counted and differences among treatments did not occur. In Experiment 1, the dietary addition of the antibiotics decreased (P < 0.05) BW, BW of process birds, and carcass weight. Dietary SynerMax was without effect on live performance, but increased (P < 0.05) breast meat yield when fed at 0.5% of diet. In Experiment 2, birds fed 1.0% SynerMax had improved (P < 0.05) BW over the control, and feed:gain was decreased (P < 0.05) in birds fed 0.5% SynerMax over the control. Dietary SynerMax and Primalac interacted (P < 0.05) to affect BW, feed:gain, feed:gain corrected for mortality, processing BW, chill weight, and breast meat weight. All interactions, except feed:gain, indicated that the optimal response occurred when dietary SynerMax was fed at the 1.0% level without Primalac. All treatment diets had lower (P < 0.05) feed:gain over the control. Broilers fed 1.0% dietary SynerMax had greater (P < 0.06) intestinal strength than broilers fed the control diet in Experiment 1, but treatment additions of Primalac or SynerMax did not affect intestinal strength in Experiment 2.

Key Words: SynerMax, Broiler, Antibiotic

131 Effects of an oxygenized water supply on the health and gut microflora of broiler chickens. S. M. Ellis 1 and K. J. McCracken 1, 2. 1Queens University Belfast, 2DARDINI.

Studies were carried out into the effects of an oxygenized water supply on the performance, immune system and gut microflora of broiler chickens. An electrocatalytic process was used to dissociate hydrogen and oxygen thus producing a stable increase in dissolved oxygen usually in the region of 10 ppm. A unit of 40,000 broiler birds was maintained to 40d of age. Half were provided with drinking water which had been oxygenized by the process described, and the other supplied with normal water (controls). Performance characteristics and mortality were recorded for both groups. At 35d, ten birds from each group were killed and their gut microflora studied using samples of proximal ileal and caecal digesta. Appropriate dilution series were prepared and samples were plated onto MR5S agar, for presumptive numbers of lactic acid bacteria, and Macconkey agar, for presumptive numbers of coliforms. In addition, the bursa was excised from each of the birds and its weight recorded. Lactic acid bacteria numbers in the ileum (7.91 log10 cfu/g) were similar but Coliform counts tended to be reduced with oxygenized water (7.49 v vs 7.76 log10 cfu/g) with the result that the ratio of lactic acid bacteria to coliforms was increased from 1.43 in controls to 3.06 in birds supplied with oxygenized water. A similar pattern was seen in the caecal counts with lactic acid bacteria increased from 8.10 to 8.39 log10cfu/g, coliform counts reduced from 9.16 to 8.65 log10cfu/g, and the ratio increased from 1.04 to 3.32, when birds were supplied with the oxygenized water. The mean weight of the bursa was higher in birds given the oxygenized water, (2.04g vs 0.87g in controls). Mortality was 3.9% for birds given oxygenised water compared with 7.2% for controls. It is concluded therefore that the oxygenization of a broiler water supply can modify the microflora in ways which may be beneficial to the bird, and that part of the response may be mediated through the bird’s immune system.

Key Words: Broiler, Oxygenized water, Microflora, Mortality, Bursa

132 Effect of energy (fat) at different protein levels on egg weight of older hens under summer conditions. S. S. Sohail, M. M. Bryant, and D. A. Roland, Sr., Auburn University.

A study was conducted to determine the effect of energy (fat) on egg weight at two dietary protein levels under summer conditions. Hyline W36 hens (n = 1600; 60 wk old) were randomly assigned to corn-soy diets containing two levels of protein (18.7 and 16.1%) and five graded levels of energy (2783, 2816, 2849, 2882, and 2915 kcal ME/kg feed) in a 2 x 5 factorial arrangement of treatments. Egg weight, egg production, egg specific gravity, feed consumption, body weight, and mortality were measured. Increasing protein from 16.1 to 18.7% increased feed consumption and egg specific gravity, body weight, and mortality were measured. Increasing protein from 16.1 to 18.7% increased feed consumption from 89.2 to 91.3 g (P < 0.05) and 4.0 to 5.1 g (P < 0.05) within one wk. No effect of increasing protein was observed on egg production, egg specific gravity, body weight or mortality. Increasing dietary energy from 2783 to 2915 kcal/kg feed had no effect on egg weight, egg production, egg specific gravity, feed consumption, body weight or mortality. This indicates that increasing dietary energy level above 2783 kcal/kg feed had no beneficial effect on egg weight of older hens under summer conditions.

Key Words: Egg weight, Energy, Hens, Protein

133 Evaluation of Xylanase Enzyme in Wheat Based Diet with Different Level of Energy and Protein. A Bazzazadehakani 1, A Kamyb, 1 M. R. Abdollahi 1, and A. Z. Shahn1e. 1Animal Sci. Dept. College of Ag. U of Tehran, Karaj-Iran.

An experiment was conducted in a completely randomized design to study the efficiency of a xylanase enzyme (VETAZYME). Eight hundred and twenty five adult mixed sexed chicks were randomly allocated into 11 dietary treatments with three replicates of 25 birds each. The diets were mixed separately for starter (1-21d) and grower (22-42d) periods. The experimental diets consisted of 1) wheat with no enzyme supplement, and 2) wheat, 250 ppm of xylanase enzyme (VETAZYME) in a complete diet.
2) same as 1, but plus enzyme, 3) wheat, increased ME by 5%, plus en-
zyme, 4) wheat, increased ME by 10%, plus enzyme, 5) wheat, increased
CP by 5%, plus enzyme, 6) wheat, increased CP by 10%, plus enzyme,
7) wheat, increased CP by 5%, plus enzyme, 8) wheat, plus enzyme,
9) wheat, increased ME by 10% and CP by 5%, plus enzyme, 10) wheat,
increased both ME and CP by 10%, plus enzyme, and 11) corn + soybean
meal with no enzyme addi-
tion as positive control. The enzyme was added to mashed diets at the
recommended level (500g/ton of feed). The chicks body weight and feed
conversion were measured weekly up to the end of experimental period
(42 day of age). At the end of the study, three birds from each repli-
cate were selected to determine carcass quality. The results showed that
there were marked diet effects (P < 0.05) on body weight gain (WG) and
feed efficiency (FE) which the birds fed the diet 5 having the greatest
WG, and better FE for the entire period of the study. On day 42, there
was no significant difference among groups in liver, abdominal fat, and
gallbladder as a percentage of carcass weight (P > 0.05), but significant
differences in percentage of breast and thigh were obtained (P < 0.05).
In addition, feed cost per unit of live body weight, in group 5 was lowest.
The result of this study suggests that one may need to evaluate enzymes
based on their effects on nutrients in order to reduce feed cost.

Key Words: broiler, enzyme, xylanase, wheat, ME

134 The response of laying hens to phytase added to corn-soybean meal based diets containing two levels of crude protein. S. Muji*, L. M. Kamberi1, A. Gagic2, G. M. Pesti3, and R. I. Bakalli1,1,1 The University of Prishtina, Kosovo, 2 The Univer-
sity of Sarajevo, Bosnia and Herzegovina, 3 The University of Georgia, Athens, GA.

Phytate is a powerful anti-nutritional factor that significantly reduces the
availability of several nutrients, mainly phosphorus but also calcium,
zinc, magnesium, carbohydrates, etc. Nutritional significance of phytate
is further complicated by protein-mineral phytate interactions and its
inhibitory effects on proteolytic enzymes (pepsin, amylase and trypsin).
Phytate-protein interactions may influence the digestibility of protein.
A trial was conducted to determine the effects of adding phytase
(Natuphos®, BASF) to corn soybean laying hen diets for 8 weeks with
different crude protein (CP) levels. After 14-d adjustment on a common
layer diet, 144 Hysex Brown hens were allotted using a randomized
complete block design, to four treatments in a factorial arrangement of two
CP levels (17 and 14%) and two phytase levels (0 and 600 FTU/kg).
Each treatment was assigned to 3 replicates of 12 hens. Body weight,
feed consumption, egg weight, and egg specific gravity were measured
biweekly. Egg production was recorded daily.
The 14% CP diet with no supplemental phytase resulted in significantly
lower egg production (73.84 %, 89.10.6 ; 83.01.9 , and 84.00.9 %, for
hens fed 14% CP no phytase, 14% CP + phytase, 17% CP no phytase,
and 17% CP + phytase, respectively), and egg weight (61.45 g, 62.40.41 g,
63.30.5 g; and 63.20.5 g, respectively). The 17% CP diet with no
supplemental phytase resulted in significantly lower egg specific
gravity (1.0880.001; 1.0880.001; 1.0810.001; and 1.0870.002,
respectively). Crude protein level and added phytase did not have any effect
on final body weight, or daily feed intake per hen.
The results of this study indicate that 600 FTU/kg phytase improves the
utilization of crude protein in corn-soybean meal diets of laying hens
containing 14% CP. In this short term study, 14% CP was adequate to
support maximum performance egg numbers and weight in layers as long as
phytase was also fed.

Key Words: Laying Hens, Crude Protein, Phytase


An experiment was conducted to marketing age of 42 days. In this trial,
three diets were administered: 1) NRC available P; 45%, 2) same as 1, but
available P at 45%), and 3) same as 2 but supplemented with phytase
at recommended level. All the mash, starter (0-21) and grower (22-42),
diets were fed to Arian broiler chick ad lib. At 3 and 6 weeks of age
birds fed with diet 2 had significantly lower body weight gain than other
groups (P<0.05). Even though, feed intake for the same age periods was
higher, but it was not statistically significant (P>0.05). Overall, the avail-
able phorous levels tested in this study did not affect carcass quality of
birds. At the same age, breast yield and leg weight were higher for
birds received dietary treatment 3 (P<0.05). Leg abnormality percent-
age was higher and bone ash percentage was lower (P<0.05) in-group
two compared to others. Likewise percent livability also improved with
phytase-supplemented diet (P<0.05).

Key Words: broiler, phytase, carcass, performance, bone ash

136 The effect of a xylanase and protease enzyme on egg production in laying birds fed wheat based diets. F Short1, M Hruby2*, B Burrows2, and M Bedford2, 2 ADAS Gleadthorpe, Mansfield, UK, 2 Finnepps International, Marlborough, UK.

It is well known that in broiler diets xylanase and protease based enzymes
reduce digesta viscosity and make nutrients more available to the bird
by initiating arabinoyxylan breakdown. This increases nutrient digestion.
In laying bird diets there is also evidence that this is the case. Work has
shown that enzymes can increase fecal amino acid digestibility by 4.7%
and ileal protein digestibility by 14.8% (SAC Auchincruive, UK). A fur-
ther study was undertaken at ADAS Gleadthorpe to assess the efficacy
of Avizyme 1300® (a xylanase and protease enzyme) on production and
amino acid digestibility in laying birds. Two dietary treatments com-
prising of wheat based diets to which enzyme was added at an inclusion
rate of either 0.75g/kg or zero were imposed on a flock of 384 Hubbard
ISA laying hens. Each replicate used 8 hens and there were 24 repli-
cation and treatment. Feed and water were ad lib. Sample
bodyweights were made at 18, 24, 30, 48 and 60 weeks. Feed usage and
feed conversion efficiency were determined at six-weekly intervals and egg
production calculated weekly. At the end of the study, diets were made
incorporating titanium dioxide at a rate of 1g/kg and ileal samples were
 taken for amino and acid analyses to enable determination of amino
acid digestibility. The presence of the enzyme in the diet signifi-
cantly improved production throughout the study (p<0.05). Average egg
production throughout the study was 1.6% higher in the birds fed the
enzyme supplemented diet compared with the control. This was partic-
ularly evident during the last six weeks of the study, when production in
hens on the enzyme supplemented diet, increased by 4.25% to a mean of
87.4%, compared with 83.1% for the control birds. These results were also signifi-
cantly higher during this period at 56.53g/bird/day (p<0.05). The presence of the enzyme in the diets also resulted in improvements in other production variables which were not significant. Birds fed the enzyme supplemented diets produced fewer
second quality eggs. Feed intake and mortality were not influenced by
enzyme supplementation. The presence of the enzyme resulted in
improved amino acid digestibilities for all the amino acids analysed. The
improvement was significant (p<0.05) for valine, histidine and threonine.

Key Words: Layers, Wheat, Enzymes

137 Pelleting stability of Ronozyme P (CT) phytase in commercial feedmills: an update. N.E. Ward*1 and J.W. Wilson1, 1 Roche Vitamins Inc., Parsippany NJ.

Ronozyme P (CT) is a dry source of phytase designed for improved
stability in pelleted feeds and other feed applications that coexist with
moisture and heat. This phytase is produced by Aspergillus oryzae car-
ging a gene for Peniophora lycii phytase, and is manufactured with a
patented carbohydrate-based matrix surrounded by a thin, lipid coating.
The combination is intended to reduce exposure to moisture and heat,
while having no effect on phytase bioavailability. A substantial improvement in percent retention over that of the
commercial form of Aspergillus niger phytase (Natuphosp) was determined
in controlled pelleting studies. Initial trials found 75-80% of Ronozyme P
(CT) to survive pelleting as opposed to less than 20% Natuphosp 5000G
at 190°F. This report provides an update on the testing of this phytase in commercial
crude fat in feedmills in the U.S. In 64 feedmills that have been tested, 0.25 to 0.60 lb (113 to 272 gams) was added without the aid of a carrier in
2,000 lb (907 kg) feed. A total of 10-20 mash samples was collected as the feed exited the mixer, and 10-20 samples of the pelleted feed were col-
lected at the cooler. All samples were taken at equal time intervals based on
feed exit rate. Pellet feed temperature was determined as pellets exiting
the die. Analysis of the phytase in feed samples was used to determine
percent phytase retained in the pelleted portion of the feed.
In 64 feedmills tested, the mean pellet temperature was 189.6°F (88°C),
while the mash conditioning time averaged 32.4 seconds, across all feed-
mills. Under these conditions, the phytase retention from Ronozyme P
(CT) was 81.0% while the coefficient of variation for mixibility was
11.3%. Testing 90-180 days later found the retention value to be highly

Key Words: broiler, enzyme, xylanase, wheat, ME
repeateable. These results confirm initial findings that Ronozyme P (CT) phytase can mix well in feed, and provide excellent recovery in commercial poultry feedmills.

<table>
<thead>
<tr>
<th>Pellet Conditioning Mixability Phytase number</th>
<th>P/F/°C</th>
<th>time, number</th>
<th>coefficient of retention, variation, %</th>
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</thead>
<tbody>
<tr>
<td>Pellet</td>
<td>64</td>
<td>189.6 (13.0)</td>
<td>32.4 (17.9) 11.3 (2.8) 81.0 (8.8)</td>
</tr>
</tbody>
</table>

*Data given as means with standard deviation within parentheses

Key Words: Ronozyme P (CT), Phytase, Pelleting

**138 Zinc and Copper Excretion of Broiler Chicks Fed Gradient Concentrations of Zinc and Copper from Three Different Sources.** W. A. III Dozier*, A. J. Davis*, M. E. Freeman, and T. L. Ward, 1University of Georgia, 2Zinpro Corporation.

Nutrient accumulation on cropland has created environmental concerns in areas of intensive animal production. An excessive concentration of heavy metals in poultry manure applied to cropland has been reported to cause phytotoxicity in peanuts. Organic sources of zinc and copper have been reported to be more available to the chick than inorganic sources; therefore, dietary manipulation may be a strategy to reduce excretion of heavy metals. Two experiments were conducted to assess zinc and copper excretion of straight-run broiler chicks (Ross x Ross 308) fed gradient concentrations of zinc and copper during an 18-day assay. For each experiment, chicks were randomly distributed into 72 battery cages (8 chicks/cage). A 48-hr excreta collection period was conducted from Days 16 to 18 to measure zinc and copper output on DM basis. Treatment structure consisted of a 3 x 3 factorial arrangement. In Exp. 1, supplemental zinc (40, 80, or 120 ppm) from 3 different sources (zinc sulfate, Availa zinc amino acid complex, 50% zinc sulfate: Availa zinc combination) was added to a basal diet containing 30 ppm of zinc. Progressive additions of supplemental zinc increased absolute zinc excretion (40 ppm zinc = 33; 80 ppm zinc = 48; 120 ppm zinc = 59 mg; P < 0.001) as well as zinc excretion as a percentage of zinc intake (P < 0.001). Supplying dietary zinc as zinc sulfate reduced absolute zinc excretion over Availa zinc, but no difference occurred providing with zinc as a combination of zinc sulfate:Availa zinc compared with zinc sulfate. In Exp. 2, dietary treatments consisted of adding 3 concentrations of copper (4, 8, or 12 ppm) from 3 different sources (copper sulfate, Availa copper amino acid complex, and 50% copper sulfate: Availa copper combination) to the basal diet that contained 6 ppm of copper. Increasing concentrations of supplemental copper reduced copper excretion linearly (4 ppm copper = 1.35; 8 ppm = 1.83; 12 ppm copper = 2.09 mg; P < 0.001). These data indicated that reducing supplemental zinc diet from 120 to 40 ppm decreased zinc excretion by 44% and reducing supplemental dietary copper from 12 to 4 ppm decreased copper excretion by 35% with 18-day-old broilers.

Key Words: Broiler, Zinc, Copper

**139 Zinc utilization is improved in broiler chicks fed a diet containing low phytic acid barley (Hordeum vulgare L.), E. A. Guaíme*, J. N. Broomhead*, P. Butkeraitis*, D. R. Ledoux*, T. L. Veum2, V. Raboy3, and K. Zyila2, 1Universidade Estadual Paulista, Brazil, 2University of Missouri, Columbia, MO, 3Universidade de Sao Paulo, Brazil, 4USDA-ARS, Aberdeen, ID, 5University of Agriculture, Krakow, Poland.

Phytic acid can form insoluble salts with minerals like Ca and Zn, diminishing their bioavailability. In a 2 x 3 factorial experiment, 96 male broilers (4 pens of four chicks/treatment) were fed diets containing either wild type (HC) or a low phytic acid mutant barley (M955). Each barley diet was supplemented with 0, 10, or 20 mg/kg Zn from zinc sulfate to determine the effects of low phytic acid barley on Zn utilization in broilers fed diets to 21 days of age. The HC barley contained 0.30% total P (1%), 0.20% phytate P (pP), and 23 mg/kg Zn, whereas M955 barley contained 0.22% P, 0.05% pP, and 42 mg/kg Zn. Barley made up 60% of each diet and was the only source of phytic acid in the diets which were formulated to contain 1.0% Ca, 0.45% nonphytate P, and 24 mg/kg Zn. Feed intake, body weight gain, feed conversion, and percent tibia ash were not affected (P > 0.05) by dietary treatments and averaged 837 g, 585 g, 1.43 g/kg, and 46.1%, respectively. Zinc concentrations in toe ash (TZ) and tibia ash (TBZ) were affected (P < 0.001) by both barley source and Zn level. Both TZ and TBZ increased with increasing levels of dietary Zn (TZ, 462, 527, 557 mg/kg; TBZ, 333, 410, 440 mg/kg) and were higher in chicks fed M955 compared with those fed HC (TZ, 579 vs 453 mg/kg; TBZ, 456 vs 327 mg/kg). Significant barley source by Zn level interactions (P < 0.001) were also observed for both TZ and TBZ. In chicks fed HC, TZ and TBZ increased with increasing Zn supplementation, whereas in chicks fed M955 there was no increase in TZ or TBZ with increasing Zn supplementation. Results indicated that chicks fed M955 were able to utilize more dietary Zn than chicks fed HC. Differences in Zn utilization could not be due to endogenous phytase activity since barleys had similar endogenous phytase activities (183 vs 190 U/kg).

Key Words: Low phytate barley, Zinc utilization, Broilers


A study was conducted to evaluate the performance of broilers fed corn-soybean meal diets supplemented with a dry, alpha-galactosidase based enzyme system. Seven hundred and sixty eight straight-run broiler chicks were randomly distributed among 16 pens (24 male and 24 female chicks). The feeding program consisted of starter, grower, and finisher feeds fed from 0-21, 22-35, and 36-49 days of age, respectively. Treated feeds were supplemented with 500 g/ton of the experimental enzyme system. Body weights, feed conversions, and mortality at 49 days of age for control and enzyme treated broilers were 2645 and 2667g, 1.941 and 1.918, and 3.12 and 1.04%, respectively, but were not statistically different at the P ≤ 0.05 level. However, average daily gain and feed conversion for supplemented broilers were significantly (P < 0.05) better than controls from 36-49 days of age. Improvement in overall livability, as well as, rate of gain and feed efficiency in the latter grow-out phase may result in improved performance of enzyme treated broilers relative to non-treated controls.

Key Words: Performance, Broilers, Alpha-Galactosidase


An improvement in energy release from the diet components has been postulated to explain some of the benefits (improved feed efficiency, livability, increased body weight and improved breast meat yield) demonstrated in field trials using KEMZYME® C/S for Broilers liquid. The objective of this work was to determine the efficacy of an experimental dry alpha-galactosidase based system, in comparison to the existing KEMZYME C/S for Broilers Liquid, as it relates to in vitro energy release. A combination of corn and soy was utilized as the substrate for an in vitro energy release study conducted under 3 pH conditions. The improvement in production of reducing sugars due to enzyme treatment ranged from 5164 and 4746 µg/mL at pH 4.5, 4402 and 3891 µg/mL at pH 5.0 and 3927 and 3211 µg/mL at pH 6.0 for KEMZYME C/S for Broilers Liquid and the dry enzyme system, respectively, over untreated values of 2611, 1932 and 1699 µg/mL for the same pH conditions. HPLC profiles for samples treated with the products demonstrated similar increases in levels of galactose and raffinose with concomitant decreases in stachyose. Levels of soluble proteins were increased to values of 2824 and 3112 µg/mL at pH 4.5, 3520 and 3477 µg/mL at pH 5.0 and 4066 and 4227 µg/mL at pH 6.0 as a result of treatment with the liquid and dry products over untreated levels of 2295, 2645 and 2667g, 1.941 and 1.918, and 3.12 and 1.04%, respectively, but were not statistically different at the P ≤ 0.05 level. However, average daily gain and feed conversion for supplemented broilers were significantly (P < 0.05) better than controls from 36-49 days of age. Improvement in overall livability, as well as, rate of gain and feed efficiency in the latter grow-out phase may result in improved performance of enzyme treated broilers relative to non-treated controls.

Key Words: Performance, Broilers, Alpha-Galactosidase
142 Effect of Varied Amounts of Dietary Ascorbic Acid on Concentration of Plasma and Hepatic Ascorbate and L-Gulonolactone Oxidase Activity. D. Maurice1, S. F. Lightsey2, and J. E. Toler1, 1Clemson University, Clemson, South Carolina, USA.

Chickens synthesize ascorbic acid (AsA) and the inconsistent responses to supplemental AsA prompted us to examine factors affecting biosynthesis. We have previously shown that 1000 mg/kg AsA inhibited L-gulonolactone oxidase (GLO) activity in fast- and slow-growing chickens and characterized the functional relationship between GLO activity and age. The effect of dietary AsA and duration of feeding on tissue AsA and GLO activity was measured in broiler chicks fed practical diets with 0, 300, 600, 900 mg/kg AsA for 12 weeks (May-August). Birds were killed at 1, 2, 4, and 12 weeks after introduction of the diets with six replications per time-diet combination. A significant (P<0.01) diet by time interaction was detected for plasma and hepatic AsA, GLO activity, and estimated capacity for biosynthesis (ECB). Diet effect was not evident for body weight, relative liver weight, and hepatic trace elements but these responses increased with time. Dietary AsA at 250, 500, and 1000 mg/kg inhibited GLO activity and increased plasma and hepatic ascorbic acid but the response differed with time. Dose-dependent inhibition of GLO activity was detected at 1 and 4 wks post-treatment (PT). However, at 12 wks PT the differential response in GLO activity was not observed. Time-dependent changes in hepatic and plasma ascorbic acid seen in chicks fed the control diet were not observed in diets supplemented with AsA. Tissue AsA varied with dietary AsA at 1 and 4 wks PT and thereafter the dose effect was obscured. GLO activity was inhibited in a dose-dependent manner as dietary AsA increased but at 12 wks PT these differences were not detected. The results are consistent with the hypothesis that dietary ascorbic acid inhibits GLO activity resulting in decreased biosynthesis. The degree of inhibition is dose- and time-dependent and at low doses may be compounded by chronic high temperature.

Key Words: Ascorbic acid, L-gulonolactone oxidase activity, Tissue ascorbic acid


Tryptophan (TRP) supplementation in poultry rations has been shown to reduce levels of aggressive behaviour in broiler breeders and hysteria in laying hens. Reduction of stressful behavior in broiler flocks with TRP could potentially reduce stress related meat quality problems. The objectives of this study were to monitor levels of plasma creatine kinase (CK) (indicator of skeletal muscle damage) and evaluate the growth performance of two commercial broiler strains fed supplemental TRP. Six pens were randomly assigned to each possible combination of sex and broiler strain for a total of 24 pens (47 birds/pen). Half the pens were given a corn/soybean meal-based control diet and the other pens were given control diets plus an additional 6g of TRP/kg of feed. Birds were sexed at 5 days of age, and at 14, 24 and 38 days of age. On day 21, a blood sample was collected from 4 birds/pen at random. Blood plasma was analyzed for CK activity using a biotin CK monoreactif reagents. At 14 days, chicks on the TRP diet consumed more feed (P<0.0001) and were heavier for both sexes and ages (P<0.0001). TRP supplemented birds gained the same weight as un-supplemented birds between 15 and 24 days of age. TRP birds grew slower than the control birds between days 25 and 38 (P<0.01). There was also a significant interaction between supplementation and sex. Male growth was reduced to a greater extent in the finisher period by TRP than female growth. Conversion of feed to gain was not affected by TRP treatment at any point of the trial. The improvement in growth rate in the starter period combined with the reduction in the finisher period resulted in no difference in body weight between the TRP birds and the controls by 38 days of age. At 21 days of age plasma CK was elevated in females compared to males (P<0.0001) and TRP significantly increased levels of CK for both sexes (P<0.01). Plasma CK activity did not suggest that dietary TRP reduces stress related muscle damage. However, dietary TRP could be used in studies to induce changes in plasma CK and broiler growth rate to help provide valuable information for studies in this area.

Key Words: tryptophan, broiler growth performance, muscle damage

144 Effects of In Ovo Administration of Thyroxine (T4), Epidermal Growth Factor (EGF) and Peptide YY (PYY) on the Ontogeny of Whole Body Metabolism and Intestinal Function in BUT Turkey Poults. A. Meshaw*, J. Croom, and L. Daniel, North Carolina State University.

Previous studies have shown that in ovo administration of T4, EGF and PYY enhance the growth and development of the intestinal tract of turkey embryos and early post-hatch poults. The objective of this paper was to examine the effects of in ovo administration of these hormones and gut peptides on the ontogeny of whole body metabolism and jejunal function in turkey poults. One hundred and twelve BUT turkey eggs were randomly assigned to four groups. Each group was administered one of the following treatments on day 24 of incubation: saline (C), T4 (600 g/kg egg wt), EGF (300 g/kg egg wt) or PYY (300 g/kg egg wt). All treatments were injected into the air cell using 100 μl of 0.9% saline as the delivery vehicle. At hatch, the poults were randomly placed in Petersime battery pens by treatment groups. Birds were weighed individually on d 1, 8, 15 and 22 and pen feed intakes recorded. Three birds from each treatment group were monitored on d 1, 8, 15 and 22 for whole-body O2 and CO2 exchange. Additionally, on each day 3 birds from each treatment were euthanized and whole jejunal tissue O2 consumption and CO2 production were measured. 

Key Words: Thyroxine, Epidermal Growth Factor, Turkeys, Poults

145 Comparison of the immune responses induced by Salmonella gallinarum between naked neck and commercial strain (B-380) male chickens. M.T. Alvarez*,1 N. Ledesma2, G. Tellez2, and P. Tato1, 1Lab. Parasitologia FB, UMSNH, Michoacan, Mexico, 2Departamento de Produccion Animal: Aves FMVZ-UNAM, 3Departamento de Microbiologia y Parasitologia, FM-UNAM.

Indigenous naked neck chickens have shown natural resistance to adverse environmental conditions, however, immune responses against infectious agents have not been explored. Here, we compared immune responses induced by S. gallinarum (Sg) antigens in NaNa and heterocyclic Nana naked neck male chickens with those of normally feathered (nana and B-380). Groups of 10 chickens (NaNa, Nana, nana, and B-380) were immunized with Sg acetonic antigens and another 10 chicks of the same genetic strain were used as non-immunized controls. Chickens were challenged with virulent S. gallinarum (10^8 CFU) and mortality and morbidity were registered daily for 20 days. Animals were bled before the first immunization (28 days), before the challenge (52 days), 10 days after the challenge and at kill and necropsy (30 days). Specific antibodies were measured by agglutination test. Peripheral blood lymphocyte proliferation assays (PPB) were used to evaluate cellular immune responses against S. gallinarum. Results showed that 100% of NaNa; 90% of NaNa and nana; and 80% of B-380 immunized chickens survived. All animals in B-380 control group died, however 70% of Nana, 60% of nana and 40% of NaNa chickens from control groups survived, suggesting that these groups are naturally resistant to S. gallinarum infection. Nana chickens showed the highest antibody titers before and after the challenge. At sacrifice, increased of specific antibody titers (P<0.05) in Nana was observed when compared with nana and B-380. Nana control group showed differences when was compared with nana (P<0.05). Salmonella antigens induced titrated thymidine incorporation in PBP from immunized and control Nana chickens (P<0.005). We conclude that Nana chickens were the best responders to immunization with S. gallinarum antigens and they also showed a good innate immune response against Salmonella infection.

Key Words: Salmonella gallinarum, Naked neck male chickens, Immunity
146 Effect of immunization with Salmonella gallinarum somatic antigens and infection with the virulent bacilli in the weight gain, hemoglobin levels, and hemato-crit percentages of indigenous naked neck and commercial chickens strain. M.T. Alvarez*, G. Tellez2, and P. Tato3, 1Parasitología. FB, UMSH, Michoacan, Mexico, 2Departamento de Produccion Animal. Aves. FMVZ-UNAM, 3Departamento de Microbiología y Parasitología. FM-UNAM.

The aim of this study was to determine the differences in weight gain and some hematological parameters between indigenous naked neck chickens (NaNa, Nana, and nana) and B-380 after the immunization with S. gallinarum (Sg) autochtonic antigens and infection with the virulent bacilli. Groups of 10 chickens of each genotype were vaccinated with Sg antigens and 8 days later, a booster was administered. Chickens inoculated with PBS were included as controls in each group. Sixteen days after the booster, chickens were challenged with virulent bacilli (108 CFU) and were weighed at 28, 52, 62 and 72 days old. Animals were bled from the brachial vein before the first immunization (28 days), before the challenge (52 days), 10 days after the challenge and at killed (72 days). Hemoglobin levels (HL) and hematocrit percentages (HP) were measured using cyanomethan assays and a standard technique respectively. Results showed that infection with virulent Salmonella induced a significant decreasing of weight in all control groups, particularly in B-380 (P≤0.0004). Interestingly, only B-380 immunized animals showed a significant decrease in weight after the challenge (P=0.02), there were no weight lost in indigenous naked neck and normally feathered chickens 10 days after the challenge. Moreover, they gained weight although in a lesser extent when compared with the weight observed in normal animals (P=0.001). Infection induced a significant decreasing in HL (P=0.001) as well as in HP (P=0.001) in all the chickens, although it was smaller in immunized animals. At sacrifice neither control nor immunized chickens were able to reach normal HL and HP values. Nana chickens showed the best growth rate and the best levels HL and HP in control as well as in immunized birds.

Key Words: Salmonella, Naked neck chickens


The purpose of this study was to evaluate the effect of adding an organic acid containing compound, K-One®brand Feed Treatment (K-One), or a 30% formaldehyde (FORM) based compound, on survival of Coliform bacteria in pelleted feeds. Control elements, i.e., mash temperature, run time (min.), pellet mill volts, and production rate per hour (2.9 MT/hr.) in the pelleting process were maintained constant. Salmonella sp. and Total Coliform were enumerated in mash, conditioned mash and cooled pellets. A commercial broiler grower diet containing 65% corn, 27% soybean meal, and 3% meat and bone meal was used as a basal diet, to which K-One and FORM chemical treatments were applied. Treatment inclusion rates of K-One was 0.4%, and FORM was added at a rate of 0.3% (0.0% formaldehyde). No Salmonella sp. were isolated from mash or processed feed. A significant reduction in Total Coliform was observed in conditioned mash and cooled pellets containing either K-One or FORM. Reduction of Coliform bacteria was similar for K-One and FORM chemical treatments were applied. Treatment bean meal, and 3% meat and bone meal was used as a basal diet, to

Key Words: Broiler Diet, Total Coliform, Organic Acids, Formaldehyde, Pelleting

148 Effects of molting regimens on Salmonella enteritidis colonization and invasion in laying hens. R.W. Moore*, C.L. Woodward, L.F. Kubena, J.A. Byrd, K.D. Knape3, Y.M. Kwon4, D.J. Nisbet1, and S.C. Ricke5, 1USDA-ARS-SPARC, Food and Feed Safety Research Unit, 2Department of Poultry Science, Texas A&M University, 3Department of Veterinary Pathobiology, Texas A&M University.

The use of feed deprivation by the layer industry to induce molting and as well as disease resistance. This study will assist in identifying immunological end-points worthy of consideration during genetic selection for performance as well as disease resistance.

Key Words: Genetic strains, Broilers, Immune responses

149 Comparison of baseline immunocompetence in different commercial broiler lines raised on high and low energy diets. Manzoor Cheema*, R. A. Ali1, and M. A. Qureshi1, 1NC State University.

A study was conducted to compare the immunocompetence of modern day commercial broiler strains [S1a, S1b (two different strains), S2 and S3]. In addition, these birds were fed two different diets: a medium energy (20.1 & 18.1% protein,D1) and a high energy (21.9 & 20% protein, D2) and a high energy (21.9 & 20% protein, D2) starter and finisher diets, respectively. Eleven immunological endpoints were quantified between the ages of 7 to 28 days on chicks obtained from two separate hatches. The results showed that in strain comparisons, S2 and S3 were high responders in macrophage recruitment and phagocytosis functions. Birds in S3 were better in antibody production (P<0.04) whereas birds in S2 were better in T-lymphocyte functions such as responsiveness to concanavalin-A stimulation in vitro (P<0.02) and PHA-P-mediated toe-web swelling response in vivo (P<0.04). Birds in S1a (Trial 1) and S1b (Trial2) were low responders for all immunological endpoints examined. Interestingly, birds in S1b group had higher numerical body weight at 18 days of age. High-energy (D2) diet improved macrophage phagocytic potential (P<0.01), monocyte chemotactic response (P<0.01) as well as PHA-P-mediated toe-web swelling, a T-cell function (P<0.01). These data show that commercial broiler strains differ in immunocompetence and that the birds with higher body weight (e.g., S1b) are low responders for baseline immune response parameters. It must be pointed out that some of these interpretations may depend upon the diet x strain interactions. This study will assist in identifying immunological end-points worthy of consideration during genetic selection for performance as well as disease resistance.

Key Words: Salmonella enteritidis , molting, laying hens, alfalfa, zinc

150 Effects of Genistein on T Cell and B Cell Populations in Chicks. A.R. Peterson*, W.D. Berry1, S.J. Ewald1, and H. Li1, 1Auburn University Department of Poultry Science.

Neonatal exposure to sex steroids impairs bursa and thymus dependent immune function in chicks. Post hatch exposure to soy phytostrogens such as genistein may have similar adverse affects on immune competence in chickens. This study was to determine if immunological changes could be ascribed to genistein exposure in chicks. Five groups containing 10 straight-run day-old chicks received daily dosings of testosterone diethylstilbestrol (DES), genistein, or corn oil vehicle. One group of control chicks receive a standard corn/soy chick starter diet. All other chicks received a soy free corn/casein based chick starter. At 16 days of age the chicks were weighed, bled and necropsied. Weights of liver, bursa, spleen, and thymus were recorded. Spleens were harvested for flow cytometry using fluorescent antibody staining for T and B cell populations.

Poult. Sci. 81 (Suppl. 1)
Chicks receiving the genistein diet had the largest livers as a percentage of body weight (5.05%). D E S chicks had the largest spleens (0.82%). Bursa size in the D E S subjects was largest (0.276%) while the genistein group exhibited the smallest bursas (0.22%). Thymus size was markedly greater in the soy fed birds (0.416%) while the genistein group possessed the smallest thymus mass (0.2%). Flow cytometry results suggested a lower B cell population in the genistein and DES groups (41.2% and 41.4% respectively) while the soy and testosterone subjects exhibited the highest (51.5% and 48.7%). The percent of T- killer cells in the genistein and DES birds averaged 18.27% and 20.3% while the soy, caein, and testosterone diets averaged 29.2%, 23.07 %, and 23.0% respectively. The percent of T- helper cells was lowest in the genistein group (19.85%) and highest in the testosterone group (23.68%). Total percentage of T- cells was highest in the soy and testosterone group (50.2% and 46.68%) and lowest in the genistein and DES group 40.9% and 40.12% respectively. The results of this experiment indicate that the phytoestrogen genistein affects lymphocyte populations and may alter immune competence in chickens.

**Key Words:** genistein, lymphocytes, chick

151 Effect of an enzymatic complex on a high-wheat-based broiler diet and coccidial challenge in broiler chickens. A. L. Foster*, M. A. Juarez*, A. Prieto*, M. Silva*, D. Ortega*, C. S/S diet plus AM without SE; and 4) Experimental group S/S diet plus AM and T2. The administration of T2 during 15 days did not affect gut ecology. This effect was associated with no alterations on CAP, SCFA, intestinal pH, and TIW. T2 induce a reduction on GTT only at day 14.

**Key Words:** T2 toxin, Anaerobic populations, Intestinal pH, Body weight


Differences in the onset of puberty were assessed in male Japanese quail from a random-bred (RB, control) line and two lines that had been genetically selected for either reduced (low stress, LS) or exaggerated (high stress, HS) plasma corticosterone response to brief mechanical restraint. At 42 d of age, cloacal gland area (CAREA) and volume (CVOIL), proportion of individuals that produced cloacal gland foam (PICF), and intensity of cloacal gland foam production (CFP) was examined in 60 representatives from each of these quail lines. CFP was quantified by subjective scaling of the amount of foam ejected upon manual expression (squatting). By examining a scale of 1 (no foam expressed) to 5 (maximum amount of foam expression). Mean CAREA and CVOIL were similar in quail of the RB and HS lines but these measures were significantly greater (P < 0.01) in the LS quail. In addition, significantly more (P < 0.05) LS than HS birds expressed foam at 42 d, while RB quail exhibited an intermediate PICF response that was not different from either selected line. CFP results mimicked those found for PICF (i.e., LS quail produced a significantly greater (P < 0.05) amount of foam than HS birds, while RB quail showed intermediate production that was not different from either HS or LS levels). In pre-pubertal and pubertal Japanese quail, cloacal gland hypertrophy is known to be androgen dependent and highly positively correlated with testes size as well as sexual activity. Cloacal gland foam production is also considered a reliable index of testicular activity. Cloacal gland foam production increases in response to androgens, and is considered a reliable measure of androgenic activity in both the male and female birds. A rise in the amount of foam produced is indicative of a higher androgenic activity in the bird. Therefore, the detection of reduced adrenocortical responsiveness in Coturnix is associated with acceleration in the onset of puberty in males.

**Key Words:** Japanese quail, Corticosterone, Cloacal gland


The *Aspergillus* sp. meal (AM) is a primary fermentation of a non-toxic *Aspergillus* strain product. It has only about 12% of protein but with about 45% fiber. This fiber acts as a catalyst to the proliferation of lactobacillus inside the small intestine of the monogastric. The objective of this experiment was to determine the AM action on duodenal IgA concentration in young fight cockerels when they are fed with a sorghum plus soybean (S/S) diet from 1 to 18 days of age, and challenged at day 17 of age with an isolate of *Salmonella enteritidis* (SE), 10⁸ CFU/0.25ml. A completely randomized design was carried out to determine the effect of adding 0.2 % AM on duodenal IgA concentration (ng/ml). All of the S/S diets were isocaloric and isonitrogenous and consisted of four groups of birds. The four experimental groups were: 1) Negative control S/S diet without SE; 2) Positive control S/S diet with SE; 3) Experimental group S/S diet plus AM without SE; and 4) Experimental group S/S diet plus 240.36±46.23 grams for diet 1 and 2, respectively (P<0.05). Intestinal eva- luation did not show differences between groups at day 5 on DP, IP and CP pH units, neither on SCFA of cecal content (CC), CAP from CC and TIW (P<0.05). At day 10: DP 6.02±0.27* and 6.09±0.17*; IP 7.16±0.89 and 6.63±0.65*; CP 5.98±0.37 and 5.91±0.49* pH units; SCFA 886.2±294.7 and 868.7±334.8 umol/g CC; CAP 703.65±842.56 and 753.81±791.81 10⁷ CFU/g CC; TIW 30.7±3.44 and 30.48±7.61 grams. At day 15: DP 6.00±0.18* and 6.05±0.17*; IP 6.72±0.46* and 6.80±0.46*; CP 6.34±0.97 and 6.05±0.45* pH units; SCFA 1197.3±361.4 and 1066.5±590.2 umol/g CC; CAP 207.61±114.35 and 186.14±212.76 10⁷ CFU/g CC; TIW 48.24±7.76 and 43.19±8.41 grams for diet 1 and 2, respectively (P<0.05). There were only differences (P<0.05) on GTT at day 14 (142.50±47.59 and 219.50±83.50 minutes for 1 and 2 diets, respectively). There were severe reduction on BW related with T2. The administration of T2 during 15 days did not affect gut ecology. This effect was associated with no alterations on CAP, SCFA, intestinal pH, and TIW. T2 induce a reduction on GTT only at day 14.
AM with SE. On day 18, all birds from each group were slaughtered. Five-continuer duodenum samples per bird were taken for ELISA IgA quantitation. Group 4 had the highest IgA concentration, 806.5 ± 377.3 ng/ml (p < 0.05) followed by group 2, 699.9 ± 229.5 ng/ml (p < 0.05). Those not challenged groups had 265.8 ± 356.9 ng/ml (group 3) and 91.4 ± 82.5 ng/ml (group 1). Salmonella enteritidis increased IgA concentration 24 hours after challenge, in both S/S SE and S/S+AM SE groups. Interestingly, birds receiving sp. meal had a numerical increase on IgA concentration in comparison with those that did not receive it. It is suggested to carry out more studies at several ages of the birds and with different pathogen agents, in order to know if AM improves avian gut immunity. 

Key Words: Aspergillus meal, S. enteritidis, Fighn warblers, Duodenum IgA - ELISA


Selection of Japanese quail for exaggerated stress responsiveness was accompanied by a number of undesirable changes in other traits. These included increased fearfulness, and decreased sociality, body weight, and cortical bone porosity. The present study assessed the effects of divergent selection on the age at onset of puberty. Hens were examined from each of three quail lines: 12 each from a randomly bred (RB, control) line and from those bred for an exaggerated (high stress, HS) or a reduced (low stress, LS) plasma corticosterone response to immobilization stress. Egg production was monitored from the age at which the first egg was laid by any of the hens (found to be 44 d of age). Hen-day egg production (HDEP) was then calculated on a weekly basis for 10 wk of lay and the onset of puberty was assessed by calculation of the average ages at first egg lay (FIRST) and at 25% egg production (TITIVE). The mean age at FIRST was elevated (P < 0.05) in HS quail compared to controls (51.6 d vs. 49.4 d, respectively). The LS hens showed a FIRST value (50.0 d) intermediate to, and not statistically different from, the RB or the HS hens. The TITIVE was always greater (P < 0.05) in the HS line than in the RB and LS lines (67.4 d vs. 62.7 d and 60.9 d, respectively). The relative delay in puberty apparent in the HS quail was also reflected in their weekly HDEP means that were lower (P < 0.05) than those of both the other lines in weeks 1 (RB), 2 (RB and LS) and 3 (LS). Given the consistently high level of egg production in the Japanese quail, the absence of group differences in cumulative HDEP values was not unexpected. The present results suggest that the attainment of puberty would be compromised if a selection program included a high stress responsiveness phenotype.

Key Words: Japanese quail, Corticosterone, Puberty, Stress

156 Fermented soybean feed amendment to broiler diets modifies performance and CD4+/CD8+ ratios of intestinal intraepithelial leukocytes. F. W. Edens*, M. A. Qureshi, and C. R. Parkhurst, North Carolina State University, Raleigh, NC USA.

Isolavonoid aglycones are known to reduce the risk of oxidative stress, heart disease, neoplastic disease, osteoporosis, and augment both humoral and cell mediated immunity. The influence that fermented soybean feed (FSF) exerts in broiler chickens is unclear, but a recent report (Payne et al., Poultry Sci. 80:1201) indicated that broilers fed high levels of isolavones performed less efficiently than controls. FSF (Nichimo Co. Ltd., Tokyo, Japan) produced in Aspergillus oryzae culture yields a product rich in isolavonoid aglycones. Feeding of either 0.5 or 1 kg FSF/tonne for 3 wk resulted in no adverse influences on neither chick nor poult BW, FCR and mortality. In a second experiment, 0, 1, 2, or 4 kg FSF/tonne was fed to broilers (8 reps of 40 birds/rep/FSF treatment) through 42 d of age. Males given 1.0 kg FSF/tonne were heavier than controls and had higher HDEP values (P < 0.05). Increased body weights in females were lower than controls. The FCR for females was improved at 1 kg FSF/tonne but not in males. The intestinal intraepithelial leukocyte CD4+/CD8+ ratios decreased (more in females than males) with increasing FSF levels indicating a non-specific expansion of humoral immune functions. In a third experiment using a 40,000 oocyst E. tenella challenge to 1 wk old broilers given 0, 1, 2, or 4 kg FSF/tonne, increasing levels of FSF were associated with decreased cecal lesion scores in 3 wk of age, and there was an indication that there was a shift toward more intestinal intraepithelial leukocyte CD8+ cells in E. tenella challenged chickens led the higher levels of FSF. These observations suggest that FSF has the potential to stimulate the immune system of broiler chickens possibly affecting performance at levels greater than 1 kg FSF/tonne.

Key Words: Broiler, Fermented Soybeans, Intraepithelial Leukocytes, CD4+/CD8+, Performance

157 Sexual and thyroid hormones levels in serum of laying and non laying heavy breeder hens at sexual maturity. I. A. Quintana1, G. E. Antis, C. C. Lopez1, I. G. Telez1, H. J. Herrera1, A. M. Gonzales2, and B. E. Moraless. 1Universidad Nacional Autonoma de Mexico, 2Univesidad Autonoma Chapengo.

The objective of this research was to compare thyroid and sexual hormones levels in laying and non laying breeder hens starting sexual maturity by using RadioImmunoAnalysis (RIA). Thirty 25-week-old hens were randomly selected, weighted and examined for start of laying. The following hormones were measured: luteinizing (LH), follicle stimulating (FSH), prolactine (PRL), estradiol (E2), progesterone (P4), testosterone (TT), triiodothyronine (T3) and thyroxine (T4). Results were analyzed by ANOVA, and showed for LH a trend to be higher in laying hens. PRL was quite variable, and no significantly different. FSH was higher in hens (p < 0.05). E2 in laying hens was about three times that of non-laying (0.03). P4 and TT (p = 0.08) were higher in layers whereas T3 and T4 showed no difference (P > 0.05) between groups. Laying hens were 235 g heavier (P < 0.05). LH levels agreed to reported basic levels. With PRL, obtained values agreed with previous reports. As pullets become older, T4 levels rise, and growth hormone production decreases. When pullets receive food restriction, growth hormone and T4 increase, while T3 decreases. After feeding these hens reach normal levels, except T3. FSH and E2 values were higher in laying hens. When the hens start laying, LH and FSH are stable. P4 values were lower than those reported previously. It is likely that RIA is not able to detect real P4 values. TT levels, higher in laying hens, agreed reported values for humans. Lighter body weights are likely related to sexual maturity in non laying hens, which had lower sexual hormonal levels, too. PRL and T3 seemed to be higher in no laying hens, that had not reached sexual maturity. Ad libitum feeding programs in pullets can cause weakness, lameness, and delay of follicle production. Metabolism and reproductive hormones are altered due to chronic positive energy balance. Leptin, found in fat and liver of broilers, is being studied to produce feed intake reduction in hens by reducing eating time. We suggest to study leptin as an appetite inhibitor for heavy breeders as an alternative to restrict food. As conclusions: at sexual maturity, laying hens are 8% heavier than no laying hens; FSH, E2 and TT levels are higher in layers, whereas P4 is higher in non laying hens; finally, there is no difference in serum levels of LH, PRL, T3 and T4.

Key Words: heavy breeders, sexual hormones, thyroid hormones, hens


Within the last several years the poultry industry has seen a dramatic increase in the occurrence of PSE meat. This problem has been known to be associated with a rapid decline in postmortem (PM) muscle pH, which results in inferior protein functionality similar to that found in pork and turkey. Many factors such as seasonal changes and transportation stresses have been known to influence the occurrence of PSE meat in poultry and swine. The use of halothane and succinylcholine have been used within the pork industry to identify animals susceptible to stress and prone to developing PSE meat. The mechanism for the triggering of the PSE gene in poultry has not been fully understood. Therefore, a study was conducted to determine the effectiveness of screening broilers with halothane to identify those prone to developing PSE meat. Succinylcholine was used prior to slaughter to serve as a triggering agent for the PSE gene in broilers. Given either 1 or 4 kg broilers from four commercial strains (n=1000) were subjected to 3% halothane gas and classified as halothane positive (HP) or negative (HN) based on muscle rigidity. In a second experiment, 4 or 8 kg broilers from four wk of age, broilers from four commercial strains (n=1000) were subjected to 3% halothane gas and classified as halothane positive (HP) or negative (HN) based on muscle rigidity. A selection program included a high stress responsiveness phenotype. As conclusions: at sexual maturity, laying hens are 8% heavier than no laying hens; FSH, E2 and TT levels are higher in layers, whereas P4 is higher in no laying hens; finally, there is no difference in serum levels of LH, PRL, T3 and T4. 

Key Words: heavy breeders, sexual hormones, thyroid hormones, hens.
and were slaughtered at 15 min. post-injection. Pectoralis samples were collected at 0.25, 2, 5, and 24 h PM for the evaluation of rigor development (muscle pH) and meat quality (L-value, moisture, and cook loss). Halothane sensitivity had no consistent effect on rigor development, muscle color or water holding capacity in the four broiler strains. Although birds exhibited reactions to the halothane gas, the halothane sensitivity along with the use of succinylcholine was not able to identify birds prone to developing PSE meat.

**Key Words:** PSE, Broilers, Halothane

159 Reduction of Salmonella by the Armour and Standard Brands Egg White Pasteurization Methods. W. Robertson* and P. Muriana, Oklahoma State University

Pasteurization of liquid egg was initially performed "off-line" at processing facilities with eggs that could be days, weeks, or even months old. Currently, many egg pasteurization facilities are "in-line" whereby eggs are brought by conveyor from production houses directly into processing facilities. The difference between the two processes is that the egg white of fresh eggs is approximately pH 8.2 whereas that of older eggs is likely to be approximately pH 9.0. Our objectives were to evaluate the effect of pH on two popular egg white pasteurization procedures, the Armour and Standard Brands methods using a 5-strain cocktail of Salmonella. We devised a bench-top pasteurization system that mimics the two processes both of which require hydrogen peroxide to be metered into the egg white stream prior to entry into the main heating unit. Both processes were evaluated at 3 pH levels (pH 8.2, 8.6, 9.0), at 3 temperatures (125°F, 127.5°F, 130°F), and over 4 residence times to allow calculation of D-values at each temperature. When compared at the minimum allowable time and temperatures for each process, our results show a greater log reduction for the Standard Brands method than the Armour method at all pH levels tested. Almost all runs at any given temperature showed more reduction at pH 9.0 than at pH 8.2 except for the Standard Brands method at 130°F which showed the most consistent reduction levels across the board at all pH values. Linear regression (r2) values for thermal death time curves were 0.96 or better. It is important to review food process periodically as conditions change that may affect the overall process. We have demonstrated that there is less reduction of Salmonella with low pH egg white typical of modern in-line facilities than with high-pH egg white typical of off-line processing. The data obtained be utilized to determine whether changes need to be made in an updated USDA-FSIS egg pasteurization manual.

**Key Words:** Salmonella, Egg white, Pasteurization, Hydrogen peroxide


The native microflora of processed poultry is composed of many types of bacteria and yeasts. Some of these microorganisms are part of the microflora of live poultry and are carried into the processing facility on the body and in the alimentary tract of the birds. Poultry processing operations, which include scalding and defeathering (picking), generally alter the size and alter the composition of the microbial population of poultry carcasses. In the present study, carcasses were taken from 2 sites in a commercial poultry processing facility, and the number and types of yeasts on the carcasses were determined. Prescaled carcasses and scalded/picked carcasses were taken from the processing line, and whole carcass rinses were performed to recover yeasts from the broilers. Yeasts in the carcass rinsates were enumerated on acidified Potato Dextrose Agar and identified with the MIDI Sherlock Microbial Identification System. Dendrograms of fatty acid profiles of the yeast isolates were prepared to determine the degree of relatedness of the yeast isolates. Findings indicated that scalding and picking caused significant (P<0.05) decreases in the number of yeast associated with broiler carcasses and altered the composition of the yeast flora of the carcasses. Furthermore, it was determined that the same strain of yeast may be recovered from prescaled and scalded/picked carcasses and that the same strain of yeast may be isolated from carcasses processed on different days in the same processing facility. Since yeasts play an important role in the spoilage of chicken meat, determining the types of yeasts involved with poultry processing and how processing affects the yeast population might aid in the development of methods to control the growth of yeasts on chicken carcasses and increase the storage life of fresh poultry.

**Key Words:** Yeasts, Broilers, Poultry processing, Scalding, Picking

Poult. Sci. 81 (Suppl. 1)

Bacterial contamination of food products during processing can lead not only to product spoilage but also to human food-borne illness. In the poultry industry, such contamination of raw meat may result from intestinal flora released from live birds as a result of the processing steps or from bacteria already present in the processing plant (i.e., on equipment surfaces). Knowledge of the sources and properties of bacteria, including pathogens, in food processing environments will ultimately lead to their successful control and elimination. Bacterial populations from the poultry processing environment were obtained from saline rinses of cut-up chickens, samples of breast with or without skin, wings, and thighs which were either fresh or stored at temperatures (4°C or 13°C) relevant to poultry processing facilities. The substrates utilized by the isolates were assessed with Biolog microtiter plates. Of the 62 substrates common to plates for gram-positive (GP) or gram-negative (GN) bacteria, one-third were utilized by 50% or more of all bacterial isolates. Similarly, one-third of the substrates were used by gram-negative bacteria but not by gram-positive bacteria. One-fourth of the substrates were also only used by a single isolate of the respective Gram type. For the remaining 33 substrates on each of the GP and GN plates, a higher percentage of substrates on GN than on GP plates were utilized by the respective isolates. Knowledge of these profiles of nutrient substrate utilization by bacteria isolated from the poultry processing environment may aid in construction of biofilms in the laboratory for additional study of these bacteria.

Key Words: bacteria, poultry, nutrient substrate, biofilm, chicken meat

164 Effects of thickness and background color on poultry meat color measurements. M. Bianchi* and D. L. Fletcher1, 2 University of Georgia, Athens, GA, 2 University of Bologna, Bologna, ITALY.

Experiments were conducted to determine the influence of meat thickness and background color on broiler and turkey breast meat color measurements. Breast meat samples were obtained from 24 h post-mortem pectoralis major muscles from 40 turkeys and 72 broilers. Each breast fillet was sliced laterally into 1 cm thick slices and designated as number 1 for the “top” (distal) slice, number 2 for the middle turkey slice or bottom chicken slice, and number 3 for the bottom turkey slice. Color was always measured on the distal surface of slice number 1 (top) by itself, while placed over slice number 2 (chicken and turkey), or while placed over slices number 2 and 3 for turkey only (to vary sample thickness). Color readings, CIE lightness (L*), redness (a*) and yellowness (b*) were measured in triplicate and averaged for each sample reading at each thickness. The color readings by varying thickness was replicated twice using different background surfaces: plastic coated white paper, white Teflon, aluminum foil (shiny surface) and black plastic, and for the chicken only, also a yellow polystyrene commercial packaging tray. Results show that measuring color through varying thickness samples significantly affected L*, a*, and b* values of both turkey and chicken. As sample thickness increased from 1.0 to 2.0 cm, broiler meat showed darker color (P<0.01) with lower redness and yellowness (P<0.01). The increase of turkey meat thickness from 1.0 to 2.0 cm showed lower redness and yellowness (P<0.01) and a darker color was observed with sample thickness increasing from 1.0 to 3.0 cm (P<0.01). No differences were found when increasing turkey meat sample thickness from 2.0 to 3.0 cm. Background color affected measurements of the single slice samples but did not affect meat color measurements for the thicker samples (2.0 and 3.0 cm for turkey and 2.0 cm for broiler). These results indicate that under practical condition, color measurements are more influenced by sample thickness than by background color. These results may have application for machine vision or on-line color measurement systems.

Key Words: Broiler, Turkey, Meat color, Meat thickness, Background color

165 Effect of stocking density and sex on feathering, body injury and breast meat quality of broiler chickens. A. A. Mendes1, R. G. Garcia2, R. O. Roca2, I. A. Naas3, E. A. Garcia3, J. Moreira1, I. C. L. Almeida1, and T. Takita1, 1 FMVZ, Unesp, 2 FCA, Unesp, 3 FEA, Unicamp.

The experiment was conducted to evaluate the effect of stocking densities and sex on body injuries and breast meat quality. One thousand nine hundred and fifty one-day-old Ross chicks were reared until 42 days of age in a randomized factorial arrangement with three stock densities (10, 13 and 16 birds/m2) and two sexes. At 28, 35 and 42 days of age, 15 birds/treatment were sampled to determine feathering percentage related to breast weight and 50 birds/treatment to evaluate color. At 42 days of age, all birds were processed to evaluate body injuries and breast meat quality. Increasing stocking densities decreased feathering and increased cooking loss and body injuries like breast blisters, dermatitis, bruises and scratches (P<0.05). Breast meat yield and breast length, width and depth were negatively affected (P<0.05) as stocking densities increased, but tenderness was not affected (P>0.05).

Key Words: Breast meat quality, Body injury, Broiler chickens, Feathering, Stocking density

166 Effects of Dietary Menhaden Oil on Characteristics of Eggs from Broiler Breeder Hens. B. G. Lyon1, 2, D. R. Jones3, and E. M. Savage4, 1 USDA-ARS, Russell Research Center, Athens, GA, 2 University of Georgia, Athens, GA.

Quality characteristics of eggs from broiler hens fed diets supplemented with either poultry fat (PF) or Menhaden oil (MO) were evaluated. Starter and developer diets consisted of 3% fat with subsequent breeder diet containing 2% fat. Eggs were collected over 5 days, refrigerated in individual boxes, candled and quality defects removed. For each of the three replications, 10 eggs (2 per collection day) were used for homogenized whole egg (HWE), and yolks and albumen separated from 25 eggs (5 per collection day) were used for homogenized yolk (HY) and homogenized albumen (HA). Portions (20-g) of HWE, HY, or HA were dispensed into food-grade 3in x 5in cook bags, sealed, and refrigerated at 4°C. Proximate composition and color (CIE L*, a*, b*) of raw samples and color and GC volatiles of cooked samples were analyzed. Sensory triangle tests were conducted on cooked product forms, as well as hard-cooked shell eggs. HA-MO had significantly higher moisture and lower protein. HY-MO had significantly lower moisture and higher protein (16.5 vs 16.1%) and fat (35.0 vs 34.6%) than HY-PF. Color a* values of raw HY-MO were higher (P<0.05) than HY-PF (8.4 vs 7.1). Cooked HY-MO was significantly more yellow (higher b* values) than HY-PF. HWE-MO had significantly lower moisture and protein, and higher fat (13.1 vs 12.3) and ash than PF. Raw HWE-MO had higher L* values (lighter), a* values (redder) and b* values (more yellow) compared to HWE-PF. Cooked HWE-MO had higher a* values (P<0.05) than HWE-PF. Significant differences in propionic acid, 1-penten-3-ol, and hexanal were observed between PF and MO cooked egg forms. In triangle tests, aroma/taste differences were significant for cooked HY (12/20, P=0.01). Cooked HA, HWE and hard-cooked whole shell eggs were not different due to treatment (3/17, P=0.98; 10/20, P=0.09, and 2/8, P=0.80, respectively).

Key Words: Eggs, Menhaden oil, Sensory, Color, Volatiles


The aim of this study was to determine the effect of Coccivac-B® on body weight (BW), gut lesion escort (GLS), oocyst output per gram (GO) and Immunoglobulin-A (Ig-A) intestinal concentration in broiler chickens challenged at 21 days age with a Mexico field coccidial isolate (CCI) containing 6.0 x 106 E. acervulina; 5.0 x 106 E. maxima; 4.0 x 106 E. tenella/bird. All broiler diets (S/S) were isoproteic, isocaloric and without anticoccidial drugs. Experimental groups consisted of 1) Coccivac-B® without CCI; 2) Coccivac-B® with CCI; 3) Positive control with CCI. At day 28 (7 days postinoculation; PI), all birds from each group were weighed and GLS as well as GO and Immunoglobulin-A (Ig-A) from duodenum, jejunum, ileum and cecal epithelial cells. Results showed that broiler body weight were: 726.16±130.74; 731.5±120.68 and 775.05±99.05 (P<0.05) for groups 1,2 and 3 respectively. GLS to E. acervulina: 0.50±1.05; 1.0±3.0; 2.5±5.05. GLS to E. maxima: 0.1±3.0; 1.17±3.0; 2.0±5.05. GLS to E. tenella: 0.1±3.0; 0.5±3.05; 0.25±5.05 (P<0.05). At 28 days postinoculation, 36.266.0±10.927; 2.280.000.0±5.780; 8.636.666.0±8.289.985 (P<0.05) were not significant or any numerical differences in Ig-A between groups from duodenum, jejunum, ileum or cecum (P>0.05).
Positive control group showed more gastrointestinal damage than other groups. Coccivac-B® groups whith CCI and without CCI did not show significant differences in body weights, GSL or OO in broiler performance 7 days post the experimental study, humoral immunity against the CCI had no important effects. Molecular characterization of the Mexican coccidia field strains and its compression with the strains present in Coccivac-B® are necessary to determine possible antigen differences.

Key Words: Coccidiosis vaccine, Coccidial challenge, IgA concentration, Broiler chicks

168 Presence and numbers of Campylobacter in broiler respiratory tracts before and after commercial scald. N. Reimer1, M. E. Berrang2, R. J. Buhr3, R. J. Meinersmann4, and M. A. Harrison3, 1University of Georgia, Athens GA, 2USDA-ARS-Russell Research Center, Athens, GA.

Campylobacter can be recovered from broiler body cavity sponge samples taken after careful hand evisceration with no visible gut rupture or leakage. Since many broilers are reared and transported in an environment with high numbers of Campylobacter present, it is possible that these birds are subjected to airborne Campylobacter. Such a condition could result in contamination of the airways including air sacs which are torn during evisceration. Furthermore, it has been suggested that as a carcass moves through the scald tank, the respiratory tract may become contaminated with bacteria. This study was undertaken to examine the broiler respiratory tract before and after scalding as a possible source of internal carcass contamination. On each of three replicate sample days, ten pre-scald and ten post-scald broiler carcasses were collected from the shackling line in a commercial processing plant. The carcasses were examined by means of a flush of the respiratory system (trachea, lungs and air sacs). An incision was made in the trachea at a point closer to the thoracic inlet than the neck cut; sixty ml of buffered saline was gently introduced into the trachea with a syringe. In preliminary work, this technique was found to partially fill the air sacs without rupturing them. The buffered saline functioned as a rinse, remaining in the respiratory tract while the carcass was rotated by hand for 120s. The rinse was collected and serial dilutions were plated for total aerobic bacterial counts, coliforms, Escherichia coli and Campylobacter. All results are reported as log10 CFU/ml rinse. Prior to scald recovery was: total aerobic bacteria 3.0, E. coli 1.2, coliforms 1.2, and Campylobacter 0.7. After scald recovery was: total aerobic bacteria 4.1, E. coli 2.7, coliforms 3.0, and Campylobacter 1.0. Campylobacter can be recovered from respiratory tracts only in relatively low numbers. Unlike total counts, E. coli and coliforms, Campylobacter was not recovered in significantly higher numbers from post scald carcasses.

Key Words: broiler, Campylobacter, E. coli, respiratory tract, scald

169 Carcass Salmonella and Campylobacter contamination resulting from crop content spillage during evisceration can be removed by carcass washing. R. J. Buhr1, A. Hinton, Jr.1, and K. D. Ingram1, 1USDA-ARS Russell Research Center.

A processing trial was conducted to determine if carcass washing could remove bacterial contamination that occurred from ruptured crop contents. Broilers were orally challenged twice with 1 mL of Salmonella typhimurium 107 and Campylobacter jejuni 109, and 2 d prior to processing. Following an 8 h feed withdrawal, broilers were scalded, de-feathered, and manually eviscerated. During evisceration the crop was loosened and either pulled thru the thoracic cavity intact or slit in half and torn releasing its contents into the thoracic cavity. The first whole carcass rinse was not recovered in significantly higher numbers from post scald carcasses. From all carcasses, the recovery for carcasses where the crop was removed intact was 4 positive of 8 sampled at log10 2.4 CFU/ml rinse per carcass prior to carcass washing and was reduced to 2/8 positive at 1.3 CFU after washing. Salmonella recovery for carcasses where the crops ruptured during evisceration was 7/8 positive at 2.1 CFU prior to washing and was reduced to 3/8 positive at a level of 1.8 CFU following carcass washing. For Campylobacter, carcasses with crops removed intact were 8/8 positive at 3.2 CFU prior to washing and 7/8 at 2.2 CFU after carcass washing. Campylobacter recovery for carcasses where crops ruptured during evisceration was 8/8 positive at 3.0 CFU prior to washing and 7/8 positive at a level of 1.6 CFU following washing. Carcass washing reduced both recovery incidence and counts for Salmonella and Campylobacter for carcasses where the crop was removed intact or ruptured during manual evisceration. Although crop rupture increased both carcass Salmonella and Campylobacter recovery, after carcass washing there was no difference.

Key Words: Broiler, Crop Removal, Salmonella, Campylobacter, Carcass Washing

170 Recovery of bacteria from breast skin of feathered and Scaleless “featherless” carcasses following scalding and picking. R. J. Buhr4, M. E. Berrang1, and J. A. Cason1, 1USDA-ARS Russell Research Center.

Feathered and Scaleless “featherless” siblings of matched body weight were processed to determine the impact of feathers and empty feather follicles on the recovery of bacteria from carcass breast skin. One wk prior to processing, birds were orally challenged with high doses of Campylobacter jejuni. Twelve h before processing, full fed birds were placed into solid-bottom coops to maximize fecal contamination, and then transported to the pilot processing plant. The vents were plugged and sutured closed prior to scalding (134°F / 56.6°C for 90 s) to minimize the expression of cloacal content during picking. Birds were processed in alternating batches of four feathered and four Scaleless and the picker cleaned between each batch with hot water. The entire breast skin was aseptically removed with sterile scalpels and forceps. Campylobacter was recovered from 1 of 16 Scaleless and from 4 of 16 feathered carcasses at levels of log10 1.5 and 1.4 CFU/ml of rinse, respectively. From all carcasses, the recovery of E. coli (1.5 and 1.6 CFU), coliforms (1.8 CFU), and total aerobic bacteria (3.0 and 3.1 CFU) did not differ between feathered and Scaleless, respectively. The presence or absence of feathers and empty feather follicles did not impact the level of bacteria (Campylobacter, E. coli, coliforms, and total aerobic) recovered from breast skin following scalding and defeathering.

Key Words: Breast Skin, Bacteria, Scaleless, Defeathering, Chicken

171 Effect of Avizyme on energy utilization in commercial Leghorns, S. S. Sohail*, M. M. Bryant, and D. A. Roland Sr., Auburn University, Auburn, Alabama.

A study was conducted to determine the effect of Avizyme supplementation in a high (HE) and low energy (LE) diet at different protein levels on energy utilization and egg size in commercial Leghorns. Hyline W369 hens (n = 1600) were assigned to three protein levels (19.8, 18.7, and 17.4%) with high and low energy and two Avizyme levels (0 and 0.0375%) in a 3 x 2 factorial arrangement of treatments in a randomized block design with eight groups of 20 hens per treatment. Hens were caged in an environmentally controlled house at an average daily temperature of 26°C, and fed diets for 16 weeks. Egg production (EP), egg weight (EW), egg specific gravity (SG), feed consumption (FC), mortality, and body weight were determined. Increasing dietary energy reduced FC at the higher protein levels of 18.7 and 18.8%, but not at the lowest level (17.4%; energy x protein, P < 0.001). However, there was no difference in energy intake of hens fed the different diets. Avizyme reduced energy intake per g egg at 19.8% protein with low energy, and at 18.7% protein with high energy, but it did not reduce energy intake per g egg of hens fed 17.4% protein diet (energy x protein x Avizyme, P < 0.05). Similarly, Avizyme increased EP of hens fed 18.7% protein with high energy but not in hens fed other protein or energy levels (energy x protein x Avizyme, P < 0.01). Feed efficiency improved at higher protein levels but not at the lowest protein level (17.4%; energy x protein, P < 0.01). Increasing dietary energy and protein increased EW (P < 0.05) and BW (P < 0.05). However, increasing dietary energy reduced SG (P < 0.001).

Key Words: Avizyme, Energy, Leghorns


A previous report from this laboratory indicated that incorporating cottonseed meal (CSM) into broiler breeder pullet diets may be an effective means to improve pullet body weight uniformity. A concern in using CSM in rearing pullets was whether there would be any subsequent negative reproductive effects related to the consumption of gossypol in the CSM. Six hundred Cobb breeder pullets were reared to 2 weeks of age on a standard corn/soy pullet starter diet. At this time they were divided into two treatments of 300 pullets each and reared on pullet grower diets with either soybean meal (SBM) or cottonseed meal (CSM) as the major protein source. So as to ensure low gossypol levels, a CSM was employed.
which had been manufactured with no added soapstock. The meal had 6.07% free gossypol. From 18 weeks of age the CSM-fed pullets were given the same corn/soy based diet as the SBM-fed birds. From 20-29 weeks of age 5 layers were collected for gossypol analysis from randomly selected birds that had been fed the CSM diets. During the 9-week period average gossypol levels decreased with time from an initial level of 293 to a final level of 49 μg/g DM (P<0.05). At 24 weeks of age the CSM and SBM birds were selected and randomly housed in breeding floor pens. Onset of egg production, egg production and hatchability were monitored. No deleterious effects were seen for these 3 parameters when comparing the performance of the CSM-reared birds to that of the SBM-reared birds. The results suggest that incorporation of low-gossypol CSM in broiler breeder grower diets to improve flock uniformity will not negatively impact future reproductive fitness.

Key Words: Broiler breeder hens, Cottonseed meal, Reproduction

173 Performance Of Commercial Laying Hens When The Level Of Corn Oil In The Diet Was Reduced. R. H. Harms*, G. B. Russell, C. R. Bohnsack, and W. D. Merkel, University of Arkansas, Fayetteville AR.

Hy-Line W36 hens were fed diets containing zero or 6% corn oil (CO) from 26 to 38 wk. At 38 wk the hens receiving the diet with 6% CO were divided into three groups. One group continued to receive the diet with 6% CO. The level of CO was reduced to zero or 3% in two groups. The hens previously fed the diet without CO continued to receive the control diet. Egg weight continued to be significantly heavier when 6% CO was added to the diet, but was not significantly reduced when the level of CO was reduced to 3%. Egg weight from control hens was significantly lower than the EW from hens that had received CO in the diet until 38 wk but none thereafter. Hens fed the diet with CO consumed more energy than hens fed the control diet. However, when all of the CO was removed from the diet at 38 wk the hens consumed less energy than hens fed the control diet.

Key Words: Egg Weight, Energy Intake, Commercial Layer, Corn Oil

174 Comparison of Phytase Sources in Broiler Diets. Wenjun Pan*, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville AR.

A study was conducted to compare the response of broilers to two sources of phytase enzyme in phosphorus-deficient diets. A diet was formulated to provide 100% of NRC (1994) amino acid recommendations with 0.90% Ca and 0.45% nonphytate P (NPP) considered as the high P basal. Elimination of calcium and phosphorus reduced and adjusted the amount of NPP to create a P-deficient basal diet. The resulting diet was tested in two experiments, one with commercial broilers and one with commercial layers. The basal diet contained 0.20% Ca and 0.50% phosphorus. Treatments 1-4 were created by adding monocalcium phosphate to yield diets containing 0, 300 and 600 units/kg phytase for 450 FTU/kg phytase activity. There were six dietary treatments and each treatment (trt) was replicated five times in 2.46 m X 3.08 m pens with 22 or 23 birds/pen. The diets were fed in a mash form. Blood was sampled from 5 males from each diet at the end of each phase. The control group and the low P-fed groups provided 0, 300 and 600 units/kg phytase for serum osteocalcin and pyridinoline analyses. At the end of the trial three birds/pen were slaughtered for bone samples. The breaking strengths of the femur, humerus, and ulna were tested by the shear method and the tibia was tested by the 3-point load method. There were no trt effects on 17 wk BW or 9-17 wk feed efficiency (avg = 0.330 gain/feed). Bone breaking strength increased linearly (femur, P=0.059; humerus, P=0.078; tibia, P=0.112; ulna, P=0.050) as phytase level increased. By contrast analysis, bone breaking strength was higher when phytase was fed at 300-600 units/kg (femur, P=0.052; humerus, P=0.027; tibia, P=0.058; ulna, P=0.043) compared to the negative control diet. Serum osteocalcin was higher (P=0.002) at 12 wk and serum pyridinoline was higher (P=0.006) at 17 wk in the birds fed the negative control diet compared against the other trts tested. The data indicate that 454 g/t of Natuphos® was adequate in this study to maintain growth and bone strength of commercial toms growing 178 g/day from 9-17 wks of age.

Key Words: Bone strength, Osteocalcin, Phytase, Pyridinoline, Tom

177 Effect of dietary supplementation with Virginiamycin or phytase on phosphorus utilization in broiler chickens. Hector Cervantes*,1 Kenneth Bafundo1, Pettit Ewing1, Gene Pestil2, and Remzi Bakali2,1 Phibro Animal Health, Fairfield, N.J., 2University of Georgia, Athens, GA.

Several researchers have confirmed the nutrient-sparking (energy and amino acids) effect of Virginiamycin in poultry. Preliminary research studies conducted in Europe suggest that Virginiamycin may also enhance phosphorus utilization in broiler chickens. In order to determine if Virginiamycin can enhance phosphorus utilization in broiler chickens, a factorial experiment was conducted. Broiler chicks were started on the experimental diets at 18 days of age and the diets were fed until day 15. From 18 weeks of age the experimental diets were formulated to contain a control diet and a diet marginally low in phosphorus was used, 2 levels of Virginiamycin (0 or 15 ppm), and 2 levels of phytase (0 or 600 ppm) were tested with replicate pens of male and female broiler chickens resulting in a 2x2x2 factorial arrangement of treatments. Parameters measured included body weight gain, feed consumption, feed conversion and mortality at 42 days of age. Analysis of variance of the final data showed that all main variables (Virginiamycin, phytase and sex) had significant (P<0.05) effects on body weight.
### 178 Effects of different dietary electrolyte balances (Na+K-Cl, mEq/kg) on live performance of broiler chickens under heat stress in two pen trials. S. A. Borges 1, A. V. Fischer da Silva 1, J. Anci 1, D. M. Hooga 2,* and K. R. Cummings 1

Different dietary electrolyte balances (DEB; Na+K-Cl, mEq/kg) were tested using broilers under heat stress. Balance and associates showed 1.6% sodium bicarbonate (NaHCO3) beneficial (1998; Prof. Anim. Sci. 14(4):193-196). Two 42-d Brazilian pen trials on new litter were conducted with male Cobb and male Ross chicks, respectively, at university facilities in Jaboticabal, SP, Brazil to evaluate dietary NaHCO3 levels up to 2%. Millo-soybean meal and oil based diets were used. In Exp. 1 there were 5 trts with 4 rep. pens (1.5 x 3.2 m each) of 50 chicks per trt (1.00 chicks total). Daily in-house temperatures ave. 31° C max., 23° C min., with high 34°C and low 19° C, and ave. relative humidity 75.5%. The DEBs in starter and grower were: 0, 0; 120, 120; 145, 130 (control); 240, 240; 360, 360. In Exp. 2 there were 4 trts with 4 rep. pens (1.0 x 2.5 m each) of 15 chicks per trt (480 total) in each environment – thermoneutral (step down, wk max. 32 to 25°C and min. 28 to 19°C) and heat stress (wk max. 33, 35, 33, 33°C; min 28 to 19°C); relative humidities by wk averaged 49 to 58%. The DEBs were: 40, 140, 240, and 340. Brazilian soybean meals had lower K than in the US. In Exp. 1 best performance (significantly P<0.05 better than control) for 42-d body weight (BW; 2.472 kg) and feed conversion ratio (FCR; 1.705 kg/kg) resulted from DEB = 240 with added 0.02 to 0.04% salt (NaCl), 0.19 to 1.46% NaHCO3, and 0.40 to 0.30% ammonium chloride (NH4Cl). Other treatments had BW 2.261 to 2.375 kg, FCR 1.747 to 1.783 kg/kg. At DEB = 240, Na = 0.45%, K = 0.52 or 0.47%, and Cl = 0.32 or 0.26%. Mortality was not significantly affected, but higher DEB caused higher water intake and water:feed ratio. In Exp. 2 there were no significant diet x environment interactions. Best results again occurred with DEB = 240 with added 0.30% NaCl, 0.82% NaHCO3, and 0.16 or 0.06% NH4Cl (Na = 0.35%; K = 0.74 or 0.67%; and Cl = 0.37 or 0.29%) in BW (2.503 vs 2.392 to 2.400 kg) and FCR (1.757 vs 1.764 to 1.791 kg/kg) with mortality and AM vs PM rectal temperatures unaffected. Equations predicted DEB optimums: Exp. 1 BW = 186, FCR = 197; Exp. 2 BW = 236, FCR = 207. A DEB of 240 mEq/kg is recommended for broilers in heat stress, obtainable by using existing dietary K, adding NaCl, NaHCO3, and NH4Cl, and achieving 0.35 to 0.45% Na levels.

**Key Words:** Ammonium chloride, Broiler, Dietary electrolyte balance, Heat stress, Sodium bicarbonate.

### 179 Alternate Time Feeding of Diets Containing Nutrients that are Antagonistic Towards Each Other. 1. Calcium and Phytate Phosphorus. H. M. Edwards, Jr.*, University of Georgia

This study was conducted to investigate the magnitude of the effect of alternate time feeding of diets adequate and inadequate in Ca but deficient in P on phytate P utilization. Treatments were 2 corn-soybean meal diets, one formulated to contain 1.0% Ca, 0.5% total P and 0.25% phytate P, the other contained 0.25% Ca and similar amounts of P. These diets were adequate in all other nutrients. The feeding of these diets on alternate days constituted the third treatment. Ninety Peterson x Arbor Acres chicks were divided into 3 pens (1.0 x 2.5 m) each of 15 chicks per pen (45 total) in each of the 3 dietary treatments. The birds received the diet for 16 d. The birds fed the diets on alternate days had significantly faster growth, higher percent bone ash, intermediate levels of blood plasma Ca and dialyzable P. Ca and P and phytate P retention were determined on excreta samples obtained on day 13, 14, 15 and 16 of the experiment. Birds receiving the 1% Ca diets had low Ca, P and phytate P retentions. Birds receiving the 0.25% Ca diet had high Ca, P and phytate P retentions. Those receiving the diets on alternate days had retentions reflecting the diets received for the 24 hours prior to excreta collection. Birds fed the diets on alternate days had superior performance to birds receiving either the P deficient diet or the Ca and P deficient diet.

**Key Words:** Alternate feeding, Phytate utilization

### 180 Tissue Ascorbic Acid and L-Gulonolactone Oxidase Activity in Heat-Stressed and Ascorbic Acid Supplemented Chickens. D. Maurice 1, Charlotte Lauridsen 2, H. Jorgensen 2, and J. E. Toler 3

Chickens synthesize ascorbic acid and do not normally require supplementation. It is thought that requirement is increased and/or biosynthesis decreased during heat stress, disease, and intensive production but the results of supplementation are inconsistent. We have reported that biosynthesis declines with age and food deprivation for 48 hours or more, and is inhibited by dietary ascorbic acid in fast- and slow-growing strains. This study assessed the effects of dietary ascorbic acid (AsA) and acute high environmental temperature (AHET) on plasma (PAsA) and hepatic (HAsA) ascorbic acid and ascorbate biosynthesis as measured by L-gulonolactone oxidase (GLO) activity. Individually caged sexed-chicks were fed the control or experimental diet that was fortified with 1000 mg/kg ascorbic acid for 21 days. At 3 weeks half the birds were exposed to AHET and the remainder were maintained at ambient temperature (AMBT) in two open-circuit respiration chambers. The AHET group was exposed to 30 min of heating (44 C and 40% RH) on each of 3 consecutive hours and the AMBT group was maintained at 25 C and 40% RH. Chicks exposed to AHET exhibited normal adaptive responses and there was no mortality during or after exposure. Neither a diet x environmental temperature interaction nor effect of AHET was detected for any of the response variables measured. Supplemental AsA increased (P<0.01) PAsA and HAsA by 78 and 23% respectively. Addition of ascorbic acid to the diet reduced (P<0.01) GLO activity by 47% but an effect of AHET was not detected (30.9 versus 28.5 nmol/g kidney/hour for AMBT and AHET respectively). These results confirmed that dietary AsA is an important regulator of GLO activity and showed that brief and limited episodes of AHET did not impair AsA biosynthesis in chicks.

**Key Words:** Dietary ascorbic acid, Heat stress, Ascorbate biosynthesis, Tissue ascorbic acid

### 181 Field Evaluation of Cocci-Guard Anticoccidial Feed Additive. R. D. Walker 1, Distributors Processing Inc., Porterville, CA USA.

Cocci-Guard is an all natural organic anticoccidial feed additive that is neither an ionophore nor a synthetic chemical. Five field studies in 3 countries (Brazil, Mexico and Peru), utilizing a total of 121,808 broiler chickens were conducted to evaluate Cocci-Guard under commercial production conditions. Performance of Cocci-Guard was compared with two straight ionophore programs (salinomycin), a synthetic chemical to ionophore shuttle program (nicarbazine to monensin), a synthetic chemical to two straight ionophore programs (salinomycin), a synthetic chemical to a synthetic chemical to a synthetic chemical to a synthetic chemical to...
varying commercial production conditions. Cocci-Guard provides poultry producers with a new option in the control of coccidiosis.

**Key Words**: Coccidiosis, Cocci-Guard, Field Evaluation, Ionophores

### 182 Efficacy of β-Mannanase (Hemicell®) in Broiler chickens with coccidiosis and necrotic enteritis in the presence and absence of β-mannan. M E Jackson1*, R L James1, D M Anderson2, R L James2, D M Anderson2, and H Y Hisao1, 2ChemGen Corp., Gaithersburg, MD, USA, 2Southern Poultry Research Inc., Athens, GA, USA.

Low concentrations of β-mannan have been shown to reduce carbohydrate metabolism by interfering with insulin secretion and fat production. In many experiments with monogastrics, the enzyme β-mannanase has been shown to improve growth and feed conversion due to the breakdown of β-mannans originating from soybean meal. A recent study demonstrated a greater effect of β-mannanase in the presence of disease stress. This experiment was designed to determine if this phenomenon is only a result of β-mannan breakdown, or if another mechanism is involved. A 21-day male broiler chick trial was conducted in battery cages with 10 birds per cage, 6 diets, and 8 replications. All birds were challenged with 50,000 E. acervulina and 5000 E. maxima on day 7 and with 108 cfu C. perfringens on days 12, 13, and 14, all by oral gavage. Dietary treatments were 3 agents (none, medicated (BMD), 50g/ton and Sacox, 60g/ton) and β-mannanase (100 MU/ton) x 2 basal diets (Soybean meal based (SBM), and animal byproduct based with negligible β-mannans (ANBY)). Basal diet type had no effect on bird performance. Both the medication and enzyme significantly improved growth in both the CS and the ANBY basal diets (P<0.05). There was no significant difference between the 2 agents. A similar trend existed for feed conversion, except that the enzyme treatment was intermediate between the control and medication treatments with the ANBY basal for this criterion. The results suggest that β-mannanase may be a viable alternative to traditional medication in broiler management.

**Key Words**: β-mannanase, Broilers, Necrotic enteritis, Coccidiosis

### 183 Improvement of Body Weight Uniformity in Turkeys using β-Mannanase (Hemicell®). M E Jackson1*, R L James1, D M Anderson2, and H Y Hisao1, 2ChemGen Corp., Gaithersburg, MD, USA.

Four experiments were conducted with turkeys fed corn-soybean type diets with and without β-mannanase treatment at 100 MU/ton to determine its effects on body weight uniformity by weighing all birds individually in replicate pens. In Experiment 1, 6 commercial feeds were provided with and without β-mannanase inclusion for a total of 12 dietary treatments. Six replicate pens per treatment were used, each containing 40 BUTA female turkeys per pen grown to 21 days of age. The enzyme increased average body weight (BW) and decreased adjusted feed conversion (FC) and body weight coefficient of variation (CV) with all 6 feeds. Differences were significant (P<0.05) with all 6 feeds (BW), with 3 of the 6 feeds (FC) and with 5 of the 6 feeds (CV). Averaged across feeds, BW increased by 11.2%, FC decreased from by 2.1 points, and CV decreased from 22.7 to 16.78% (all significant P<0.05). In Experiment 2, 8 replications of 18 male BUTA turkeys per pen were reared to 98 days of age. β-mannanase treatment increased BW by 140 g (NS), decreased FC by 7.0 points (P<0.05) and decreased CV from 7.63 to 4.95%, (P<0.05). In Experiment 3, 10 replications of 36 male Nicholas turkeys per pen were reared to 42 days of age. The enzyme increased BW by 3.5%, decreased FC by 4.1 points, and decreased CV from 11.90 to 8.64% (all significant P<0.05). In Experiment 4, 8 replications of 20 male Nicholas turkeys per pen were reared to 155 days of age with high and low protein basal diets. In the high protein regime, the enzyme increased BW by 8% (P<0.05), decreased FC by 7.8 points (NS), and decreased CV from 14.67 to 11.43% (P<0.05). In the low protein regime, the enzyme increased BW by 4.2% (NS), decreased FC by 4.1 points (NS), and decreased CV from 14.46 to 11.22% (P<0.05). In all experiments, graphic inspection revealed that the decreased CV is a result of fewer small birds in the populations provided with β-mannanase.

**Key Words**: Turkeys, β-mannanase, Coefficient of variation, Body weight, Feed conversion

### 184 Comparison of Bio-Mos Mannan Oligosaccharide and Antibiotic Feeding Programs in Broiler Diets Containing Copper Sulfate. E O. Oviedo-Rondon1, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

A study was conducted to evaluate the growth-promoting properties of Bio-Mos, a mannan oligosaccharide obtained from the cell walls of yeast, in comparison to diets fortified with growth-promoting antibiotics. Diets containing a minimum of 110% of NRC (1994) amino acid recommendations were fortified with 250 ppm of Cu from copper sulfate to 6 wk with 62.5 ppm from 6 to 8 wk. A large lot of basal diet was prepared and aliquots used to provide the test diets. Four treatments were compared including 1) no additives; 2) antibiotic program (50 g/t BMD to 6 wk; 15 g/t Stafac 6 to 8 wk); 3) Bio-Mos (2 lb/ton to 6 wk; 1.5 lb/ton 6 to 8 wk); 4) Bio-Mos + antibiotics (half of the levels fed alone). Each treatment was fed to 12 pens of 50 males of a commercial strain. Body weights and feed consumption were determined at 21, 42, and 56 d; samples of birds were processed at 56 d for dressing percentage and parts yield. Body weight at any age was not significantly influenced by any of the dietary treatments. Feed conversion was significantly (P<0.05) improved at 42 d by both the antibiotic treatment and by addition of Bio-Mos and numerically (P=0.10) improved at 56 d by the antibiotic treatment and the combination of antibiotics and Bio-Mos. No significant effects of any dietary treatments on dressing percentage, parts yield, or abdominal fat were observed in this study. High temperatures were encountered during the study impacting upon body weight and mortality; however there was no relationship of dietary treatment to mortality. The results of this study indicate variable response of broilers to both antibiotics and Bio-Mos when incorporated into diets containing copper sulfate.

**Key Words**: Mannan Oligosaccharides, Broilers, Antibiotics

### 185 Utilization of Bio-Mos Mannan Oligosaccharide and Bioplex Copper Proteinate in Broiler Diets. M. W. Greenwood1*, F. Yan, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

An experiment was conducted to compare the response to Bio-Mos, a mannanoligosaccharide, and Bioplex Cu, a copper proteinate, in broiler diets supplemented with copper sulfate or growth-promoting antibiotics. There were 12 dietary treatments in 2x3x2 factorial arrangement with two antibiotic programs (none or 50g/ton BMD to 6 wk; 15g/ton Stafac to 9 wk), three copper sources (none, sulfate (2 lbs/ton to 6 wk; 0.5 lbs/ton to 9 wk), and Bioplex Cu 10% (500 g/ton to 6 wk; 250 g/ton to 9wk)), and two Bio-Mos programs (none or 2 lbs/ton to 6 wk; 1.5 lbs/ton to 9 wk). Eight replicate pens of 50 male broilers were fed each diet from 1 to 63 d. Body weights (BW) and feed consumption were recorded at 21, 42, 49, and 63 days of age. Five birds per pen were processed at 63 days to determine dressing percentage and parts yield. At 21 d, BW of broilers fed the antibiotic program were significantly heavier (P<0.05) than those fed the diets without antibiotics. No significant influence on BW was noted with the addition of either copper source. At 49 d, broilers fed Bioplex Cu had significantly higher feed conversion ratio (FCR) than those fed diets with copper sulfate or without any copper. Bio-Mos did not significantly improve BW or FCR at any age. An interaction between antibiotic program and inclusion of Bio-Mos was observed at 21 d; addition of Bio-Mos in absence of antibiotics increased FCR. At 49 d, there was an interaction between copper source and Bio-Mos; addition of Bio-Mos improved FCR when added to diets with no copper or with copper sulfate, but increased FCR when added to diets with Bioplex Cu. None of the main effects had any significant impact on mortality or any processing parameter. The results of this study indicate that Bio-Mos and Bioplex Cu do not exhibit growth-promoting properties that would validate their use as dietary additives for improving broiler performance.

**Key Words**: Mannan Oligosaccharides, Copper proteinate, Broilers

### 186 Presence of naturally occurring Campylobacter in the semen of mid-life (35-45 weeks old) and late life (49-65 weeks old) commercial broiler breeder roosters. N.A. Cox1*, J.L. Wilson2, M.T. Musgrove1, R.J. Buhr1, and B.P. Hudson2, 1 USDA-ARS, 2University of Georgia Poultry Science Dept...

Campylobacter enteritis is the leading cause of bacterial induced diarrheal disease both in the United States and worldwide. Even though the consumption of poultry has been associated with this disease, the source(s) of Campylobacter entry into the broiler flock is not presently...
known. Over two years ago, we demonstrated that *Campylobacter* could pass from the breeder flock to the broiler through the fertile egg. We also cultured naturally occurring *Campylobacter* from all segments of the reproductive tracts of actively laying commercial breeder hens. The objective of this study was to determine if *Campylobacter* could be isolated from the semen of commercial breeder roosters. To reduce the amount of fecal contamination during semen collection, individually caged roosters were not fed prior to collection. Samples were collected from two groups of roosters, one was 35–45 weeks of age and the other was 45–55 weeks old. The younger group, *Campylobacter* was isolated from 97 of 169 semen samples (57.4%) while in the older group, *Campylobacter* was isolated from 26 of 275 semen samples (9.4%). We have been unable to locate a reference in the literature to suggest that anyone has tried to isolate *Campylobacter* from chicken semen; perhaps because the fertile egg had been dismissed as a possible source of *Campylobacter*. The overwhelming presence of naturally occurring *Campylobacter* in chicken semen suggests that it may serve as a vehicle for the transmission of *Campylobacter* to the breeder hen’s reproductive tract and then to the fertile egg. The incidence of positive samples was 48% lower in the older roosters but still present. Breeders and the fertile egg can no longer be overlooked as sources impacting the safety of market poultry.

**Key Words:** *Campylobacter*, semen, roosters, broiler breeder, age

### 187 Isolation of *Campylobacter* from the vas deferens of 65 week old commercial breeder roosters. N.A. Cox1, J.L. Wilson2, M.T. Musgrove3, R.J. Buhr1, and B.P. Hudson2, 1USDA-ARS, 2University of Georgia Poultry Science Dept...

*Campylobacter jejuni* is a foodborne human enteropathogen that has been associated with live and processed poultry. The source of entry of this bacterium into the broiler flock is not conclusively known. Recent studies in our laboratory have shown that this microorganism is naturally present in the reproductive tracts of both the male and female breeders. Over a quarter of all semen samples (123/444) from caged commercial breeder rooster breeders were found to contain naturally occurring *Campylobacter*. This study was undertaken to determine if *Campylobacter* could be isolated from the vas deferens of 65 week old commercial roosters. The vas deferens was aseptically removed from 101 roosters and cultured for *Campylobacter*. The organism was isolated from 4.9% of the samples (5/101). Of these five roosters, four had *Campylobacter* present in previous semen samples while the fifth rooster’s semen was negative. There is no published record of *Campylobacter* or any other food-borne pathogen having been recovered from the vas deferens of breeder rooster breeders. The source(s) of *Campylobacter* has not yet been determined but an investigation is underway. Ongoing studies will be looking for *Campylobacter* in the testes of mature roosters and identifying sources of *Campylobacter* contamination of breeder male and female birds.

**Key Words:** *Campylobacter*, semen, vas deferens, broiler breeder, roosters

### 188 Relationship of ALV-J virus to the detection of *Campylobacter* in the digestive and reproductive tracts of broiler breeder roosters. N.A. Cox1, J.L. Wilson2, M.T. Musgrove3, R.J. Buhr1, J.E. Sander3, and B.P. Hudson2, 1USDA-ARS, 2University of Georgia Poultry Science Dept., 3University of Georgia Dept. of Avian Medicine.

The presence of ALV-J (J virus) in broiler breeder flocks can reduce fertility, increase mortality, as well as decrease weight and shell quality of fertile eggs. For those and other reasons, the J virus has received much attention in recent years. Our objective was to determine if the presence of this virus in mature roosters could effect the presence and level of shed *Campylobacter* from the digestive tract (ceca) and the reproductive tract (semen). There were two separate groups of individually caged commercial breeder rooster breeders. One group contained 67 healthy birds and the other group contained 35 birds infected by J virus. At 65 weeks of age, individual samples were obtained from each rooster and analyzed for *Campylobacter*. For healthy birds, 20 of 67 (30%) had an average of 1.3 log CFU Campylobacter/g ceca, while the infected group, 15 of 28 (54%) had *Campylobacter* in their ceca with an average level of 4.3 log CFU/g ceca. In semen samples taken just a few days before birds were sacrificed, 7/66 (10.6%) healthy rooster shed *Campylobacter* at 1.4 log CFU/ml on average. For the J virus group, 5 out 20 (25%) were shedding *Campylobacter* at a level of 1.9 log/ml. From these data it appears that a J virus infection in late life breeder breeder roosters results in an increased incidence and level of *Campylobacter* in both the digestive and reproductive tracts. These results indicate that J virus infection not only depresses rooster fertility and viability, but those roosters that are producing semen also have higher incidences and levels of *Campylobacter*.

**Key Words:** *Campylobacter*, broiler breeder, roosters, ALV-J virus, semen

### 189 Recovery of *Campylobacter* spp. by enrichment of fecal samples. M.T. Musgrove1, N.A. Cox2, J.L. Wilson3, and R.J. Buhr4, 1USDA-ARS, 2University of Georgia Poultry Science Dept., 3University of Georgia Poultry Science Dept.

*Campylobacter* spp. frequently colonize the intestinal tract of commercial breeders. Culturing of intestines and their contents is the most sensitive means of recovering the organism from birds. However, there are times when it is not practical to sacrifice the animal. Fecal samples are an easily obtained non-destructive sample which can be used to determine if a bird is colonized by this human pathogen. Fresh droppings are likely to contain sufficient numbers of viable cells for *Campylobacter* spp. to be detected by direct plating. However, when fresh droppings are not readily available older, drier samples may have to be used. Given this bacteria’s sensitivity to dryness and sensitivity to oxygen, enrichment could prove useful for recovery from older or lower moisture samples. Fecal samples were aseptically collected from broiler breeder roosters that were individually caged. A slurry made from each sample was directly plated (0.1 ml) onto Campy-cefex agar and enriched (0.1 ml) in 5 ml of Bolton broth. Enriched samples were also plated onto Campy-cefex agar. Following incubation for 36–48 h at 42 C in microaerobic atmosphere, presumptive colonies were confirmed by observation of typical cellular morphology and latex agglutination. *Campylobacter* spp. positive fecal samples were detected in 14/30 (47%), 9/30 (30%), 21/41 (51%), and 22/40 (55%), respectively by direct plating. Enrichment increased *Campylobacter* spp. recovery for each of the four repetitions (60%, 40%, 63%, 75%). Each method (direct plating or enrichment) detected positives that the other one missed which increased recovery rate to 63%, 67%, 77%, and 85%, respectively. For drier fecal droppings, enrichment improved recovery rate over direct plating. However, detection of *Campylobacter* spp. from older, drier fecal droppings was optimized by using both direct plating and enrichment.

**Key Words:** *Campylobacter*, enrichment, feces

### 190 Recovery of *Campylobacter jejuni* on three different solid media and its genotypic diversity. Umelaalm Idris1, Margie Lee2, Susan Sanchez3, Charles Hofacre3, Martha Zimmer4, and Harold Barnhardt4, The University of Georgia.

The aim of this study was to determine the effect of selective culture media on the isolation of resident genetic types of *Campylobacter jejuni* present in two sequential broiler flocks. Cecal droppings were cultured by selective liberation on blood agar containing the selective antibiotics present in Campy-Cefex or Blaser’s Campylobacter medium. *Campylobacter* isolates were speciated by PCR then genetically typed using RAPD-PCR. 97 percent of the colonies recovered on blood agar were identified as *C.jejuni* while 95 percent of colonies recovered with Campy-Cefex antibiotic were *C. jejuni*. But only 70 percent of the colonies cultured with Blaser’s antibiotics were identified as *C.jejuni* suggesting that this medium may be inhibitory to some strains.

**Key Words:** *Campylobacter*, Broiler Flocks, Selective Media, RAPD-PCR, Genotype

### 191 Mississippi Litter Production Assessment. Y Vizzier-Thaxton4, Mississippi State University, Mississippi State, MS, USA.

With recent changes in environmental regulations, alternatives to spreading litter on pastures have become necessary for many poultry farmers. Evaluation of the economic feasibility and practicality of new technology or creative options requires an accurate estimate of the number of houses and current practices on each farm. A questionnaire was prepared that covered a wide variety of farm practices. It was sent to each company or complex and trade association in Mississippi. The number of responses was low, yet reflective of statistics from other sources. Results of questions concerning specific practices produced both predictable and surprising results. Additionally, the responses to this questionnaire were compared to those from a similar survey conducted by the U.S. Poultry & Egg Association. The information is sufficient for potential...
investors, regulators and researchers to use in economic analysis of alternative methods of litter utilization.

**Key Words:** Nutrient Management, Environment, Litter Utilization

192 **Impact of the Litter amendment, Poultry Gaard, on the Recovery of Salmonella in Poultry Litter**


Evaluations were conducted to determine the efficacy of the litter amendment, Poultry Gaard, in reducing or eliminating Salmonella recovery from broiler litter. Bedding material was obtained from a commercial broiler house. The litter had been exposed to 3 flocks of broiler chickens with the original bedding material comprised of dried pine shavings. Litter was placed 2" deep in ft 2 baking pans and autoclaved 45 min at 121 °C. All pans were inoculated with 50 ml of 10 7 CFU/ml of malidixic acid-resistant *Salmonella typhimurium* (NAL-SAL). Poultry Gaard, at 40% sulfuric acid litter treatment carried on a attapulgite/montmorillonite mineral was applied at rates of 25, 50, 100 and 150 lb/1000 ft 2. Each treatment was applied to 4 replicate pans with 4 serving as controls. In addition there were four sampling times of 24, 48, 72 and 96 hours post litter treatment application. For each sampling time, a one half inch core sample weighing 25 grams was pulled to determine Salmonella recovery and an additional two 25 gram samples were used to determine litter pH and moisture at each sampling time. Samples were then enumerated on XLT4 agar containing malidixic acid. NAL-SAL counts were converted to log 10 values prior to analysis with the GLM procedure of SAS. Combining times, recovery rates for the control group was 3.343 log 10 Salmonella. Salmonella recovery rates were 2.762, 2.571, 1.736 and 1.031 for the 25, 50, 100 and 150 pounds/1000 ft 2 treatment groups, respectively. Recovery for all treatment groups was significant reduction in recovery for 72 and 96 hours versus 24 and 48 hours.

**Key Words:** Litter amendments, *Salmonella*, Poultry Litter

193 **Evaluating the Performance and Acceptance of Teleconference Instruction vs. Traditional Teaching Methods for Undergraduate and Graduate Students.** Mickey Latour* and Paul Collodi, 1 Purdue University.

Institutions are currently seeking alternative ways to deliver a full-line of course materials without acquiring additional staffing. Hence, faculty are charged with creating alternative ways to deliver and/or offer course content to students. The purpose of this study was to evaluate undergraduate and graduate performance and perception of teleconferencing verses traditional blackboard lectures. In the undergraduate course, we discovered that students performed equally as well on exams and provided favorable reviews of the course; however, the acceptance of this new format is lacking given the enrollment and number of students dropping, e.g., 90-40% in the first half of the course semester’s age. On the other hand, students taking the graduate course appear to accept the technology well with consistent enrollments, and achievement in course content. In summary, using teleconferencing as a way to teach students may be better suited for mature students compared to freshmen courses.

**Key Words:** teaching, education, teleconferencing

194 **Effect of precision heat distribution on broiler brooding and market age performance.** James L. McNaughton* and Michael S. Roberts, Solution BioSciences, Inc.,

Since the late 80’s, broilers are reared under either 40 or 50% conventional partial-hours brooding (CB) conditions to reduce fuel usage and assist in maintaining brooding temperatures. With existing heating systems, precise heat distribution and reduced hypo- and hyper-thermic conditions over the entire brooding area has proven to be difficult; consequently, ventilation and ceiling fan assistance is employed for even air distribution. AirComfortTM, a patent-pending air distribution system (AC) engineered to precisely distribute air to the entire brooding area without interference to normal management practices. For each 3600-4200 ft 2, the system employs a central overhead air-mixing duct and round metal tubing over all water lines. For testing, AC and CB were employed in two different 3600 ft 2 chambers and temperature data tracked every 15 min throughout the study. A total of 4240 broiler chicks (Ross x Cobb) were randomly placed (0.85 ft 2 per bird) in each chamber on built-up litter. Temperature goal included 85°F the first week and reduced 1°F each day until 70°F was reached (at housing ambient temperature range 23-45°F). Normal ventilation techniques were employed. At all ages, mean body weight (14, 21, and 49 days of age), feed conversion and market body weight variation (5.81 vs 9.28 CV) was significantly (P<0.05) improved with the AC as compared to CB. Litter moisture and ammonia was 3.5% and 3 ppm less for AC as compared to CB, respectively. Bird weights of the lower 25% percentile were greatest for the CB. AC utilized 42% less fuel due to less time required to initially reach optimum brood heat, thermostat goal achieved quicker and less run time. The conclusion may be drawn that a precision AC will reduce fossil fuel usage and improve performance by decreasing lower 25% body weight percentiles. Practically, because of more efficient air distribution, each heating system may be used in a greater area as compared to conventional warm-air systems (by as much as 4200 ft 2 for AC vs 2500-3600 ft 2 CB).

**Key Words:** Brooding, Heating System, Broiler, Body Weight Uniformity, Brood Heat Distribution


Contract broiler growers do not have a reliable method to assess flock performance during the growout process. It is well established that water consumption is highly correlated with feed consumption. Therefore, monitoring water consumption could be used as a tool to predict feed consumption and in turn estimate growth rate. Eight flocks (total of 230,000 straight-run broilers) were monitored from December 2000 until May 2001 for water consumption, feed consumption, air temperature, humidity, and bird weight on two commercial broiler farms. An electronic controller was used to monitor water consumption. Each house was also equipped with bird and bin scales to determine bird weight and feed consumption, respectively. All measurements were recorded on 15 min intervals. Regression analysis was conducted for each flock using water and feed consumption as the independent and dependent variables, respectively. The regression equations were averaged and the results indicated that birds consumed 1.61 lb of water for every 1.0 lb of feed consumed with a R 2 = 0.978. However, additional variation was observed during the first week of the growout and from 25-40 days. Accurately predicting feed consumption based on water consumption during the first seven days of production is difficult because typical water meters are not sensitive enough to measure water consumption at low flow rate. Once the birds consumed 5,000 lb of water (10 days of age), water consumption was a reliable estimate of feed consumption. From 25-40 days of age, water consumption tended to be more variable than 10-25 days of age. This variance was probably attributable to differences in house temperature. Because of the difference in water consumption due to environmental temperature, a prediction equation for feed consumption was developed using water consumption and average house temperature as the independent variables (Y = 0.0981x + 12.578; R 2 = 0.6498). These data indicate that water consumption can be a reliable predictor of water consumption. Using a water meter accurate at a low flow rate, could be an excellent tool to assess broiler performance during brooding.

**Key Words:** Broiler, Feed consumption, Water consumption

196 **Oasis® Hatching supplement during transit: Effect on broiler breeder egg production.** T. J. Walsh*, S. D. Peak1, C. D. Knight1, C. A. Atwell1, J. J. Dibner1, and J. Brake2, 1 Novus International, St. Louis, MO, USA, 2 North Carolina State University, Raleigh, NC USA.

Oasis® is a hydrated nutritional hatching supplement generally fed immediately after hatch to ameliorate the negative effects of delayed feed and water when holding chicks overnight or by transporting them long distances before placement. Two experiments were conducted to evaluate the effects of Oasis® provided after chick processing and during transit on egg production of broiler breeder females. Both experiments utilized Arbor Acres FSY pellets that were fed either 4.5g Oasis® paste (Experiment 1), or 2.5g Oasis® pellet (Experiment 2), compared to pellets not given Oasis® in the chick boxes after processing at the hatchery. Thus, the no Oasis® treatment (control) resulted in females being held for 24-36 hours with no feed or water, a normal practice in today’s industry. In Experiment 1 the pellets also received either a 15% CP or 20% CP starter diet to 3 weeks of age. In Experiment 2 the pellets were reared.
on one of four feeding programs that varied in cumulative nutrition at photostimulation. The Oasis\textsuperscript{a} fed chicks produced 9.4 more eggs per hen ($P < 0.13$) with the greatest effect observed in the presence of the 15% CP stating in Experiment 1. Much of the effect was due to improved consistency of lay as evidenced by 4.1 more eggs ($P < 0.06$) per hen from 45 to 54 wk. The Oasis\textsuperscript{b} fed chicks produced 17.42 more eggs in Experiment 2 when fed to the lowest cumulative feed intake during rearing in a manner similar to Experiment 1. However, on an overall basis across all feeding programs there was no significant effect. The beneficial effects of Oasis\textsuperscript{a} appeared to be most obvious when the pullets were more marginal in nutrition during rearing.

Key Words: Oasis, Broiler Breeder, Early Nutrition, Egg Production, Hatchling Nutrition

A turkey model for evaluating the efficacy of adsorbents to ameliorate the toxic effects of aflatoxin. P. Butkeraitis\textsuperscript{1}, J. N. Broomhead\textsuperscript{2}, E. A. Guaime\textsuperscript{1}, D. R. Ledoux\textsuperscript{3}, A. J. Bemudez\textsuperscript{2}, and G. E. Rottinghaus\textsuperscript{4},\textsuperscript{1} Universidade de Sao Paulo, Brazil, \textsuperscript{2}University of Missouri, Columbia, MO, \textsuperscript{3}Universidade Estadual Paulista, Brazil.

A 21-day experiment was conducted to determine if the turkey could be used as a model for evaluating the efficacy of adsorbents to ameliorate the toxic effects of aflatoxin (AF). Dietary treatments included: 0 µg AF/kg, 100 µg AF/kg, 200 µg AF/kg, 300 µg AF/kg, 400 µg AF/kg, 500 µg AF/kg, and 600 µg AF/kg. AF was supplied by A. parasiticus culture material that contained 986 mg AFBS/kg, 29 mg AFBG/kg, 464 mg AFPG/kg, and 9 mg AFG/kg. Compared with controls, poult fed ≥200 µg AF/kg had reduced (P < 0.001) feed intake and slightly lower body weight gains. Significant mortality (14/20) occurred in pouls fed 600 µg AF/kg. Compared with controls, pouls fed ≥ 100 µg AF/kg had lower (P < 0.001) relative liver weights, whereas pouls fed ≥ 200 µg AF/kg had increased (P < 0.001) relative kidney weights. Histopathological analysis indicated the presence of liver lesions in pouls fed ≥ 100 µg AF/kg. The primary hepatic lesions were biliary hyperplasia, hepatocellular hyperplasia, and hepatic necrosis with the severity of lesions increasing with increasing AF dose. Kidney lesions were noted in pouls fed diets containing ≥ 400 µg AF/kg with a mild to moderate membranous thickening of the glomerular capillary basement membrane noted in most specimens. Results confirm previous reports that suggest turkeys are very sensitive to the toxic effects of AF. The lowest level of AF (100 µg/kg) that caused toxic effects in pouls in this study is 20 fold lower than the levels (>0.1 µg/kg) reported to cause toxic effects in broilers under laboratory conditions. These results suggest that the turkey could be used as a more sensitive model to evaluate the efficacy of adsorbents to ameliorate the toxic effects of AF at levels that have been reported to cause toxicity under field conditions.

Key Words: Adsorbents, Aflatoxin, Turkeys, Biliary hyperplasia


The inclusion of aluminum (as the sulfate) in a low-P basal layer diet (0.17% available P), with or without phytase, as a molting agent was studied using 720 hens of a commercial brown egg producing strain (Hy-Line Brown). Twelve replicate groups of 10 hens, 72 wk of age, were assigned to each of the following treatments: 1) basal diet fed on an ad libitum basis during Days 1-14, restricted to 40 g/hen/d during Days 15-21; 2) complete feed withdrawal during Days 1-7, basal diet restricted to 40 g/hen/d during Days 15-21; 3) basal diet + 0.3% Al + phytase (11,500 ptu/kg diet, Alltech, Inc., Nicholasville, KY); 5) basal diet + 0.45% Al; and 6) basal diet + 0.45% Al + phytase). The Al-supplemented diets (Treatments 3-6) were fed on an ad libitum basis during Days 1-21. Light was restricted to 8 hr during Days 1-21, increased to 13 hr on Day 22 and then gradually increased to 16 hr/d for all treatments. A 15% PF was fed (0.30% available P) was fed on an ad libitum basis to all treatment groups starting on Day 22. Average feed intake for Treatment 1 was 65 g/d and 95 g/d during Weeks 1 and 2 of the molting period, respectively. Respective values for average feed intake during Weeks 1 and 2 were 49 g/d and 64 g/d for Treatments 3 and 4 and 64 g/d and 51g/d for Treatments 5 and 6. Egg production for Treatment 2 decreased to 0% by Day 7. By Day 19, feeding Al decreased egg production to 20% (Treatments 3 and 4) and 12% (Treatments 5 and 6).

Total egg production during a 24-wk post-molt period was unaffected by treatments. Compared with Treatment 1, all other treatments improved eggshell breaking strength. Complete feed restriction or feeding 0.45% Al (Treatments 2 and 5) increased numerus breaking strength at 15 wk post-molting. The results indicate the use of dietary AI as a force molting agent was similar to the use of a conventional feed-restriction molting procedure and that the presence of phytase had little effect on the response to dietary aluminum.

Key Words: Aluminum, Force molting, Phytase

199 Influence of genotype and gender on weight and lipid pattern of brain tissue of developing chicken embryo. A. K. Pal*\textsuperscript{1}, M. A. Quadri\textsuperscript{2}, S. B. Jadhao\textsuperscript{3}, H. S. Kushwah\textsuperscript{2}, and I. C. Datta\textsuperscript{2}, \textsuperscript{1}Central Institute of Fisheries Education, 7 Bungalow, Versova, Mumbai 400 06, India, \textsuperscript{2}College of Veterinary & Animal Sciences,JNKVV, Jabalpur 482 001 (M.P.), India.

The hypothesis was tested that even with equalised egg weight at setting during incubation, there could be some effect of genotype(G) and gender(G) on brain lipid profile of developing chicken embryo at various (12, 16, 18, 20th) stages of development(St). Data with 128 chicks of both sexes, revealed that wet weight of brain in the pre-hatch chicks was not affected by Gt. but was higher(P<0.05) in male vs. female and increased 22% Much more significantly during post-hatch development of chicks. Brain total lipid concentration was higher (P<0.01) in the male vs. female pre-hatch chicks. The value significantly decreased at day 20. No significant effect of Gt. could, however, be demonstrated. Brain total phospholipid concentration was higher (P<0.05) in the broiler vs. layer and in the male vs. female pre-hatch chicks. The value significantly increased at day 16, compared to day 12, but reverted to the initial level at day 18. Brain total cholesterol concentration was higher in the broiler vs. layer and male vs. female. St did not have any effect on this parameter but interaction of GtXGSt was significant. Brain total triglycerides in the pre-hatch chicks did not reveal any significant effect of genotype or sex. The value significantly increased at day 18, but decreased below the initial level at day 20 of incubation. The study concludes that G and Gt affects brain lipid profile particularly cholesterol and phospholipid.

Key Words: Pre-hatch chicks, Genotype, Gender, brain lipid profile

200 Influences of Various Dietary Factors on Egg Quality Responses to Age Inoculation with F-Strain Mycoplasma Gallisepticum in Commercial Egg Laying Hens. M. R. Bunning\textsuperscript{a}, E. D. Pebbles\textsuperscript{b}, S. L. Branton\textsuperscript{c}, and P. D. Gerard\textsuperscript{d},\textsuperscript{a} The University of Mississippi, Mississippi State, Mississippi, United States of America, \textsuperscript{b}United States Department of Agriculture, Mississippi State, Mississippi, United States of America.

Influences of dietary factors on internal and external egg constituents of commercial egg laying hens inoculated at different ages with F-strain Mycoplasma gallisepticum (MgG) were determined. Determinations were made at 24, 34, 44, 50, and 58 wk of age. At 12 and 22 wk of age, one hundred and twenty layer hens were randomly assigned to individual cages in each of two enclosed ends of a temperature regulated cage layer facility and were either sham (control) or FMG inoculated (treated). Four differently supplemented layer diets were randomly provided to birds within each treatment group at 20 wk of age. Diets included: 1) normal basal diet (NB); 2) NB with 1.5% additional poultry fat (PF); 3) NB with 1.5% additional PF and supplemental phytase (P) and 25- hydrocortisone (D3); and 4) NB with supplemental P and D3. Treatment-inoculation age-diet combinations were thric replicated, with ten hens in each replication. Variables investigated were egg weight (EW), and percentages of shell (PSW), albumen (PAW), and yolk (PYW) weight, along with percentages of yolk moisture (PYM) and lipid (PYL). FMG-treatment increased overall EW. The addition of all three supplements increased PSW at 24, 34, and 50 wk in comparison to controls. Furthermore, at 24 wk PAW was increased by sham or FMG inoculation at 22 wk compared to that at 12 wk, but at 50 wk was decreased by sham or FMG inoculation at 22 wk compared to that at 12 wk. In birds fed the added PF, PYW at 24 and 50 wk was depressed by FMG inoculation at 12 wk. In birds inoculated with FMG at either time period, PYM was increased at 34 and 58 wk of age. At 24 wk in birds fed Diet 1 and inoculated at 22 wk of age, PYM was increased in comparison to those inoculated at 12 wk. The 22 wk inoculation also increased PYM at 58 wk in birds fed Diet 3 or 4. At 24 wk of age, FMG-treated birds inoculated at either period exhibited an elevated PYL when fed any of the four diets. In association
with a delay in initiation of lay by FMG-inoculation, as has been shown in previous studies, EW may be increased over the complete laying cycle due to FMG inoculation. Age dependent effects of PF, P, and D3 can modify responses in PYW and PYM to FMG inoculation at 12 or 22 wk in commercial layers.

Key Words: albumen, D3, inoculation, layer, Mycoplasma gallisepticum, phytase, shell, yolk

201 Accelerating embryonic growth during incubation improves livability of poult embryos following prolonged egg storage. V. L. Christensen1, J. L. Grimes, and M. J. Wineland, North Carolina State University, Raleigh, NC, USA.

We proposed the hypothesis that shortening the incubation period and simultaneously accelerating the turkey embryonic growth rate would improve embryonic survival and hatching physiology. Increased incubation temperatures were tested for their efficacy in improving embryonic mortality in fertilized eggs stored for at least 15 d prior to setting in the incubator compared to controls stored for only 3 d. Two incubator temperature treatments were applied. In Experiment 1, 37.8 C set points for dry bulb temperatures were used to accelerate development for the initial two weeks of development compared to controls at 37.5 C. Following treatment, the accelerated embryos were returned to the same machine as the controls. In Experiment 2, the higher temperature eggs were used only for the initial week of development. The temperature and storage treatments were applied to eggs in a completely random 2 x 2 factorial arrangement of treatments. At the completion of 28 d of incubation, the survival rates of all treatments were determined by opening all unhatching eggs to discriminate truly fertilized eggs from infertiles. Hatching ability was determined by dividing the total number of poults on a hatching tray by the number of fertilized eggs on each tray. The incubator tray served as the experimental unit. Data were analyzed using SAS and means determined to differ significantly were separated by the least square means treatment with 0.1% NaD. Water activity and pH values were similar (P > 0.05) for all treatments.

Key Words: Egg Storage, Incubation, Hatchability, Embryonic Growth

202 Oral anti-candida whole eggs in Alzheimer’s patients. The patient’s and care giver’s assessment. Marilyn A. Coleman1,2 and Mitchell V Kaminski3, 1OvImmune, Inc, 2FUHS/Chicago Medical School.

Egg laying hens had candida albicans/tropicalis vaccines added to their vaccination schedule. In a previous study of ADD/ADHD and autistic patients fed eggs containing anti-candida immune elements, symptoms improved significantly. Therefore, the same eggs were fed to patients with Alzheimer’s Disease. Seven patients ate these eggs every other day for 6 weeks prepared to avoid denaturation of the yolk. Patients ranged in age between 45 to 72 years old. All patients were diagnosed by professionals. Several of the patients were end stage with around the clock supervision. Voluntary testimonials were given by patients and care givers. Within 48 hours of first consumption 50% of the patients demonstrated gradual improvement in behavior which by 2 weeks was dramatic. Improvements continued for up to seven months as long as one egg was eaten twice weekly. All patients had regularly eaten off-the-shelf eggs in the past with no effect. Care givers consistently observed the following: less irritable, concentrated better, better appetite, less anxious with reduction in the number of accidents. The painting was unveiled July 27, 2001 with news media present. Eating eggs containing anti-candida immunogenic elements from chickens hyper-immunized against candida seems to improve symptoms in patients with Alzheimer’s disease. Fungi are known to produce depsides and depsidones some of which are neurotoxins. These neurotoxins may be responsible for symptoms expressed by Alzheimer’s patients. The hypothesized mechanism of action is the enhancement of the patient’s natural immune control of candida which appears to reduce these candida derived neurotoxins.

Key Words: Antibodies, Behavior, Candida

203 Relationship and possible identity of bursal anti-steroidogenic peptide (BASP) and histone H1. G. Garcia-Espinosa1, W.R. Moore2, L.R. Berghman3, L.A. Newberry1, and B.M. Hargis4, 1University of Arkansas, 2SPARC, USDA-ARS, 3Texas A&M University.

Previous research from our laboratory has demonstrated the existence of a protein purified from the chicken bursa of Fabricius with potent anti-steroidogenic and anti-proliferative action on lymphocytes in vitro. Previous research has characterized this protein as a heat-labile, basic protein that is both amino- and carboxy-terminally blocked. In highly purified form, the protein migrates as a doublet on SDS-PAGE electrophoresis with an apparent MW of 29 and 32 kDa. Recently, highly sensitive Nanoflow Q-TOF Mass Spectrometry amino acid sequencing technology allowed determination of a convincing partial amino acid sequence, strongly suggesting a probable relationship of BASP with histone H1. Very recently, bursal cDNA expression library screening, using an antibody produced against electrophoretically pure BASP, also identified a clone with a sequence matching histone H1. Presently, we have demonstrated that SDS-PAGE electrophoresis of highly purified and bioactive BASP, and commercially available calf thymus-derived histone H1, produced similar doublets at approximately the same apparent MW. Subsequently, the BASP doublet produced on SDS-PAGE was recognized by a commercially available monoclonal antibody directed against a highly conserved region of histone H1. Furthermore, calf thymus histone H1 was found to suppress mitogen-stimulated chicken B-cell proliferation in a concentration-related manner, similar to the action of BASP. These data indicate that BASP shares substantial structural homology with, and may be identical to, histone H1.

Key Words: Histone H-1, bursa of Fabricius, anti-Steroidogenic, B-lymphocytes, chicken

204 The antimicrobial effects of Sodium diacetate and sodium lactate on the psychrotrophic microflora of a restructured turkey steak product. M. S. Hussain, S. K. Williams*, and R. L. West, University of Florida.

The objectives of this research were to determine the antimicrobial effect of sodium diacetate (NaD) and/or sodium lactate (NaL) on the total psychrotrophic microflora of a restructured turkey steak product; and to ascertain the effects of the sodium diacetate and/or sodium lactate treatments on pH and water activity of the product. Approximately 100 g turkey breast pieces were processed into restructured turkey steaks by blending with a Fibrime® cold-set binding system. The restructured turkey breasts were also formulated with either 1.5% NaL, 2.0% NaL, 1.5% NaD + 0.1% NaD, 2.0% NaL + 0.1% NaD, 0.1% NaD, or no treatment (control), stuffed into 94 cm (length) X 12 cm (diameter) cellulose casings and stored at -30°C for 0, 1, 2 and 3 mo. At the completion of each storage interval, restructured turkey breast slices were placed on Cryovac® trays containing absorbent pads, and overwrapped with PVC film and stored at 0°C for 10 d. The steaks were analyzed for psychrotrophic organisms, water activity, surface and total pH after 0, 1, 2 and 3 mo storage. Sodium diacetate, when used alone at 0.1% or in combination with either 1.5% or 2.0% NaL, significantly (P < 0.05) reduced the growth of psychrotrophic organisms. The psychrotrophic counts for all restructured turkey steaks treated with sodium diacetate remained less than 5 log10 CFU/g through 10 d storage at 0°C, when compared to control steaks and steaks treated with 1.5% or 2.0% NaL only. This study suggested that 1.5% is the appropriate usage level for NaL when used in combination with 0.1% NaD. Water activity and pH values were similar (P > 0.05) for all treatments.

Key Words: Sodium lactate, Sodium diacetate, antimicrobial agents, Turkey breast steaks, Microbiology
A Quantitative Microbial Risk Assessment Model for a Broiler Hatchery within a Poultry Production and Processing System. 1. Zakarias* and Y Li, University of Arkansas, Fayetteville, Arkansas.

This study is part of the quantitative microbial risk assessment model for commercial broiler production and processing system. The objectives of this study were to construct a quantitative microbial risk assessment model, develop a computer simulation program for a hatchery, select and determine primary, secondary and tertiary time to growth and survival models of S. typhimurium. The whole hatching process was divided into six nodes: Receiving, Holding, Setter- Incubating, Hatch- Incubating, Chick Processing and Vaccinating-Disinfecting. The first phase of microbial risk assessment model was to estimate the time dependence of the incidence and prevalence of S. typhimurium on eggs, described by a mean and distribution of samples that contained various levels of bacteria. All of the inputs were treated as probability distributions rather than numbers. Best fit was used to compare and decide the distribution of S. typhimurium cells on eggs as their moving from one node to another. The second phase generated statistical simulation and a distribution of the risk associated with the overall hatching process. The output of the current node was one of the inputs of the nodes of the next. Therefore, the nodes were linked together to make a whole microbial risk assessment model. Beta distribution was applied to Receiving, Holding, Setter- Incubating and Vaccinating- Disinfecting. Lognormal distribution was applied to Hatch- Incubating and Chick Processing. The greatest overall value of S. typhimurium occurred at Hatch- Incubating node and the cell number of S. typhimurium significantly decrease during Vaccinating- Disinfecting node. The medians (50 percentile) for all the six nodes were zero and for Holding and Vaccinating even 75 Percentile was zero because the distribution contributed to this result more than the other nodes.

Key Words: Hatchery, Risk Assessment, Production, Salmonella, Hazard


An experiment was conducted to determine the effect of bird age, diet (feed formulated with either 69.5% corn, 69.7% milo, or 73.6% wheat), and feed withdrawal times (0 or 8 h) on color (CIE L*, lightness; a*, redness; and b*, yellowness) of raw broiler breast fillets. Broilers were placed on treatment diets at 28 d of age. Each day from 42-45 and 49-52 d of age, replicate groups of 24 birds (eight each from diet, four of which were either full fed or feed withdrawn) were slaughtered and eviscerated under simulated commercial conditions (n=192). Carcasses were chilled and fillets deboned 4 h postmortem. Triplicate color measurements were taken from the medial (bone) side of the fillet. Bird age did not significantly affect fillet color values (P<0.05). Fillets from the wheat diet were significantly lighter than the corn or milo diets (48.9 vs. 46.9 and 46.7, respectively). Fillets from the corn diet were significantly more yellow than milo or wheat (4.8 vs. 2.4 and 2.6, respectively). Feed withdrawal significantly increased fillet lightness from an average of 46.1 to 48.9, decreased redness from 4.1 to 2.4 and 2.6, respectively. Feed withdrawal significantly increased fillet yellowness from 2.8 to 3.7. Diet and feed withdrawal may significantly affect raw broiler breast fillet color.

Key Words: diet, feed withdrawal, broiler breast, fillet color

Variation in tibia and skin puncture strength in a commercial broiler strain. V. Gorsuch1, C.Z. Alvarado*, and J.H. Wilson1, 1Virginia Polytechnic Institute and State University.

Tibia strength is an important variable to both producers and processors because broilers are subjected to the stressors of growing, transportation, and slaughter equipment. Skeletal weakness is involved in leg problems, bone deformities, breakage, and infections, all of which lead to poor performance, mortality, condemnation, and downgrading. These problems can create both economic and animal welfare concerns for both processors and producers. Therefore, this study was designed to determine variations in tibia and skin puncture strength between males and females. A total of 2000 male and female samples were obtained from a processor. Tibia strength characteristics such as force (N), energy (N-mm), and stress (N/mm²), skin thickness (mm), and skin puncture characteristics such as force (N) and energy (N-mm) were determined using an MTS Universal Testing Machine. The results indicate that bone width is moderately heritable and breaking strength is highly heritable. There is also a negative correlation between tibia width and breaking strength. There were no statistical differences in skin thickness between males and females. However, force and energy were significantly higher in the male samples when compared to the females. Therefore, there are sex variations in bone breaking strength and skin puncture.

Key Words: skin puncture, tibia, drum


Purpose: To demonstrate the feasibility of using ozone and membrane technology to treat chicken bath water in poultry processing and show the efficiency of highly ozonated water in poultry pre-wash operations. Experimental Design: In a pilot operation, eviscerated chickens were pre-washed with tap water which had been ozonated 4-12 ppm concentration and afterwards chilled for 30 minutes in an immersion chiller containing approx. 4 ppm ozone. In a side-stream, water from the chiller was purified by 10k MWCO hollow fiber ultrafiltration at one gallon per bird, achieving a COD level in the chiller water of less than 400 mg/L, which is the maximum for effective use of ozonation. E. coli, Aerobacter, and Coliform counts of the processed birds were determined at different steps of the test program with various process conditions, using USDA procedures. A one-minute in-and-out spray wash with ozonated water effectively reduced the bacterial counts on the birds. Compared with commercial in-and-out bird washers using chlorinated water, bacterial counts were lower with ozonated water using 1/3 less water volume. The bacterial kill rate in the ozonated pilot chiller was comparable to a commercial chiller operation using chlorine dioxide as the anti-microbial agent. Microbial analysis of the ultra-filtered and recycled chiller water showed a considerable reduction of total bacterial count and complete removal of pathogens through ultra-filtration alone. Turbidity measurements of the chiller water indicated that the minimum USDA requirement for only 0.44 g/L of bacterial overgrowth could be obtained. Sensory evaluation, TBA and fatty acid analyses of cooked ozone treated chicken showed no statistical difference as compared to commercial chicken. Conclusion: Ozone can replace chlorine as an effective antimicrobial agent in poultry wash and chilling operations. Properly filtered chiller water can be safely recycled, saving water and refrigeration energy. Ozone treated birds were fully acceptable as commercial product. Control of fugitive ozone emissions was an issue.

Key Words: Ozone, Birdwash, Membranes, Chiller

The use of SNAPs (Safe and Natural Absorbent Polymers) in food pads: a safe and effective way to increase absorption and retention of poultry exudates. Serge Hupp1, Lysac Technologies Inc./Boucherville (Quebec)/Canada.

Most food pads are made of cellulose materials and absorb most of the exudates released by meat and poultry. However, as their retention capacity is quite low, they do not retain absorbed fluids. Recent food pads containing polyacrylate-based superabsorbents (SAPs) are an improvement. However, SAPs made with petroleum derivatives are approved only for indirect contact with food. To remedy this situation, Lysac Technologies has developed Safe and Natural Absorbent Polymers (SNAPs), based on natural polysaccharides. SNAPs have been approved for direct contact with food by the FDA, Health Canada and the European Union. In addition, food pads containing SNAPs have vastly superior retention capacity compared to regular pads. To support these claims, we conducted a study under real conditions using different pieces of poultry. Food pads in current use, containing various absorbent materials, were placed on trays in contact with poultry and wrapped in plastic film. Packages of poultry weighing 0.5 lb. to 0.7 lb. were kept between 2C and 4C for 5 days. The amounts of exudate released by each piece of poultry and the amounts absorbed by each food pad were then measured every day. Pressure was also applied to pads to reproduce actual handling and storage conditions. Under pressure, food pads with SNAPs absorbed and retained more than 75% of the poultry exudates, compared to 35% for those without. These results compare favorably with the performance of SAPs currently employed. The use of a safe, natural, food-grade superabsorbent in food pads is an innovative concept with great potential for the poultry industry. The
study shows that adding SNAP’s to food pads increases absorption and greatly adds to retention of exudates released by poultry. This results in more appealing and safer products, protecting against leakage and contamination, while improving the price/performance ratio of the pad.

**Key Words:** Food / Meat Soaker Pad, Superabsorbent, Absorption / Retention, Food-grade, Safe

### 210 A breakthrough in plastic belt cleaning.

L. Cediel*, Habasit AG, Reinach-Basel/Switzerland.

The food industry is striving to improve safety and shelf-life of products leading to new and challenging hygiene requirements and standards. These in turn are driving innovation in all areas of food design and processing in general, and in particular impede laboratories in cleaning and disinfection techniques complemented with the implementation of tougher Quality and Hygiene Management Systems such as HACCP, GMP, Hurdle Technology and others. Processing and conveyor belts are critical components in contemporary food production. Research effort in areas of technology such as Functionality Modification combined with Improved Design Criteria is leading to a breakthrough in conveyor belt cleaning and sanitation. This paper explains the technical aspects of both technologies and the important benefit that offers to the food industry by providing an additional hurdle to microorganisms. The first technology deals with a formulated belt, meeting all relevant US regulations (i.e. FDA), that prevents growth of spoilage microorganisms, mold proliferation, related odors and degradation of belt surfaces, without affecting the physical properties and life of the belt. The effectiveness of this treatment is demonstrated with lab data. However, this technology is not designed to replace proper cleaning practices and will not protect users or others against food-borne or disease-causing bacteria. The second development involves a plastic modular belt with improved hygienic design and unique easy to clean characteristics. The main features of the new design are explained. By combining these two technologies with new cleaning and disinfection techniques, a significant breakthrough in plastic belt’s cleaning is achieved.

**Key Words:** Belts, Conveyor, Plastic

### 211 Virginiamycin and the antibiotic resistance debate: a review of recent scientific findings.

Kenneth W. Eafundo*, Phibro Animal Health, Fairfield, New Jersey USA.

In the last four years, much discussion has taken place on the use of virginiamycin in animals and its purported effects in producing strains of *Enterococcus faecium* that may not be responsive to other streptogramin antibiotics (e.g. Synercid). Because a paucity of information has been available on this subject, several independent laboratories have carried out research to determine whether concerns raised over virginiamycin use in animals could be supported by sound scientific data. The purpose of this review is to provide an update on the key scientific information that has recently been generated on virginiamycin in this debate. Among the key studies on the subject, the work of Jones et al. (1998) points out that of over 1000 clinical isolates of *E. faecium* collected in the US and Canada, 99.8% were sensitive to Synercid. Recent European studies (FEANA, 2000; Bywater, 2001) illustrate that no correlation exists between the sensitivity patterns of *E. faecium* collected from animals and man. This finding is supported by the work of Park et al. (2000), and shows no genetic relatedness between human and animal *E. faecium* in Korea. Johnson et al. (2000) have also demonstrated that *E. faecium* do not move freely between animals and man. Addition work by these authors (2000) has shown that streptogramin resistant *E. faecium* from humans are currently rare and do not come from a farm environment, a finding that is also supported by McDonald et al. (2001). Perhaps most importantly, Willems et al. (2001) have identified a variant gene that causes hospital outbreaks of *E. faecium*. This gene is common from *E. faecium* in hospitals on three continents, but it is absent from all isolates from healthy humans and from all animal isolates that were examined. These studies support the notion that virginiamycin usage in animals poses little risk to humans who enter the hospital setting. Assessments currently underway will elaborate actual risk.

**Key Words:** Virginiamycin, antibiotic resistance, *Enterococcus faecium*

### 212 Potential value of antibiotics and anticoccidials for control of blackhead (Histomonas meleagridis) in chickens.

Jinghui Hu and L.R. McDougald*, Department of Poultry Science, University of Georgia, Athens GA 30602.

Broiler chicks inoculated with both Histomonas and cecal coccidia (as a model for studying blackhead in chickens) developed moderately severe blackhead disease. Several antibiotics commonly used in poultry were tested at normal feed or water additive levels, but had little effect on Histomonas lesions or weight gains. Bacitracin at 100, 200, or 300 g/ton reduced liver lesion scores somewhat (p<0.05), but had no other positive effects. Apramycin at 300 ppm in water reduced liver lesion scores (p<0.05), but did not ameliorate cecal blackhead lesions or weight gains. Penicillin (100ppm), chlorotetracycline (100 ppm), tylosin (110 ppm), or sarafloxacin (40 ppm), in water gave no improvement in liver or cecal blackhead lesions. Weight gains were improved relative to infected controls with penicillin, tylosin, or sarafloxacin treatment (p<0.05). Five anticoccidials (salinomycin, diclazuril, nicarbazin, roxarsone, and lasalocid) were tested at recommended levels in two trials. Results were similar in both trials. Liver lesion scores in the nicarbazin treatment were improved (p<0.05) in comparison with controls and other medicated groups, and the number of birds positive for liver lesions was lower (p<0.05). Otherwise, anticoccidials had no effect on liver or cecal lesion scores or weight gains. Control of coccidiosis by the anticoccidials (as shown by oocyst counts) varied from product to product, but was not correlated with severity of blackhead lesions. These results suggest that the effect of cecal coccidia on susceptibility of chickens to H. meleagridis is not a simple function of mechanical damage to the cecal mucosa.

**Key Words:** Histomonas, antibiotic, anticoccidial, chemotherapy, blackhead

### 213 A new method to purify Histomonas meleagridis from in vitro culture.

Jinghui Hu* and Larry McDougald, University of Georgia.

Histomonas meleagridis were purified from in vitro culture media using a snowball technique. Collected samples were washed twice with PBS to remove some bacteria by centrifuging at 1000g for 20 min and applied to nylon wool column. The filtrates supplemented with 20% horse serum were distributed in dishes with 2 mm deep. Shake the dishes gently and clusters of H. meleagridis will be formed in the center of dishes like snowball. Move the clusters to the tube that contained Sucrose gradient. After centrifuged, A band was formed on the surface between two sucrose gradients. Remove the band and pure H. meleagridis will be obtained by washing the clusters twice with PBS. This is rapid method that allows the purification of large amounts of highly purified H. meleagridis.

**Key Words:** Histomonas meleagridis, Purification, Sucrose gradient, In vitro culture, Protozoa

### 214 Performance Improvement with β-mannanase Feed Enzyme in Broilers Challenged with Coccidiosis and Necrotic Enteritis.

Greg Mathis1, Hung-Yu Hsiao2, and David Anderson2. 1Southern Poultry Research, Inc., 2ChemGen Corp.

Two, 21 day coccidiosis and Necrotic Enteritis battery cage studies were performed to evaluate the anti-pathogenic effects of feeding the feed enzyme 1,4-β-D-mannanase on broiler performance. In both studies, birds were challenged at 8 days of age with E. acervulina and E. maxima and on Days 11, 12, and 13 with Clostridium perfringens. Each treatment consisted of 8 replicates in a complete randomized block design. Males from a Cobb X Cobb strain were used. Feed in mash form was fed ad libitum throughout the test period. The basal feed was a standard broiler starter feed containing 22% crude protein, with an ME of 1400 kcal/lb. β-mannanase was also compared to Salinomycin 60 g/t and or Bacitracin Methylene Disalicylate 50 g/t (BMD). In both studies β-mannanase was added at the rate of 100 MU/ton. In study two, β-mannanase was also added at 500 MU/ton (5X). The performance parameters measured were (Day 0 to 21 and Day 8 to 21) feed consumption, average live weight and mortality. On Day 14 (6 days post inoculation), 2 birds per pen were lesion scored. β-mannanase did not significantly reduce coccidial lesions in either study. Salinomycin did dramatically reduce coccidiosis lesions. In both studies the nonmedicated, infected controls had significantly the lowest performance. Birds fed β-mannanase at 1X or 5X level had significantly better performance than the nonmedicated, infected, but less than Salinomycin alone or in combination with BMD. Performance of birds fed β-mannanase in study two were equal to birds
fed BMD alone. The two studies demonstrate the reproducibility of the benefits of adding β-mannanase into the feeds of broiler chickens exposed to these commonly occurring poultry pathogens.

Key Words: β-mannanase, Necrotic Enteritis, Coccidiosis


The objective was to compare the performance of broilers vaccinated with Coccivac-B to anticoccidial shuttle programs using a coccidiosis challenged broiler floor pen study. At the hatchery, chicks were either unvaccinated or spray cabinet vaccinated with Coccivac-B. The controls were nonmedicated, nonimmunized, nonchallenged (NMNIC) and medicated, nonimmunized, challenged (NNMIC). The shuttle programs were Nicarb 125 ppm in the starter (Day 0-21) to Salinomycin 60 ppm or Narasin 74.8 ppm in the grower (Day 22-35). All birds were fed a nonmedicated finisher (Day 36-42). The study was a randomized complete block design with 6 replications. Average live weight and feed consumption was measured on Days 35 and 42. All challenged birds were inoculated with a mixed inoculum of E. acervulina, E. maxima, and E. tenella. On Day 34 (6 days post inoculation), 4 birds per pen were lesion scored. The lesions in the NMNIC birds averaged 2.83 for E. acervulina, 2.13 for E. maxima, and 2.72 for E. tenella. Average lesions for all species was less than 0.65 in the Coccivac-B birds. Salinomycin and Narasin did not significantly increase lesions at the time of scoring, but all averaged above 1.50. On Day 35 and 45, the NNMIIC birds had significantly the best performance and the NMNIC birds had the worst. On Day 35, there was no significant performance difference between the two shuttle program birds and the Coccivac-B birds. On Day 42, the Coccivac-B birds had significantly better performance than the shuttle program birds. It can be inferred that the Nicarb controlled background coccidia and thus limited immunity developed. The birds fed the ionophores were not adequately protected against a late challenge. The Coccivac-B birds, as expected, had some early loss in performance, but were protected from the coccidial challenge. Due to this immunological protection and compensatory gain the Coccivac-B birds did not suffer from a late coccidial challenge and thus had good performance on Day 42.

Key Words: Coccivac-B, Salinomycin, Narasin, Coccidiosis, Immunity

216 Antioclostridial Efficacy of Flavomycin® In Conjunction with Coccivac-B. Greg Mathis*, 1 Herb Kling2, and Charles Hofacre3, 1 Southern Poultry Research, Inc., 2 Internet, 3 University of Georgia Poultry Diagnostic Center.

The objective was to evaluate the antioclostridial efficacy of Flavomycin at 2 grams per ton when used in conjunction with the coccidial vaccine, Coccivac-B. In the floor pens the initial stocking density was 0.66 square ft/bird. The Ross X Ross chicks were sprayed vaccinated at the hatchery with Coccivac-B. Bird weights and feed consumption were measured on Days 21, 35, and 49. The treatments were nonmedicated and Flavomycin 2 grams per ton. The two treatments were randomized within twelve blocks. On Day 35, the Flavomycin group was divided into two groups of six replications. One group was fed Flavomycin 2 g/t and the other fed nonmedicated feed. On Days 17, 18, and 19 all birds were dosed with a C. perfringens at 1.0 X 10^9−10^9. On Days 21 and 27, pre-selected birds were examined for the degree of Necrotic Enteritis lesions. Very few classical lesions were seen, possibly due to a fast developing infection and toxins being released; but the mucosa was not fully necrotic at the time of scoring. Necrotic Enteritis related mortality did show a significant treatment separation. Thirty seven percent of the nonmedicated birds died from Necrotic Enteritis while only twenty four percent died in the Flavomycin pens. Flavomycin did moderate this severe Necrotic Enteritis challenge, as seen by almost a 9 point improvement in feed conversions and 0.3 lbs heavier on Day 35. On Day 49, the Flavomycin group (to 35 and 49) birds had significantly better feed conversions, male, female, and average live weights than the nonmedicated birds. The continuous feeding of Flavomycin further improved performance. Thus Flavomycin is a viable feed additive for the aid in control of Necrotic Enteritis, providing good antioclostridial protection and performance enhancement.

Key Words: Flavomycin®, Necrotic Enteritis, Chickens, Coccivac-B

Poult. Sci. 81 (Suppl. 1)

217 Evaluation of the possible immunological function of the chicken crop (inlguvies). L.E. Vaughn1,1, P.S. Holt1,1, K.S. Crowdis1, K.-H. Seo1, and R.K. Gast1,1, 1 USDA, ARS, Southern Poultry Research Laboratory, Athens, GA, 2 Michigan State University, College of Veterinary Medicine, East Lansing, MI, 3 FDA, CFSAN, Washington, DC.

The study evaluated crop (inlguvies) immunity and lymphoid tissue presence in pre- and post-SE infection. Forty adult specific-pathogen-free (SPF) White Leghorn hens age 78 weeks and forty-eight White Leghorn chicks age 5 weeks were selected for the study. Both groups were orally infected with Salmonella Enteriditis, phage type 13, nalidixic acid resistant strain. The humoral immune response was monitored pre-infection and then post-infection over a four week period by measuring antibody levels against SE lipopolysaccharide (LPS) antigen in serum, bile, crop and alimentary tract by Enzyme Linked Immunosorbent Assay (ELISA). The presence or absence of lymphoid tissue was evaluated in excised, formalin-fixed crop tissues by routine Hematoxylin and Eosin (H&E) staining. Crop serial tissue sections were also used for immunohistochemistry (IHC) for the detection of the general leukocyte cluster of differentiation 45 (CD45) cell surface antigen. Each week crop contents were cultured to assess SE levels. Results indicated an increase in crop IgA levels and prominent lymphoid structures post-SE infection. Crop lymphoid aggregates were identified by routine H&E and CD45 positive cells were detected by IHC. These aggregates increased in size and number by week 2 post-SE infection and remained prominent through week 4 PI. IgA anti-SE IgA antibody levels peaked at week 3 and week 4 for hens and chicks respectively.

Key Words: Crop, Inlguvies, Salmonella, Food-safety, Mucosal immunity

218 Integrons, genetic elements responsible for acquisition of antibiotic resistance genes and their prevalence among gram-negative enterics in poultry litter. D. Rokey1,1, M Maier1, T Liu1, C. Hofacre1, D White2, and J Maurer1, 1 University of Georgia Department of Avian Medicine, 2FDA, Laurel Maryland.

Integrons are genetic elements, similar to transposons that mediate multiple drug resistance. This genetic element has the potential for acquiring “new” antibiotic resistance genes through the recombination of these genes into the integron’s integration site //italicizeintI1. An integrase gene, /italicizeintI1, a signature of class 1 integrons, mediates this recombination event. Our hypothesis is that the integron serves as a vehicle for exchange of drug resistance genes and their eventual dissemination within microflora in the farm, including their final disposition into food-borne pathogens like //italicizeSalmonella and //italicizeCampylobacter. This study examines the prevalence of class 1 integrons in gram-negative bacteria in chicken litter from two poultry farms. Litter was collected from two farms participating in this study. Samples were collected at the time of chick placement (time 0), as well as at 2, 4, and 6 weeks following chick placement. Gram-negative enterics isolated from poultry litter were screened for //italicizeintI1. The number of gram-negatives with //italicizeintI1 consistently increased, during the maturation of the flock. The class 1 integrons were present among a diverse number of genera, species, and genetic types. //italicizeEscherichia coli was the most prevalent organism found with class 1 integron. Those isolates positive for //italicizeintI1 were further analyzed using a PCR that amplifies an antibiotic resistance gene cassettes commonly present in //italicizeintI1 site of class 1 integrons. There were isolates that varied in number and size of gene cassettes present in class 1 integron. One isolate had as many as 8 integrons that varied in size with respect of its cognizant, gene cassette. The size of integron gene cassettes varied in size from 600bp to 4 kb. Most isolates had a 1 kb gene cassette that was later identified as streptomycin-spectinomycin resistance gene, //italicizeaadA1. Our results indicate that integrons are not confined to veterinary or human pathogens, but are present among the normal microflora of the poultry farm as well as serve and provide a potential reservoir of antibiotic resistance genes for important food-borne pathogens like //italicizeSalmonella.

Key Words: Integron, Antibiotic Resistance, Poultry Microflora

219 Salmonella isolates from commercial poultry operations in Northeast Georgia. K. Liljebjelke1,1, M. Maier2,1, K. Lui2, D. White2, C. Hofacre1, M. Lee1, and J. Maurer1, 1 University of Georgia, 2FDA.

The use of antibiotics in agriculture has been implicated as contributing to emergence of drug resistance in food-borne human pathogens.
Salmonella losses remain a major food safety issue in the United States. The purpose of this study was to describe the Salmonella populations present on two commercial broiler operations, in order to examine the presence and transfer of antibiotic resistance genes in the microbial population. We used PCR, southern blot, and pulsed-field gel electrophoresis to “fingerprint” Salmonella and characterize drug resistance genes, in order to follow antibiotic resistance from the hatchery to the finished product. Six consecutive flocks on each farm were sampled, yielding 295 Salmonella isolates. Consistently more Salmonella were isolated from farm A than farm B. The majority of isolates from both farms were S. typhimurium. Serotypes differed between the farms and varied between flocks. S. enteritidis was isolated from farm A and seems to be associated with a rodent infestation, as it was also isolated from mice trapped in the houses. Genetic fingerprinting of isolates showed no single dominant genetic type, but did show genetic types persisting from one flock to another. Isolates were screened for class I integrons by Southern hybridization. Eighty percent contained class I integrons. Gene cassettes in the integrons were characterized by PCR using primers to conserved sequences of the integron. The PCR yielded amplicons of 280 - 4,000bp. The majority of antibiotic resistance genes identified using PCR-ELISA confer aminoglycoside resistance. Sulfonamide resistance genes and beta-lactamases were also identified. Statistically significant association was observed between class I integrons and resistance to sulfamethoxazole, gentamicin, tetracycline, and streptomycin. Integrons are known to be a major factor in the spread and dissemination of antibiotic resistance in Salmonella and other human pathogens. When this study is completed these data will provide insight into the ecology of drug resistance in commercial poultry operations.

Key Words: Salmonella, Integron, Resistance

220 Development of a RFLP PCR scheme for serotyping Salmonella sp. isolated from poultry environment. Yang Hong*, Margie Lee, and John Maurer, University of Georgia, Athens, GA.

The phase-1 (fliC) and phase-2 (fliB) Salmonella flagella genes were analyzed by RFLP-PCR to help with the identification of different Salmonella serotypes based on distinct restriction profiles of fliC and fliB. The results showed that twenty-three phase-1 flagellins and 7 phase-2 flagellins could be differentiated among each other when using restriction endonucleases Sau3A and HhaI in RFLP analysis. These flagellins make the antigenic formulas for fifty serotypes of Salmonella sp., which include the common serotypes adapted to the poultry and other animal species. With the knowledge of the serotype an organism, ninety-six percent of the diphasic Salmonella serotypes could be identified using this double restriction enzyme RFLP analysis of fliC and fliB genes. This serotyping scheme was applied to molecular serotyping of twenty-three Salmonella isolates from poultry environment and the result was compared to the conventional serological tests. Overall, RFLP-PCR proved to be a fast and economic alternative approach to serotyping Salmonella sp.

Key Words: Salmonella, RFLP-PCR, flagellin, serotyping

222 PEMS-associated astrovirus infection in adult turkeys. J. B. Stanton*, S. Schultz-Cherry*, D. Larsen*, L. Kelley*, and C. C. Brown†, 1 Department of Pathology, University of Georgia, Athens, GA 30602, 2 Southeast Poultry Research Laboratory, USDA-ARS, 934 College Station Road, Athens, GA 30605.

PEMS enteritis mortality syndrome (PEMS) is an incompletely understood multifactorial syndrome of young turkeys defined by mortality rates, immunosuppression, and enteritis. No studies to date have addressed the effect of PEMS on adult turkeys. This study determined the response of 6-week old commercial turkeys to an inoculation of filtered PEMS homogenate and the humoral response to the PEMS-associated astrovirus. Clinically the birds displayed watery diarrhea and visually observed weight loss. Enzyme linked immunosorbent assays (ELISA’s) revealed a mild humoral response to the astrovirus peaking 21 days after initial infection, but no evidence of an anamnetic response was found following reinfection. Total immunoglobulin measurements failed to demonstrate evidence of humoral immune suppression. Reverse transcriptase-polymerase chain reaction (RT-PCR) for astrovirus performed on fecal samples indicated some animals were passing viral genome in feces. In situ hybridization detected viral replication in the distal ileac, cecal, and proximal colonic epithelial cells, with positive staining concentrated at the basolateral surface of the villus. No other sites of replication were found. These findings contradict the current thinking that PEMS agents do not affect adult turkeys. In our study, turkeys were both clinically affected and served as sources of viral amplification and environmental contamination. Consequently, control efforts should include consideration of adult turkeys in the transmission and maintenance of the disease in a flock.

Key Words: Poul enteritis mortality syndrome, PEMS, Turkey astrovirus

223 Characterization of a unique Reovirus Isolated from Poult Enteritis Mortality Syndrome-Affected Turkeys. Elizabeth Thompson*, Darrell Kapczynski, and Stacey Schultz-Cherry, Southeast Poultry Research Lab/ USDA-ARS: Athens, GA.

Avian reoviruses (ARV) are ubiquitous among poultry flocks. Although infection can be present without disease, reoviruses may be involved in several disease syndromes including viral arthritis/tenosynovitis in chickens and malabsorption syndrome of turkeys. Not surprisingly, a turkey reovirus was isolated from the bursa of turkey poults affected with Poul enteritis and mortality syndrome (PEMS). PEMS is a highly infectious, transmissible disease of young turkeys between 7-28 days of age characterized by enteritis, severe growth depression, high mortality, immunosuppression, and lack of flock uniformity. The objective of these studies is to CHARACTERIZE THE PEMS-ASSOCIATED REOVIRUS. The PEMS-associated reovirus causes enteritis and growth depression in commercial turkeys. Antigenic and nucleotide comparisons were performed to compare the PEMS ARV isolate to the chicken reference strain S1133. Methods: PEMS ARV and S1133 were propagated in African Green Monkey kidney (Vero) cells and purified using established procedures. Virus neutralization and western blot analysis were performed using S1133 specific antiserum (SPAFA). RNA was isolated from purified virus using Trizol following manufacturer instructions and RT-PCR performed using oligonucleotide primers designed to conserved regions of avian reovirus S1 and S3 genes. Results: Replication profiles demonstrate that the PEMS ARV, unlike S1133, can replicate to high titers in Vero cells without prior adaptation suggesting that the viruses are different. Additionally, antisera against S1133 fails to neutralize PEMS ARV and does not fully recognize the PEMS ARV isolate by indirect immunofluorescence. To support this data, we sequenced S1 and S3 genes of both

Poult. Sci. 81 (Suppl. 1)
viruses and compared nucleotide and amino acid similarity. Preliminary results suggest that the PEMS AV is genetically distinct from SI133. Further studies are needed to determine if the PEMS AV is unique amongst turkey reoviruses.

**Key Words:** Reovirus, Poult Enteritis Mortality Syndrome, SI133, Molecular Characterization

### 224 Fertility and Sperm Quality of Broiler Breeder Males Infected with Subgroup J Avian Leukosis Virus

In order to assess the effects of subgroup J Avian Leukosis Virus (ALV-J) on semen quality, breeder broiler males were separated by ALV-J status (positive=“POS” or negative=“NEG”). One hundred and one of the 249 males originally placed at 1 day of age (40.6%) died within 43 weeks of age, suggesting that many of the males that died prior to being obtained for this study were infected with ALV-J. It is likely that the POS males had relatively high levels of ALV-J antibodies because of their ability to live through 44 weeks. From 47 to 56 weeks of age, hens were inseminated every third week with 7.5x10⁷ sperm from either POS or NEG males. Fertility and hatch data were collected by incubating eggs laid during the 2 weeks post-insemination (PPI). The number of sperm that penetrated the perivitelline membrane of the ovum was determined from eggs laid on the eighth day post-insemination (DPI). Sperm mobility index (SMI) was determined at 58 and 60 weeks of age. The SMI of males produced by POS males was significantly higher (P<0.05) while SMI and sperm hole penetration measurements indicated that the sperm quality from treatments POS and NEG were similar (P>0.05), fertility was significantly greater (P<0.05) in the POS treatment during the first 89.0 vs 79.0% and second WPI (59.3 vs 45.0%). However, there were no viral effects (P>0.05) in hatchability of either fertile eggs or total eggs set. Mortality from 44–59 weeks of age was increased (P<0.05) in the POS group (37.5 vs 6.25%). Although sperm quality of caged males infected with ALV-J did not suffer, their mating efficiency in a commercial setting would likely be poor due to high morbidity and mortality.

**Key Words:** Avian Leukosis Virus-J, Sperm quality, Breeder breeder males, Hatchability, Fertility

### 225 Persistence of infectious bronchitis virus (IBV) in commercial broilers. Ivan Alvarado*, Pedro Villegas, Jhon El-Attrache, and Mark Jackwood, 1 University of Georgia.

**SUMMARY.** The persistence of Arkansas and Massachusetts IBV commercial vaccines in several tissues from commercial broilers was evaluated. The vaccines were administered by coarse spray at one day of age. Maternal antibody levels at one day of age were consistent with those commonly observed under field conditions. After vaccination, the presence of IBV at different sampling periods was determined by virus isolation, IBV rapid plate hemagglutination assay, RT-PCR/RFLP, and in situ hybridization. High correlation between the rapid plate hemagglutination assay and RT-PCR was observed. The RT-PCR/RFLP test confirmed the presence of the vaccine virus used in each treatment group, discarding the possibility of cross-contamination among groups. Compared with the Massachusetts IBV, the Arkansas IBV was detected more frequently in the examined tissues.

**Key Words:** IBV, Arkansas, Project

### 226 Disease in domestic chickens after inoculation with chicken-passaged Newcastle disease virus isolates from wild and exotic birds. G.D. Kommers*1, D.J. King2, B.S. Seal2, and C.C. Brown1, 1University of Georgia, Athens - GA, USA, 2Southeast Poultry Research Laboratory - USDA/ARS, Athens - GA, USA.

Three Newcastle disease virus (NDV) isolates recovered from wild (Anhinga) and exotic birds (Pheasant and Dove) were passaged four times in domestic chickens prior to this pathogenesis study. Groups of ten 4-week-old SPF White Leghorn chickens, inoculated intraconjunctivally with each of the passaged isolates, were observed for clinical disease and were sampled at 2, 5, 10, and 14 days post-inoculation (dpi) or at the occurrence of mortality. Tissues were examined by histopathology, by immunohistochemistry (IHC) for presence of NDV nucleoprotein, and by in situ hybridization (ISH) for mRNAs using a digoxigenin-labeled riboprobe to the NDV matrix gene. Birds inoculated with the Pheasant and Dove isolates had severe disease, characterized by marked depression, and died at 4 and 5 dpi, respectively. Although birds inoculated with the Anhinga isolate did not show clinical signs, mild to severe lymphoplasmacytic enteritis was detected histologically at 2, 5, 10 (more prominent), and 14 dpi. Severe diffuse lymphocellular necrosis of the lymphoid organs and aggregates was the main histologic finding in birds inoculated with the Pheasant (at 4 dpi) and Dove (at 4 and 5 dpi) isolates. Viral nucleoprotein and viral mRNA were detected by IHC and ISH, respectively, among all the affected organs. The results of this study demonstrate that moderate to highly virulent NDV isolates from wild and exotic birds represent a serious threat for commercial poultry flocks.

**Key Words:** chickens, immunohistochemistry, in situ hybridization, Newcastle disease, pathology


A mild upper respiratory disease of broilers was found to be caused by an ILT virus of low virulence. The gross lesions of the disease include mild conjunctivitis, mild tracheitis, and rhinitis. Clinical signs are mild to almost inapparent signs of upper respiratory disease. The virus has been isolated on flocks 3–7 weeks of age. Infected flocks generally recover, however, environmental stress can lead to the development of chronic respiratory disease, characterized by pneumonia, airsacculitis, pericarditis, and swollen heads.

**Key Words:** Infectious laryngotracheitis, ILT

### 228 Development of real-time PCR to study replication kinetics of Duck Hepatitis B Virus in cell culture. Chi-Young Wang*, Joseph Giambonne, and Bruce Smith, Auburn University, Auburn, AL.

Duck hepatitis B virus (DHBV) is in a family of DNA-containing viruses that include human hepatitis B virus (HBV). It is widely distributed in domestic and wild ducks. HBV is a public health problem and can cause liver diseases in ducks. The hypervariable region of the VP2 gene of IBDV was amplified by RT-PCR. Products from vaccine strains confirmed the presence of the vaccine virus used in each treatment group, discarding the possibility of cross-contamination. We applied it to quantify DHBV DNA in serum from experimentally and congenitally infected ducks and results were 8.8 X 10 to 11 and 5.4 X 10 to 10 /ml, respectively. Virus titer from experimentally infected ducks was higher than congenitally infected ducks. The assay was used to study replication kinetics of DHBV in cell culture including duck hepatocytes, duck embryonic hepatocytes, and frozen and thawed duck and embryonic hepatocytes. All cells were infected with the same amount of virus. Titers were different at 24 hours post infection. Replication peaks appeared four days post infection for all types of cells and then cells released mature progeny virus. Duck embryonic hepatocytes had highest yield for DHBV. Real-time PCR system is a sensitive and reproducible test for detection and quantification of DHBV and duck embryonic hepatocytes were the best choice for in vitro study.

**Key Words:** Duck hepatitis B virus, Real-time PCR, duck embryonic hepatocyte

### 229 The use of the heteroduplex mobility analysis (HMA) for genotyping field isolates of the infectious bursal disease virus (IBDV). A. Banda*, P. Villegas, J. El-Attrache, and H. Sellers, College of Veterinary Medicine. The University of Georgia, Athens, GA USA.

The heteroduplex mobility analysis (HMA) relies on the formation of mismatches when two different DNA molecules are mixed, denatured and allowed to reanneal. HMA has proven to be a useful and inexpensive method to categorize several viruses such as measles, polio, hepatitis C, HIV and Newcastle disease. The hypervariable region of the VP2 gene of IBDV was amplified by RT-PCR. Products from vaccine strains and other known strains were used as reference strains. By using HMA, several IBDV field samples were classified by analysis of the RT-PCR

Infectious bursal disease virus (IBDV) infections by 2 weeks of age can cause profound and lasting immune suppression in chickens. Although passive immunity is the most efficient way to prevent early field infections, some flocks still become challenged by two weeks of age. The objective of this study was to see if adding IBD vaccine to Marek’s at day of age would improve early IBDV protection in commercial broiler flocks with different levels of maternal immunity. Broilers were chosen from a 54-week old breeder flock A and a 39-week old flock B. Breeders had received two 100% bursa-derived shots prior to lay. Broilers (N=25) from flock A and B had day-old ELISA GMTs of 3148 and 5984 (Idexx XR). Both breeder flocks were then divided into 3 groups, according to the following day of age vaccination programs: Marek’s serotype-2-3 full dose, and Marek’s plus IBD vaccine #1 or #2. At 11 days of age, challenge birds received 3.0 logs of IBD viruses 1174 and V1, recent California and Georgia isolates. Bursal protection was evaluated 7 days post challenge using bursa to body weight ratios (B:BW). Birds with B:BW less than 2 standard deviations below the mean of the non-IBD controls (Marek’s-only) were not considered protected. In the non-challenge groups there were no significant differences in B:BW between Marek’s-alone and Marek’s/IBDV vaccines in either flock A or B. However, significant differences were seen in IBD challenge groups. Within flock A, groups given Marek’s/IBDV#2 had significantly higher B:BW than Marek’s-alone vaccines after challenge with both IBD isolates. Percent protection scores to 1174 and V1 were 84-96-60% and 88-96-75%, respectively, for Marek’s/IBDV#1, Marek’s/IBDV#2 and Marek’s-alone groups. Within flock B, both Marek’s/IBDV groups had significantly higher B:BW than the Marek’s-alone groups after challenge with both IBD isolates. Percent protection scores against 1174 and V1 were 96-96-65% and 88-100-68%.

Key Words: IBDV, Vaccination, Broilers

231 Development of a plant expression construct containing the VP2 gene of a infectious bursal disease viral isolate. Hongzhuan Wu1,2, Narendra Singh3, Robert Lacy2, Karyn S Gunn2, and Joseph J Gambrone1

Infectious bursal disease (IBD) is caused by the IBD virus (IBDV), and is an important source of economic loss within the chicken industry worldwide. Control of this disease is mainly by vaccination, however commercial vaccines are not totally effective. Over the past decade, advances in molecular biology and immunology have improved understanding of many diseases and contributed to new therapies for vaccination. The development of compounds that express antigens is a particularly promising approach. Plant-derived antigenic proteins have delayed or prevented the onset of disease in animals and have proven to be safe and efficacious in human clinical trials. IBDV is classified within the Birnaviridae family, which is characterized by a bisegmented double-stranded RNA genome. The VP2 gene has been confirmed to be the major host-protective antigen of IBDV. Extensive characterization of the VP2 protein has stimulated research for its use in various subunit vaccines. In this study, the VP2 gene of IBDV variant E strain was amplified by a reverse transcriptase-polymerase chain reaction (RT-PCR). It was introduced into a gene under control of a plant specific promoter vector. A transgenic Arabidopsis (a common weed) was developed containing the VP2 gene by Agro bacterium tumefaciens-mediated transformation after characterization by restriction enzyme digestion and nucleic acid sequencing. Further experiments toward an edible vaccine in alfalfa are in progress.

Key Words: IBDV, VP2 gene, edible vaccine, arabidopsis, alfalfa


Five commercially available live IBDV vaccines were examined for their effect on the immune system of SPF Leghorns. All vaccines were given at 1 week of age by eye and nose drop at their recommended use level. At 1 week after vaccination, all were given a standard dose of Lasota NDV vaccine by the same route. Also at this time, 10 birds per group were killed and bursa to body weight ratios determined. At 1, 2, and 3 weeks post NDV vaccination, all birds were bleed and sera collected for NDV ELISA titers using a commercial kit. Also at each bleeding time, 10 birds per group were killed and bursa again taken for bursa to body weight ratios. Two of the vaccines were intermediate products. Neither had an adverse effect on NDV titers nor bursa weight. In contrast, the other 3 intermediate plus IBDV vaccines caused atrophy of the bursa and significantly reduced NDV antibody titers. Results showed that intermediate plus IBDV vaccines are not safe in susceptible chickens without antibody, and that they should only be given as a second booster dose to chickens.

Key Words: IBDV Vaccines Immunity

233 Molecular Characterization of Mexican Isolates of Newcastle Disease Virus from 1997-2001. Mireya Ortiz1, Tamas Fehervari1, Belem Huerta1, Bela Lomniczi3, Nestor Ledesma1, Billy Hargis2, Rogelio Alonso2, and Guillermo Tellez1


Newcastle disease (ND) is a highly contagious infection of poultry. In Mexico, the last outbreak caused considerable economic losses in the beginning of 2000 affecting 15 500 160 broilers. The objective of the present study was to determine the molecular characteristics of some Mexican ND viruses (NDV) isolated between 1997 to 2001. A comparative study used the restriction site analysis method was carried out with five reference velogenic viscerotrophic (Ishii, Chimahualacan, Miyadera, Queer-taro, and Torreon), two lentogenic (La Sota and Queensland V4) and 19 field NCV isolates obtained from field cases by the Department of Avian Medicine of Veterinary Medicine College at the National Autonomous University of Mexico. The reverse transcriptase-polymerase chain reaction technique (RT-PCR) was used to amplify the RNA of NDVs. The RNAs obtained from NDV infected chicken embryo allantoic fluid were purified and used for cDNA synthesis that were used as a template to amplify the fragment of 1349 nucleotide (nt) long region of the F-gene. The fragments were then digested by 3 enzymes (BstO I, Hinf I and Rsa I) and separated by size in agarose gels to determine the electrophoretic pattern (EP) of the Mexican field strains. The EP of the 19 isolates corresponded to: Torreon 6/19 (31.5 %); Chimahualacan 1/19 (5 %); and La Sota 4/19 (21.5 %). However, 8/19 (42.1 %) had different EPs from the reference strains. Sequence analysis of these 8 isolates is necessary to determine if they are related to other either know or unknown NDV strains.

Key words: Transcriptase-polymerase chain reaction, allantoic fluid, Newcastle disease virus.

234 Molecular Characterization of 11 Mexican Isolates of Avian Infectious Bronchitis Viruses. Belem Huerta1, Ruben Merino1, Mireya Ortiz2, Magdalena Escorcia1, Guillermo Tellez1, Nestor Ledesma1, and Rogelio Alonso2


Avian Infectious bronchitis virus (IBV) is a highly transmissible virus, which a morbidity who can reach up to 100% in only 36 hours. IBV is associated with respiratory, reproductive and renal infections. With the purpose not only of implementing better and specific diagnostic, but also, to distinguish among IBV strains isolated in Mexico. The goal of the present study was the molecular characterization of 11 strains retrieved from a collection of IBV strains, from the Avian Medicine Department of the College Veterinary Medicine at the National Autonomous University of Mexico. A fragment of 1720 bp corresponding to the glycoprotein
S1 gene was amplified by the reverse transcriptase-polymerase chain reaction (RT-PCR) technique. The amplified fragment was digested with 3 restriction enzymes (BstY1, HaeIII and Xcm1) which allow molecular characterization of the strains. The digested patterns obtained for the 11 IBV isolated corresponded: 2/11 (18.2%) to Massachusetts IBV strain, 2/11 (18.2%) were identified as BL-56 IBV Mexican variant strain; 1/11 (9%) corresponded to UNAM97 IBV Mexican strain. Interestingly two new strains were identified with the same frequency 3/11 (27.3%) each. These 2 new strains differed from the patterns of the IBV local variant strains that have been officially recognized for the Mexican Government. DNA Sequence analysis of these isolates is necessary to further characterize them.

Key Words: transcriptase-polymerase chain reaction, infectious bronchitis virus, restriction enzymes


Avian influenza (AI) is a major cause of important economic losses around the world, requiring strict control measures for the mobilization and commercialization of avian products and byproducts. For the serodiagnosis of AI, the most frequently used tests are Hemagglutination Inhibition and the Agar-Gel Immunodiffusion (AGID). The ELISA test has shown to be useful for both detection and quantitation of antibodies against the AI virus. The objectives of this study were: a) to determine the Kappa value between HI and ELISA tests, in the detection of antibodies against AI in serum samples; and 2) to evaluate the specificity and sensitivity of the HI, ELISA and AGID tests when detecting AI antibodies in egg yolk samples. Ninety serum samples from broilers of different ages were evaluated with both HI (HSN2, 4 HAU) and ELISA (Synbiotics AIV ProFLOCK ELISA) tests. The results were: 22 serum samples positive for both techniques, 4 were ELISA (+) and HI (-), 3 were ELISA (-) and HI (+), and 61 were negative in both tests. The Kappa value was 0.67 (excellent). Besides, for the detection of anti-AI antibodies in egg yolks, fertile eggs (n=15) were obtained from 4 different sources: 1) SPF hens (-), 2) Avian Influenza virus vaccinated hens (9%), 3) hens suspicious of an Avian Influenza outbreak (?) and 4) hens of unknown epidemiology (?). The yolk samples were analyzed twice with HI (HSN2 antigen, 4 HAU), ELISA and AGID tests. All samples assayed were negative by the AGID test. The HI and ELISA results were: Group 1: HI: 2+ /15 & ELISA: 0+/15; Group 2: HI: 15+/15 & ELISA: 15+/15; Group 3: HI: 13+/15 & ELISA: 15+/15; Group 4: HI: 7+/15 & ELISA: 8+/15. The HI test showed low specificity (87%) and high sensitivity (100%) when detecting antibodies in Groups 1 (not infected) and Group 2 (vaccinated), respectively; while ELISA showed 100% of specificity and sensitivity in both Groups. Therefore, ELISA is recommended as the test of choice when analyzing anti-AI antibodies in egg yolk samples.

Key Words: Avian Influenza, Serologic tests, Yolk samples


Hemagglutination Inhibition (HI) and ELISA are the most used serologic techniques for the detection of anti-NDV antibodies in chickens. Several attempts have been made to establish a correlation between the titers obtained with both HI and ELISA, with conflicting results. The present study aimed to establish whether or not there is a direct and proportional correlation between the HI and the ELISA tests when measuring anti-NDV serum antibodies. Using the HI test (10 HA units), 10 serum samples with a titer of 2560 were first identified. Each serum was diluted two-fold to obtain samples with titers of 1280, 640, 320, 160, 80, 40, 20 and 10. Undiluted as well as diluted samples were assayed 10 times using the Synbiotics NDV ELISA kit (NDV+ ProFLOCK ELISA) and Geometric Mean Titer (GMT), Standard Error of the Mean (SEM) and Coefficient of Variation (%CV) were determined. The titer value correlation between the HI and the ELISA tests was determined by linear regression analysis. The results were, for HI, ELISA GMT ± SEM and %CV, respectively: 10, 1834 ± 48, 9%; 20, 4103 ± 187 19%; 40, 5271 ± 224, 16%; 80, 6416 ± 253, 15%; 160, 7973 ± 151, 7%; 320, 8735 ± 133, 5%; 640, 10388 ± 117, 4%; 1280, 12889 ± 172, 5% and 2560, 13363 ± 257, 7%. The results showed a significant correlation between ELISA titers and previously obtained HI titers (p<0.01). Furthermore, serum samples (n=10 each) with low (10), medium (160) and high (1280) HI titers were first identified and then their titers determined 3 times by ELISA test. The results were, for HI, ELISA GMT ± SEM and %CV, respectively: 10, 1126 ± 12, 3.56%; 160, 7583 ± 134, 5.70% and 1280, 9147 ± 90, 2.60%. These results clearly show that there is a linear and proportional relationship between the HI test and the NDV ELISA test over a wide HI titer range. Acknowledge: Synbiotics Corporation, for donating the NDV ELISA kit.

Key Words: Newcastle Disease, Serologic tests, Titer correlation.


The presence of interferon (IFN) in the primary response of splenic lymphocytes T (SLT) stimulated with Concanavalin A (Con-A) during a primary or minimal challenge with 1 x 10^8 sporulated oocysts of Eimeria tenella (ET) in 20 days old broiler chickens (Hubbard×Hubbard) was investigated. Spleen pools from challenged and control-non-challenge chickens were prepared separately. Nylon wool columns were used to isolate SLT in four spleens pools at 1, 3, 5 and 9 days post-infection (p.i.). SLT were in vitro stimulated with Con-A. In order to detect the presence of IFN, the virus of Newcastle disease (NDV) was used in vitro antiviral assays, as positive control was used one IFN international reference preparation (80 U1/mL). On the 3rd day p.i the IFN levels in challenged group from NDV assay (10.00±0.00 Log2) was different (P<0.05) to negative control group (3.00±1.09 Log2). On the 5th p.i. day the IFN levels in challenged group from NDV assay (12.00±4.38 Log2) reached the highest level and a different (P<0.05) peak concerning to negative control group (3.00±1.09 Log2), the challenged group level decreased on the 7th p.i. day (6.67±2.06 Log2) and this increased again on 9th p.i. day (8.00±0.00 Log2). The IFN secretion pattern from in vitro stimulated SLT with E. tenella challenge is different to pattern from in vitro stimulated SLT without E. tenella challenge. Early interferon response is related to immunity resistance. Antiviral assay was able to detected the immunity action from E. tenella challenge and in vitro stimulated SLT.

Key Words: Interferon, T lymphocytes, Eimeria tenella, Antiviral assay, Broiler chicks

238 Biochemical characterisation of different strains from nest material, fertile egg and chicks with yolk sac infection. C. Rosario1, G. Tellez1, M.Castaeda1, C. Elsaeva2, and C. Lopez2, DPA.Aves, Fac de Med Vet y Zoot, UNAM, D Salud Publica, Fac de Medicina, UNAM.

Yolk sac infection (YSI) is one of the most important causes of mortality during the first days of chicks. It is believed that transmission of YSI occurs by bacterial contamination of the eggshell, in the breeder’s flock little time after laying when cuticle is still moist. In spite of YSI is a very important disease from economical point of view, information about it is very poor, for this reason the objective of this paper is to determine the main place of contamination and the most important bacteria involved in this problem. Sixty samples of each sampling area were taken: nest sawdust, fertile eggs from nest, eggs from hatchery at 19th, dead in shell embryos (21th day). Samples from 216 chicks, which died the first week were taken too. All samples were cultured and identified using biochemical tests. Five hundred eighty eight different strains were found in the present study. The main bacteria was Escherichia coli in all sampling places, except in egg from nest were only 4 strains were recovered, and in nest sawdust where E. coli was not found. Staphylococcus aureus was the most common bacteria isolated from nest sawdust but it was not important as a cause of yolk sac infection in broilers. In hatchery the amount of E. coli strains was increased. In broilers farm, both, mortality and output are decreased if E. coli is decreased. The IFN levels on the 5th day p.i when they start going down. The highest rate of mortality was found at 5th day (25%), it agree with the day when the highest rate of isolation of E. coli was found (37%). Bacteria like Proteus spp, previously reported as a cause of YSI was not isolated in broilers. Results in the present study suggest that contamination of fertile egg as cause of YSI may not occur in breeder’s farm, and it may take place in a later stage. The main agent causing of YSI was E. coli, since mortality curve and isolation of...
E. coli curve agree in their presentation with the highest rate between 3rd to 5th day of broilers life.

Key Words: Yolk sac infection, Fertile eggs, Escherichia coli, Eggs contamination

239 Serotyping of Escherichia coli isolated from fertile egg and chickens with yolk sac infection. C Rosario1, G Tellez1, A Navarro2, C Lopez1, and C Eslava2, 1DPA-Aves, Fac de Med Vet y Zoot, UNAM, 2Depato de Salud, Fac de Medicina, UNAM.

Yolk Sac Infection (YSI) is one of the main causes of early mortality in chickens during the first week. There has been isolated a great variety of bacteria, but the most frequently is Escherichia coli. Developing of trusty serological methods, has led that a great number of strains of E. coli are identified, however, serotyping is not used as a routinary method in diagnostic laboratories. Some studies to identify on strains of E. coli has been carried. Serotypes O1, O2, and O78 are the most frequently reported in chickens. The objective of the present work was to serotype avian strains of E. coli isolated from nest sawdust, fertile egg and chicks with yolk sac infection. Two hundred sixty seven strains of E. coli isolated from sawdust, fertile egg laid in nest, fertile eggs from hatchery at 19th and 24th day of incubation, and mortality during the first week were analysed. Serotyping was carried out with 173 O monovalent antisera for E. coli and 47 O antisera for different species of Shigella. Fifty six H antisera for E. coli were used, too. The most frequent serogroups identified were O19 (12%), OR (10.86%), O84 (9.90%) and O8 (6.37%). Some serogroups like O167, O69, O112, O125, were isolated only at 19 day of incubation, whereas O19, O120, O8, O41, only at 21 day. On the other hand O84, O78, O155, O118 were identified only in dead broilers. A great variety of H groups was identified. But the 30% of the strains were non motile. Into this category the most frequent serotypes were O19 NM and OR NM. In the present study were identified only O2 and O78, but not O1 from the strains previously reported as pathogens for chickens, probably due to our strains were isolated from yolk sac, and not from respiratory infections where this serotype is frequently isolated. Results from this work show that the most important strains isolated from chickens were O19, OR, O84 y O8, and they have not been reported as pathogens for chickens. This was the first study in Mexico, which shows the possible etiology of yolk sac infection.

Key Words: Escherichia coli, Serotyping, Yolk Sac Infection, Mexico

240 Determination of pathogenicity of different strains of Escherichia coli isolated from fertile eggs and chickens with yolk sac infection through hybridizacion of DNA. C. Rosario1, G. Tellez1, C. Lopez1, and C. Eslava2, 1DPA: Aves, Fac de Med. Vet. y Zoot., UNAM, 2Depato de Salud Publica, Fac de Medicina, UNAM.

Yolk sac Infection (YSI) is one of the most important causes of mortality during the first days of chicks. There has been isolated a great variety of bacteria, but the most frequently is Escherichia coli. For many years has been known that strains of E. coli causing YSI are non pathogenic, although, different from other bacteria, E. coli is able to cause a great number of diseases in man and animals. This fact depends on the genes of virulence the strain is carrying. It is known that virulence vary among serotypes, and even inside the same serotype. This work was carried out in order to clarify the participation of different serotypes of E. coli in the YSI, as well as, to determine if these strains was carriers of virulence genes. Two hundred sixty seven strains of E. coli isolated from fertile egg in breeders farm, hatchery and mortality due to YSI was studied. Hybridization of DNA in colony was performed using nine probes of different virotypes of E. coli: sth, eae, agg1, agg2, shi, ipah, bfp, lth and cdt. Forty one percent of the strains were carriers of a virulence gene. The most common gene found was ipah (51 strains). The second most frequent was eae (15 strains). Fourteen strains were positive for both ipah and eae. Next group was cdt strains, and finally nine strains have three genes ipah-cdt-eae. In broilers farm, days of highest mortality agree with the isolation of strains which present virulence genes, basically ipah genes, this could be an indicator that invasive strains of E. coli play an important role in YSI.

Key Words: Escherichia coli, virulence genes, yolk sac infection, hybridization of DNA

241 Sequence analysis of the avian adeno associated virus. C. N. Estevez1 and P. Villegas, Poultry Diagnostic and Research Center, Athens, GA. USA.

With the current advances in molecular techniques, the availability of new forms of treatments based on in vivo DNA-mediated immunogenic protein expression has been greatly increased. The most constraining problem involved in these types of therapeutic procedures is the delivery of the necessary DNA sequence to the target cells. To date, different systems have been used to achieve this purpose, including naked DNA delivery by means of DNA guns, liposome delivery and recombinant vector-mediated delivery. Of the three, viral recombinant vectors are favored due to the ease of manipulation and effectiveness of delivery achieved with them. In humans, a non-pathogenic parovirus, the adeno associated virus, has been intensely studied for this purpose due its ability to infect a wide variety of cell populations in vivo and the dispensability of a great proportion of its genome, which can be used as a carrier for the DNA sequence of interest. The chicken counterpart of this virus, the avian adeno-associated virus, is a non-pathogenic parovirus that like its human homologue is able to infect a wide variety of cells, and thus, may be a prime candidate for the development of a DNA delivery system to be used in the poultry industry. To date, no sequence information regarding this virus has been obtained. Sequence analysis of the genome of the avian adeno-associated virus will be presented.

Key Words: DNA delivery, avian adeno-associated virus, cloning, sequencing

242 Effect of vaccination and challenge with Newcastle virus disease (NDV) in the weight gain, hemoglobin levels, and hematocrit percentages of indigenous naked neck and commercial strain (B-300) male chickens. M.T. Alvarez1, P. Tato2, and G. Tellez1, 1Parasitolgia. FB, UMSH, Michoacan, Mexico, 2Departamento de Microbiologia y Parasitologia. FM-UNAM, 3Departamento de Produccion Animal. Aves. FMVZ-UNAM .

Infection of chickens with viral agents produced a delay in weight gain and even lost of it. The aim of this study was to determine the differences in weight gain and some related hematological parameters between indigenous naked neck chickens (NaNa, Nana, and nana) and B-300 after the immunization with NDV La Sota strain vaccine and infection with the virulent NDV strain. Groups of 10 chickens of each genotype were vaccinated with NVD vaccine and 8 days later, a booster was admininstered. Chickens inoculated with PBS were included as controls in each group. Twenty-two days after the booster, chickens were challenged with virulent NDV Chimalhuacan strain (109 HU) and were weighed at 28, 50, 55 and 65 days old. Animals were bled from the brachial vein before the first immunization (28 days), before the challenge (50 days), 5 days after the challenge and at sacrifice (65 days). Hemoglobin levels (HL) and hematocrit (HP) percentages were measured using cyanomethane assays and a standard technique respectively. Results showed that all genotypes of naked neck chickens gained more weight than the B-300 chickens, specially the Nana (P<0.05). Immunization induced a significant decreasing of weight only in normally feathered chickens (nana and B-300) (P=0.002). Infection with virulent NDV induced a significant decreasing of weight in all control groups, particularly in B-300. In contrast, no weight lost was observed in vaccinated chickens 5 days after the challenge although weight gain was smaller than that observed in control group. Infection induced a significant decreasing in HL as well as in HP in all chickens but was smaller in immunized birds. At sacrifice neither cholesterol nor immunized chickens were able to reach normal HL and HP values. Nana chickens showed the best growth rate and the best levels of HL and HP.

Key Words: Newcastle disease, Naked neck chickens

243 Comparison of the immune responses against Newcastle disease virus (NDV) between naked neck and commercial strain (B-300) male chickens. M.T. Alvarez1, M. Escorcia2, P. Tato1, G. Tellez1, 1Parasitolgia. FB, UMSH, Michoacan, Mexico, 2Departamento de Produccion Animal. Aves. FMVZ-UNAM, 3Departamento de Microbiologia y Parasitologia. FM-UNAM.

Immune responses against viral agents have not been explored in indigenous naked neck chickens. The aim of this study was to determine the immune responses induced by NDV La Sota strain vaccine in homocygotic (NaNa) and heterocygotic (Nana) naked neck male chickens
and compared with those of normally feathered (nana and B-300) chickens. Two trials were performed each one with 4 groups of 10 chickens (NaNa, Nana, nana, and B-300). Birds were immunized ocularly with \(10^{8.2}\) HU of NDV La Sota strain vaccine, boosting was 8 days later. Chickens inoculated with PBS were included as non immunized controls. Twenty-two days after the booster, chickens were challenged with virulent Chimalhuacan strain (\(10^9\) HU) and mortality and morbidity were recorded daily for 15 days. Birds were bled from the brachial vein before the first immunization (28 days), before the challenge (50 days), 5 days after the challenge and at killed (65 days). Specific antibodies were measured by hemagglutination inhibition tests. Cellular immune responses to NDV were evaluated by peripheral blood proliferation assays. Results showed that all immunized chickens survived while none animal in B-300 and only 20% in nana and 50% in NaNa control groups survived. An interesting finding was that 80% of Nana control chickens survived, suggesting that this genotype is naturally resistant to Newcastle infection. Immunized Nana chickens at sacrifice showed a significant increasing of specific antibody titers (\(P \leq 0.05\)) and tritiated thymidine incorporation (\(P \leq 0.05\)) when compared with NaNa, nana, and B-300. On the other hand, Nana control animals also showed the highest specific antibody titer when compared with NaNa and nana (\(P \leq 0.05\)) control groups, and the specific cellular immune response was also significantly increased (\(P \leq 0.05\)) at sacrifice. Nana chickens were the best responders.

**Key Words:** Newcastle disease, Naked neck male chickens, Immune responses