**1 Impact of Phase-Feeding on Growth Performance of Broilers Subjected to Heat Stress from 23 to 63 Days of Age.** H. R. Pope*1 and J. L. Emmert1, University of Arkansas.

Two experiments were conducted to evaluate the effects of decreasing dietary amino acid levels (phase feeding; PF) during heat stress (15 h at 95°F, 9 h at 75°F) during the grower and finisher period. Experimental diets were formulated to contain amino acid levels based on NRC recommendations or on linear regression equations that were derived from best estimates of lysine (Lys), sulfur amino acid (SAA), and threonine (Thr) requirements. A single NRC diet was fed from 23 to 42 d and 42 to 63 d in experiments 1 and 2 respectively, whereas with PF diets were switched and amino acid levels were lowered every other day. In both experiments heat stress lowered (P < 0.05) weight gain, feed intake, feed efficiency and percent breast yield, and increased (P < 0.05) percent leg quarter yield. Regardless of environmental setting, in Experiment 1 (23 to 42 d) growth performance was unaffected (P > 0.05) by PF with the exception of feed efficiency, which was decreased (P < 0.05) by PF in birds reared under normal temperatures. In both environmental settings PF decreased percent abdominal fat (P < 0.05) without affecting percent breast, wing, or leg quarter yield. During the finisher period (Experiment 2, 42 to 63 d) weight gain, feed intake, feed efficiency, and percent abdominal fat, breast and wing yield were unaffected (P > 0.05) by PF, regardless of environmental setting. In Experiment 2, percent leg quarter yield was reduced (P < 0.05) by PF under both environmental settings. These data indicate that Lys, SAA and Thr levels may be reduced as often as every other day under a PF program without sacrificing growth performance or carcass yield, even in birds subjected to high environmental temperatures.

**Key Words:** Broiler, Phase-Feeding, Amino Acids

**2 An Interaction Between Arginine and Methionine in Young Broiler Chicks Raised at Low and High Temperature Conditions.** M. Chamruspollert*1, G. M. Pest1, and R. I. Bakalli1, 1Department of Poultry Science, The University of Georgia, Athens, GA 30602.

Two experiments (exp) were conducted to investigate the interaction between arginine (ARG) and methionine (MET) in broiler chicks at low (22-25°C) and high (32-35°C) temperature conditions. In the first experiment, temperatures were set at 22°C and 32°C for low and high temperature conditions. In the second experiment, temperatures were changed to 25°C and 35°C for low and high temperature conditions, respectively, to exacerbate differences. In both experiments, one-day-old Ross x Ross chicks were fed a standard corn and soybean meal starter diet for seven days. From days 7 to 21, each group of chicks was fed with randomly assigned dietary treatments (corn-soybean meal basal diet). Six replications (2 controlled temperature rooms x 3 replications per room, and 3 rooms x 2 replications per room in Exp 1 and 2, respectively) were used for each treatment. In exp 1, 2 levels of ARG (1.52% and 2.52%) and 2 levels of MET (0.35% and 0.55%) were dietary treatments. As expected, birds raised in high temperature rooms consumed less feed (p=0.0618), compared to those in low temperature rooms. No temperature main effect on body gain (p=0.5785) was observed, but there was an effect on feed conversion ratio (FCR) (p=0.0769). There were interactions between ARG and MET for feed consumption, body gain, and FCR (p=0.01) at the higher temperature. At the lower temperature, there was an interaction between ARG and MET only for body gain (p=0.0266) but not consumption and FCR (p>0.1). In exp 2, the dietary treatments were 3 levels of ARG (1.52%, 2.52%, and 3.52%) and 3 levels of MET (0.35%, 0.55%, and 0.75%). At day 21, 2 birds were killed and breast muscles were collected for creatine analysis. There were temperature effects on consumption (p=0.0002) and gain (p=0.0016) but not on FCR (p=0.2048). We observed interactions between ARG and MET for consumption and gain (p<0.05) but not on FCR (p>0.1) at high and low temperature conditions. There were no effects of ARG and MET on muscle creatine concentration at either low or high temperatures. In conclusion, there were interactions between ARG and MET for body gain found at high and low temperature conditions.

**Key Words:** Amino acid interaction, Arginine, Methionine, Temperature effect, Broiler
3 Dietary effects of soy isoflavones on growth and carcass traits of commercial broilers. R. L. Payne1, T. D. Bidner1, L. L. Southern1, and K. W. McMillin1, 1Louisiana State University.

Three experiments (EXP) were conducted to determine the effect of soy isoflavones (ISF) on growth and carcass traits of commercial broilers. The EXP were conducted simultaneously and a commercial control was used. In each EXP, treatments were replicated five times with five chicks each. Average initial and final BW were 102 and 2,890 g, 102 and 2,657 g, and 102 and 2,803 g for EXP 1, 2, and 3, respectively. In EXP 1, the treatments were: 1) corn-soybean meal (C-SBM), 2) C-SBM + ISF levels equal to those in C-SBM. Daily gain and feed intake were decreased (P < 0.05) compared with chicks fed the C-SBM diet regardless of ISF level. Gain/feed of chicks fed the C-SBM diet was decreased (P < 0.02) compared with chicks fed the C-SBM diet, and gain/feed of chicks fed C-SBM was intermediate between the two. Carcass traits were not affected (P > 0.10) by treatment. In EXP 3, the low ISF levels in a corn-soy protein concentrate (C-SPC) diet were studied. The treatments were: 1) C-SBM, 2) C-SPC (low ISF), and 3) C-SPC + ISF (ISF levels equal to those in C-SBM). Daily gain and feed intake were decreased (P < 0.05) in chicks fed the C-SPC diets regardless of ISF level. Gain/feed of chicks fed the C-SPC + ISF diet was decreased (P < 0.05) in chicks fed the C-SPC diet and low ISF + ISF diets relative to those fed the C-SBM diet. Abdominal fat pad percentage was increased (P < 0.05) in chicks fed the low CP diet compared with those fed the C-SBM diet or the low CP + ISF diet, but chicks fed low CP + ISF had a decreased (P < 0.10) fat pad weight relative to those fed the low CP diet. Dietary ISF can affect daily gain and feed intake and may affect carcass traits in some instances.

Key Words: Broiler, Isoflavone, Growth

4 The effect of lysine level, lysine addition time and pelleting temperature on growth performance, feed intake, and feed conversion ratio in male broiler chicks. S. D. Crow1, P. R. Ferken1, and K. V. Middlekoop2, 1NC State University, Raleigh, NC USA, 2J. V. Harn Center for Applied Poultry Research, Spelderhoit, Netherlands.

Lysine is generally the most reactive amino acid in feedstuffs, and increasing pelleting conditioning temperatures (PCT) to destroy pathogens can have detrimental effects on its availability. To compare the effect of PCT on free synthetic lysine a modified factorial design of 12 treatments (TRT) was used: 2 times of adding lysine (pre- and post-pelleting), x 2 dietary lysine levels (80 and 90% NRC recommendations) x 4 PCT (65, 80, 90, 120°C). The 80% lysine level TRT were represented only by pre-pelleting diets because not of amount of synthetic lysine could be added to maintain this marginal level of lysine post-pelletling. Nine hundred and sixty Ross 308 male broilers were housed in 96 floor pens containing 10 birds/pen with experimental diets fed from 7 to 28 d of age. Body weights and feed intake were measured on d 7, 14, 21, 28 to evaluate the response criteria of average daily gain (ADG), average daily feed intake (ADFI), and feed conversion ratio (FCR). There were no TRT interaction effects observed, so only main effects will be reported. Broilers fed 80% of dietary NRC recommendation for lysine had significantly inferior growth performance relative to birds fed 90% of NRC level for all parameters measured. There were no significant differences between the two TRT groups fed 90% NRC level of lysine during the 7 to 28 day growth trial for any parameter measured. However, weekly analysis showed that PCTs above 90°C caused significant decreases in feed intake (7-14 days 285g 90°C Caud 273g 120°C; LSD 9.9g) and body weight (day 21, 621g 90°C and 609 120°C; LSD 16.2g), likely due to the formation of indigestible compounds. The addition of synthetic lysine pre- or post-pelletling had no effect on broiler performance when PCT are at or below 90°C. These results indicate that PCT up to 120°C Chas minimal effect on lysine availability.

Key Words: Broiler, Growth performance, Lysine, Pellet processing, Temperature

5 Evaluation of Acidifier (Lucta’cid®) Efficacy on Performance, Carcass Characteristics, and Serum Chemistry of Broilers Under Heat Stress Conditions. M. Daskiran1, and R. G. Teeter1, 1Oklahoma State University.

An experiment was conducted to evaluate the efficacy of an acidifier on performance and survivalability, and to determine therapeutic effects on serum chemistry and carcass characteristics of broilers under heat stress. In Phase 1 (day 0-18), 1,440 chicks were reared on floor pens with optimum growth conditions until 18 day of age. Two dietary acidifier levels during this phase were 0 and 0.2%, with 20 replicates each. In Phase 2 (day 19-40), 480 birds from each treatment were randomly selected and placed into battery compartments with three birds from each acidifier history level represented in each compartment. This phase included five dietary acidifier treatments and controls, with 20 replicates each (pre- and post-pelleting) with no acidifier history had significantly lower (9.41%) mortality (p < 0.10) compared to the birds with acidifier history (13.72%). Mortality of birds without acidifier history declined quadratically as the acidifier level increased, while no such effect was observed in birds with acidifier history. Neither acidifier feeding nor acidifier history had a significant impact on serum chemistry. As a result, these data suggest that acidifier supplementation may reduce economic losses under heat stress.

Key Words: Heat stress, Acidifier, Broiler, Mortality, Performance

6 Comparison of ad libitum versus paired feeding on the utilization of reduced protein diets for broilers. Q. Jiang1, C. A. Fritts1, P. W. Waldroup2, and D. J. Burnham2, 1University of Arkansas, Fayetteville, AR, 2Heartland Lysine, Chicago, IL.

Reduction of dietary crude protein by amino acid supplementation is effective to a point but performance eventually declines. This study was conducted to determine if alteration in feed intake on diets low in crude protein was responsible for the reduction in performance. Diets were formulated to meet minimum NRC recommendations for indispensable amino acids with CP levels of 16, 18, 20, 22, or 24% with the CP and ME equivalency values of the amino acids considered in formulation. A minimum dietary electrolyte balance of 200 meq/kg was maintained. Male broiler chicks were grown to 7 d on 24% CP and then randomly assigned to treatments. From 7 to 21 d one group of birds was fed the various CP levels on an ad libitum basis, while a second group was fed the various CP levels on a control basis. The control amount was 90% of that consumed the previous day by birds fed the 16% CP diet ad libitum. Six pens of six birds were fed each dietary treatment. When fed on an ad libitum basis, feed consumption did not differ significantly among birds fed the different levels of CP. However, body weight of birds fed less than 22% CP was significantly reduced and feed conversion was adversely affected. When birds were fed the diets on a controlled basis, similar trends in BW gain and feed conversion were observed. These results indicate that a reduction in feed consumption is not the cause of reduced performance of birds fed reduced CP diets formulated to provide recommended levels of indispensable amino acids.

Key words: Broilers, crude protein, amino acids, feed intake .

Key Words: Broilers, Crude protein, Amino acids, Feed intake, Paired feeding

Relationship of dietary lysine content to the concentration of other essential amino acids in broiler diets. M. A. Matt1, J. S1, C. A. Fritts1, D. J. Burnham2, and P. W. Waldroup1, 1University of Arkansas, Fayetteville, AR, 2Heartland Lysine, Chicago, IL.

Breast meat yield is sensitive to the amino acid content of the diet, especially Lys. Some studies have suggested interactions between Lys and other essential amino acids (EAA) in regard to response to breast meat yield. A study was conducted to explore the relationship of Lys and other
EAA in diets for male broilers grown for further processing. Diets were formulated to provide four levels of Lys (100% of NRC; + 0.1%; + 0.2%; + 0.3%) in all combinations with four levels of other EAA (100, 110, 120, and 130% of NRC) resulting in sixteen dietary treatments. Sodium, Cl, and electrolyte balance were kept constant. Each treatment was assigned to six replicate pens of 50 male broiler chicks (Cobb 500) in litter floor pens. Body weight and feed consumption were determined at 21, 42, and 56 d; five birds per pen were processed at 56 d for parts yield. There were no significant interactions between Lys and other EAA for live performance or parts yield. Addition of 0.1% Lys significantly improved BW at 21 and 42 d; higher levels did not improve BW with a significant depression at 0.3%. Effects on FCR were inconsistent and did not follow a linear trend. Level of other EAA had no significant effect on BW but did significantly improve FCR in a linear manner. The Lys level had no significant impact on dressing percentage, abdominal fat, or breast yield. Other EAA in addition to 0.1% Lys had no impact on breast yield or abdominal fat. These data indicate that Lys levels recommended by NRC may be marginal at 21 or 42 d but adequate at 56 d for live performance and breast yield.

Key Words: Broilers, Amino acids, Lysine, Breast yield, Carcass composition

8 Nutritional Approach To Reduce Phosphorus Excretion By Chickens. A. Abudabos*, D. V. Maurice, and S. F. Lightsey, Clemson University.

Growing concerns about the impact of manural P on environmental pollution prompted us to examine levels of dietary P that sustain performance while reducing P excretion. Chickens have intestinal phytase activity and retain phytate P. Hence the safety margin of P could be reduced to decrease P output. We measured the effects of total dietary P [TP] on growth, feed conversion, breast muscle yield, serum P, and intestinal phytase activity in broilers. Corn-soybean meal diets were formulated, on the basis of determined TP values, to contain 0.5, 0.55, 0.6, and 0.65% TP from 3-6 weeks and each diet was fed to 6 pens of birds. From 6-7 weeks of age each treatment was divided into two groups. Three pens received the same treatment as the growing period while the other 3 pens were fed a diet without supplemental inorganic P, yielding 8 dietary treatments. At 6 weeks of age significant differences were noted between treatments in body weight gain, feed conversion, and yield of breast muscle. Birds fed the diet with 0.65% TP had significantly higher serum P compared to those fed the diet with 0.5% TP. Phytase activity was 22% lower in birds fed diets with 0.6-0.65% TP compared to birds fed 0.5-0.55% TP. Statistically significant effects on body weight gain, feed conversion, and breast muscle yield were not detected at 7 weeks of age. Serum P was a function of the amount of inorganic P in the diet. Birds fed the supplemented diets had 49% higher serum P than birds that consumed the unsupplemented diets. The differences in serum P during the finishing period did not affect the performance variables measured. In summary, our findings indicate that dietary P can be reduced to 0.5-0.6% from 3-6 weeks and to 0.4% TP from 6-7 weeks of age and that the concentration of this diet to reduce P and increase P excretion. We conclude that it is possible to sustain productivity on lower levels of dietary P from 3-7 weeks of age and this could decrease P excretion.

Key Words: Total Phosphorus, Breast Performance, Muscle Yield

9 Effect of non-uniform application of phytase on male broiler performance from 0-21 days of age. J. R. Timmons1, 1 J. M. Harter-Dennis1, and A. E. Sefton2, 1University of Maryland Eastern Shore, Princess Anne, MD, 2Altech, Inc., Guelph, Ontario, Canada.

Three trials were conducted to evaluate the effects of high coefficients of variation % (CV) of phytase application (Allzyme©, Altech, Inc.) when added to a standard corn and soybean meal diet that was deficient in available phosphorus (AP), and fed to 0-21 day old male broilers. The AP levels were 25% in trials 1 and 2 and 30% in trial 3. A RCB design was used for all of the trials and weight gain (WG), feed efficiency (G/F), tibia breaking strength (TBS), and % tibia ash (TA) were the dependent variables. Trial 1 was designed to evaluate the effect of a high CV (103%; 23,000 PTU/kg fed every other day) of added phytase compared to 0% CV (11,500 PTU/kg fed daily). There were no significant differences (0% vs. 103%, respectively) in WG (486g vs. 483g), G/F (0.75 vs. 0.72), TBS (4.9kg vs. 4.51 kg), and TA (36.5% vs. 37.2%). Trial 2 was conducted to reevaluate the effect of the every other day feeding of phytase, as well as establish a standard curve using graded levels of inorganic phosphorus to determine the amount of phosphorus released due to phytase supplementation. Using TA, there was a linear response to the graded levels of AP, and the requirement was determined to be 39% AP. The amount of phosphorus released from the phytase added to the 25% AP diet was 0.05%. There were no significant differences (0% vs.103%, respectively) in WG (462g vs. 459g), G/F (0.696 vs. 0.715), and TBS (10.9kg vs.11.5kg). There was a significant difference (P<0.05) in TA (42.8% vs. 47.5%, respectively). Trial 3 was designed to determine the maximum tolerable level of phosphorus intake in broilers. Treatments included 4 diets with various CV levels of added phytase (0%, 103%, 140%, and 178%), respectively. There were no significant differences (0%, 103%, 140%, & 178% respectively) in WG (490g, 497g, 463g, & 470g), and G/F (1.761, 1.754, 1.751, & 1.750). The results for TBS (0%, 103%, 140%, & 178%), respectively were 6.81, 4.93, 5.43, & 5.41kg . The TA results were 0%, 103%, 140%, & 178%, respectively. The results of these studies suggest that %CV’s of applied phytase up to 103% were not detrimental to the parameters evaluated. Only when the CV exceeded 103% were TBS and TA negatively affected.

Key Words: Phytase, Coefficient of variation, Allzyme©, Available phosphorus

10 The Effect of Replacing Soybean Meal with Cottonseed Meal on Broiler Performance. K. G. Sterling*, M. H. Henry, G. M. Pesti, and R. I. Bakali, Department of Poultry Science, University of Georgia.

Two experiments were conducted to evaluate the performance of broiler chicks fed diets with Cottonseed Meal (CSM) as the major protein source. In Experiment 1, male Ross x Ross broiler chicks (n=336) were used to determine the lysine requirement of chicks fed a Corn/CSM diet with 20% CSM and 6% Soybean Meal (SBM). The basal diet contained 3,200 kcal/kg of ME, 20% CP and 0.86% lysine. Graded levels of lysine (0.86, 0.93, 1.00, 1.07, 1.14, 1.21, and 1.35 % lysine) were fed to chicks from 10 to 20 days and body weights and residual feed were measured on day 20. The requirement as determined by breakpoint analysis was 1.023±0.01% lysine (R² = 0.84) for gain and 1.028±0.02% lysine (R² = 0.56) for feed conversion ratio (FCR). Experiment 2 was conducted to compare the performance of male broiler chicks fed diets with protein supplied by CSM to those fed SBM. A 2 x 2 x 3 factorial arrangement of treatments involving fed either CSM or SBM to Peterson x Arbor Acres male chicks (n=768) from 21 to 42 days at 4 dietary protein levels (17, 20, 23, and 26% CP). The lysine to protein ratio was fixed at 0.0550 and consisted of the calculated minimum level, established in Experiment 1, plus 10 % . There was a significant effect on feed intake (P<0.0001), FCR (P<0.0001) but not gain (P>0.05) due to protein source. The average gains were 1.53, 1.74, 1.78, and 1.81 kg for birds fed CSM, compared to 1.46, 1.72, 1.84, and 1.82 kg for those fed SBM (17, 20, 23, and 26% CP). There was a significant linear effect on FCR due to protein level (P<0.0001). The average FCRs were 2.36, 2.14, 2.05, and 1.97 for CSM compared to 2.35, 2.04, 1.87, and 1.80 for SBM. Carcass yield was affected by protein level (P<0.0001) with average carcass yields of 68.6, 69.1, 69.6, and 69.5% for CSM compared to 69.1, 71.6, 71.3, and 70.2% for SBM (17, 20, 23, and 26% CP). Chicks fed SBM had higher average breast fillet and tender yields for all protein levels (P<0.05 and P<0.001, respectively). CSM fed chicks had higher average leg portion yields for all protein levels (P<0.001). Broilers fed 26% protein from the Corn/CSM diet had FCRs roughly equivalent to those fed 26% protein from the Corn/SBM diets. This study shows that at slightly higher protein levels CSM can replace SBM in broiler finisher diets.

Key Words: Broilers, Cottonseed meal, Lysine, Soybean meal, Crude protein

11 Using supplemental L-cystine to attain NRC (1994) recommended TSAAs proportions for broiler males through 7 weeks of production. A Kalinowski* and E.T. Moran, Auburn University, Auburn, AL.

Cystine is usually the first-limiting amino acid with broilers receiving corn-soybean meal type feeds. In practice, total sulfur amino acid (TSSA) deficit has been entirely satisfied by supplemental DL-methionine on a weight-weight basis disregarding the approximate 80% conversion of methionine to cystine. The objective of this study was to compare the use of DL-methionine versus L-cystine supplementation to attain cystine needs of broiler males. A total of 800 day-old Ross x Avian male broiler chickens were randomly allocated to 12 floor pens and given corn-soybean
meal feeds that were either supplemented with DL-methionine to attain TSAA need or its partial displacement with L-cystine to the extent advocated by NRC (1994). Diets for each of three age consecutive periods (0-22, 22-33, and 32-44 days) were formulated to satisfy all nutrient needs according to NRC (1994) but resemble industry terms for TSAA (905%, 0.85%, and 0.75%, respectively). Cystine levels representing the requirement were 0.45%, 0.40%, and 0.35% for the aforementioned ages. No differences in body weight gain, feed:gain ratio, and mortality occurred between broilers receiving these two dietary treatments throughout 7 weeks of experimentation. All birds were processed, and the proportions of abdominal fat, eviscerated carcass, grade defects, pectoralis major, and p. minor were also observed to be equivalent between treatments. Cystine deficient in the corn-soybean meal diets used in present experimentation approximated 22% of the total expected requirement. Absence of differences in all measurements probably relates to the greater than recommended TSAA levels used in practice together with small amounts of L-cystine necessary to fully attain the requirement.

Key Words: Broiler, Methionine, Cystine


There are few studies on the stability of phytate in chicken feces. A previous study indicates phytate is stable for up to 32 hours when no phytase or 1,25-dihydroxycholecalciferol (1,25-(OH)2 D3) is added to the diet. The present study was conducted to test the stability of phytate in feces when phytase and 1,25-(OH)2 D3 are added to the diet. Two hundred forty mixed sex Ross X Ross chicks were housed in a Petersime battery and fed a corn-soy diet adequate in all nutrients except phytosphorus. Four treatments consisted of a basal control diet, the addition of 600 phytase/kg diet, 5 µg 1,25-(OH)2 D3/kg diet, or their combination. Feed and water was given ad libitum. Sunlight was excluded from the laboratory and UV blocking tubes were used to prevent exposure to any ultra violet light. The diets were formulated to contain 1.0% calcium, 0.55% total phosphorus, and 0.25% phytate phosphorus. The chicks in each pen were allowed to deposit excreta for 1.12,12,24, and 48 hours, respectively. The excreta were immediately placed in a forced air oven for drying. The samples were analyzed for chromic oxide, calcium, phosphorus, and phytate phosphates. The results show that the addition of phytase, 1,25-(OH)2 D3, or their combination markedly decreased the incidence of phosphorus rickets. The addition of phytase resulted in significant increases in the retention of Ca, P, and phytate P. 1,25-(OH)2 D3 supplementation resulted in significant increases in P and phytate P retention. Fecal phytate level was significantly reduced by 1,25-(OH)2 D3 but only by phytase, and their combination significantly improve body weight, gain:feed, and bone ash. Furthermore, basal supplementation with phytase, 1,25-(OH)2 D3, or their combination markedly decreased the incidence of phosphorus rickets. Differences in phytate levels, calcium levels, broilers, phytate phosphorus respectively. Supplementing 150 units of phytase improved growth and reduced the incidence of rickets (14.3 to 13.3%), however, there was a decrease in weight gain (413 to 385 g) and percent bone ash (34.8 to 33.5%) as calcium level increased within each phytase group. Further supplementation with 300 or 600 units of phytase did maximize body weight gain (446 g) and percent bone ash (39.4%). While minimizing the incidence of phosphorus rickets (0.0%) between 0.8 and 1.1% calcium (P≤0.05). Supplementing 0.8 to 1.1% calcium had relatively no effect on weight gain or percent bone ash in a diet deficient in available phosphorous (0.217%). While the incidence of phosphorus rickets decreased with each increase in phytase, 1,25-dihydroxycholecalciferol, or Both on Phytate Phosphorus Stability in the Feces. W. B. Escoe*, H. M. Edwards, and G. M. Pesti, Department of Poultry Science, The University of Georgia.

Key Words: Phytase, Calcium levels, Broilers, Phytate phosphorus


Cobb chicks (male + female; 5,280) were randomized in 11 treatments of 8 pens each at a density of 0.079 m2/bird. The April to June (56 d) Maryland trial had occasional hot weather. New wood shavings were put on built-up litter. All treatments except negative control (+CON) received coccidial inoculation with Eimeria species at 14 d via water. Practical (Agri Stats) basal diets contained corn-soy-meat blend, with salinomycin 66 mg/kg (first 2 feeds), bacitracin-MD 55 mg/kg in all feeds, and electrolytes added at expense of ground soy hulls. Two-lab average values for 3-phase basal diets were: potassium (K) 92.8, 0.84, and 0.76%, and sodium (Na) or chloride (Cl) 0.11 to 0.097. Starter Na levels (basal analyzed, then supplements figured in) were 0.19, 0.28, or 0.37% and of Cl 0.11, 0.25, or 0.39% in various combinations from sodium chloride (NaCl), Na sesquicarbonate (SSC; 30.4 % Na; equivolcar bicarbonate and carbonate), or ammonium Cl (66% Cl). Levels of Na and Cl were nearly constant in complete diets across phase feeds by treatment. The Na+K-Cl, mEq/100 g (DEB), levels in starters ranged from 21 to 36, growers 19 to 35, and finishers 17 to 32. Significance was by LSD (P≤0.05).

The effects of dietary sodium x chloride from sodium chloride or sesquicarbonate, or ammonium chloride, on performance of Cobb broilers on built-up litter with coccidial challenge and occasional heat stress. D. M. Hooge1, K. R. Cummings2, W. J. Rittenhouse2, and J. L. McNaughton1. Hooge Consulting Service, Inc., Eagle Mountain, UT, 2Church & Dwight Co., Inc., Princeton, NJ, 3PARC Institute, Inc., Easton, MD.

Coccidial challenge worsened most performance parameters (vs -CON). In inoculated birds, at 56 d 0.11% Cl and 0.19 or 0.25% Na decreased body weight vs positive control (+CON; 0.19% Na, 0.25% Cl). Higher Na improved most performance and processing parameters. Increasing Cl tended to decrease litter bacteria (cfu/g). Effects of increasing DEB were inconsistent. Effects of Na, Cl, or DEB on litter moisture were inconsistent. Generally, higher Na increased both phytase by hour interaction. This study does not conclusively prove that there is no breakdown of phytate in feces as it is expected.

Key Words: Phytase, 1,25-Dihydroxycholecalciferol, Fecal phytate

15. Effects of varying dietary calcium levels on phytase efficacy in broilers. R. B. Shirley*, H. M. Edwards, Jr., and G. M. Pesti, University of Georgia.

The objective of this study was to determine if low or high calcium levels have an effect on phytase phosphorus utilization in a diet deficient in available phosphorous (AP), at varying phytase levels. To evaluate the effects of varying calcium levels on phytase efficacy, phytase and calcium levels were evaluated in a completely randomized 4 x 4 factorial chick experiment using a corn-soybean meal:poultry by-product meal diet (22.3% CP; 0.217% AP (0.45% total phosphorus (TP))). The diets contained either 0, 150, 300, or 600 units of phytase (5000 U/g); and each phytase level was fed with calcium levels of either 0.8, 0.9, 1.0, or 1.1%. A series of positive controls containing no phytase, the same range of calcium levels, and a higher level of available phosphorous (AP) were also fed. Chicks responded to phytase linearly and quadratically for weight gain (P<0.035), incidence of phosphorus rickets (P<0.0001), and percent bone ash (P<0.0001), however, there was no calcium effect or calcium-by-phytase interaction as calcium level increased within each phytase group. For example, as calcium increased from 0.8 to 1.1 at 0 phytase units, weight gain, percent bone ash, and incidence of phosphorus rickets decreased from 321 to 277 g, 26.5 to 25.2%, and 88.9 to 84.3%, respectively. Supplementing 150 units of phytase improved growth and reduced the incidence of rickets (14.3 to 13.3%), however, there was a decrease in weight gain (413 to 385 g) and percent bone ash (34.8 to 33.5%) as calcium level increased within each phytase group. Further supplementation with 300 or 600 units of phytase did maximize body weight gain (446 g) and percent bone ash (39.4%), while minimizing the incidence of phosphorus rickets (0.0%) between 0.8 and 1.1% calcium (P≤0.05). Supplementing 0.8 to 1.1% calcium had relatively no effect on weight gain or percent bone ash in a diet deficient in available phosphorous (0.217%). While the incidence of phosphorus rickets decreased with each increase in phytase, 1,25-dihydroxycholecalciferol, or Both on Phytate Phosphorus Stability in the Feces. W. B. Escoe*, H. M. Edwards, and G. M. Pesti, Department of Poultry Science, The University of Georgia.

Key Words: Broiler, Chloride, Coccidiosis, Processing yield, Sodium


Many studies have been reported on the optimum level of individual amino acids (AA) in broiler diets in relation to dietary crude protein (CP) level. Only limited information is available regarding the optimum dietary level of the AA profile, at constant AA to CP ratio, in relation to the genetic potential of broilers. Two experiments with broilers were conducted to study the effect of graded dietary levels of CP and corresponding AA on performance and carcass quality. The CP levels tested varied between 17.4 and 27.5% with an optimized AA Ideal Protein profile.
in all diets. The apparent fecal digestible amino acid profile, expressed as ratio to lysine was: Lys (100), Met + Cys (75), Thr (63), Trp (18), Arg (111), Val (76) and Ile (67). Male Ross 208 birds were housed in battery cages and fed the diets during the age period of 14 to 34 days or from 28 to 41 days of age in experiments 1 and 2, respectively. Diets based on corn, soybean meal and wheat were calculated to be adequate in all nutrients, except CP and AA, and isocaloric at 12.88 MJ (3080 kcal) AMEn/kg. Each diet was fed to six cages with 20 birds per cage. In exp. 1, weight gain and feed conversion ratio improved linearly up to the highest CP level of 26.8%, containing 1.66% total lysine in the diet. From the lowest to the highest CP level, weight gain and feed conversion improved by 13 and 14%, respectively. In exp. 2, feed conversion ratio improved up to a CP level of 25.6%, whereas breast meat yield improved up to the highest CP level (27.5%, 1.64% total lysine in the diet). This is in agreement with previous studies, which demonstrated that higher levels of AA are needed to reach maximum breast meat yield as compared to maximum daily gain. From the results of the present experiments, it can be concluded that the response of broilers to a truly optimized essential AA profile may be significantly higher than reported in the literature.

Key Words: Broiler, Amino acids, Ideal protein


Corn types having starchy with high amylopectin (waxy) as well as those with high oil contents exist for use in broiler feed. This study compared normal dent corn with corn having a normal oil content, high oil, and the combination of both characteristics on pellet quality of associated feeds as well as broiler response when fed. Each corn was ground through a hammer mill, then fed were formulated based on their composition and the resulting mixtures steam pelleted (ca. 70°C conditioning). A total of 800 Ross 1 Ross 308 male broilers were randomly distributed into 32 floor pens (25 chickens/pen). When 8-weeks old, birds were offered a 4 feed commercial regime to 7 weeks of age that contained the test corns. After hammer milling, small differences in resulting particle size occurred among corns. Upon steam-pelleting each complete feed, an increased proportion of large particles having additional durability was particularly obvious whenever waxy starch had been present. Displacement of added fat during mixing with the use of the high oil corn also led to an increase in feed particulate size; however, this advantage occurred to a lesser extent and was usually additive to improvements from waxy starch when both factors were combined. Waxy starch led to improved body weight at 49 days of age when associated with a normal oil content as did high oil corn with normal starch but gain was adversely affected when both characteristics were combined. Increased abdominal fat and reduced deboned breast meat in broilers fed waxy starch in combination with high oil suggest that the increased productive energy afforded by pellet quality adversely altered the calorie to protein ratio.

Key Words: Broiler production, High oil corn, Pellet quality, Waxy corn


This experiment was conducted to determine if Thr should be expressed as a percentage of CP in a broiler chick diet. A 2 x 3 factorial arrangement of treatments was used in one experiment to evaluate dietary CP (19.0 and 22.5%) and dietary Thr (0.6, 0.7, and 0.8%) in Ross x Ross 308 male broilers from Days 5 to 15. At Day 5, 336 chicks were randomized among 48 battery pens (7 chicks/replicate and 8 replicates/treatment). Essential amino acids, except Thr, were in excess of NRC (1994) specifications and similar between both CP diets. Chicks receiving the 19% CP diet had increased (P < 0.001) BW gain and feed intake over chicks fed the 22.5% CP diet. Protein efficiency ratio was improved (P < 0.001) in chicks fed the 19.0% CP diet versus chicks fed the 22.5% CP diet. Chicks fed the 19.0% CP diet had reduced N excretion (P < 0.001) in comparison to chicks receiving the 22.5% CP diet. Increasing dietary Thr from 0.6 to 0.7% of diet improved (P < 0.001) BW gain and feed intake. Immune organ weights were not affected by dietary treatments. Feed:gain was improved (P < 0.016) in chicks receiving both CP diets as dietary Thr was increased from 0.6 to 0.7% of diet. Chicks fed 0.8% dietary Thr had lower (P < 0.016) feed:gain when fed the 22.5% CP diet versus chicks fed the 19.0% CP diet. Male broiler chicks had improved growth performance measurements when fed 0.7% dietary Thr.

Key Words: Threonine, Crude Protein, Broiler

18 The effect of intestinal bacterial on the absorption of methionine and 2-hydroxy-4-methylthiobutanoic acid in germ-free and conventional broiler chickens. M. D. Drew*1, and D. D. Maenz1. 1Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon SK Canada.

On a molar basis, the bioefficacy of the hydroxy analog of methionine (HMB) is 70-80% of that of methionine (Met). Previous studies have shown a partial conversion of HMB relative to Met will increase exposure of HMB to intestinal bacteria which may then take up and metabolize the hydroxy analog. To test this hypothesis we compared the absorption of HMB and Met in germ-free and conventional broiler chickens. The two diets contained 0.236% of added Met or HMB. Nineteen germ-free broilers were maintained in isolators and fed diets that had been sterilized by gamma irradiation (50 KGy). Twenty conventional birds were reared in batteries and received non-irradiated feed. The diets were fed ad libitum for 3 weeks. On day 21 of the experiment, the birds were fasted overnight and then refed the experimental diets to which 300 µCi of 3H-DL-HMB or 3H-DL-Met per Kg of feed had been added. 300 µCi of 51CrCl3 per Kg of feed was added as an indigestible marker. The chickens were fed the radiolabelled diets for 3 hours and then euthanized. The intestinal tracts were removed and partitioned into 6 sections and the specific activity of the feed and digesta samples was calculated as the ratio of 3H: 51Cr in each sample. The residual specific activity of HMB and Met in the distal ileum of the conventional broilers was 10.2% and 3.7%, respectively. In the germ-free broilers, the residual specific activity HMB and Met in the distal ileum was 4.7% and 3.0%, respectively. The residual specific activity of HMB in the distal ileum of germ-free broilers was significantly higher than in conventional (P < 0.05). This study demonstrates that absorption of HMB by intestinal bacteria is significant and is at least partly responsible for the lower bioefficacy of HMB compared to Met.

Key Words: Methionine, Hydroxy-analogue, Broiler, Germ-free, Absorption

19 Ileal digestibility of amino acids from soybean or meat&bone meals in broilers. M. Pack*, D. Hoehler1, H.S. Rostagno2, S. Cremeres*, and J. Pallauf*. 1Degussa-Huels AG, Hanau, Germany, 2Fed Univ of Vicos, MG, Brazil, 3Justus-Liebig Univ, Giessen, Germany.

Digestibility as a means to predict availability of amino acids (AA) to the bird has been subject of much debate. The force-feeding method using adult roosters is currently favored due to its convenience and repeatability, however questions remain over the validity of the results for broiler chicks in a commercial ad lib feeding regime. Furthermore, the variability of digestibility within one ingredient has not been comprehensively tested. In order to determine ileal digestibility coefficients for two key ingredients in young broilers, the present study was conducted across 27 commercial samples of soybean meal (SBM), and 25 samples of meat&bone meal (MBM). Samples were collected in various states across Europe and US. The SBM work was done in Vicos, Brazil, and the MBM work in Giessen, Germany. Both studies used the slaughter technique with an inert dietary marker. Complete diets (~17% CP) were fed to 4 cages of 8 or 12 birds from 14 to 24 days of age. The protein component exclusively originated from the test sample, whilst the residual diet consisted of starch and non-protein supplements. Apparent ileal digestibility (% AA in SBM did not vary substantially between samples despite their origin from different countries and processors (mean ± SD): Lysine 90.0 ± 1.6, Met 90.6 ± 1.5, Cys 81.8 ± 2.3, Thr 83.6 ± 1.7. In MBM, there was a large variation in app. dig. %: Lysine 67.7 ± 10.9, Met 71.4 ± 9.9, Cys 19.6 ± 12.8, Thr 59.2 ± 8.2. AA digestibility in MBM was generally low, especially Cys was poorly utilized. In both ingredients, there was virtually no correlation between the content of an AA in the sample and its digestibility coefficient. It is concluded that the ileal digestibility
method is sensitive to pick up differences within one ingredient, and may well serve as a basis for feedstuff evaluation. Quality of SBM as judged from AA digestibility was consistently good, whilst MBM showed lower and extremely inconsistent quality. The latter calls for further work towards rapid predictive tools.

**Key Words:** Broilers, Amino acids, Digestibility

### 20 Feeding strategies to reduce phosphorus excretion in broiler chickens grown to market weights. 1. Full term feeding program

F. Yan1, C. A. Fritts1, and P. W. Waldroup1, 1University of Arkansas, Fayetteville, AR.

Poultry producers are facing growing concerns regarding P content of litter as a nonpoint source of water pollution. A combination of phytase supplementation with reduced P levels will be needed to reduce excess levels of fecal P. Studies were conducted for 0-3, 3-6, and 6-9 wk to estimate nonphytate phosphorus (nPP) needs to maximize BW or tibia ash, with or without the addition of 1000 U/kg of phytase. The nPP needs for 0-3, 3-6, and 6-9 wk, respectively, were as follows: 0.375, 0.20, and 0.15% for BW w/o phytase; 0.30, 0.15, and 0.10% for BW with phytase; 0.20, 0.30, and 0.20% for tibia ash w/o phytase; 0.30, 0.25, and 0.15% for tibia ash with phytase. Each of these four series was fed in two consecutive floor pen trials from 1 to 63 d. To test sensitivity, levels of 0.05% nPP above and below the estimates were also fed. Positive control diets consisted of NRC or NRC + 0.05%. At 21, 42, 53, and 63 d birds were weighed, samples taken for tibia ash, and fecal P determined. Feed conversion and mortality were not significantly affected by nPP levels. Body weight at any age was not significantly affected by the estimated nPP levels although estimate for BW w/o phytase appeared borderline. Tibia ash was reduced slightly by BW estimates and by tibia ash estimate w/o phytase but tibia ash estimate with phytase gave ash values that were not different from positive controls. Fecal P levels could be markedly decreased without loss of performance by using modified nPP levels with or without phytase supplementation.

**Key Words:** Phosphorus, Broilers, Environment, Fecal phosphorus, Eutrophication

### 21 Feeding strategies to reduce phosphorus excretion in broiler chickens grown to market weights. 2. Modified early feeding program

F. Yan1, C. A. Fritts1, and P. W. Waldroup1, 1University of Arkansas, Fayetteville, AR.

Poultry nutritionists may reduce dietary P levels in conjunction with phytase to reduce fecal excretion. However, P is a critical nutrient for early stage development and problems may arise if those fed the positive controls. At 42, 53, and 64 d of age, the digestible P content of NRC birds was 1.46, 1.30, and 1.61% while those fed NRC+0.05% were 1.84, 1.23, and 1.58%. Fecal P of birds fed modified program w/o phytase were 1.24, 0.66, and 0.91% while those fed modified program with phytase were 1.05, 0.62, and 0.73%, resulting in markedly reduce fecal P levels without sacrificing performance. The modified nPP levels are suggested for use when fecal P must be reduced.

**Key Words:** Broilers, Phosphorus, Environment, Eutrophication, Fecal phosphorus

### 22 Interaction of methionine and lysine in broiler diets changed at typical industry intervals

M. B. Cafe*, C. A. Borges, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

Met and Lys are the most limiting amino acids in broiler diets. Some research suggests that response to Lys is mediated by Met content of the diet. This study was conducted to evaluate the use of Met and Lys in excess of NRC (1994) recommendations, adapted to feeding periods more consistent with current industry applications. Diets formulated to provide a minimum of 110% of NRC recommended levels for amino acids other than Met and Lys were fortified with DL methionine and Lysine HCl to provide 3 levels of Met (100, 115, 130% of NRC) and four levels of Lys (100, 110, 120, and 130% of NRC) in a factorial arrangement. Feeding times were 0-16 d for starter; 16-35 d for grower; and 35-49 d for finisher. Four pens of 65 male birds were fed each test diet. Birds were weighed and feed consumption determined at 16, 35, 42, and 49 d; samples of birds were processed at 35, 42, and 49 d for parts yield. Three diets were formulated based on phosphorus content, such that supplemental Met was not utilized to the extent that were not different from positive controls. Fecal P levels could be markedly decreased without loss of performance by using modified nPP levels with or without phytase supplementation.

**Key Words:** Broilers, Lysine, Methionine, Carcass yield, Feeding programs

### 23 Sulfur Amino Acid Requirement of Broilers During the Late Starter and Early Grower Periods

J. A. Townsend*, H. R. Pope, and J. L. Emmert, University of Arkansas.

Phase-feeding (PF) has been explored in broilers as a means of reducing feed costs without reducing growth performance or carcass yield. Predicted amino acid requirements for PF are generated using linear regression equations from best estimates of lysine (Lys), sulfur amino acid (SAAs), and threonine (Thr) requirements. During the late starter and early grower periods predicted requirements for methionine (Met) and cysteine (Cys) are higher than levels recommended by NRC, and previous research with PF suggests that SAA may be lowered during the grower period without sacrificing growth performance or carcase yield. The objective of this study was to determine the methionine requirement of fast- and slow-feathering broilers during the late starter and early grower periods. A Met-deficient corn-peanut meal diet was formulated to contain excess Cys, such that supplemental Met was not utilized for Cys synthesis. A factorial arrangement of treatments was used that included 6 levels of supplemental Met (0, 0.045, 0.09, 0.135, 0.18, and 0.225%) and two rates of feathering: fast and slow. Experimental diets were fed to 6 replicates of 5 broilers per pen and broken-line analysis was used to estimate methionine requirements. The main effect of methionine was significant (P < 0.0001) from 2 to 3 and 3 to 4 weeks of age, whereas the main effect of feathering rate was not significant (P > 0.05). The digestible Met requirement for fast- and slow-feathering broilers from 2 to 3 weeks of age was 0.32 and 0.33%, respectively. The digestible Met requirement for fast- and slow-feathering broilers from 3 to 4 weeks of age was 0.37 and 0.29%, respectively. With the exception of the fast-feathering birds from 3 to 4 weeks of age, requirement estimates for Met were lower than those predicted by PF equations or recommended by NRC, indicating that lower Met levels may be utilized in a PF program, particularly for slow-feathering broilers.

**Key Words:** Broiler, Phase-feeding, Methionine, Sulfur Amino Acids

### 24 Feeding and management of Bovans White hens for optimum egg size and profits during phase I using cool temperatures

A. Bateman*, M. Bryant, and D. A. Roland, Sr., Auburn University.

A study was conducted to determine the earliest age at which the Bovans White hen would obtain a 48 lb. case weight (60.5 g/egg), and also to determine the most economical nutrient (protein and lysine) level to feed during phase I (weeks 2-36) using cool temperatures. A. Bateman*, M. Bryant, and D. A. Roland, Sr., 1Auburn University.

A study was conducted to determine the earliest age at which the Bovans White hen would obtain a 48 lb. case weight (60.5 g/egg), and also to determine the most economical nutrient (protein and lysine) level to feed during phase I (weeks 2-36) using cool temperatures. Nine hundred and sixty 21-week old hens were randomly divided into six groups of 160 hens per group. Diets were formulated based on protein as well as lysine. The three diets formulated based on protein (0.90%, 1.02% and 1.17% lysine; 17.06%, 18.70% and 20.80% protein) each contained 1305 kcal ME/lb. The three diets formulated based on lysine (0.75%, 0.83% and 0.92% lysine; 14.98%, 16.19% and 17.34% protein) each contained 1288 kcal ME/lb. The criteria used were egg production, feed consumption and egg weight. Neither the diet nor the method of formulation had a significant (P<0.05) effect on any of the criteria other than egg weight. A combination of phytase to reduce fecal excretion. However, P is a critical nutrient for early stage development and problems may arise if those fed the positive controls. At 42, 53, and 64 d of age, the digestible P content of NRC birds was 1.46, 1.30, and 1.61% while those fed NRC+0.05% were 1.84, 1.23, and 1.58%. Fecal P of birds fed modified program w/o phytase were 1.24, 0.66, and 0.91% while those fed modified program with phytase were 1.05, 0.62, and 0.73%, resulting in markedly reduce fecal P levels without sacrificing performance. The modified nPP levels are suggested for use when fecal P must be reduced.

**Key Words:** Broiler, Phase-feeding, Methionine, Sulfur Amino Acids

A study was conducted to determine the earliest age at which the Bovans White hen would obtain a 48 lb. case weight (60.5 g/egg), and also to determine the most economical nutrient (protein and lysine) level to feed during phase I (weeks 2-36) using cool temperatures. Nine hundred and sixty 21-week old hens were randomly divided into six groups of 160 hens per group. Diets were formulated based on protein as well as lysine. The three diets formulated based on protein (0.90%, 1.02% and 1.17% lysine; 17.06%, 18.70% and 20.80% protein) each contained 1305 kcal ME/lb. The three diets formulated based on lysine (0.75%, 0.83% and 0.92% lysine; 14.98%, 16.19% and 17.34% protein) each contained 1288 kcal ME/lb. The criteria used were egg production, feed consumption and egg weight. Neither the diet nor the method of formulation had a significant (P<0.05) effect on any of the criteria other than egg weight.
27 The Determination of the Betaine Content of Feed Ingredients Using High Performance Liquid Chromatography. T. P. Chendrimada1, M. N. García1, G. M. Pest1, A. J. Davis1, and R. I. Bakall2, 1Department of Poultry Science, University of Georgia, 2Universidade Estadual Paulista/FAPESP, SP-16052-680 Brazil.

A study was conducted to establish a methodology for the accurate determination of betaine in different feed ingredients. The methodology involves an extraction step, in which the feed sample is heated for three hours in a methanolic KOH solution using a Goldfisch apparatus. Impurities are removed by the addition of activated charcoal and concentrated (36%) HCl. After centrifugation, the extractant is passed through a strong cation exchange resin (Dowex 50W-X8, H+). The betaine retained in the column is eluted with 1.5 N of the eluate is air dried, and reconstituted with 1 ml of deionized water. A cation exchange column (Partisol SCX-10) was used for separation of betaine from other components. The mobile phase is 50 mM KH2PO4 in water, with a detection wavelength of 200 nm. Flow rate is maintained at 1.5 ml min⁻¹. This assay is very accurate over the range of betaine concentrations from 0.04 mg mg⁻¹ to 0.3 mg mg⁻¹, with a lower detection limit in feeds of approximately 500 mg gm⁻¹. Recovery assays done with standard betaine hydrochloride and hard red wheat resulted in a consistent recovery of 80%. This method is a very reliable to determine betaine in feed ingredients. Betaine was quantified in several feed ingredients including alfalfa (1.77 ± 0.03 g kg⁻¹), wheat (3.96 ± 0.24 g kg⁻¹), wheat middlings (4.48 ± 0.44 g kg⁻¹), poultry meal (0.72 ± 0.13 g kg⁻¹), fish meal (1.11 ± 0.52 g kg⁻¹), pea meal (2.52 ± 0.13 g kg⁻¹), and meat and bone meal (0.60 ± 0.08 g kg⁻¹). Using this method, betaine was undetectable in samples of soybean meal or corn.

Key Words: Betaine, Feed, HPLC

28 Influence of dietary formulation methods on response to arginine and lysine in diets for broiler chickens. E. O. Oviedo-Rondon1*, C. A. Fritts1, D. J. Burnham2, and P. W. Waldroup1, 1University of Arkansas, Fayetteville, AR, 2Heartland Ly- sine, Chicago, IL.

The antagonism between Lys and Arg in poultry diets is well documented, with adverse effects noted when Lys is markedly in excess and Arg is marginal. Recent research has focused on the relationship between these two amino acids with conflicting results. Use of ingredients with reduced digestibility, amino acid imbalances, or various antinutritive factors may cloud results and make it difficult to determine if the results were due to amino acid levels per se or type of diet used. A study was conducted to compare response of chicks to various levels of Lys and Arg with two different dietary approaches. In both diet types, a 4 x 5 factorial arrangement with Lys levels of 1.1, 1.2, 1.3, and 1.4% and Arg levels of 1.25, 1.35, 1.45, 1.55, and 1.65% were used. All other essential amino acids were a minimum of 110% of NRC (1994). Corn, soybean meal, and corn gluten meal (CGM) of known composition were used. In the first diet set (BASAL+AA) a diet which contained 1.1% Lys and 1.25% Arg was fortified with Lysine HCl or L-Arg to provide the various levels of Lys and Arg. In the second diet set (INTACT) each of the 20 diet combinations was formulated independently to provide the desired Lys and Arg levels with the primary difference being in amount of CGM allowed. The results between the two diet types existed. In BASAL+AA diets there were no significant differences in BW or FCR due to Lys; 1.35 to 1.45% Arg was necessary for optimum FCR. Although the Lys x Arg interaction was not significant the reduction in BW or FCR at high Lys with low Arg appeared primarily responsible for the increased Arg needs. In INTACT series there were significant interactions in BW and FCR for Arg and Lys, but appeared to be associated with reduced performance on diets high (15-30%) in...

Two experiments were conducted to study the effects of 25-hydroxycholecalciferol (25-(OH)D3) on growth performance, tibia ash and incidence and severity of tibial dyschondroplasia (TD) in broilers grown in battery brooders. A preliminary study demonstrated that ultraviolet light could be effectively blocked by filters used on the fluorescent tubes in the battery brooder. In Experiment 1, chicks were fed a TD-inducing diet (0.65% Ca and 0.50% non-phytate P (npp), 1100 ICU/kg cholecalciferol) for 18 days. Six replicate pens of 10 male chicks each were randomly allocated to four dietary treatments consisting of 25-(OH)D3 added at 0, 10, 40 or 70 g/kg. Experiment 2 was similar to Experiment 1 except a normal broiler starter diet (0.85% Ca, 0.45% npp, 2200 ICU/kg cholecalciferol) was fed. Body weight gain and feed efficiency were not affected in either experiment and tibia bone ash was increased linearly from 41.8 to 43.9% (p < 0.001) in Experiment 1, but was not affected in Experiment 2. The incidence of TD was decreased linearly in Experiment 1 (73 to 2%, p < 0.001) and Experiment 2 (25 to 5%, p < 0.003) and quadratically in Experiment 1 (p < 0.001). In Experiment 1, contrast analysis indicated that TD incidence and severity was not different between 40 and 70 µg/kg 25-(OH)D3. In Experiment 2, 70 µg/kg was needed to reduce (p < 0.05) TD lesions as analyzed by contrast analysis. Severe TD lesions were decreased linearly in both experiments (p < 0.001, 0.03) and quadratically in Experiment 1 (p < 0.001) and eliminated when 70 µg/kg 25(OH) D3 was fed in Experiment 2. According to NLIN analysis, the estimated requirement for 25(OH)D3 to prevent the incidence of TD overall and severe lesions specifically is 14.8 or 13.5 µg/kg, respectively, with a TD-inducing diet. In Experiment 2, 65.4 µg/kg 25(OH) D3 was the estimated level needed to prevent TD. The results indicate that the 25(OH) D3 requirement to minimize TD in broilers is higher when a typical broiler diet is fed compared to a TD-inducing diet.

Key Words: Broiler, Tibial dyschondroplasia, 25-Hydroxycholecalciferol, Requirement

30 Effect of Moisture Addition at the Mixer to a Corn-Soybean Based Diet on Broiler Performance. J. S. Moritz*1, R. S. Beyer2, K. J. Wilson3, K. R. Cramer1, L. J. McKinney1, and F. J. Fairchild1. 1Kansas State University.

Moisture addition at the mixer has been shown to increase pellet durability and decrease pellet mill energy consumption for corn-soybean based diets; however, the effect of this process on animal performance has not been tested. Two experiments were conducted to examine the effect of moisture addition on male broiler live weight gain (LWG), feed efficiency (FE) and mortality. Moisture was added to the diets at the mixer. The diets were fed in the form of mash or crumbled/standard pellets. Feed form and moisture treatments were applied to a (0-3) week battery study and a (0-6) week floor pen study. Feeding crumbled/standard pelleted diets resulted in higher LWGs and FEs compared to mash diets in both studies. High moisture pelleted treatments contributed to significantly higher adjusted FEs in the (3-6) week period of the floor pen experiment compared to the low moisture treatments. Broiler death was affected only in the (3-6) week period of the floor pen experiment, where standard pelleted diets produced a significantly higher percentage of mortality relative to mash diets. These results conclude that high moisture pelleted diets are beneficial to bird performance when fed in the (3-6) week grower period and crumbled/pelleted diets are superior to mash throughout broiler rearing.

Key Words: Broiler Performance, Feed Form, Feed Manufacturing, Moisture, Pellet Durability

31 Effects of electrolyte-glucose therapy on poult infected with turkey corona virus. L. El-Hadri*, J. Guy, M. A. Qureshi, J. D. Garlich, and P. R. Ferket, NC State University, Raleigh, NC USA.

Turkey corona virus (TCV) has been associated with poult enteritis and mortality syndrome (PEMS). TCV causes enteritis with severe diarrhea, mortality and poor performance of survivors. The objective of this study was to determine the effects of an electrolyte solution with or without glucose on livability, growth and immune parameters in pouls challenged with TCV. Turkeys, 128 Nichols pouls, received an oral dose of TCV (NC 95) at 3 × 10^10 CP/3 at 7 days of age. All pouls consumed feed and were ad libitum. The infected pouls were divided into 3 groups and received drinking water supplemented with electrolytes (E), E + glucose (EG), or water only (W). These treatments were given from 2 days post infection (DPI) until 14 DPI. Forty pouls of the same strain were reared in separate room as controls. Mortality was recorded daily. Body weight and serum samples were taken at 7 and 14 DPI. Compared to the control group, C, body weights of the TCV-infected pouls were significantly reduced (P<0.0001). Among the challenged pouls, body weight and feed conversion were improved significantly (P<0.01) in the glucose-supplemented group, EG, compared to E or W. Cumulative mortality was 0, 9, 15 and 20% in C, EG, E, and W respectively. Fluorescence intensity of serum samples was higher in EG pouls than in E and W. Antibody response, Log3 score, was 2.25, 2.5, and 2.15 (P<0.028) in E, EG, and W, respectively. This study indicates that supplementation of water with electrolytes and glucose improved survival and immune functions of TCV-infected pouls.

Key Words: Pouls, Corona virus, Immune response, Body weight, Electrolytes

32 Effect of Natugrain™ supplementation in diets containing different qualities of wheat on growth performance and AME of turkey pouls. A. A. Santos, Jr.*, P. R. Ferket, A. D. Israel, and E. B. Morris, NC State University, Raleigh, NC USA.

Antinutritional factors in wheat vary with growing conditions, reducing the apparent metabolizable energy (AME) of wheat. AME of poor quality wheat can be improved by the dietary enzyme supplements like Natugrain Blend® (NB). Pouls from 0-17 d of age were fed diets containing various wheat sources (WS) with or without NB, and growth performance, AME, and nitrogen retention (%NR) were measured. Five replicate cages of 10 Nichols males were assigned each to 8 SBM/wheat treatment diets and a control SBM/corn diet. The treatments were a factorial arrangement of 4 WS (A, B, C, and D) and 2 enzyme levels (0 and 200 mg NB/kg). The WS differed by the degree of frost damage during seed development. Pouls were weighed on d 7, 13, and 17 and FCR calculated. Feces from each cage were collected from d 11 to 14 to determine AME and %NR. Jejunal digesta was measured for viscosity; viscosity varied with all feeds. Birds were killed at 17 d. There were no significant (P>0.05) NB X WS interaction effects although significant main effects were observed. NB increased 17 d BW (351 vs 380 g, P<0.001), decreased 1-7 d FCR (1.55 vs 1.49, P<0.05), increased AME (2219 vs 2473 kcal/kg, P<0.001) and increased %NR (35.0 vs 41.4 %, P<0.001), regardless of the source of wheat. No effects of WS were seen on BW or FCR, but WS A and B had lower (P<0.05) AME than sources C and D (2261 and 2232 vs. 2413 and 2479 kcal/kg, respectively). Viscosity was higher (P<0.05) in pouls fed wheat-based diets than the control diet, without differences among WS. Addition of NB to the wheat-based diets decreased viscosity (5.57 vs 3.98 Cps, P<0.05) to a level similar to the corn-based control diet and resulted in equivalent growth performance. This study demonstrates the positive effect of enzyme supplementation on enhancement of nutrient utilization.

Key Words: Wheat quality variation, Enzyme, ME, Nitrogen retention, Turkeys

33 Modeling amino acid requirements in turkeys 0 to 18+ weeks of age. E. C. Blair*, J. D. Firman, K. A. Baker, and D.T. Moore, Univrsity of Missouri-Columbia.

A model was constructed to predict the digestible amino acid requirements for male turkeys from 0 to 18+ weeks of age. Data from research previously collected at our research facility was used to develop the current model. The Missouri Ideal Amino Acid Profile was used to determine all digestible essential amino acid numbers other than lysine. The model
was designed to take into account on an individual basis body weight, intake per day, and essential amino acid requirements on a digestible basis. The model was designed so that one may enter a body weight and the predicted intake, digestible lysine requirement as a percent of the diet, the ratio of other essential amino acids based on lysine, and all essential amino acids on a grams per day basis are calculated. The model was tested versus previously derived data for intake and amino acid requirements. The models predicted results were not found to be significantly (p<.05) different from the derived numbers.

Key Words: Turkeys, Digestible, Modeling, Amino acids, Intake


An experiment was conducted to evaluate phosphorous availability of NutriDense® low-phytate (LP) corn compared to dent corn in commercial toms. Day-old pouls (B.U.T.A.) were group brooded for 3 wks and then allocated into 4 replicate treatment (trt) pens with 29 pouls/pen for four dietary trts and phase fed on a three-week interval to a final BW of 14.50 kg. The phosphorus availability of LP corn was assigned 90% (trt 3) and 75% (trt 4). The available P (%aP) level in the control diet was the same for trts 2 and 3. For example, the 15-17wk phase, %aP was calculated to be the same for trt 1, 3, and 4 and total P (tP) was the same for trts 2 and 3. For example, the 15-17wk phase, %aP and %tP were assigned as follows: trt1=0.40, 0.60; trt2=0.30, 0.50; trt3=0.40, 0.51; and trt4=0.40, 0.51. For all trts, Ca:aP was 2:1 throughout the study. The phosphorus availability of LP corn compared to dent corn was decreased (p=.022) in trt 1 compared to trt 3 (2579 vs. 2290 N). Ulna breaking force was the same for trts 2 and 3. For example, the 15-17wk phase, %aP and %tP were assigned as follows: trt1=0.40, 0.60; trt2=0.30, 0.50; trt3=0.40, 0.51; and trt4=0.40, 0.51. For all trts, Ca:aP was 2:1 throughout the trial. The ME values used in diet formulation were 3480 kcal/kg for LP corn and 3410 kcal/kg for dent corn. Birds were weighed on a 3-wk basis and at 115 d of age. Feed disappearance was measured for each phase to estimate feed intake and calculate gain/feeding. Walking ability score (1-3, 3 best) was evaluated at 115 d of age and was not affected by dietary trts (p=.216). Three tom pens were selected based on average BW by pen and processed at 118 d of age. Leg and wing bones and middle toes were sampled from one side of the carcasses. At 118 d of age, BW was higher (p=.008) for toms fed LP corn (14.32 vs. 14.75 kg). Ulna breaking force was not affected by dietary trts.

Key Words: Feed enzyme, β-mannanase, Hemicell®®, Body weight, Coefficient of variation

35 Digestible Lysine Requirements of Hen Turkeys 0 to 6 Weeks of Age. K.L. Thompson*, J.D. Firman1 and D. Langendoerfer1, 1University of Missouri, Columbia, MO.

Two floor pen trials were conducted to determine the digestible lysine requirements of female turkeys from 0- and 3-6 weeks of age, 2080 day-old Nicholas female pouls were obtained and fed a typical corn-soy diet. For the 0-3 week period, 480 three-day-old pouls were weighed, sorted, and assigned a treatment with 10 pouls per pen. For the 3-6 week period, 384 twenty-nine-day-old pouls were weighed, sorted, and assigned a treatment with 8 pouls per pen. In both trials, pouls were fed experimental diets with the digestible lysine levels ranging from 1.10% to 1.45% in the 0-3 week period and 0.90% to 1.32% in the 3-6 week period. These levels were obtained by the titration of L-lysine HCl into a low-protein diet. Other synthetic amino acids were added back to the low protein diet to obtain sufficient amino acid and nitrogen levels and to support growth similar to a high protein positive control. The experiments were of the complete randomized block design with eight treatments and six replicates per treatment. The highest level of lysine received three replicates at the expense of the positive control groups which were fed a standard corn and soybean meal diet based on the NRC (1994) requirements. Experimental data was analyzed by analysis of variance and breakpoint analysis. Broken-line analysis indicates that the digestible lysine requirements for body weight gain during the 0-3 and 3-6 week periods are 1.30% and 1.14%, respectively. These data are contingent upon further analysis of the digestibility of the corn and soybean samples used in the study.

Key Words: Turkey, Lysine, Amino acid


Significant improvement in the uniformity of body weight was demonstrated in independent, carefully controlled pen trials. All the animals were weighed individually to generate the uniformity data. Results are from six tests with turkeys, two tests with broilers, one test with ducks and one test with hogs. The original focus for these studies was to determine the weight and feed conversion improvement afforded by β-mannanase application. This retrospective analysis now shows a very statistically significant reduction in the coefficient of variation in animal weights. In broilers and ducks the coefficient of variation in body weight decreased 12.5 to 15.8% relative to controls. In turkeys and pigs, the coefficient of variation in body weight decreased 23.5 to 29.8% relative to controls. Histogram analysis of the data shows that the greater uniformity caused by enzyme use is obtained specifically by reducing the number of animals on the low end of the distribution. The biological mechanism for increasing uniformity by using mannanase enzyme will be discussed.

Key Words: Feed enzyme, β-mannanase, Hemicell®®, Body weight, Coefficient of variation


Commercial broilers fed the direct fed microbial Avi-Lution™ (AVN) at 1.5 lb./ton (starter) and 0.5 lb./ton (grower and finisher) were compared to broilers on a conventional feed program (CF). The AVN program: Starter - Avi-Lution 1.5 lb./ton + Salinomycin 60 g/t + Roxarson 45 g/t; Grower - AVN 0.5 lb./ton + Diclazuril 0.91 g/t; Finisher - AVN 0.5 lb./ton. The CF program: Starter - Salinomycin 60 g/t + Bacitracin MD 50 g/t + Roxarson 45 g/t; Grower - Diclazuril 0.91 g/t + Bacitracin MD 50 g/t; Finisher - Oxytetracycline 200 g/t. Corn-soy based starter, grower and finisher diets containing up to 4% poultry by-product meal were used. Performance data were collected during Weeds 3, 6, 7 and 8. Week 3 and 6 AVN group average live weights were heavier (p<0.05) than those of the CF group. Week 7 and 8 AVN average feed conversions were significantly lower (p≤0.05) than those of the CF. Week 6, 7 and 8 AVN and CF carcass and breast yields were not different (p≥0.05). AVN group intestinal (p≤0.05) and cecal (p≤0.07) coliforms were lower than those of the CF group. AVN cephal and intestinal Campylobacter spp. and Clostridia spp. counts were significantly lower (p<0.05) than those of the CF group. AVN group percent cecal content dry matter was significantly less (p≤0.05) than that of the CF group. Broilers reared on the AVN feed program had live weights, feed conversions, carcass yields, breast yields, coliform reduction, Campylobacter spp. reduction and Clostridia spp. reduction equal to or better than those of broilers reared on the CF feed program.

Key Words: Avi-Lution™, Broilers, Direct Fed Microbial, Bacitracin MD, Oxytetracycline


In three previous pen trials, the direct-fed microbial, Avi-Lution™, has been shown to improve broiler weight gain and feed conversion similar to bacitracin-md or virginiamycin and can be used as an economical alternative for these purposes. In the present experiment, straight-run Ross x Arbor Acres chicks (3,000 total) were placed in a randomized complete block arrangement with 12 blocks (12 replicate pens/treatment)
of 5 pens (each 60 chicks/pen) which contained 5 dietary treatments – control (CON; basal); virginiamycin (VM) 16.5, 11, 11 mg/kg; Avi-Lution™ (AVN) 0.025%; AVN 0.015%; and AVN 0.075, 0.05, 0.025% (step down). There were three feed phases, and starter and grower feeds contained salinomycin 55 mg/kg. The direct-fed microbial was added at the mixer, and all feeds were steam pelleted (starter crumbled). Built-up litter was covered with fresh pine shavings. Stocking density was 0.0855 m²/bird. The pen trial was conducted in Georgia from July to September and provided mild disease stress on the birds. Chicks which died during the first 3 days were replaced. At 21 d, mortality-adjusted feed conversion ratio (FCR) was not significantly different for VM or AVN treatments, but CON was higher than VM or AVN 0.05%. At 35 d, body weight (BWT) was improved for each AVN treatment vs CON. The FCR was better for AVN step-down treatment than for CON. The mortality-adjusted FCR was better for AVN 0.025% or AVN step-down treatments than CON. At 48 d, VM, AVN 0.025%, or AVN step-down treatments each improved female BWT vs CON. The AVN 0.025% or AVN step-down treatments improved combined male and female BWT vs CON. Mortality-adjusted FCR was reduced by AVN step-down treatment vs CON. Mortalities did not differ significantly by treatment at any age. By microbial analysis of intestinal contents (48 d), it was found that AVN treatments significantly lowered coliforma, Campylobacter, and Clostridia, and raised lactic acid bacteria (cfu/g dry matter) vs CON (also vs VM, except in the case of Clostridia). Based on samples of nine feeds, survivability of AVN microbes through pelleting averaged 95.9%. The AVN provided similar performance to virginiamycin for broilers.

Key Words: Avi-Lution, Broiler, Direct-fed microbial, Intestinal microflora, Virginiamycin


An experiment was conducted to determine the effectiveness of 1alpha-hydroxycholecalciferol (1α-OH3D3) as a substitute for cholecalciferol (D3) in the diet of young broilers. A corn-soybean meal practical type diet that contained all nutrients in adequate amounts, except a source of vitamin D3, was used as the basal diet. The Ross x Ross mixed sex day-old chicks were reared in Petersime battery brooders in a room where sunlight was excluded and all fluorescent lights were covered with plastic to prevent exposure of the chicks to ultraviolet light. Feed and water were supplied ad libitum and the experiment was terminated after 16 days. Vitamin D3 was fed at 0, 2.5, 5, 10, 20, and 40 µg/kg and 1α-OH3D3 was fed at 0.625, 1.25, 2.5, 5, and 10 mg/kg of diet. The criteria used to evaluate the supplements were 16-d body weight, gain/feed, plasma Ca, incidence of rickets, percent bone ash and mg bone ash/tibia. Slope ratio analysis indicates that 1α-OH3D3 is very potent compared to D3, with its activity being 10 times as active as D3 for 16-d body weight, 2x for gain/feed, 5x for plasma Ca, 6x for incidence of rickets, 4x for bone ash percent, and 7x for mg bone ash/tibia. The requirement for 1α-OH3D3 and cholecalciferol also varied depending upon the criteria and, in most cases, the amount of 1α-OH3D3 required was approximately one-fourth the amount of cholecalciferol needed to maximize the specific response.

Key Words: Cholecalciferol, 1Alpha-hydroxycholecalciferol, Chickens, Rickets

40 Effects of source and level of vitamin D in broiler diets. C. A. Fritts* and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

Vitamin D is important for proper bone development, and poultry diets are usually fortified at levels far in excess of minimum NRC recommendations. However, problems with bone development in the form of field rickets and tibial dyschondroplasia (TD) are still observed under commercial conditions. A study was conducted to compare two forms of vitamin D at various levels in broiler diets. Cholecalciferol (VIT-D3) and 25-hydroxycholecalciferol (25-OH-D) were used to provide 125, 250, 500, 1000, 2000, or 4000 IU/kg vitamin D activity in nutritionally complete broiler diets. Calcium and nonphytate P were provided at NRC recommended levels. Four pens of 60 males, grown on builtup softwood litter, were assigned to each diet and grown to 42 d. Body weights and feed consumption were determined at 21 and 42 d., with five birds per pen sacrificed at both 21 and 42 d for tibia ash determination and evaluation for incidence and severity of TD.

Birds fed the diets supplemented with 25-OH-D3 had significantly higher BW at both 21 and 42 d than those fed diets with comparable levels of activity from VIT-D3. Differences were much more apparent at the lower levels of vitamin D supplementation. Tibia ash was also greater in birds fed the 25-OH-D3, again being more apparent at lower levels of vitamin D. The incidence and severity of TD was significantly lower in birds fed diets with 25-OH-D3 and was also more apparent at lower levels of vitamin D supplementation. These results indicate that 25-OH-D3 is a more effective source of vitamin D activity than VIT-D3 and under critical conditions may aid in reducing leg disorders under field conditions.

Key Words: Broilers, Vitamin D, Leg disorders, Tibial dyschondroplasi
of 50, 75 or 100% had average body weight gains of 409, 418, 435 and 419rams per bird, respectively and feed conversions of 1.44, 1.42, 1.41 and 1.44, respectively. There were no statistically significant differences in the weight gains or feed conversions between the four dietary treatments for either experiment. The results suggest that millet could be an effective alternative grain for poultry diets.

Key Words: Pearl millet, Protein, Broilers, Corn, Energy

43 A Comparison of Eight Fat Sources for Broiler Chickens. G. M. Pesti1 and R. I. Bakalli, The University of Georgia, Athens, GA/USA.

Experiments were conducted with broiler chickens to compare eight different fat sources. Differences in metabolizable energy were detected by substituting 3% of each fat for glucose at 10 and 40 days of age. There were significant differences due to source and age (7.53 and 9.35 kcal/g at 10 and 40 d, respectively), but no source by age interaction. Main effects of MEa means were 6.94±.84 kcal/g (feed grade poultry grease), 6.32±.82 (pet food grade poultry grease), 7.44±.60 (feed fat from waste frying oil), 8.20±.128 (choice white swine grease), 10.34±.61 (animal/vegetable blend), 6.47±.84 (palm oil), 10.70±.65 (yellow grease). The MEa values of the samples were most closely related to their AOM Stability at 20 hr (r = .925, P = 0.001), Iodine Value (r = .921, P = 0.01), and Peroxide Values (r = .642, P = 0.086). Differences in determined MEa due to fat source were not reflected in differences in 18-39 day gain (avg = 1.79 kg), consumption (2.847 kg), feed conversion ratio (1.645 g/kg), or mortality (2.4%) when fat sources were fed to broilers in floor pens at 3 or 6% of the diet. Feeding 6% of the fat sources resulted in 3.4 points better PC from 18 to 39 days than feeding 3% (1.662 vs. 1.628 g/kg, P = 0.117). There were no differences in % chilled carcass or fat pads due to dietary fat level. Significant differences in fat pad color were detected due to fat source: Choice white grease and A/V blend had the most (73.7) and least (70.4) lightness. A/V blend gave the most redness (3.70) contrast to palm oil (1.95) and food grade soybean oil. There were no significant differences in yellowness.

Key Words: Broilers, Grease, Oil, Fat, Metabolizable energy

44 Effect of Choline Replacement by Betaine on Broiler Performance and Carcass Quality. A Kamyab1, 1University of Tehran.

ABSTRACT A factorial study was conducted to determine the effects of choline chloride replacement by different levels of betaine on growth performance and carcass quality of broilers. Two isocaloric and isonitrogenous dietary treatments, consisting of a) corn-soy and b) corn, soy, wheat, and barley control diets, were fed to 900 Arian broiler chicks from day 1 to 40 d of age. In both diets choline chloride was replaced in a ratio of 3, 3.5, and 4 to 1 by betaine. The chicks were randomly assigned to 36 pens (25 chicks per pen, 6 pens per diet). Body weights and feed to gain ratio were measured at 23, 42, and 47 day of age. The leg abnormalities were monitored throughout the study. At the end of study, day 47, three birds per replicate were chosen and their abdominal fat content, liver weight, and breast weights determined. The results showed that body weights and feed to gain ratios were improved significantly (P<0.05) when compared to control at all phase feeding periods for the groups received betaine in their diets compared to choline chloride fed groups. These differences were statistically significant at age 47 (P<0.05).

Even though, all the betaine fed groups had heavier breast weight and less abdominal fat content, but these differences were not statistically different from basal control groups. Likewise, no significant differences were found on liver weight, mortality or leg abnormalities (P>0.05). Keywords: Betaine, Choline, Broiler, Leg abnormality.

Key Words: Broiler, Betaine, Choline

45 Fertility following selection for the OptiBreed Sperm Quality Index when hens are inseminated with a constant number of sperm. H.M. Parker1, A.G. Karaca2, J.B. Yeatman1, L.R. Frank2, and C.D. McDaniel1, 1Mississippi State University, Miss. State, MS, 2Alpharma Inc., Fort Lee, NJ.

If breeders knew semen quality prior to insemination, sperm doses could possibly be decreased, maximizing the number of hens inseminated. The objectives of this study were 1) to determine the age at which the OptiBreed Sperm Quality Index (SQI) becomes a static predictor of semen quality and 2) to determine if fertility of males with a higher SQI responds more favorably to insemination dose reduction than that of males with a lower SQI. Weekly from 23-32 wk of age, 144 Cobb males were tested for the SQI. At 32 wk of age, males were placed into four groups which represented the SQI population quartiles as follows: poor, fair, good, and best. A fifth SQI group (pooled) was created to obtain the fertility of the original, unselected population by mixing equal amounts of semen from each of the four groups. Semen was collected weekly from 33 to 40 wk of age and 15 males in each of the four groups, pooled by group, and used to inseminate 30 hens per group with either 50 or 100 million sperm. Eggs were collected daily, incubated, and broken out to obtain fertility. Correlation coefficients between weekly SQI results and overall averages indicated that the SQI stabilized after the birds were 28 wk of age. The main effect for SQI selection revealed that the best SQI group had the highest fertility (88%), which did not differ from the good (83%) or fair group (82%), but was greater than the pooled group (80%). Fertilities of the top three groups and the pooled group were higher than the poor group (63%). In addition, there was an interaction between SQI selection and insemination dose. Fertilities of the top three SQI groups were similar at the 50 and 100 million sperm doses. However, the poor and pooled SQI groups had lower fertility at the 50 million dose as compared to the 100 million dose. By selecting males for the SQI after 28 wk of age, insemination dose can be reduced, maximizing a male's fertilizing potential.

Key Words: sperm quality index, broiler breeder, fertility, insemination dose

46 Effects of Light on Aerobic Microorganisms, and Escherichia Coli Levels on Eggshell Surfaces. C. Chavez*, C.D. Coufal, R.P. Burgess, T.P. Niemeyer, R.A. Russo, and J.B. Carey, Texas A&M University College Station, TX.

The effects of 254 nm ultraviolet light (UV) reduction on aerobic plate counts (APC) and Escherichia coli (E. coli) of eggshell surfaces were investigated. In the first experiment eggs were exposed to a UV treatment of (14 mW/cm2) for 3 minutes, in the other 2 experiments they were exposed to a minimum of (18 mW/cm2) for 4.5 minutes. All eggs are placed in an eggwasher and passed through UV lights and a conveyor system to carry the eggflats. In the first experiment, broiler hatching eggs were collected over a 2 day period and divided into control and UV-treated groups. Each day 40 control and 40 UV-treated eggs were randomly selected for APC. Eggs were aseptically collected and placed in sterile plastic bags with 50 ml of phosphate buffer solution (PBS). Serial dilutions of the PBS were plated on Eosin Methylene Blue plates and incubated at 37°C for 48 hours. UV-treated eggs were randomly selected for APC. Eggs were again sampled and placed in sterilized plastic bags with 50 ml of phosphate buffer solution (PBS). Serial dilutions of the PBS were plated on Eosin Methylene Blue plates and incubated at 37°C for 48 hours. UV-treated eggs had an APC reduction of 0.75 log CFU/egg and 1.1 log CFU/egg reduction compared to control eggs, for days 1 and 2 respectively. On the day prior to setting the eggs into the incubator, 40 control and 40 UV-treated eggs were again sample for APC by the same method described above. UV treated eggs had an APC reduction of 0.68 log CFU/egg collected prior to setting into the incubator compared to control eggs. In the second experiment, 48 eggs from each treatment were collected for APC prior to setting into the incubator. Sampling and dilution methods were as described for experiment 1. A similar significant reduction in APC was also observed in eggs sampled at the hatchery in experiment 2. In experiment 3, E. coli was inoculated on 14 unwashed clean eggs. Seven eggs inoculated with E. coli were placed on the eggflat, and surrounded with other unwashed clean eggs, and passed through the UV light chamber. Sampling and dilution methods were as described for the previous experiments. Serial dilutions of the PBS were plated on Eosin Methylene Blue plates and incubated at 37°C for 24 hours. Three trials were conducted and there was a significant 4 to 5 log CFU/egg on E. coli levels between UV-treated and control eggs. The results of these studies show that E. coli levels are significantly reduced by this method of UV treatment.

Key Words: UV light, Eggshell surface, APC, E. coli, Eggflats

47 Comparison of Direct Plating Versus Filtering of Egg Shells Inoculated with Salmonella typhimurium. P.L. Reynolds*, K.D. Knape, and J.B. Carey, Texas A&M University College Station, TX.

Microbial contamination of egg shells is important in the poultry industry for consumer satisfaction and as an important component of HACCP programs. Commonly used methods of enumerating microbes found on egg shells yields no fewer that 50 CFU/egg. A rapid and simple test for
Evaluation of water treatments for reducing shrink in turkeys held for different feed withdrawal times. C.L. Esters*, B.W. Esters, and S.E. Watkins, University of Arkansas Fayetteville, AR.

The perfect feed withdrawal program continues to elude the turkey industry as it strives to reduce feed and feed contamination on carcasses in the plant, yet also minimize the loss of weight by birds off feed and water. Several water treatments were evaluated to determine if they would impact live weight shrink when birds were withdrawn from feed for 8, 10 or 12 h during the warmer months of the year. Ema-Sol which is a cocktail of mineral sulfates, a carbonated soft drink and a water soluble aspirin were all evaluated. In trial 1, 240, 14-week-old turkey hens of a commercial strain were randomly placed into groups of five birds/pen to give forty-eight pens of birds. Twenty-four hours prior to slaughter, birds were given either tap water, Ema-Sol at a rate of 2 tsp/gallon or the carbonated soft drink at a rate of 2 cups/gallon of drinking water. Birds on each water regime were subjected to either 8, 10 or 12 h feed withdrawal. In trial 2, 76 toms and 76 hens that were 20 weeks of age were given either tap water or aspirin at a rate of 1 grain/gallon. Birds were given the aspirin treated water for five days prior to slaughter. For each water regime birds were placed on either 8, 10 or 12 h feed withdrawals. In both trials all birds were weighed at initiation of feed withdrawal and all birds had access to drinking water until 2 h prior to slaughter. All birds were individually weighed at slaughter and carcass weights were obtained after evisceration. Results were analyzed using the GLM procedure of SAS. In trial 1, no statistical difference were observed for the different water treatments for shrink. Withdrawal time had the greatest impact on shrink with the 12 h withdrawal time resulting in the greatest shrink. In trial 2, the birds receiving the aspirin treated water did not have a statistically different amount of shrink as compared to the birds receiving the untreated water.

Key Words: Turkeys, Feed withdrawal, Aspirin

Evaluation of litter treatments on Salmonella recovery in poultry litter. J.B. Payne* and S.E. Watkins, University of Arkansas, Poultry Science Department.

Evaluations were conducted to determine the efficacy of 2 litter amendments in reducing or eliminating Salmonella recovery from broiler litter. Bedding material was obtained from a commercial broiler house. The litter had been exposed to 1 flock and 3 flocks of birds for trial 1 and trial 2, respectively, with the original bedding material composed of dried pine shavings. Litter was placed at a 2° depth in ft³ baking pans and autoclaved 45 min at 121°C. In trial 1, all pans were inoculated with 100 mL of 10⁶ CFU/mL of nalidixic acid-resistant Salmonella typhimurium (NAL-SAL). In trial 2, all pans were inoculated with 50 mL of 10⁷ CFU/mL. In trial 1, a 46% by weight sulfuric acid litter treatment was applied at rates of 100 and 150 lb/1000 ft². Each treatment was applied to 4 replicate pans with 4 serving as controls. In trial 2, a sodium bisulfate amendment, along with the sulfuric acid litter treatment, were evaluated. Each treatment was applied at rates of 25, 50, 75 and 100 lb/1000 ft² to 4 pans with 4 pans again serving as controls. Samples were obtained from 4 locations/pan, 24 h post treatment. Samples were then enumerated on XLT4 agar containing nalidixic acid. NAL-SAL counts were converted to log₁₀ values prior to analysis with the GLM procedure of SAS. In trial 1, the NAL-SAL control recovery rate was 4.4 log₁₀/sample with a 0 recovery for the 2 rates of litter treatment. pH for the control samples was 6.47. Litter treatment dropped the pH to 1.95 and 1.53 for the 100 and 150 lb/1000 ft² rates respectively. In trial 2, control levels of NAL-SAL were 2.77 log₁₀/sample. NAL-SAL levels increased to levels higher than those observed for the control at the litter treatment rate of 25 lb/1000 ft² for both treatments. A treatment level of 100 lb/1000 ft² was required for both litter treatments in order to drop NAL-SAL to levels significantly different from the control. In trial 2, the 100 lb/1000 ft² treatment rate dropped litter pH to 2.67 and 3.47, respectively, for the sulfuric acid and sodium bisulfate treatments.

Key Words: Litter Amendments, Salmonella, Poultry Litter

50 Effects of Ultraviolet Irradiation on the Microbiology and Hatchability of Broiler Hatching Eggs. R.A. Russo*, C.D. Coufal, C. Chavez, K.D. Knape, T.P. Niemeyer, R.P. Burgess, and J.B. Carey, Texas A&M University, College Station, Texas.

Implementation of an effective sanitation method on hatching eggs is necessary, because this point is the beginning of the poultry industry. Sanitation must be conducted in a way that does not disrupt the normal embryological development of the chick or disturb any egg components integral for proper hatchability. The germicidal effects of ultraviolet (UV) light (radiation) of wavelength 254nm (UV-C) have been well documented in other sanitation applications. Field trials were conducted to test the impact of UV exposure on hatching eggs on hatchability and microbiology. In order to treat the eggs in a way that could be commercially reproduced by the industry, a chamber was constructed to house the ultraviolet lights. A conveyor system was used to carry a standard (42 egg) hatching egg flat through the chamber for a period of 4.5 min at a minimum UV intensity of 18mW/cm². Between two trials, a total of 60,000 brown-shelled, broiler chicken eggs were either treated with ultraviolet light (30,000) or used as controls (30,000). Prior to placement in incubators on day 0 and 18, selected egg flat weights were taken in order to determine egg weight loss during incubation. On day 18, candling of all eggs was performed and all infertile eggs as well as those containing dead embryos were removed. Those with dead embryos were broken-out for microbial sampling. Each egg was submerged in an iodine solution for one minute, aseptically removed and broken-out into a sterile petri dish. Sterile cotton swabs were used to sample the egg contents and streak inoculate Eosin Methylene Blue (EMB) agar and Blood agar plates. Plates were incubated for 24 hrs at 37°C and then examined for countable viable colonies. Additionally, on day 21, hatch residue and meconium samples were taken as an indicator of chick gut microflora. Improvement on hatchability was not conclusively shown. There was an approximate 20% reduction in the number of contaminated chicks within the treated group.

Key Words: UV Light, Sanitation, Hatching Eggs


Previous research has shown that alkaline hydroxides can be used as a preservation method for on farm storage of broiler mortalities. This method creates two by-products, the first is an alkaline poultry by-product meal (APBPM), which can be used as a feed additive. The second is a residual alkaline effluent, which can be used as a soil amendment for acidic soils. In two trials APBPM was added to a balanced broiler starter diet at 0, 1, 3 and 5% for evaluation on the effect on broiler performance, organ morphology and body score strength. The first trial included 192 birds with three groups per treatment each containing 16 birds. The second trial included 160 birds also with three groups per treatment and 13 birds per pen. The feed conversion for the 5% treatment in the first trial was significantly higher compared to the control, 1% and 3% treatments. The feed consumption per bird for the first trial was significantly higher in the control compared to the 5% treatment. The birds were euthanized using cervical dislocation and
the liver, proventriculus, gizzard, heart, and tibias were removed. There were some significant differences with the heart, proventriculus, gizzard, and moisture of the tibias. The percentage of organ weight tended to be enlarged in the 5% treatment group compared to the control. The tibias were also tested for shear strength using a Lutron universal testing machine where no significant differences among the treatments were found. The residual alkaline effluent was applied in amounts of 0, 100, 200, 300, 400, 600, 800, and 1000 gallons per acre with four reps per treatment group each year for two years. The study was harvested three times in 1999 and four times in 2000 and the dry matter yield per acre was evaluated. There were significant differences in the forage potassium and nitrogen concentrations among the plots with only slight differences in the phosphorus concentrations. This data indicates that APBP util-
ized in commercial broiler diets at 5% decreases feed intake and increases feed conversion efficiency and can show enlargements of internal organs and the residual alkaline effluent will increase the potassium and nitrogen levels on the forage if applied to soils.

Key Words: Mortality, Alkaline, Preservation, By- Product, Broiler

52 Different effects of carbon dioxide and oxygen concentration on perinatal chick viability. B. D. Fairchild*, M. J. Wineland, V. L. Christensen, and W. E. Donaldson, NC State University, Raleigh, NC USA.

Genetic selection of broilers may have created perilous conditions for embryos due to atmospheric CO₂ and O₂ concentrations. Three experi-
ments examined the effects of incubator pCO₂ and pO₂ during hatch on broiler breeder eggs. In Experiment 1, eggs were assigned to 124, 153 or 168 (mm Hg) pCO₂. In Experiment 2, eggs were assigned to 0.7, 2.2 or 5.1 (mm Hg) pCO₂ and in Experiment 3 the interaction of O₂ and CO₂ was tested by assigning eggs to a 2x2 factorial arrangement with two levels of O₂ (168 pCO₂ and 124 pO₂) and two levels of CO₂ (5.1 pCO₂ and 0.7 pCO₂). At external pipping and hatching plasma was collected. Body weights with and without yolk, heart and liver weights were recorded. Plasma glucose and heart and liver glycogen were measured. Data were sub-
jected to analysis of variance. In Experiment 3 troponin T measured heart damage. The frequency of elevated troponin T was analyzed by chi-square. Chick embryos in the 124 and 153 pO₂ treatments catalyzed more hepatic glycogen at hatching than chicks in 168 pO₂. Plasma glu-
cose was significantly elevated in 168 pO₂ when compared to the other treatments. Heart, liver nor yolk weights were effected by CO₂ in Exper-
iment 1. Stage of development and CO₂ interacted to affect cardiac and hepatic glycogen. In both tissues more glycogen was utilized between pip-
ing and hatching in 5.1 pCO₂ where 0.7 pCO₂ utilized the least amount. Plasma glucose was not affected by CO₂ treatments. In Experiment 3 O₂ and CO₂ interacted to affect residual yolk weights and plasma glucose. All other organ variables replicated results of Experiments 1 and 2. Troponin T indicated less heart damage in the 168 pO₂ treatment than 153 or 124 pO₂, but some damage occurred at 168 pO₂. In conclu-
sion, O₂ concentrations had more impact on the chick cardiac physiology than CO₂ concentrations, which may be precursory to asciites. This fact coupled with changes in incubator design and management warrants the reevaluation of the effects of CO₂ and O₂ on broiler chick physiology.

Key Words: Oxygen, Carbon Dioxide, Embryo, Incubation

53 Female broiler breeder livability and egg production is improved by presence of AstroTurf™ during rearing. B. A. Lenfesty*, S. D. Peak, and J. Brake, North Carolina State University, Raleigh, NC USA.

Two experiments were conducted to expose boiler breeder pullets to large pieces of gray AstroTurf™ nest pad material during the growing period prior to photostimulation. The intent of the work was to investigate if exposing the pullets to the nest pad material during rearing would influence the laying habits of the pullets after sexual maturity consistent with a theory that the color of the nest pad material that is preferred by broiler breeders during lay is influenced positively by the colors present in the growing environment. A flock of Ross 308, non-sexed, were reared (Experiment 1) in groups of 200 females in 12’ x 36’ pens with one 3’ x 6’ piece of gray AstroTurf™ nest pad material in half of the 12 pens. A flock of Arbor Acres FSY females were reared (Experiment 2) in groups of 65 females in 10’ x 16’ pens with one 3’ x 3’ piece of gray AstroTurf™ nest pad material in half of the 16 pens. The pullets were photostimulated and mixed with separately reared males at 21 weeks of age. Eggs collected were increased by 9.0 eggs and 4.1 eggs per hen housed in Experiments 1 and 2, respectively. Female mortality was de-
creased by 4.8% and 3.7% in Experiments 1 and 2, respectively. These data suggest a positive effect of the “training” and “behavioral enrich-
ment” during rearing on both egg production and female livability. We could not find an effect on the incidence of floor and slat eggs, however, these eggs could have been missed in our typical twice per day collection regime. We do not think that there was any real effect on rate of lay as some eggs may have just been left ungathered, lost, or eaten. Neverthe-
less, the beneficial effect on numbers of collected eggs was similar for the two experiments.

Key Words: Broiler Breeders, AstroTurf™, Egg Production, Livability

54 The Nutrient Content of Mississippi Broiler Litter. R. L. Todd* and T. N. Chamblee, Mississippi State University.

Litter samples were collected from Mississippi broiler companies. The litter samples ranged in age from 1 to 28 flocks based on the number of flocks produced. The samples were analyzed for moisture, nitrogen, phos-
phate and potash and nutrient concentration was expressed as pounds of nutrient per ton of litter. On an as-is basis, nitrogen levels increased significantly in litter from 1 through 5 flocks of age, but remained rela-
tively constant in litter from 6 through 28 flocks of age. Phosphate levels increased significantly in litter from 1 through 3 flocks of age, with no significant difference observed in litter older than 3 flocks of age. Potash levels increased significantly in litter from 1 through 4 flocks of age with, no significant differences observed in litter from 4 through 21 flocks of age. However, there was an unexplained increase in potash in litter from 21 through 28 flocks. There were significant differences observed among the samples on an as-is basis in nitrogen, phosphate and potash lev-
els in the litter. Litter moisture levels varied from 18% to 22%. On a dry matter basis, nitrogen levels increased significantly in litter from 1 through 5 flocks of age, but remained constant in litter from 6 through 25 flocks of age. An increase in litter nitrogen was noted in litter that had produced 28 flocks. Phosphate levels increased in litter from 1 through 5 flocks of age, with no significant increase in litter phosphate from 6 through 28 flocks of age. Potash levels increased significantly in litter from 1 through 6 flocks of age, and remained constant thereafter. Sig-
nificant differences were observed among the companies on a dry matter basis in nitrogen, phosphate and potash levels in litter. These data will be valuable to Mississippi broiler producers for calculating application rates when utilizing litter as fertilizer.

Key Words: Broiler litter, Nitrogen, Phosphate, Potash


Darkling beetles or the lesser meal worm have been implicated in the spread of diseases in commercial poultry as well as in the destruction of poultry facilities. Unfortunately, beetles have developed resistance against many of the commonly used insecticides and in addition, many of the commonly used insecticides have a reduced efficacy when exposed to high pH levels as might be found in used poultry litter. An evaluation was conducted to determine if blending a commonly used insecticide, cyfluthrin, with a product called Ultra Litter Treatment, would result in an improvement in the effectiveness of the insecticide against dark-
ling beetles. The insecticide and ULT combination was applied to twelve pens of new kiln dried pine shavings and twelve pens of untreated shav-
ing served as the control. Day old broiler chicks were placed in the pens and grown to 56 days of age. A second application of the insecticide and ULT were then reapplied to the same pens and a second flock of birds was reared to 56 days of age. Beetle counts were determined on a weekly basis for each flock. A one-half pound sample of litter was taken from each pen and adult and larvae beetle counts were determined. For the pens treated with insecticide and ULT, adult and larvae beetle counts were zero for the life of both flocks. For the untreated pens, adult and larvae beetle counts steadily increased and remained above two hundred for the half pound litter sample. In a third trial, the insecticide was applied alone and in combination with the ULT to each of twelve pens of kiln dried pine shavings which had supported one flock of birds. Twelve untreated pens served as the control. In this trial, the ULT and insecticide combination provided the greatest control against the darkling beetles.

Key Words: Darkling beetles, Insecticides, Poultry litter
56 The Sensitivity of Two Selected Strains of Cocciidia to Monensin. V.G. Stanley*1, 1Prairie View A&M University.

The objective of the study was to evaluate the sensitivity of two selected strains of coccidia (Eimeria tenella and Eimeria maxima) to dietary inclusion of monensin. One hundred and fifty-day-old broiler chicks were separated into treatment groups and fed diets supplemented with monensin (0; 340.5 g/kg). The chicks were challenged by crop gavage with 106 Salmonella typhimurium (ST). One day later, the chicks were killed for ST cfu enumeration in the crop and cecal. Broilers provided chlorate 24 hours prior to slaughter were found to consume slightly more chlorate-water than broilers provided distilled water. Treatment with chlorate caused a significant decrease (P < 0.05) in the incidence of ST in crop contents (22%) as compared to the controls (96%). Similarly, chlorate treatment (0.80 Log10 ST /g cecal content) caused a significant decrease (P < 0.05) in the number of ST detected in the ceca compared to the controls (3.06 Log10 ST). This study suggests that incorporation of chlorate in the drinking water 24 hours prior to slaughter can reduce Salmonella contamination in broilers.

Key Words: Chlorate, Ceca, Salmonella


The crop is a known source of Salmonella and Campylobacter contamination. Previously, we evaluated lactic acid in the drinking water during a simulated pre-transport feed withdrawal (FW) and reported 40.4% lactic acid significantly (P < 0.05) reduced the number of Salmonella recovered in market-age broiler crops. However, total consumption of the organic acid-treated drinking water was reduced. Presently, we evaluated the effect of sodium chlorate (15-30 mM) during an 8 hour pre-transport FW. Market-age broilers were obtained from a commercial processing plant and randomly assigned to chlorate-treated or control (non-treated) groups. Immediately upon arrival and 1 day prior to termination of the experiment, the birds were challenged by crop gavage with 106 Salmonella typhimurium (ST). One day later, the birds were killed for ST cfu enumeration in the crop and cecal. Broilers provided chlorate 24 hours prior to slaughter were found to consume slightly more chlorate-water than broilers provided distilled water. Treatment with chlorate caused a significant decrease (P < 0.05) in the incidence of ST in crop contents (22%) as compared to the controls (96%). Similarly, chlorate treatment (0.80 Log10 ST /g cecal content) caused a significant decrease (P < 0.05) in the number of ST detected in the ceca compared to the controls (3.06 Log10 ST). This study suggests that incorporation of chlorate in the drinking water 24 hours prior to slaughter can reduce Salmonella contamination in broilers.

Key Words: Chlorate , Ceca, Salmonella

58 LitterPlus as a bedding material for broilers. James L. McNaughton* and Michael S. Roberts, Solution BioSciences, Salisbury, MD/USA.

LitterPlus (LP) is a bedding for farm animals produced from recycled wood pellets through grinding and processing systems. Three experiments were conducted to determine the effectiveness of LP as a litter source. In Experiment 1, in vitro moisture uptake of LP was 1.29, 3.68, 4.18, and 5.26 times greater for LP as compared to kiln-dried shavings (KDL), Delmarva litter source (DML), sawdust (SDL), and rice hulls (RHL), respectively. Fresh new litter sources were placed at hatch at a depth of 4 in pens containing 80 birds, replicated 8 times, and reared to simulate full house brooding. After rearing broilers on LP for 6 weeks, litter moisture at 1 depth was about 8% less than other litter. Litter ammonia, bacteria and fungi counts were found to be approximately 10%, 20%, and 40% less for LP as compared to KDL, DML, SDL, and RHL, respectively. Experiment 2 was conducted to determine the effect of litter source and color on litter. Litter consumption at 14 and 21 days of age post-hatch. Litter consumption on 7th day was less to greater for litter colored black, green, white and red as measured by gizzard litter appearance. Birds reared on litter colored white and red had particularly noticeably greater gizzard litter. No significant differences were found for days 14 and 21. Experiment 3 was conducted to determine the effects of litter depth when broilers were reared under either full house or 33% partial house brooding techniques for a 49-day period. Prior to litter placement at hatch, fresh new litter sources (LP, DML, and RHL) were placed at a depth of 1”, 2”, or 4” in experimental pens containing 80 birds, replicated 8 times, and reared to simulate either full house or 33% partial house brooding technique. Broiler live performance (body weight, feed conversion and body weight consistency) was significantly improved (P<0.05) at 49 days of age with the use of LP at a depth of 1” when broilers were reared under partial house brooding as compared to other treatments and litter depths. Litter appeared to cake less when LP was used at a depth of 1” as compared to other litter sources and litter depths. In conclusion, LP appeared to be an effective litter bed when used under a partial house brooding technique with a depth of 1-2”.

Key Words: Litter, LitterPlus, Broilers, Performance

59 Measuring Air Filtration in a Tunnel Ventilated Broiler House. J. D. Simmons1, B. D. Lott1, and T. E. Hannigan2, 1USDA, Agricultural Research Service, South Central Poultry Research Unit, 2Department of Aerospace Engineering, Mississippi State University.

In the poultry industry, tunnel ventilation has become common place in broiler houses. Among the many reasons that this configuration was conceived was the desire for complete control over the air flow in the house. However, because during normal operation the entire inside space of the house is under negative pressure, there is unwanted air infiltration. During hot summer days, infiltration air does not pass through evaporative cooling pads and therefore, adds unconditioned air to the interior of the house. In smaller structures there are simple techniques for measuring infiltration, but no procedures exist for the huge volumes of modern broiler houses. Using a unique air volume measuring device, the USDA-ARS Poultry Research Unit measured the infiltration in a commercial tunnel ventilated broiler house. Tests were done both with and without the use of an overlapping top flap located at the uppermost travel of the side curtain. Results revealed that during normal operation infiltration amounted to 7.7% of total flow without the use of the top flap and 4.6% when the top flap was employed.

Key Words: broilers, ventilation, tunnel house air flow, FANS

60 High Cyclic Temperatures with Differing Air Velocities: The Effect on Performance of Male Broilers. B. D. Lott*, J. D. Simmons1, J. D. May1, S. L. Branton1, and D. M. Miles1, 1USDA, Agricultural Research Service, South Central Poultry Research Unit.

Previous research at this laboratory investigated the effect of air velocities of 120 and 180 m/min as compared with still air on body weight gain and feed conversion at moderate cyclic temperatures. The present studies at high cyclic temperatures were conducted in 2 trials with 742 male broilers per trial. Broilers were reared in a common environment with normal brooding practices and fed a basal diet through 3 wk of age. Two wind tunnels with 4 pens per tunnel were located inside an environmentally controlled house. Air velocities of 120 or 180 m/min were used. Six conventional floor pens in the same house were used for still air controls (<15 m/min). Each pen was stocked with 53 3-wk old birds. The temperature was a diurnal cycle of 24-35-24 C with a constant 21 C dewpoint. The experimental period in the tunnels was 4 weeks. Body weight and feed consumption data were collected weekly. No significant improvement in body weight gain at 180 m/min versus 120 m/min air velocity was observed for the first 7 d in the wind tunnel. However, weight gains were significantly greater in both air velocities as compared with still air. Significant improvements in body weight gain and feed conversions with an air velocity of 180 m/min as compared with 120 m/min for the 7-14 d period continued throughout the experiment. Performance data for the birds in still air was significantly reduced at all weekly intervals.

Key Words: body weight, feed conversion, mortality, tunnel
Effect of Stocking Density on Broiler Performance Using Sand and Wood Shavings as Broiler Bedding Material. D. M. Miles1, B. D. Lott1, J. D. May1, J. D. Simmons1, and S. L. Branton1, 1USDA, Agricultural Research Service, South Central Poultry Research Unit.

Heightened awareness regarding broiler litter utilization has prompted much research activity in source management as well as continued interest in agronomic management practices. Sand is emerging as a popular bedding material alternative to wood shavings. Lengthening the time to full house clean out is the driving force for using sand. This research objective was to determine the effect of stocking density on bird performance for the two litter materials. Two trials were conducted using 16 pens of broilers reared on sand at a depth of 0.2 cm (4) and half with a 10.2 cm depth of washed mortar sand. Male broilers were stocked in the 5.42 m² (58.3ft²) pens at 604 and 883 cm²/bird (0.65 and 0.95 ft²/bird). Other sand litter research has shown that body weights are higher for broilers reared on sand and that there are no other significant influences on broiler performance. Body weight gains in these trials were also greater for birds on sand. Livabilities were consistently best on the shavings at the lowest stocking density. Feed conversion for the 42 to 49 d period was significantly greater for the birds on wood shavings.

Key Words: litter, stocking density, sand, bedding, broiler

Development of a Phosphorus Index for Pastures Fertilized with Poultry Manure. P.A. Moore1, T.B. DeLaune2, T.C. Daniel2, D.C. Carmans2, and A.N. Sharples2, 1USDA/ARS, 2University of Arkansas.

Phosphorus (P) runoff from agricultural lands fertilized with animal manure is believed to play an important role in eutrophication. Many state and federal agencies are assuming that high soil test P levels are causing high levels of P in runoff, however, recent research indicates that this is not the case. The objective of this study was to develop a Phosphorus Index (PI) for pasture systems fertilized with animal manure, such as chicken litter. Rainfall simulators were used to produce 5 cm/hr storms on small plots cropped to tall fescue to determine the effect of multiple variables on P runoff. The variables tested included: 1) soil test P; 2) soluble P in poultry litter; 3) P contents of poultry diets (normal diets, phytase, HAP, CAF, HAP + phytase); 4) fertilizer type (manure versus commercial fertilizer); 5) poultry litter application rate; and 6) application timing on P runoff. The results of this research showed that P applications (as manure or triple superphosphate) were much more important in regulating P runoff that soil test P. Commercial P fertilizer resulted in significantly higher P runoff than poultry litter applications when applied at the same rate of P. Phosphorus concentrations in runoff were most affected by soluble P content in the fertilizer source. Multiple regression was used to analyze the data and determine the relative importance of each variable (by modeling P loads with the various parameters studied). Validation studies showed that this index predicted P loads in runoff from pastures fertilized with poultry litter much better than soil test P alone.

Key Words: Water Quality, Animal Manure, Phosphorus, Runoff, Eutrophication

Use of AstroTurf® in the broiler breeder scratch area. J. Brake1, and S. D. Peak, North Carolina State University, Raleigh, NC USA.

The efficacy of AstroTurf® as a litter material in the scratch area of 2/3 slat, 1/3 litter broiler breeder pens was evaluated in two production experiments. In Experiment 1, conventional pine shavings were compared to textured wheat color AstroTurf®, textured gray color AstroTurf®, and non-textured gray color AstroTurf®. The percentage floor eggs was significantly reduced with all the AstroTurf® treatments but female mortality was significantly higher in the two gray AstroTurf® treatments. Total egg production was comparable. Fertility and fertile hatchability were not significantly different. A second experiment was conducted to clarify issues related to color and texture treatments on fertility and mortality. In the second experiment, gray and wheat textured and non-textured AstroTurf® were directly compared. In this experiment, the birds came into production in very hot weather that necessitated feed restriction to limit mortality. Generally, through 60 weeks, the gray color was related to fewer floor eggs in comparison to the wheat color. Male mortality was equivalent by color but the presence of texture reduced male mortality. The females produced a similar pattern of mortality with the textured floors exhibiting lower mortality than the non-textured floors. Fertility and fertile hatchability were not significantly different between treatments. Taken together, these data show that AstroTurf® can be used as the sole bedding in the broiler breeder scratch area. Texturing of the blades produced beneficial effects on livability.

Key Words: Broiler Breeders, AstroTurf®, Egg Production, Mating Area

Influence of Carbon Dioxide On Viability of Salmonella Enteritidis In Different Egg Components at Temperature Abused Conditions. Joshua Gutler* and Dr. Don Conner, Auburn University, Auburn, AL 36849.

Cryogenic cooling of shell eggs with CO₂ has been shown to increase CO₂ content and reduce Salmonella Enteritidis (SE) levels in eggs. A preliminary study was undertaken to determine the effects of elevated CO₂ levels on the viability of SE in different egg components at various temperature abused conditions. Freshly laid eggs from single-combed white leghorns were disinfected and aseptically opened to collect egg contents. Four experimental media representing different combinations of yolk and albumen were prepared: whole egg (WE), yolk only (Y), albumen only (A), and 99 parts albumen to one part yolk (99A:1Y, vol:vol). Each medium was placed (100 mL) into sterile flasks and inoculated to ca. 10⁷ cfu/mL with SE. Media were subjected to one of three atmospheric treatments with aerobic, flushed with CO₂ and sealed, or continuously bubbled with CO₂. Flasks were incubated at 10 C, 23 C or 37 C for 4 days, 48 hours, and 24 hours, respectively. At comparable intervals, samples were obtained from each flask and analyzed to enumerate SE. In WE bubbled with CO₂, SE levels were lower than aerobically stored WE in all three temperature treatments by 0.5, 0.75 and 2.30 log cfu/ml, respectively. In WE flushed with CO₂, stored at 23 C and 37 C, SE levels were 0.7 and 3.8 log cfu/ml lower than WE aerobically stored. Y held at 10 C and bubbled or flushed with CO₂ was 1.8 and 1.9 log cfu/ml lower than Y aerobically stored, respectively. At all temperatures and CO₂ treatments for 99A:1Y, vol:vol and A, SE levels were greater than for those held aerobically. This may be attributed to the inactivation of albumen by CO₂. This factor would be insignificant, however, in high yolk containing media commonly used in retail food processing. Data suggest that elevated CO₂ content within shell eggs may account, in part, for the inactivation of SE that occurs with CO₂ cryogenic cooling.

Key Words: Salmonella Enteritidis, eggs, carbon dioxide

Effects of F-Strain Mycoplasma Gallisepticum on Serum Lipids and Lipoprotein Profiles in Commercial Laying Hens. M.R. Burnham1, S.L. Branton2, E.D. Peebles1, R.L. Walzem1, S.K. Whiteman1, and P.D. Gerard1, 1Mississippi State University, Mississippi, MS, 2University of Arkansas, SCPRL, Mississippi State, MS, 3Texas A&M University, College Station, TX.

The effects of F-strain Mycoplasma gallisepticum (FMG) on serum lipids and lipoprotein profiles in commercial laying hens were investigated from 16 to 60 wk of age (40 wk of lay). Ten hens were assigned to each of sixteen negative pressure biological isolation units. Birds in eight units served as uninoculated controls and those in eight other units were inoculated with FMG at 12 wk of age. Blood samples were collected every 4 to 6 wk from four tagged birds within each unit. Variables determined included serum VLDL particle diameter distributions (10th, 50th, and 90th population percentiles), %VLDL, %IDL, %HDL, %CHL, ST, SC, and TP. At 16, 24, 28, 34, 40, and 46 wk, hematocrit was lower in FMG-treated hens. These data suggest that changes in egg production in response to FMG infection in commercial layers, as noted in a previous report, is not due to changes in sediment lipids and lipoprotein profiles. However, the birds in this study were not subjected to handling stress to the extent as in the previous report, which suggests that degree of stress in laying hens infected with FMG influences performance.

Key Words: Mycoplasma gallisepticum, Lipoproteins, Cholesterol, Triglycerides, Laying hens
66 Effects of an Immunomodulator and Phasic Challenges of S6 Strain Mycoplasma Gallicippticum and Escherichia coli on Egg Production and Egg Characteristics in Commercial Laying Hens During Peak and Post-Peak Lay. M.S. Jones, 1, E.D. Peebles, 1, S.L. Branton, 2, K.O. Willeford, 1, T. Pharr, 3, R. Montgomery, 1, T.A. Parker, 1, S. Whitmarsh, 1, and W. Maslin, 1 1Mississippi State University, Mississippi State, MS, 2USDA ARS SCPRL, Mississippi State, MS, 3College of Veterinary Medicine, Mississippi State, MS.

The effects of S6 strain Mycoplasma gallicippticum (MG) challenge and dual challenges of MG and Escherichia coli (serotype O-35) with or without an immunomodulator (derived from caprine serum) on egg production and egg characteristics in commercial laying hens was investigated from 29 to 50 wk of age. Ten hens were randomly assigned to each of 16 negative pressure biological isolation units. Four treatment groups consisted of: negative control, pre-lay challenge with MG (10 wk), dual challenge with MG (20 wk) and E. coli (22 wk), and Caprine Serum Fraction Immunomodulator 2 (CSF-12) treatment in conjunction with dual challenges of MG (20 wk) and E. coli (22 wk). CSF-12 was administered on Days 0 and 5 relative to challenge. Weekly means for egg production (EP), egg weight (EW), Haugh units (HU), incidences of shell pimpling and egg blood/meat spots, and eggshell breaking strength were compared. Mean BW, eggshell weight per unit surface area (SWUSA), and percentages of yolk, albumen, and eggshell weight were compared monthly. None of the variables examined were affected by treatment; however, BW, EP, EW, HU, percentage yolk, albumen, and eggshell weight, and eggshell breaking strength and pimpling were affected by bird age. The performance of commercial laying hens during peak and post-peak lay was not affected by individual challenge of MG or dual challenge of S6 strain MG or E. coli with or without a caprine serum immunomodulator.

Key Words: Caprine serum fraction immunomodulator 2, Escherichia coli, Egg production, Layers, Mycoplasma gallicippticum

67 Internal and External Components of Enterococcus faecalis as Caustive Agents of Pulmonary Hypertension Syndrome. J.D. Tankson 1, J.P. Thaxton 1, Y. Vizzier-Thaxton 1, and J.D. Wilbourn II 1 1Mississippi State University, Mississippi State, MS.

Previous studies have shown that within 48 h after injection of Enterococcus faecalis into broilers at a dose level of 3.6 x 10 9 , symptoms of pulmonary hypertension syndrome (PHS) occurred. When E. faecalis was subjected to autoclaving, freezing, or equal aliquots of chlorox, then injected into broilers, PHS again occurred within 48 h. These results indicated that either internal factors, which were not inactivated by the procedures, or external factors secreted into the bacterium's environment subsequent to the procedures, caused PHS. The objective of the present study was to determine if the factors were internal or external following autoclaving, freezing, or adding equal aliquots of chlorox. Two replicate trials were conducted. Twenty-five broilers were reared in each of 16 floor pens. At 5 wk of age, the following 16 treatments were administered by injecting 0.5 ml intra-abdominally (IA) into each broiler. The treatment inocula were: 1) E. faecalis grown in tryptic soy broth (TSB), 2) E. faecalis removed from its growth broth (TSB), and added to sterile TSB, 3) growth broth with E. faecalis removed, and 4) sterile TSB. Treatments 5-8, 9-12, and 13-16 were the same as Treatments 1-4, with the exception that Treatments 5-8 were frozen (~120 C for 1 h and then thawed), Treatments 9-12 were autoclaved, and Treatments 13-16 had equal aliquots of chlorox added prior to injection. At 48 h post-challenge, each bird was killed and BW, heart weight, right ventricular weight, and total ventricular weight were determined. The ratio of right ventricular weight to total ventricular weight was also calculated. As in previous studies, E. faecalis caused symptoms of PHS. It is probable that E. faecalis produced an endotoxic factor that can cause PHS.

Key Words: Enterococcus faecalis, Pulmonary hypertension syndrome, Endotoxins, Exotoxins

68 Freezing and Oocyst Numbers in Litter. J.D. Wilbourn, II 1, J.P. Thaxton 1, and J.D. Tankson 1 1Mississippi State University, Mississippi State, MS.

Coccidiosis is a disease caused by a microscopic protozoan named Eimeria. In chickens, nine species of Eimeria are pathogenic. Transmission of coccidiosis is through fecal material. Oocysts of Eimeria remain dormant in litter, yet capable of infecting birds, for years. In order to determine if a given litter contains oocysts, samples are collected, oocysts extracted and counted microscopically. Often litter samples are stored frozen before counts are made. The objective of this study was to determine if freezing oocysts affects oocyst numbers. Eight litter samples were collected from floor pens which contained pine shavings litter that had been built-up after five consecutive trials involving challenged broilers with E. tenella. Each sample was divided into five aliquots, each weighing 5 g. Oocyst numbers in aliquot 1 were determined the same day that litter collection occurred. Aliquots 2 and 4 had 50,000 sporulated E. tenella oocysts in 100 mL of tap water added. Aliquots 3 and 5 received 100 mL of water which did not contain oocysts. All five aliquots were then air dried and placed in a freezer (~20 C). After 24 h, aliquots 2 and 3 were removed from the freezer and oocyst numbers were determined. After 30 d in the freezer, aliquots 4 and 5 were removed and oocyst numbers were determined. Results indicated that freezing for 24 h and 30 d caused a marked decrease in oocyst numbers.

Key Words: Litter, Coccidiosis, Eimeria, Oocyst

69 Beak Lesions in Trypanophen-Deficient Chicks. A.D. Monroe, 1 K. S. Latimer, 2 G. M. Pestie, 2 and R. I. Bakali, 1 1Department of Poultry Science, University of Georgia, 2Department of Pathology, University of Georgia.

The purpose of this experiment was to determine if trypanophen deficiency was responsible for lesions developing around the nares of broilers. Day old broiler chicks (Ross X Ross 308) were placed in either floor pens with fresh pine shavings or in Petersime battery brooders. Broiler chicks from 0 to 21 days of age were fed control (0.24%) or deficient (0.09%) concentrations of trypanophen in diets based on corn, corn gluten meal, and gelatin. Separate groups of control chicks were pair-fed daily with the deficient chicks. Deficient chicks grew less efficiently than the pair-fed controls. Histologic samples were taken at 7, 14, and 21 days of age from deficient and pair-fed birds for microscopic examination. A lesion of the nares was observed in 0.065% control birds and 50% of deficient birds housed in the battery. The lesion was located along the upper portion of the beak between the nares and appeared as a crusty or scab-like area on gross examination. The crust was composed of detritus, heteropil, and plasma protein. Inflammation occasionally was observed at the dermoepidermal junction. A similar incidence of gross lesions in trypanophen deficient chicks in the battery and pens with different flooring and waterers suggests that mechanical injury does not appear to be a contributing factor in lesion development. However, the number of lesions seen grossly and histologically in trypanophen deficient birds, as compared to control birds, supports the concept that trypanophen deficiency is the primary cause of these lesions around the nares of broilers.

Key Words: Trypanophen, Broilers, Nares' lesion, Dermatitis, Deficiency

70 Effect of oral L-arginine administration on salmonella gallinarum organ invasion and mortality in neonatal broiler chicks. C.A. Ramirez, 1 N. Ledezma, 2 V. Petrone, 2 G. Tellez, 2 and T. W. Odom, 1 1Department of Poultry Science, Texas A&M University, College Station, TX 77843, 2Departamento de Produccion: Aves FMVZ, UNAM, Ciudad Universitaria, D.F. Mexico Coyoacan 04510.

We have previously reported that L-arginine (L-arg) administration results in significant reductions in salmonella organ (liver and spleen) invasion and increased nitric oxide synthesis in neonatal chicks. The purpose of these experiments was to evaluate the effect of L-arg against salmonella gallinarum (SG). In Experiment 1 (Exp1), 160 one-day-old broiler chicks were randomly assigned into 4 groups (n=40); control (0 mg L-arg/chick), 25, 50, and 75 mg L-arg/chick. All chicks were challenged with 1x10 6 cfu SG, 8 h after L-arg treatment. Chicks were euthanized 48 h after SG challenge and the organs aseptically collected, enriched (18 h), and streaked to determination SG infection. In Experiment 2 (Exp2), 160 one-day-old broiler chicks were randomly assigned into 2 groups (n=80); control and 50 mg L-arg/chick. Chicks were challenged with 1x10 6 cfu SG in a similar fashion as Exp1. Forty-eight hours after SG challenge, 40 chicks from each group were euthanized and the organs cultured, enriched and streaked for SG in a similar fashion to Exp1. The remaining chicks were held for 10 d to determine SG related mortality. In Exp1, administration of 50 and 75 mg L-arg lead to significant (p<0.05) reductions in SG organ invasion compared to controls (50% and 48% vs 88%, respectively), while 25 mg L-arg did not result in significant changes compared to controls (78% vs 88%, respectively). In Exp2, administration of
50 mg L-arg lead to significant (p≤0.05) reductions in SG organ invasion (48% vs 85%) and significantly (p≤0.05) lower mortality compared to controls (20% vs 50%). These results parallel those previously observed in our laboratory and indicate that L-arg may have some efficacy as an antimicrobial agent.

Key Words: Broilers, L-arginine, Salmonella, Nitric oxide

71 Evaluation of an Early Granulocytic Response in Specific Pathogen-Free Embryos Inoculated in Ovo with the Herpes Virus Turkey Strain. V.M. Petrone1, G. Tezè1, M. Escorcia1, T. Fehervari1, and X Hernandez2, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

The evaluation of an early granulocytic response in specific pathogen-free embryos inoculated in ovo with the herpes virus turkey strain was performed. The cell associated HVT commercial strain vaccine used to evade Mareks disease with a titre of 6,180 PFU/dose was as an antigen to evaluate the granulocytic response when applied at 10 days of embryonic development. Fifty specific pathogen-free embryos of 10 days were used. Embryos were randomly divided into 2 groups of 10 embryos each and inoculated via yolk sac on day 10 of incubation, as follows: Group I. Embryos inoculated with a complete dose of 200ml of HVT. Group II. Embryos inoculated with 200ml of vaccine diluent. Samples of yolk sac, liver, corioalantoid membrane, brain and heart were taken from 5 embryos of each group on days 12, 14, 16, 18 and 20 of embryonic development. Embryos were applied the euthanasia and were fixed with pins to a paraffin plate, and the necropsy was made with a magnifying glass to remove the needed organs. Organ samples were fixed in 10% formalin, buffered to pH 7.4 and processed with the routine technique for paraffin sections and stained with hematoxin and eosin. Histological evaluation included: Yolk sac, liver, corioalantoid membrane, brain and heart. The presence of granulocytes in these organs was evaluated. There were a significant increased in the number of granulocytes in the group of embryos that received the HVT as compared with the control groups (P<0.05) at 14 and 16 days of embryonic development in the yolk sac and at 14 and 20 days in the liver. In the corioalantoid membrane inoculated with HVT there was hyperplasia of the endoderm and ectoderm epithelia with a granulocytic infiltrate. There were no significant changes in heart or brain between the two groups. Results of the present study suggest that the application of antigens, such as HVT on day 10 of embryonic development, increments granulocytopenosis in lymphoid organs such as the liver and yolk sac.

Key Words: chicken embryos, granulocytes, herpesvirus, histopathology, Polymorphonuclear granulocyte


Three experiments were conducted to evaluate the safety of the anticoccidial feed additive Cocci-Guard in broiler chickens. In experiment 1, birds were reared in floor pens under commercial conditions for 42 days and received 0, 500 ppm(1X)(the recommended level of Cocci-Guard), 1500 ppm(3X) or 5000 ppm(10X). The dose of Cocci-Guard had no effects on mortality, weight gain or feed conversion. Histopathology examination of the livers of these birds found no negative effects associated with dose of the product. In experiment 2, the effects of elevated environmental temperature (29°C) on mortality and performance were evaluated in a 21 day starter study, comparing Cocci-Guard, Nicarbazine and a combination of Nicarbazine and Narasin. Cocci-Guard had no negative effects on morality or performance, while both nicarbazine diets depressed performance. In experiment 3, the effects of over dosing of anticoccidials were evaluated in floor pen birds fed for 42 days under commercial conditions. Cocci-Guard had no negative effects on mortality or performance at 2X (1000 ppm) the recommended level, while Salinomycin, Monensin and Maduramicin severely depressed weight gains (29, -18, -18%, respectively) and feed conversion (+28, +15, +21%, respectively). Cocci-Guard demonstrated a high margin of safety and is not affected by high environmental temperatures.

Key Words: Cocci-Guard, Safety, Nicarbazine, Ionophores

73 Effect of Mycoplasma gallinarum on Selected Production Parameters of Layer Chickens. S. L. Branton1, B. D. Lott1, J. D. Simmons1, S. M. D. Pearson2, S. D. Collier1, and G. T. Pharr2, 1USDA, Agricultural Research Service, South Central Poultry Research Unit, 2College of Veterinary Medicine, Mississippi State University.

Three trials were conducted in which 10-week-old layer chicks were eye-drop inoculated with brood cultures of Mycoplasma gallinarum and maintained in biological isolation units through 60 weeks of age. Within each trial, egg production was recorded daily, and egg weight was determined for four days of each week throughout the trials. For each 28-day period, hen weight, egg size distribution, and feed consumption per dozen eggs were determined. No significant difference (P<0.05) was observed between the treatments for average hen day egg production across the three trials. No significant differences were observed for any of the nine test intervals for average hen or egg weight. No significant differences were noted for egg size distribution.

Key Words: poultry, eggs, mycoplasma, weight, feed

74 Development of an inhibitory absorbent cellulose gum tray pad for reducing spoilage microorganisms and the risk of cross-contamination. Brian W. Sheldon1, North Carolina State University, Raleigh, NC USA.

One aspect of the farm to table HACCP program that has been neglected to some degree is the control of bacterial pathogens and spoilage microorganisms on poultry and red meat products throughout distribution and marketing, especially at the retail and food service level. In response to this problem, the objective of our research was to develop a new generation of absorbent tray pads containing a cellulose gum and bacterial inhibitors effective against pathogens and spoilage microorganisms residing in the drip loss from fresh poultry products and other food commodities.

For each trial, the treated (dry and wet blended) cellulose gum tray pads containing varying concentrations of the bacteriocin, nisin, or sodium lactate and other inhibitory components were challenged with the fluid exudate recovered from a commercial absorbent paper tray pad taken from a tray pack of cut-up chicken and the inoculated pads incubated at 4C for 0.5 to 168 hours. Triplicate pad samples were taken at 0.5, 24, 96, 168, and 206 hours and the population of surviving bacteria (mesophiles and psychrotrophs) enumerated using standard recovery and plating procedures. In one trial where the inhibitors were added by dry blending, the range of bacterial inhibition in comparison to the non-treated control gums was 0.97 logs at 0.5 hours of exposure to 4.23 logs after 168 hours. Similar levels of inhibition were also observed after storing the treated pads for 37 days at 4C and then introducing the bacterial challenge. In two other trials, the effect of these treated pads on extending the refrigerated shelf life of fresh skinless, boneless breast fillets packaged under a modified atmosphere was examined. The breast fillet shelf life of those samples stored with the treated pads was extended from 2 to 6 days beyond the control of the non-treated control samples. These findings clearly demonstrated the positive impact of employing the treated cellulose gum pads to inhibit the spoilage microflora in poultry product exudates and extend product shelf life.

Key Words: Absorbent Tray Pad, Cellulose Gum, Spoilage Microorganisms, Shelf Life, Poultry Products

75 Tissue culture plate enrichment method for recovery of Campylobacter spp. from broiler carcass rinses. M.T. Musgrove1, N.A. Cox1, N.J. Stern1, M.E. Berrang1, and M.A. Harrison2, 1United States Department of Agriculture, Agricultural Research Service, 2Food Sci and Tech., University of Georgia.

Efficient and reliable methods for the recovery of Campylobacter spp. from poultry samples are needed. Direct plating of broiler rinses is frequently sufficient for identifying contaminated carcasses, particularly if samples are collected at the plant and quickly analyzed. However, immediate sampling is not always possible. Selective enrichment is often used in conjunction with plating to recover injured cells or to increase numbers of bacteria when samples with a level of contamination below the detection limit for direct plating are being surveyed. As they exited the chill tank, 500 broiler carcasses were rinsed in 100 ml of sterile water for 1 min. Within 48 h of collection, rinses were transported back to the laboratory. Each sample was directly plated onto Campy-cfelx agar which was incubated in microaerobic atmosphere (5% O2 10% CO2 85% N2) at 42°C for 24-36 h. In addition, a 0.1 ml aliquot of each rinse was
added to 1 ml of Bolton broth in a 24 well tissue culture plate well and incubated for 36 h at 42°C in microaerobic atmosphere before plating on Campy-Cefex agar. Presumptive colonies were confirmed by wet mount observation and latex agglutination tests. By direct plating, 340 (75.4%) of the samples were Campylobacter spp. positive while enrichment recovered 386 positive samples (77.2%). This sampling modification allowed for increased recovery with less expense and effort than required by a traditional protocol.

Key Words: Campylobacter, Carcass rinse, Bolton enrichment, Campy-Cefex


Numbers of Campylobacter recovered from whole carcass rinse samples typically increase after broilers are defeathered. This study was designed to test the possibility that escape of feces from the cloaca during picking could cause an increase in numbers of Campylobacter recovered from breast skin. Forty broilers from a flock determined to be Campylobacter negative by fecal sampling were processed in a pilot plant. After exsanguination, while hanging in shackles, each carcass was intra-cloacally inoculated with 10^4 cfu Campylobacter suspended in PBS in a gelatin capsule, and then scalded at 56°C for two minutes. Breast skin along the sternal feather tracts of each carcass was sampled by sponge after scalding and again after passing through a single pass commercial picker. Campylobacter was enumerated by direct plating from the moistened sponges on Campy-Cefex agar. Prior to defeathering, none of the 40 sponge samples were positive for Campylobacter. After passing through the picker, 27 of 40 sponge samples from the same area of the breast were positive for Campylobacter with an average of log10 2.8 cfu per sample. In order to compare these results to those found with birds naturally colonized, Campylobacter positive flock were processed in a pilot plant. Breast skin, along the sternal feather tracts, was sampled by sponge before and after passing through a commercial style picker. Prior to defeathering (after scalding), none of the forty sponge samples were positive for Campylobacter. After passing through the picker, 35 of 40 sponge samples from the same area of the breast were positive for Campylobacter with an average of log10 3.4 cfu per sample. These results suggest that some of the increase in Campylobacter numbers recovered from breast skin after defeathering may originate with feces expressed from the cloaca during picking.

Key Words: Campylobacter, Defeathering, Feces, Processing, Broilers

77 Visible ingesta on pre-chill carcasses do not affect the microbiological quality of broiler carcasses after immersion chilling. S. F. Bilgili*1, A. L. Waldroup2, D. Zelenka3, and J. E. Marion3, 1 Auburn University, 2 University of Arkansas, 3 Tyson Foods, Inc., 4 National Chicken Council.

Recently, a number of food safety initiatives have been implemented in poultry processing plants to assure product safety. The "zero tolerance" for visible fecal contamination on pre-chill carcasses is a regulatory performance standard, currently mandated by the USDA to maintain the microbiological quality of carcasses during immersion chilling. In this study, microbiological quality of broiler carcasses, with or without visible ingesta contamination, were compared both at pre- and post-immersion chilling sites to evaluate the scientific basis of a potentially similar standard for visible ingesta contamination. A total of 1,080 carcasses, with or without visible ingesta contamination, were microbiologically assessed in seven commercial processing plants over a 4 day sampling period, both at pre- and post-immersion chilling sites (40 carcasses per site/sampling day/plant). 20 carcasses each with and without visible ingesta contamination were sampled from each plant. Whole carcasses were sampled, rinsed, and plated for aerobic bacteria (APC), E. coli, and Campylobacter counts (CFU/ml), and incidence of Salmonella based on USDA approved procedures. Count data was transformed prior to analysis. Salmonella incidence data was analyzed by contingency tests. Microbial load on pre- and post-chill carcasses differed significantly (P<0.05) among the processing plants participated in this study. However, there were no statistical differences in microbial counts between the carcasses with or without visible ingesta contamination both at pre- and post-chill sampling sites. In all plants, APC (400 vs. 80 CFU/ml), E. coli (280 vs. 20 CFU/ml), and Campylobacter (185 vs. 20 cfu/ml) counts and Salmonella incidence (20.7 vs. 5.7%) were significantly reduced on pre- vs. post-chill carcasses, respectively, due to immersion chilling. Overall, immersion chilling resulted in excess of 70% improvement microbiological quality of carcasses, compared to pre-chill levels. These results verify the lack of a direct correlation between visible ingesta and microbial contamination on broiler carcasses. As expected, and observed in this study, immersion chilling is an highly effective food safety intervention step in poultry processing plants.

Key Words: Broilers, Contamination, Ingesta, Pathogens, Chilling

78 On-line product enhancement: Influence of an anti-microbial treatment prior to chilling on microbiological quality of broiler carcasses. S. F. Bilgili1, N. Apple2, D. Zelenka3, and J. E. Marion1, 1 Auburn University, 2 Tyson Foods, Inc., 3 National Chicken Council.

On-line product enhancement, or the process of treating all carcasses, with or without visible contamination, with an anti-microbial rinse on the evisceration line and prior to immersion chilling, provides means to achieve process control and improve the microbiological quality of carcasses. In this study, effectiveness of on-line product enhancement was assessed under commercial conditions. In Experiment (Exp.) 1, microbiological quality (E. coli, and coliform incidence and counts, and Salmonella incidence) of visibly clean (VC) and fecally-contaminated carcasses, either reprocessed off-line with standard procedures (FR) or on-line with trisodium phosphate (TSP; Assur-RinseTM) treatment (FOR) were compared. In Exp. 2, microbiological quality of carcasses were assessed immediately before (B-TSP) and after TSP application (A-TSP), as well as after immersion chilling (A-C). Recovery of microorganisms was also compared in refrigerated and frozen A-TSP rinse samples in Exp. 1 and 2. In Exp. 3, E. coli and coliform levels were compared on carcass rinses immediately after TSP application (A-TSP) and after chilling carcasses (<40 F) on individual containers (A-IC). E. coli and Salmonella incidence was 98 and 19.6% on VC carcasses prior to carcass wash, but was significantly (P<0.05) reduced to 93 and 15.4% on FR, and to 53 and 9.4% on FOR carcasses, respectively, in Exp. 1. Similar reductions in E. coli and coliform counts (CFU/ml) were observed on VC (129 and 145), FR (69 and 81), and on FOR (0.3 and 0.3) carcasses, respectively, in Exp. 2. E. coli and Salmonella incidence varied significantly at B-TSP (97 and 13.9%), A-TSP (44 and 7.1%), and at A-C (68 and 5.6%) carcasses, respectively. Whereas, E. coli and coliform counts (CFU/ml) were 84 and 112 (B-TSP), 0.8 and 15 (A-TSP), and 2.4 and 12 (A-C), respectively. In both Exp., freezing the A-TSP rinse samples significantly reduced the subsequent recovery of microorganisms tested. Although carcasses were individually chilled in Exp. 3, E. coli and coliform incidence and counts were significantly increased from 33 and 47%, and 0.4 and 0.5 on A-TSP carcasses to 90 and 97%, and 9.5 and 19.3 on A-IC carcasses. This study confirms and verifies the effectiveness of on-line product enhancement as a valuable food safety intervention process in poultry processing.

Key Words: Broilers, Processing, Contamination, salmonella, Anti-microbial

79 Allyl isothiocyanate exerts anti-campylobacter and general antimicrobial properties on commercial broiler breast meat treated with Campylobacter jejuni and stored at 4°C. S. F. Bilgili*, I. G. Mello, and G.E. Rodrick, University of Florida.

The objectives of this study were to determine anti-Campylobacter properties, and antimicrobial properties of allyl isothiocyanate (AIT) on the spoilage microflora of commercial broiler breast meat stored at 4°C for 7 d. Four concentrations of AIT (i.e., 0, 100, 300 and 600 #L of AIT per 100 g of sample) were added directly to the absorbent reservoirs of Fresh-R PaxTM trays, followed by placing the breast meat (inoculated and un inoculated) into the trays, and packaging each tray in metalized Maylard oxygen impermeable bags. The bags functioned as a barrier against AIT dissipation. The packaged samples were stored at 4°C, and analyzed for pH, presence of Campylobacter jejuni, psychrotrophic organisms, and objective color after 0, 3, 5 and 7 d storage at 4°C. The pH values for the breast meat were similar throughout the 7 d storage period for all treatments. No psychrotrophic organisms, which are the predominant spoilage organisms of fresh poultry, were detected after 3 d storage for breast meat treated with 300 and 600 #L of AIT per 100g. The 300 and 600 #L per 100 g treatments resulted in total elimination of Campylobacter in all breast meat sampled during the 7 d storage period. The 0 and 100 #L per 100 g AIT treatments were not effective in reducing Campylobacter nor psychrotrophic organisms during storage: All analyses were discontinued after 7 d because of the development of
that the antioxidant effects of carnitine may preserve sperm membranes, thereby extending the lifespan of sperm.

Key Words: Ascorbic acid, Carnitine, Lipid peroxidation, Rooster, Sperm concentration

82 The immunotoxic effects of fumonisin B1 (FB1) on chickens of different age groups. B.J. Boone* and A.B. Bodine, Clemson University.

Fumonisin B1 (FB1) is a mycotoxin produced by the fungus **Fusarium verticilloides** (formerly **F. moniliforme**) and is found in diverse crops such as corn, wheat and barley. The purpose of this study was to investigate the immunotoxic effects of fumonisin B1 on New Hampshire chicks of varying ages. Three different age groups were selected, i.e. 1 to 4 weeks, 5 to 8 weeks and 9 to 12 weeks. Spleen, thymus and peripheral blood lymphocytes (PBLs) were obtained from each age group. The cells were cultured with varying concentrations of FB1 and evaluated for changes in viability using the reduction of MTT assay. In addition, cells were cultured with either 10 µg/ml Concanavalin A (ConA) or 5 µg/ml lipopolysaccharide (LPS) and the mitogenic response evaluated to determine if FB1 had a greater effect on either the T or B cell populations. Furthermore, spleen cells were stimulated with LPS and pokeweed mitogen (PWM) and assessed for any alterations in nitric oxide (NO) production using the Griess reagent. The results indicate that the severity of FB1 toxicity on avian immune cells was organ and age specific, as well as concentration dependent. Overall, it appears that FB1 increases NO production in a dose dependent manner while lowering the mitogenic response and decreasing viability. The data show that FB1 is immunotoxic to avian immune cells, albeit to varying degrees depending on cell type.

Key Words: Fumonisin B1, Chicken, Immunotoxicity

83 Improved hatchability of freshly laid chicken eggs cultured ex ovo. S. Bonwormpinyo*, J. Brake, and J. N. Petitte, North Carolina State University, Raleigh, NC.

An ex ovo method of culturing chicken embryos is useful for developmental studies and genetic manipulation. Various studies using ex ovo procedures for freshly laid eggs have reported relatively low hatchability. The purpose of the present study was to improve the hatchability of chicken embryos from freshly laid eggs when cultured in surrogate eggshells. For the first 3 days of incubation, chicken embryos from freshly laid eggs were cultured in surrogate chicken eggshells that had a window made on the small end and sealed tight with a plastic cling film without an air space. Eggs were positioned with the small end up and incubated at 37.5 °C, 60% RH and turned through 90° hourly. Sealing the eggs with Handi Wrap®, a plastic film with moderate gas permeability, produced the best survival compared to those sealed with Saran Wrap®, which has low gas permeability. When eggs were positioned with the small end down, no difference in survival was observed during the first 3 days of incubation. After the first 3 days, the embryos from the first surrogate eggshell were transferred into turkey eggshells, sealed with cling film while providing an air space, and cultured until hatch. During this period, the eggs were incubated at 37.5°C, 60% RH and turned through 30° hourly. Three trials were performed. The cultures sealed with Handi Wrap® hatched significantly better than those observed using Saran Wrap® (75% ± 10% vs. 45.2% ± 13.8%, respectively). The hatchability of control intact eggs was 92% ± 4.8%. These results suggest that the hatchability of chicken embryos cultured ex ovo can be improved through the use of a suitable gas permeable plastic film. The improved hatchability of cultured embryos using surrogate eggshells in this study can facilitate procedures required for manipulation of early avian embryos.

Key Words: Chicken, Embryo culture, ex ovo, Hatchability, Surrogate eggshell

84 Validation of the OptiBreed Sperm Quality Analyzer® to Monitor Sperm Traits in Male Turkey Breeders. S.L. Neuman*, C.D. McDaniel2, J. Radu1, L. Frank3, and P.Y. Hester1, 1 Purdue University, 2 Mississippi State University, 3 Alpharma, Inc.

The effects of storage time and age of turkey breeder toms on sperm quality and quantity were evaluated through the use of the OptiBreed Sperm Quality Analyzer® (SQA). The SQA provides a sperm quality...
index (SQI) which is indicative of sperm concentration, motility, and viability. Four replicate pools of semen, from each of 43 and 62 wk-old flocks, were diluted 1:1 with Beltsville Poultry Extender and placed on a shaker at 3°C for 8 h. Sperm viability, expressed as % dead sperm, and SQI values, diluted 1:20, were recorded hourly. Values for SQI and viability were subjected to an ANOVA utilizing a split plot in time. Storage time and age of the flock were considered fixed effects. The SQI values and viability were regressed on storage time. The SQI values and sperm viability from both flocks responded similarly to storage time (nonsignificant flock x storage time interaction). The SQI readings declined linearly with increased storage time ($y = -22.6x + 466, r^2 = 0.63, P < 0.0001$), while % dead sperm increased linearly with increased semen storage ($y = 1.89x + 13, r^2 = 0.69, P < 0.0001$). In a subsequent experiment, semen from 220 tom breeders were analyzed at 32 and 36 wk of age to determine the variability of SQI values among individual toms. The semen collected from each individual breeder was diluted 1:30, 1:40, and 1:50 with saline at 32 wk of age and at 1:40, 1:45, and 1:50 at 36 wk of age. The SQI values were subjected to univariate analysis. The largest variation among individual SQI values was observed with the 1:50 dilution of semen with coefficients of variation of 26% and 16% at 32 and 36 wk of age, respectively. These results indicate that the SQA accurately detected the decline in sperm quality that occurs with prolonged storage of turkey semen. In addition, a 1:50 dilution of semen was the best dilution to use in identifying the semen quality and quantity of individual breeder toms.

**Key Words:** Sperm Quality Analyzer, Sperm Quality Index, Sperm viability, Turkey breeder

### 85 Comparison of Growth models in an unselected randomly mated Chicken population. S. E. Aggeray*, Department of Poultry Science, The University of Georgia.

Growth data from an unselected randomly mated chicken population were compared using the cubic polynomial and Gompertz growth curve models. Birds were either fed a 17% or 25% CP diet after day 18. There data were analyzed by sex and protein level. The cubic polynomial regression appeared to provide the best fit, however, the parameters have no meaningful biological interpretation. From the parameters of the Gompertz model, the birds fed on the higher protein diet grew faster. The rate of growth was slightly faster in the females than in the males under both protein levels. The males under both diets achieved a higher asymptotic weight, but took significantly more days to reach the time of maximum growth compared to the females. Within each sex and protein subclass, there was a high positive correlation between the asymptotic weight and the age of maximum growth. The correlation between the asymptotic weight and the rate of growth was highly negative, and there was also a high but negative correlation between the rate of growth and the age of maximum growth.

**Key Words:** Growth, Gompertz, Polynomial

### 86 Stress and Heart Morphology in Broilers. J.P. Thaxton*1, J.D. Tanskon1, J.D. Wilbourn II1, and Y. Vizzier-Thaxton1, 1Mississippi State University, Mississippi State, MS.

In two separate trials, broilers were reared in a curtain-sided growout house on built-up pine shavings litter. At 5 wk of age, 15 birds in each trial received surgical implantation of an osmotic pump. Controls received sham implantations. Each pump delivered adrenocorticotropic (ACTH) at 8 IU/kg BW/d for 7 d. At 0, 3, 6, and 9 d post-implantation, 5 birds were weighed, killed and necropsied. Within 5 min after death, the heart was dissected and weighed. Then, the total atria and right and left ventricles were dissected and weighed. Body weight, heart weight and left ventricular weight were reduced at 3, 6, and 9 d by ACTH treatment. However, total atrial and right ventricular weights were not affected by ACTH treatment. Additionally, the ratio of the right ventricular weight to total ventricular weight was not different between ACTH-treated and control birds.

**Key Words:** broiler, ACTH, heart, stress

### 87 Effects of phytase supplementation on release of energy and amino acids from corn-soybean meal based diets for broiler chicks. W Pan1, F Yan1, C. A. Fritts1, and P. W. Waldroup1, University of Arkansas, Fayetteville, AR.

Phytase has been shown to release not only phytate-bound P in corn-soybean meal diets but also to enhance release of energy and amino acids that have been proposed that credit be given to phytase for these responses when formulating diets. However, it must be demonstrated that these responses will occur and be observable in a commercial situation. A study was conducted in which release of nutrients by phytase was evaluated in diets varying in nutrient content. In one series, diets were formulated to contain 90, 100, and 110% of NRC (1994) amino acid (AA) levels without phytase release nutrients (PRN) other than P. These diets were fed with or without the addition of 600 U/kg phytase (Natuphos, BASF). In a second series, diets were formulated to contain 90% of NRC amino acids considering the PRN; this diet was fed with and without 600 U/kg phytase. Body weights and feed conversion were determined at 21 and 42 with tibia ash and tibial dyschondroplasia examined at 42 d. In the first series in which diets were formulated without considering the PRN addition of phytase to 110% AA diets significantly improved BW at 21 and 42 d but not at 42 d. Feed conversion (FC) was significantly improved by phytase supplementation at 42 d when the 90% AA diet was fortified. In the second series in which PRN was considered 90% AA diets formulated considering the PRN, the BW and FC of birds fed 90% AA diets formulated with PRN but without phytase supplemented diets was impaired compared to that of birds fed 90% AA without the PRN; addition of phytase restored performance. These data indicate that phytase supplementation may release nutrients in addition to P from corn-soybean meal diets; the response may be influenced by the amino acid status of the diets.

**Key Words:** Broilers, Phosphorus, Phytase, Nutrient release, Diet formulation

### 88 Strain Response of Laying Hens to Varying Dietary Energy With and Without Enzyme Supplementation. S.E. Scheideler1, M. A. Jalali1, and E. Pierson2, 1University of Nebraska, Lincoln, NE, 2Finnefeeds International, St. Louis, MO.

A study was conducted to assess the response of four strains of laying hens to varying dietary energy with and without enzyme Avizyme 1500 supplementation during a full laying cycle. Four strains of laying hens (Hy-Line W-36, Hy-Line Brown, Babcock 300, and Shaver White) aged 22 weeks were fed three diets (Moderate ME (2,900 kcal/kg), Low ME (2,810 kcal/kg) and Low ME with Avizyme 1500) in 4 x 3 factorial arrangement for 28 weeks. Dietary treatments were allotted 8 replicate pens each with 7 birds per pen and assigned in a randomized complete block design. Results showed no significant effects of diet, strain or their interaction on feed intake, egg specific gravity, hen weights, and wet and dry shell percents. There was a significant strain difference for egg weight and egg mass, with Hy-Line Brown and Babcock 300 having significantly heavier egg weight and egg mass in contrast to Hy-Line W-36 or Shaver White. Hy-Line Brown had significantly more albumen percent among the four strains. Hy-Line W-36 had significantly (P<0.05) higher wet and dry yolk percents among the different strains, while Hy-Line Brown had the lowest. A significant (P<0.05) diet x strain interaction showed that Babcock 300 hens fed low ME diets with and without enzyme supplementation had the highest egg production, while Shaver White had the lowest rate of lay at the same time. An opposite trend was observed with Moderate ME diet with Shaver White having the highest egg production percent and Babcock 300 the lowest. Supplementation of Avizyme 1500 to low ME diet had no significant effect on production of egg parameters, even though there were strain differences for egg weight and mass, albumen and wet and dry yolk percents.

**Key Words:** Laying Hen, Strain, Energy, Enzyme, Production Parameters

### 89 Bioavailability Assessment of Eggshell Derived Monocalcium Phosphate Source. J. A. Ash1, and S. E. Scheideler1, 1University of Nebraska, Lincoln, NE.

Eggshell waste, a by-product of the egg breaking industry, was utilized to design a novel monocalcium phosphate source. This eggshell derived monocalcium phosphate (EDMCP) is comprised of approximately 19% Calcium, and 21.5% Phosphorus (P) with a dry matter content of 94%. A study was conducted to evaluate the relative bioavailability of EDMCP in...
comparison to a commercial dicalcium phosphate (CDP) source in starter broiler chicks. Nine hundred and twenty-four, 2-day-old male Cornish Rock broilers were fed the 2 phosphate sources in a 2 x 7 factorial design experiment. EDMCP was compared to CDP at seven levels of inclusion for available phosphorus (AP) ranging from 0.1% to 0.45% AP. Each dietary treatment was replicated 6 times with 11 chicks per pen during a 21 day experimental period. Analysis showed body weight (BW) at 3 weeks as affected by AP levels to be highly significant (P ≤ 0.0001) as expected. No significant difference was found, however, between AP sources for body weight at 3 weeks. At day 21, the chicks fed 0.45% AP levels weighed on average 861.6 g for the EDMCP group and 853.6 g for the CDP group. A slope ratio assay using linear regression analysis was used to determine relative bioavailabilities. Regression of AP levels on P source for week 3 BW resulted in a relative bioavailability of 102.1% for EDMCP in comparison to the CDP. No significant difference (P ≤ 0.8) was found for feed conversion with respect to AP source, and, again, feed conversion was significant in relation to level of P fed (P < 0.0009). For the 21 day experimental period, chicks fed EDMCP at the 0.45% AP level converted at 1.51 where as the CDP chicks converted at 1.53. There was no statistical significance in death loss with relation to the source of P. In conclusion, these investigations show that the EDMCP is biologically equivalent to the commercial standard of phosphorus for supplemental phosphorus in broiler chick diets.

Key Words: Bioavailability, Monocalcium phosphate, Dicalcium phosphate

90 Modulation of Immune System Development in Broilers by Dietary Vitamin E, Vitamin A, and Zinc. R. G. Bottje, T. K. Beris, and G. F. Erf, University of Arkansas, Fayetteville, AR.

Supplemental dietary vitamin E (VE, alpha-tocopherol acetate, 87 ppm) was shown to increase the percentages of CD4+CD8- thymocytes and splenocytes in 7 wk-old broilers. To determine whether similar increases in the percentages of CD4+CD8- T cells could be achieved by supplementing dietary VE for only 3 weeks instead of for the entire 7 wk growing period, the following study was conducted. Day-old male broiler chicks (Cobb 500) were randomly assigned to five floor pens, each representing one dietary VE treatment. From 0-3 wks of age, the chickens were fed 15% (standard supplementation), 100, and 200 IU VE/kg of feed. From 4-7 wks, the chickens were either maintained on the same diet (15, 100 and 200), or switched to standard dietary VE levels (referred to as 100-15 and 200-15 IU VE/kg treatments, respectively). Blood, thymus and spleen were obtained from each bird at 3, 5 and 7 wks. Single cell suspensions were immunofluorescently stained and analyzed by flow cytometry to determine proportions among various lymphocyte subpopulations. At wk 7, body weight was significantly higher in birds fed 100-15 IU VE/kg compared to birds fed 100 IU VE/kg (P = 0.02). Relative spleen weights were significantly higher in birds fed 100-15 IU VE/kg compared to birds fed 100, 200-15 and 200 IU VE/kg (P = 0.01). Relative thymus weights were significantly higher in birds fed 15 IU VE/kg compared to birds fed 200-15 IU VE/kg (P = 0.02). Birds that were maintained on high dietary VE levels (100 and 200 IU VE/kg) throughout the 7 wk study had significantly higher percentages of CD4+CD8- splenocytes (T helper cells, P < 0.001) compared to birds fed 100-15 and 200-15 IU VE/kg. Dietary VE did not affect other CD4 and/or CD8-defined splenocyte subsets. Based on these results, it appears that additional dietary VE supplementation (100 and 200 IU VE/kg) beyond 3 wks is required to yield increased proportions of CD4+CD8- splenocytes observed at 7 wks of age.

Key Words: Vitamin E, Broilers, Lymphocytes, T cells, Spleen

91 Performance of Broilers Fed Corn and Sesame Seed Meal Diets. K. G. Sterling*, G. M. Pesti, R. I. Bakalli, and H. M. Edwards Jr., Department of Poultry Science, University of Georgia.

Three experiments were conducted to evaluate the performance of broiler chicks fed a high fat Sesame Seed Meal (SSM) as a full substitution for Soybean Meal (SBM). The SSM tested contained 26% ether extract, 49% crude protein, 1.28% total phosphorus, 0.51% phytin phosphorus, 0.39% calcium and 1.26% lysine. All experiments were conducted with Ross x Ross chicks and all diets were formulated to NRC, 1994 recommendations except where noted. Experiment 1 was conducted to determine the calcium level required in a Corn/SSM diet for optimum broiler performance from 0 to 18 days. A 2x3 factorial design consisted of 2 levels of phytase (0 and 600 U/kg) and 3 levels of calcium (0.85, 1.00 and 1.15%). The basal level of Non-phytin phosphorus (NPP) was 0.33% and no supplemental phosphorus was added. A significant effect due to calcium level (P < 0.005) and phytase (P < 0.0001) was observed for gain. Average gain was 261, 225 and 229g for chicks fed diets without supplemental phytase compared to those with phytase at 325, 275 and 284g. (0.85, 1.0 and 1.15% calcium). Experiment 2 evaluated the addition of 2 NPP levels (0.33 and 0.45%) and 2 phytase levels (0 and 600 U/kg) in diets containing 1.00% calcium. A Corn/SBM based control diet was included for comparison. The addition of NPP improved gain of chicks fed SSM with gains of 274 vs. 319g. (0.83 and 0.45% NPP, respectively) however, control diet fed chicks gained more (573g). In Experiment 3, 2 levels of phytase (0 and 600 U/kg) were tested with 3 levels of NPP (0.45%, 0.50% and 0.55%) in diets containing 1.00% calcium. There were no significant differences between any SSM diets for gain, feed intake, and FCR. Average gain, feed intake and FCRs were 466g, 498g, and 1.07 (g/g) respectively. Chicks fed the control diet compared to those fed the SSM diets, 378g, 472g, and 1.25 (g/g), respectively. The incidence of phosphorus rickets decreased with additional NPP and phytase (P < 0.0001). The average incidence of rickets for chicks fed SSM without phytase was 70.8, 12.5 and 0% vs. 12.5, 4.2, and 0% for chicks fed phytase (0.45, 0.50, 0.55% NPP). The performance of chicks fed SSM as a full substitution of Soybean Meal was reduced. Additional phytase and NPP did not improve performance however, the incidence of rickets was reduced.

Key Words: Sesame seed meal, Broilers, Phytase, Phosphorus, Rickets


The objective of this study was to evaluate the performance of broilers fed diets with varying levels of expanded corn substituted on an equal weight basis of unprocessed corn. The treatments consisted of 100% unprocessed corn (UNC), 50% expanded corn and 50% unprocessed corn (EUC), and 100% expanded corn (EXC). Each treatment consisted of 12 replicated pens of 7 commercial male broiler chicks. The study was conducted using Petersime battery brooders (Gettysburg, OH) for a 18-day growing period. The diet was formulated to meet or exceed NRC recommendations. Feed and fresh water was provided ad libitum and lighting was 24 hours continuous. Expansion of the corn was performed using an Amandus Kahl (Hamburg, Germany) model OE 15.2 annular gap expander with conditioning temperature set at 200°F (93.3°C) and cone pressure set at 250 PSI (17.3 kg/cm2). Chromic oxide was added to the diets at 0.5% as a digestibility marker. All treatments post-mixing were reground through a 1/4” hammermill screen to eliminate particle size differences. Results for 18d broiler performance found that birds fed the UNC diet had significantly lower feed intake as compared to the other treatments. There were no significant differences among all the treatments for body weight gain. High significance was found between all three treatments for 18d feed efficiency with average values of 0.78, 0.76, and 0.73 for UNC, EUC, and EXC, respectively. A highly significant linear effect was found in 18d feed efficiency from UNC decreasing through EUC and EXC. The results of this study suggest that nutrient damage occurred to corn expanded at these conditions, however more research is necessary to determine the nutrients damaged.

Key Words: Expansion, Corn, Feed Manufacturing, Broiler Performance

93 Influence of dietary selenium source and level on selenium content of fertile eggs incubated for 10 to 15 days. N. D. Paton*, A. H. Cantor, A. J. Pescatore, M. J. Ford, and C. A. Smith, University of Kentucky, Lexington, KY.

A study was conducted to evaluate the effect of dietary selenium source (organic vs inorganic) and level (0.1 vs 0.3 ppm added Se) on the selenium content of eggs incubated for 10 to 15 d. Ninety six Hy-Line W36 laying hens, 63 wk of age, were fed a low Se (0.06 ppm Se) corn-soybean meal based diet (5.3% Ca, 16.6% CP) without Se supplementation for 8 wk, prior to feeding experimental diets. Four replicates of six caged hens were assigned to each of four dietary treatments: basal diet + 0.1 ppm (treatment 1) or 0.3 ppm (treatment 2) added Se as inorganic sodium selenite (Na2SeO3); basal diet + 0.1 ppm (treatment 3) or 0.3 ppm (treatment 4) added Se as organic selenium yeast (Sel-Plex, Alltech1, Nicholasville, KY). Fertile eggs were collected after 30 d of feeding the experimental diets. Eggs were incubated for 10, 11, 12, 13, 14 or 15 d, and then separated into embryonic and non-embryonic material and each portion
96 Utilization of Wheat Gluten Meal in Broilers Diets. A Kamyab1 and H Yahyazadeh2, 1University of Tehran, 2University of Tehran.

Utilization of wheat gluten meal in broilers diets.

A.Kamyab and H. Yahyazadeh. Department of animal science, university of Tehran. A study was conducted to determine the effects of utilization of wheat gluten meal on feed intake, body weight gain, feed conversion, %viscera, toe ash, litter moisture, mortality and leg abnormality of broilers (day 1 to 49). This experiment was conducted in a completely randomized design and consisting of four diets in five replicates. All of the diets were isocaloric and isonitrogenous. Experimental diets containing of 0, 3, 6 and 9% wheat gluten meal respectively. At 15th to 26th day of the study, during the study the average difference between non-embryonic and embryonic selenium concentrations was 0.05 ppm, 0.08 ppm and 0.05 ppm and 0.09 ppm respectively. Increases in embryo Se concentration from day 10 to 15 were 0.10 ppm, 0.076 ppm, 0.032 ppm and 0.034 ppm pp for treatments 1, 2, 3 and 4 respectively. The data indicate that while both source and level of dietary Se affected Se concentrations in embryonic and non-embryonic fractions (organic > inorganic Se source; 0.3 ppm > 0.1 ppm added Se), they did not influence the time at which Se began to concentrate in the embryo. Key Words: Embryo, Selenium, Laying hen

97 The Response of Laying Hens to Phytase Added to Corn-Soybean Meal-Based Diets Containing Two Levels of Available Phosphorus. M. Kamberi1*, E. T. Moran, Jr., and M. T. Kidd2. 1Auburn University, Auburn, AL, 2Nutri-Quest, Chesterfield, MO.

A trial was conducted to determine the effects of adding phytase (Natuphos®, BASF) to corn-soybean laying hen diets for 8 weeks with different available phosphorus (AP) 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 AP levels (0.12 or 0.42%) and two phytase levels (0 or 600 FTU/kg). Each treatment was assigned to 3 replicates of 12 hens. Body weight, feed consumption, egg weight, egg specific gravity, and egg shell weights were measured biweekly. Egg production was recorded daily. Left tibia (for ash analysis) and blood (for P and Ca blood plasma analysis) were collected from three hens per replicate in the end of experiment. The 0.12% AP diet with no supplemental phytase resulted in significantly lower body weights (1496 ± 18g; 1827 ± 20 g; 1829 ± 8g; and 1870 ± 30 g, for hens fed 0.12% AP no phytase, 0.12% AP + phytase, 0.42% AP no phytase, and 0.42% AP + phytase, respectively), daily feed intake per hen (75 ± 11g; 106 ± 11g; 105 ± 4g; and 110 ± 2g, respectively), egg production (51 ± 8%; 96 ± 2%; 93 ± 4%; and 95 ± 1%, respectively), egg weight (55 ± 11 g; 63 ± 1 g; 63 ± 1 g; and 65 ± 1 g, respectively), and egg shell weight (6.8 ± 0.2 g; 6.3 ± 0.1 g; 6.4 ± 0.1 g; and 6.5 ± 0.1 g, respectively), but did not have any effects on relative egg shell specific gravity or specific gravity. Blood plasma P and Ca levels significantly increased when phytase and P were added to the low P diet (0.37 ± 0.51 g; 1.27 ± 0.20 g; 1.24 ± 0.30 g; 1.68 ± 0.134 mmol/L P, and 3.55 ± 0.11 g; 4.01 ± 0.09 g; 4.20 ± 0.02 g; and 4.06 ± 0.15 mmol/L Ca, respectively). Added phytase significantly increased tibia ash (48.9 ± 2.34 g; 53.6 ± 0.6 g; 52.5 ± 0.36 g; and 54.9 ± 0.36 g, respectively). The results of this study indicate that 600 FTU/kg phytase improves the utilization of phosphorus in corn-soybean meal diets for laying hens containing 0.12% AP. In this short term study, 0.12% AP was adequate to support maximum performance in layers as long as phytase was also fed. Key Words: Phytase, Available phosphorus, Laying hens, Egg production, Egg quality

98 Utilization of corn-by-products in broiler diets. A Kamyab1 and S Parhizkar2*, 1University of Tehran, 2University of Tehran.

Utilization of corn-by-product in broiler diets were evaluated. This experiment was conducted of 3 diets and six replicate. Diets: 1) Control (Corn-soybean) 2) Corn by-product soy plus amino acid supplemented 3) corn by-product-soy with no amino acid supplemented. At all age of periods T1 and T2 diets resulted in heavier birds and better feed conversion ratio (P < 0.05). Over all feed intake for T3 was lower

94 The Effects of a Multi Enzyme in Wheat and Barley Based Diets on Arian Broiler Performance. A Kamyab1 and A Taghipour2, 1University of Tehran, 2Telavang Co.

ABSTRACT In a randomized design experiment, mixed sex Arian broilers fed varying levels of wheat and barley diets with and without GP-5000 from day 1 of age to determine the effect of the multi enzyme on the performance of chickens, until 47 day of age. In the starter, grower, and finisher diets the levels of wheat and barley were: 5 and 5; 15 and 10; 35 and 30; 40 and 40 respectively. There were also a corn-soy diet with no enzyme addition as a positive control for all periods of phase feeding. Feed consumption, body weight gain, mortality, vent pasting, carcass quality, and litter quality were the criteria used. Increasing the wheat and barley levels with supplementation of the enzyme did affect weight gain at day 21 (P<0.05). At the same age, feed conversion of all dietary treatments were significantly better (P<0.05) than positive control. At ages 42 and 47, birds which fed the highest level of wheat and barley greatly heavier and had better feed conversion compared to others (P<0.05). Cumulative feed intake were lowest for the group with higher levels of wheat and barley and lowest for the group fed less wheat and barley with no added enzyme. There was no significant mortality or fat content differences between treatments (P>0.05). Birds with enzyme addition in their diets had both lower percentage of vent pasting and litter moisture. The results of the present study suggest that the effect of GP-5000 supplemented diet may pronounced with high levels of wheat and barley in broiler diets. Key Words: Broiler, Enzyme, Wheat, Barley

95 Threonine Requirement of Broiler Males from 42 to 56 Days of Age in a Summer Environment. W.A. Dozier, III1, E.T. Moran, Jr., and M.T. Kidd2. 1Auburn University, Auburn, AL, 2Nutri-Quest, Chesterfield, MO.

Amino acid requirements of broilers should be altered during extreme environmental conditions. Threonine is a limiting amino acid for broilers, particularly at finishing when a hot environment would decrease feed intake. This study examined the dietary threonine requirement of male broilers from 42 to 56 days of age during Summer production. A total of 750 Ross × Ross 308 male broilers was randomly distributed into 30 floor pens (25 chicks/pen) of an open-sided house having thermostatically controlled curtains with cross-ventilation. Birds were given a common feeding regimen until six weeks of age, then six experimental diets consisting of progressive increments of threonine that ranged from 0.50 to 0.80% were fed from 42 to 56 days of age. Feed conversion was optimized at a total dietary threonine concentration approximating 0.67% (progressive Thr feed conversion results are: 2.82, 2.85, 2.48, 2.34, 2.49, 2.50; P ≤ 0.05); however, growth rate and feed consumption were not significantly affected by dietary threonine. Increasing dietary threonine also did not alter carcass yield nor the proportions of abdominal fat and Grade “A” carcasses; but, fillet weight and its relative yield were optimized at 0.62% dietary threonine (progressive Thr fillet weight results are: 416, 416, 477, 455, 413, 415 g; P ≤ 0.05)(progressive Thr fillet yield results are: 19.0, 19.1, 20.4, 20.0, 19.4, 19.5%; P ≤ 0.05), respectively. Threonine need for male broilers appears less for optimum breast meat recovery than feed conversion ratio during hot temperature conditions. Key Words: Amino Acid, Broiler, Threonine


ABSTRACT In a randomized design experiment, mixed sex Arian broilers fed varying levels of wheat and barley diets with and without GP-5000 from day 1 of age to determine the effect of the multi enzyme on the performance of chickens, until 47 day of age. In the starter, grower, and finisher diets the levels of wheat and barley were: 5 and 5; 15 and 10; 35 and 30; 40 and 40 respectively. There were also a corn-soy diet with no enzyme addition as a positive control for all periods of phase feeding. Feed consumption, body weight gain, mortality, vent pasting, carcass quality, and litter quality were the criteria used. Increasing the wheat and barley levels with supplementation of the enzyme did affect weight gain at day 21 (P<0.05). At the same age, feed conversion of all dietary treatments were significantly better (P<0.05) than positive control. At ages 42 and 47, birds which fed the highest level of wheat and barley greatly heavier and had better feed conversion compared to others (P<0.05). Cumulative feed intake were lowest for the group with higher levels of wheat and barley and lowest for the group fed less wheat and barley with no added enzyme. There was no significant mortality or fat content differences between treatments (P>0.05). Birds with enzyme addition in their diets had both lower percentage of vent pasting and litter moisture. The results of the present study suggest that the effect of GP-5000 supplemented diet may pronounced with high levels of wheat and barley in broiler diets. Key Words: Broiler, Enzyme, Wheat, Barley

than other treatments. Breast and thigh percentage for t1 and t2 were significantly higher than t3. No significant difference (P > 0.05) were observed between treatments. Regarding liver and abdominal fat percent- age were greater for t1 and t3 compared to the others. Toe ash for t3 lower (P < 0.05) than other treatments, but litter moisture and inci- dence of leg abnormalities and mortality were greater for t3 compared to the others. Key words: Corn by-product, Broiler, Leg abnormality, Feed intake, Toe ash.

Key Words: Broiler, Corn by-products, Leg abnormality

99 Lack of continuous utilization of a multiple Enzyme in broiler diet. A Kamya1 and M Ashtiani1,2, 1University of Tehran, 2University of Tehran.

A study was conducted to determine the effects lack of continuous utilization of a multiple Enzyme on feed intake, body weight gain, feed conversion, litter moisture, mortality and leg abnormality of broilers (day 1 to 49). This experiment was conducted in a completely randomized design. All the diets were isocaloric and isonitrogenous and consisting of six diets with five replicates, in which 25 birds were housed. The experimental diets consisting of: 1) Corn-soybean diet as positive control. 2) Wheat-barley based diet plus Enzyme. 3) As 2 but Enzyme added every other day. 4) As 2 but Enzyme added every two days. 5) As 2 but Enzyme added up to 42 days of age. 6) As 2 but Enzyme added up to 35 days of age. At day 49 birds which feed diet 3 had greater weight gain (P < 0.05). At the same age diet 6 resulted in better feed efficiency (P < 0.05). Like wise birds which received diets 1, 5 resulted higher litter moisture. There was no significant difference between over all mortal- ity and quality of carcasses (P > 0.05). Key words: Multiple Enzyme, Broilers, Litter moisture, Leg abnormality, Wheat-barley.

Key Words: Broiler, Multiple Enzyme, Leg abnormality

100 Unhydrolyzed vegetable sucrose polyester in broiler diets. B. L. Damron*, S. K. Williams, and A. R. Eldred, University of Florida, Gainesville, Florida / USA.

Duplicate 42-day broiler studies were conducted in litter-floored pens, begin- ning with day-old chicks obtained from a commercial hatchery. Seven replicate pens, each starting with 12 male and 12 female chicks, received each dietary treatment in a randomized-block design. Dietary treatments consisted of 0, 0.5, 1.0, 1.5, 2.0, or 2.5% unhydrolyzed vegetable sucrose polyester (UVSP) added to the starting and finishing diets at the expense of filler. Feed and water was provided ad lib through tube feeders and bell-type waterers. Infrared heat lamps were utilized for brooding. At 42 days of age, group body weights were taken by sex within pen and feed consumption determined. Litter samples were also taken from three locations in each pen and blended for moisture determination. On the day after weighing, four birds of each sex from each pen were randomly selected for shank pigmentation evaluations using a Minolta Chroma-meter. In 42-day broiler studies, up to 2.5% UVSP did not have a significant neg- ative effect on body weights, daily feed intake, feed efficiency or litter moisture. In Exp. 2, average body weights were significantly greater than control for groups that received 0.5, 2.0 or 2.5% UVSP. However, the degree of shank yellowness was consistently and significantly reduced by 0.5% or more UVSP. While xanthophyll levels were intentionally low- ered somewhat to improve sensitivity (7.9 and 9.6 mg/kg for starter and finisher feeds, respectively), it is obvious that, as in humans, the utiliza- tion of carotenoids was reduced somewhat by UVSP. Additional pigment titration trials could provide valuable information about the levels re- quired to overcome this effect.

Key Words: Broilers, Olestra, Unhydrolyzed Vegetable Sucrose Polyester, Pigmentation, UVSP

101 Response of Male Broilers to two Commercial sources of Supplemental L-Lysine. M.E. Jackson*, A. Lemme1, J.L. Emmert2, and T. Pope2, 1Degussa-Huls Corporation, 2University of Arkansas.

Biolys 60 is a new form of lysine containing 46.8% Min. L-Lysine in a sulfated form plus nutritional fermentation co-products. Biolys 60 is pro- duced by microbial fermentation of C. glutamicum, and the lysine sub- stitution value is calculated as 60% of the value of L-lysine.HCl. A 36-d floor pen trial with 1890 male Ross X Cobb broilers, 54 floor pens, and 35 birds/pen was conducted to determine responses to 2 forms of supplement- al lysine. Starter and grower series of corn-soybean meal-corn gluten

meal based diets were provided from 0-18 and 18-36 d. Nine isonitroge- nous dietary treatments (x 6 replicates) included a non-supplemented control and 4 levels of added lysine from the 2 sources. Starter and grower basal diets contained 20.69 and 18.04% CP and 0.83 and 0.66% Lys, respectively. L-Lysine was added at 0.08, 0.16, 0.24, and (0.42 Starter, 0.30 grower) % from each source. Birds responded to both lysine sources with 0-36 d gain ranging from 965g (no supplementation) to 1900g (highest supplementations) and feed conversion ratio (FCR) de- creasing from 2.23 to 1.62. The rate of response to the 2 lysine sources was compared using non-linear exponential regression analysis. The data fitted well to predicted values with r-squares of 0.97 and 0.96 for gain and FCR, respectively. Comparing the coefficients of the response to the 2 products, Biolys 60 compared to L-Lysine.HCl was 97.9 and 99.1% for growth and FCR, respectively. Both values were not significantly differ- ent from 100%. It is concluded that the 2 products are equal in eliciting performance response in broiler chickens.

Key Words: Lysine Sulfate, L-Lysine.HCl, Broilers

102 Nutritional Profile of Dehydrated Poultry Meal as a Feed Ingredient. J. B. Hess1, J. P. Blake1, R. A. Norton1, and C. M. Parsons2, 1Auburn University, Auburn, AL, 2University of Illinois, Urbana, IL.

An operation in central Alabama processes frozen broiler farm mortalities as a feed ingredient. Frozen birds are ground, mixed with soybean meal (60% soy/40% mortality mix), then dried in a massive drum dryer. The resulting product is offered for sale as a feed ingredient. Compos- ite samples of this product were collected from the manufacturer and analyzed for proximate analysis and minerals (Auburn University Soil Testing Lab) and amino acid (AA) digestibility (Cecectomized rooster bioassay, Dr. Parsons’ Lab) to provide a nutritional profile of this ingre- dient. Subsamples were screened to remove feathers. Analyses are presented on an as is basis. Crude protein levels were 2% higher for the product with feathers (50.27 vs. 48.4%). TDN was similar between samples (74.05% with feathers vs. 74.16% w/out). Calculated ME values were 2860 kcal/kg w/feathers and 2820 w/out feathers. AA digestibility showed a trend similar to TDN, with good digestibility for both products (avg. 89.6% w/feathers vs. 91.5% w/out feathers). Selected total AA levels for the product w/feathers were: 2.81% Lys, 0.64% Met, 1.36% TSAA, 1.85% Thr and 3.14% Arg. Total AA levels for the product w/out feathers were: 2.60% Lys, 0.50% Met, 1.21% TSAA, 1.67% Thr and 2.70% Arg. Moisture levels were low at 2.4 to 3.6%. Crude fat was 17.6% of this product with crude fiber composing 2% of the total. Calcium (1.13% vs. 0.76%) and phos- phorus (1.07% vs. 0.91%) levels were higher in the product containing feathers. Average mineral levels were: 1.40% K, 0.18% Mg, 28 ppm Mn and 64 ppm Zn.

In formulating feeds with the ingredient as presented (with feathers), it was concluded that the product was essentially equal in value to 48% soy- bean meal in shadow cost. Several integrators have included this product in broiler formulations to date.

Key Words: Dehydrated Poultry Meal, Nutrient Profile, Mortality disposal

103 Effect of Ascogen on the growth performance of Japanese quails. M. Pavič*1, H. Mazić2, D. Gresić1, and S. Muzić1, 1Faculty of Agronomy, 2Faculty of Veterinarian Medicine.

The effect of Ascogen, a biogenic performance enhanced on growth, carcass composition, feed intake and feed efficiency of 600 mixed sex Japanese quails (Coturnix coturnix japonica) was investigated. The quails were fed with a basal diet (25% CP and 13.2 MJ/kg ME) (control) and a basal diet supplemented with 500 ppm and 1000 ppm Ascogen, from 1 till 35 days of age. The supplementation of 1000 ppm Ascogen to the quail diet increased the body weight at 28 days of age (P<0.05), increased final body weight (P<0.05), decreased the feed consumption by 3.61%, improved feed conversion by 7.24%, increased carcass weight by 5.30% (P<0.05), carcass yield by 2.85% (P<0.01), wings weight by 19.8% (P<0.01) and weight of drumsticks by 5.34% (P<0.05) compared to the control group. The addition of 500 ppm of Ascogen to the diet of quails increased final body weight by 4.56 grams, improved feed conversion by 1.24%, increased carcass weight by 1.89% and carcass yield by 3.10% (P<0.01) compared to the control group.

Key Words: Japanese quail, Ascogen, growth performance
104 Effects of time of exposition to artificial heat in broiler brooder over productive parameters and mortality produced by ascites syndrome. C Lopez1, J Arce2, E Avila1, and E Gutierrez3, 1FMYZ - UNAM, 2INIFAP, 3UMSNH.

A total of 2700 one-day-old non-sexed Ross broiler chicks were randomly distributed in three treatments: T1 Artificial heat (AH) until the third week; T2 AH until the fourth week; T3 AH until the fifth week, with 9 replicates of 100 birds each one, located at 1940 meters over sea level to determine the effect of different times of exposition to AH on the productive parameters and mortality caused by ascites syndrome (AS). A crumbled feed was used, fed ad libitum, and temperature recorded every hour. Brooder minimum temperatures (°C) were significant different (P<0.01) at the fourth (14a, 17a, 19b) and fifth weeks (12a, 16b, 19b), mean temperature only in the fifth week (20a, 23b, and 23b). The temperature range showed differences (P<0.01) only in the fourth (17a, 16b, 13b), and fifth (17a, 16a, 12b) weeks. Maximum temperature values did not show differences (p<0.05) between treatments during the trial. At 53 days of age, there were significant differences (P<0.01) for body weight (2715, 2866, 2610 g), feed consumption (5247, 5199, 5112g), general mortality (22.25, 12.37, 13.12%) and mortality caused by AS (19.25, 8.37, 9.87%), without differences (p<0.05) in feed conversion (1.96, 1.96, 1.98 g/l). Low temperatures, even at late ages, affected performance and increased the incidence of AS.

Key Words: Ascites syndrome, Brooder temperature, Broilers, High altitude.


The objective of these experiments was to investigate the feeding of Powerfeel supplementation on performance and intestinal microflora of broiler chicks. Two hundred forty chicks were randomly assigned to 0, 0.05, 0.10, 0.20, 0.40, 0.80 and 1.60% Bio-plus with 4 diets including control and naturally-contaminated blends of soybean meal. The number of ileum yeast and Lactobacillus showed significantly lower FC than control (P<0.05). The number of ileum salmonella were examined from E. coli and salmonella were examined from cecum and ileum at the end of experiment. ND titer were also measured at five weeks old after primary and booster vaccination. In experiment 1, weight gain of Powerfeel treatments was significantly higher than control (P<0.05). Feed intake tended to increase in all Powerfeel treatments. Chicks fed Powerfeel improved FC significantly compared to that of control, but was not consistent trend. Bio-plus supplements increased weight gain, the number of ileum yeast and Lactobacillus of broiler chicks.

Key Words: Broiler chicks, Fruit extract, Weight gain, FCR, Intestinal microflora.

107Calcium requirement of Bovans hens. Hafiz A. Ahmad1, Sashidhar Yadalam2, and David A. Roland, Sr.2, 1Tukeyege University, 2Auburn University.

Calcium requirements of laying hens are although widely studied, yet keep challenging us with new genetic make-ups, operation management, environmental concerns, and economics considerations. The present research conducted to determine the calcium requirement of Bovans hens. A total of nine hundred and sixty hens were divided into six dietary treatments of 160 hens per treatment. These hens were fed diets containing 2.5, 3.0, 3.5, 4.0, 4.5, and 5.0% calcium levels for eight weeks. The performance criteria evaluated were egg production, feed consumption, egg weights, and egg specific gravity.

Increasing dietary calcium levels had a significantly linear effect on egg production and egg specific gravity. Dietary calcium levels ranging 2.5 to 5.0% increased egg production from 75.3 to 82.4% and egg specific gravity from 1.078 to 1.083 units. Calcium levels had no effect on feed consumption or egg weights. Bovans hens required 5.57 g calcium/h/d for highest egg specific gravity index of 1.083. The decision to feed this level of calcium to achieve maximum shell quality however depends upon the nature and cost-benefits analysis of the layer operation.

Key Words: calcium requirements, egg production, egg specific gravity, egg weight, feed consumption.


Broiler chickens are considered to be quite tolerant of feed-borne Fusarium mycotoxins when compared to more sensitive species such as swine. It has been reported, however, that a toxicological synergism exists between deoxynivalenol (DON, vomitoxin) and fusic acid (FA) and that the trichothecene Claiming, including DON and T-2 toxin, and fusic acid have similar effects on brain neurochemistry. A total of 360 male day-old Cobb broiler chicks (30 birds per floor pen, 3 pens per diet) were fed a total of 4 diets including control and naturally-contaminated blends of soybean meal, corn and wheat. The diet containing the highest level of contaminated (9.7 ppm DON, 21.7 ppm FA and 0.2 ppm zearealenone) was also fed with 0.2% organic polymer extracted from yeast cell wall (MTB-100, Altech, Inc.). Growth rates and feed consumption were measured during the starter (1-21d), grower (22-42d) and finisher (43-56 d) phases with blood samples taken at the end of the starter and finisher phases. There was a significant depression in growth rates with the feeding of increasing levels of contaminated grains but this effect was seen only in the finishing phase (P<0.05). This was accompanied by elevations in hemoglobin concentration (P<0.05) and a trend towards increased RBC count. Blood uric acid levels were also increased (P<0.05) indicating altered protein metabolism. The growth depression and metabolic changes were not seen when the contaminated grains were fed together with yeast powder. It was concluded that the feeding of grains naturally-contaminated with Fusarium mycotoxins can reduce the growth rate and alter the metabolism of broilers and that use of an appropriate mycotoxin binding agent can prevent these changes.

Key Words: Mycotoxins, Broilers, Fusarium, Growth, Yeast polymers.
The use of cottonseed meal in laying hen diets. A. J. Davis*, 1, N. M. Dale*, and M. M. Lordelo*, 1 University of Georgia, 2Instituto Superior de Agronomia, Lisbon, Portugal.

Laying hens fed diets containing cottonseed meal (CSM) can produce eggs that have pink albumen discolorations and brown colored yolks due to the respective presence of cyclopropenoid fatty acids and free gossypol in the CSM. Possibly the concentration of these two compounds is less in the CSM produced in the modern expander-soybean expeller meal mills which leave little residual oil in the meal. To examine the amount of egg discoloration produced from feeding CSM obtained from an expander-soybean expeller mill, an initial experiment was conducted in which four groups of 17 individually caged, 45 week old Hy-Line W-36 laying hens were fed diets containing either 0, 10, 20 or 30% CSM which corresponded to free gossypol levels of 0, 100, 200 and 300 mg/kg of diet. At the initiation of the study and after 2, 4 and 6 weeks on the respective diets, 30 eggs from each treatment were opened and examined. The eggs were stored at 4°C for 28 days before examination. Egg weight was significantly reduced (P<0.05) in hens fed the 30% CSM diet when compared to the other diets. Although no discolored eggs were found in the eggs from hens fed the 10% CSM, hens fed the 20 and 30% CSM diets produced brown yolk discolored eggs at a rate of about 16 and 70%, respectively. In Experiment 2, the same levels of CSM were included in the feeding the hens, but the CSM did not contain the usually added soapstock which is a rich source of gossypol. The respective free gossypol contents of these diets were 0, 72, 144 and 216 mg/kg of diet. With this experiment, there were 25 individually caged 37 week old Hy-Line W-36 birds for each dietary treatment. Every egg produced in each group during the 37 day experiment was examined for egg yolk discoloration after a 2 week storage period at 4°C. Egg weights were equal between the four dietary treatments. Objectionable egg yolk discoloration was only detected in a small number of the eggs produced by the hens fed the 30% CSM. The results suggest that cyclopropenoid fatty acids are not a problem while free gossypol is still a potential problem in the CSM produced today. CSM without added soapstock, however, could potentially be used in laying hen rations at 10% or less.

Key Words: Cottonseed meal, Laying hens, Eggs, Gossypol, Yolk

Evaluation of special amino acid supplementation to diets low in crude protein. Q. Jiang**, 1 C. A. Fritts 1, D. J. Burnham2, and P. W. Waldroup1 1University of Arkansas, Fayetteville, AR, 2Heartland Lysine, Chicago, IL

Reduction of dietary crude protein by amino acid supplementation is effective to a point but performance eventually declines. This study was conducted to determine if supplementation with amino acids that serve as precursors for metabolites involved in the urea cycle or function as dispensable amino acids might improve performance at low protein levels. Diets were formulated to meet 100 or 110% of NRC recommendations for indispensable amino acids (110 or 120% of Lys) with CP levels of 16, 18, 20, 22, or 24% with the CP and ME equivalency values of the amino acids considered in formulation. A minimum dietary electrolyte balance of 200 meq/kg was maintained. Amino acids added to the low CP diets included: 1) Gly; 2) Gly + Arg; 3) Gly + Pro; 4) Arg + Pro; 5) Gly + Arg + Pro; 6) Gly + Arg + Pro + Glu. Gly, Arg, and Pro were added at 0.2%; while Glu was added at 0.4%. Each treatment was fed to six pens of five male chicks from 1 to 21 d. Feeding diets with less than 22% CP resulted in loss in BW and impaired feed conversion regardless of amino acid status. Supplementation of low CP diets with Gly significantly improved performance but did not reach that obtained on diets with 22 or 24% CP. None of the other amino acid supplements influenced performance. These data suggest that Gly may be a limiting factor in diets low in crude protein.

Key Words: Broilers, Glycine, Crude protein, Amino acids

Avizyme improves performance of broilers fed corn-soybean meal based diets. M. B. Cafe*, C. A. Borges, C. A. Fritts, and P. W. Waldroup, University of Arkansas, Fayetteville, AR.

Although a number of enzymes have been shown to be beneficial when added to diets based on wheat or barley, few studies have demonstrated consistent response when corn-soybean based diets are treated with enzymes. A study was conducted in which nutritionally adequate (NRC, 1994) diets were fed with or without the addition of 0.1% Avizyme 1500 (Finnfeeds, St. Louis, MO). Avizyme contains xylanase, protease, and amylase activity and is designed to improve the nutritional value in poultry diets based on low viscosity grains, such as corn and sorghum, and containing significant levels of soybean meal. Each diet was fed to 48 pens of male broilers. Body weights and feed conversion were determined at 16, 35, 42, and 49 d. At 35, 42, and 49 d five birds per pen were processed to determine dressing percentage and parts yield. Birds fed the diets supplemented with Avizyme had significantly higher body weights at 16, 35, and 49 d as compared to birds fed the unsupplemented diets. Response in feed conversion was inconsistent. Addition of Avizyme had no consistent effect on dressing percentage or yield of breast, thigh, or wing components. Abdominal fat, expressed as a percentage of the carcass, was consistently increased by Avizyme supplementation, the differences being significant at 42 and 49 d. This suggests that birds fed the diets containing Avizyme obtained a greater amount of net energy from their diets.

Key Words: Broilers, Enzyme, Abdominal fat, Growth performance

The influence of phytase on micro-mineral utilization in commercial layers. M.M. Bryant*, D.A. Roland, Sr., and S. Sohail, Auburn University, Auburn, AL

A study was conducted to determine the effect of phytase on micro-mineral utilization of hens after peak production (43 wks of age) and to determine the margin of safety for micro-minerals in a commercial layer diet. Hyline W36 (1760) laying hens were randomly housed 4 to a cage. Hens were fed one of 11 diets in a random block design with eight replications. Diets consisted of a commercial corn-soy layer feed with 100% of the micro-mineral premix included (positive control) or one of five graded levels of micro-mineral premix (0, 15, 30, 45, or 60%) with and without phytase. Control diets contained 4% available phosphorus (AP) and diets with phytase contained 3% AP. Diets were fed for ten weeks and performance was evaluated based on egg production (EP), egg weights (EW), egg specific gravity (ESG), feed consumption (FC) and hen mortality (HM). Removing all of the micro-mineral premix had no significant adverse effect on thecriteria measured. This suggests that producers may be over feeding micro-minerals. Because there were no detrimental effects observed in hens fed diets containing no added micro-minerals, the potential benefit of phytase on micro-mineral utilization could not be determined.

Key Words: Layer, Micro-minerals, Phytase

Use of ground cottonseed as a means of inducing molting in laying hens. A. J. Davis*, N. M. Dale*, and M. M. Lordelo*, 1 University of Georgia, 2Instituto Superior de Agronomia, Lisbon, Portugal.

In an unrelated study, it was observed that laying hens tended to reject feed containing ground, delinted, whole cottonseed (i.e., cottonseed meats, CSmt). If feed rejection were of a sufficient magnitude, this ingredient might have use as an agent to promote molting. A preliminary controlled study confirmed an aversion to CSmt by laying hens, and that the magnitude of feed rejection was greater at a 40% level of CSmt inclusion than at a 20% level. Further, feed containing finely ground CSmt was completely rejected, while use of a coarse grind resulted in only limited intake.

In a final study, 50% finely ground CSmt was incorporated into a nutritionally balanced laying hen diet. Three replicate groups of 16 White Leghorn Hy-Line W-36 laying hens received either the CSmt diet, or were subjected to total feed withdrawal as in commercial molting programs. Egg production and body weight decreases were not significantly different between the two treatments. Thus, the use of CSmt can be considered an effective alternative to standard procedures to induce molting.

Key Words: Cottonseeds, Molting, Laying hens, Feed rejection

Commercial Broiler Responses to Enzymes and Diet Density. M. T. Kidd*, 1, G. W. Morgan, Jr., 1, S. R. Rogers**, E. E. Pierson1, and C. Wyatt5, 1Department of Poultry Science, Mississippi State University, Mississippi State, MS 39762, 2R. C. Rogers Poultry Inc., Morton, MS 39117, 3Finnfeeds, St. Louis, MO 63147.

This experiment was conducted to evaluate the effect of a combination of xylanase, amylase, and protease (AVIZYM® 1500-AZ1500; Finnfeeds) in diets differing in nutrient density. Straight-run Cobb chicks received a crumble starter diet and subsequent diets were pelleted. Diets were fed from 0 to 15, 15 to 31, 32 to 39, and 40 to 49 days of age. Treatments...
were represented in a 2 x 3 factorial arrangement and were fed to broilers from Days 1 to 49. Enzyme treatments consisted of diets with or without AZ1500. Diet treatments consisted of: 1) a control diet mimicking industry nutrient levels; 2) the control diet with 0.2% phytase added, which can also be considered an enzymatic control; and 3) the control diet with increased TSAA and Lys levels. Average nutrient levels in diet 2 were reduced 2, 3, 4, and 5% relative to the control diet from 0 to 15, 16 to 31, 32 to 39, and 40 to 49 days of age, respectively. Lys and TSAA nutrient levels in diet 3 were increased 2, 4, 5, and 6% over the control diet in the 0 to 15, 16 to 31, 32 to 39, and 40 to 49 days periods, respectively. Each of 60 birds were assigned to each treatment. Interactions did not occur for BW. Day 15 and 31 BW were increased (P<0.05) in dietary treatments 1 and 3 over that of diet 2. Day 39 BW, however, was increased (P<0.05) in diet 3 over that of diets 1 and 2. The dietary addition of AZ1500 did not affect BW. An interaction (P<0.05) occurred for 1 to 39 day feed conversion whereby diet 2 with AZ1500 had better feed conversion than diet 1 with AZ1500. Diets 1 and 3 had optimal feed conversion for the 1 to 15, 1 to 31, and 1 to 49 day periods. However, 1 to 49 day feed conversion corrected for mortality was improved (P<0.05) by AZ1500. Diet 3 and AZ1500 improved (P<0.05) cold carcass weight, but treatment differences for breast meat responses did not occur.

Key Words: Enzyme, Broiler, Xylanase, Amylase, Protease

115 Feasibility of Post-Pellet Application of Dry Phytase to Broiler Diets. F. W. Edens1, C. R. Parkhurst1, P. R. Ferket2, and A. E. Sefton2, 1 North Carolina State University, Raleigh, NC USA, 2 Alltech, Inc., Nicholasville, KY USA 40356.

Methods that decrease manure phosphorus (P) concentration have focused on the use of microbial phytase enzymes coupled with reduction in feed-supplemented Ca and inorganic P. Until recently, it was not possible to incorporate phytase into pelleted feeds because the pelleting process denatured the enzyme. Liquid phytase has been used principally for post-pellet application, but shipping and handling is expensive. Therefore, post-pellet application of dry phytase would be desirable. Experiments were conducted to evaluate the influence of post-pellet application of dry phytase on performance of broilers in floor pens. Arbor Acres high yielding male broilers per pen. The chickens were managed using a standard protocol for broiler production trials in floor pens in a curtain-sided walled house. In this study, starter, grower, and finisher feeds were formulated and used. There was one control-fed group, 5 positive-fed groups in which Natuphos (Natuphos 5000, BASF Corp.) was substituted for P at the rates of 0.004, 0.006, 0.008, 0.010, and 0.012% of the diet with enzyme activities of 200, 300, 400, 500, and 600 FTU/kg of feed, respectively. Group 5 negative-fed groups in which no phytase was substituted but P was removed at the rates shown above. Use of phytase as a nutrient substitute for P in broiler diets was shown to maintain BW, maintain excellent feed:gain ratios, significantly improve body P retention, significantly decrease P excretion, maintain normal serum P (elevated in some cases) and Ca concentrations, and maintain cut-up yield of edible parts from processed broilers. The results of this study validate the concept that phytase can be substituted for P in broiler diets. In this study, phytase could be substituted for 0.55 g of P when utilized at 400 to 600 FTU/kg, but 400 and 500 FTU were more effective than 600 FTU. Our data show increased digestibility of phytate P and decreased P excretion when phytase is incorporated into the diets of broilers. However, removal of P from the feed without phytase supplementation, resulted in a negative influence on broiler performance.

Key Words: Broiler, Phytase, Phosphorus, Retention, Excretion


The effect of adding phytase (Alltech, Nicholasville, KY) and organic forms of Mn, Zn and Cu (ES49) (Eggshell 49®, Alltech) to a low-P diet on performance of a commercial strain of laying hens (Hy-Line W36) was evaluated. Eighteen replicate groups of 12 hens, housed two per cage, were assigned to each of four dietary treatments. Hens were housed and subjected to photostimulation at 17, 18 or 19 wk of age. Dietary treatments consisted of feeding a low-P basal diet alone or supplemented with phytase (11,500 ptu/kg diet) or ES49 (providing 4.5 mg Mn, 7.5 mg Zn and 1 mg Cu per kg diet as proteinates) in a factorial arrangement. The calculated nutrient content of the basal diet was: 1315 kcal AME/kg, 16.6% CP, 0.47% Met, 3.75% Ca and 0.17% available P. The trace mineral content was provided at 50 mg for Mn, 60 mg Zn and 8 mg Cu per kg diet as inorganic salts. Age at photostimulation had no effect on production parameters. Average feed intake (x = 97.4 g/hen/day), hen-day egg production (x = 80.2%), egg weight (x = 59.8 g), eggshell breaking strength and per cent shell during 13 periods of 28 days were unaffected by dietary treatments. Breaking strength and per cent ash of the humerus and tibia, measured after 8 and 10 periods of production, were also unaffected by diet. These results indicate that the level of available P and the levels of Mn, Zn and Cu in the basal diet were adequate to support layer performance.

Key Words: Phosphorus, Phytase, Mineral proteinates, Laying hen

118 Evaluation of Citrus Pulp Pellet as a Broiler Litter Chemical Composition. J.O.B. Sorbara1, M.F. Rizzo1, E.S. Nakagle1, G.L. Franco2, 1 Faculdade de Agronomia e Veterinaria - Campus de Jaboticabal, 2 UnB - Faculdade de Agronomia e Veterinaria.

The object of this experiment was the evaluation of citrus pulp pellet (CPP) as a broiler litter and the chemical composition. The first part evaluated the CPP as a broiler litter and it was published with all parameters and the broiler performance at the 89th Poultry Science Annual Meeting in Montreal, Canada. The experiment used 1,792 one-day-old male chickens divided into two phases: 1 to 21 and 35 to 49 days of age. The experimental design was a factorial 2x2x2 with four replicates. The factors were type of broiler litter (CPP and Woodshaving), broiler litter depth (7 and 10 cm) and stocking densities (10 and 14 broilers/m²). The objective was to evaluate the possible alteration in the chemical composition from the Weende, the Van Soest analysis, and the conduct of gross energy. The chemical analysis showed significant differences caused by treatment (P<0.05) for all variables except to mineral matter. This did not show significant differences between the means. However, the results indicate that the energy (gross and ash) increased, the mineral matter decreased the gross energy. Better values of crude protein were obtained with the CPP and the best values were founded in the treatment with 14 broilers/m². The comparisons of woodshaving litter before and after receiving the feces showed a difference of 18.06 point percent. The CPP showed 15.61 point percent in the crude protein; however, better values of neutral detergent fiber and acid detergent fiber was obtained with the CPP. The high level of lignin affected the
woodshavings fiber quality. The crude protein values found in the
research studies are extreme opposite because they did not consider how many
times the litter was reused and the population density used; also, they did not consider the litter depth. In conclusion, the best values
of crude protein, neutral detergent fiber and acid detergent fiber were
obtained with the CPP used as material for broiler litter. More research
is necessary to evaluate the digestibility, degradability, preservation and
microbiological quality of the material. It is recommended that chemical
analysis of poultry litter should consider the depth and the population
density.

**Key Words:** broiler, chemical analyses, citrus pulp pellet, litter

### 119 Incubation and rearing temperature effects on hsp70 levels and heat stress response in broilers. P.E.N. Givisiez*1, and M. Macarl, 1 State University of Sao Paulo, Jaboticabal, SP, Brazil.

Incubation temperature may influence the heat stress (HS) responsive-
ness of broilers. After incubation d 13, broiler embryos were subjected to
lower (L-36.8C) or higher (H-38.8C) than control (C-37.8C) tempera-
ture to evaluate prehatch thermal effects on hsp70 in heart (HHSP), liver
(LHSP) and brain (BHSP) in chicks. Birds were reared in low (l), high
(h) or thermoneutral (tn) temperatures in 9 treatment groups: Ll, Lh, Ltn;
Hl, Hh, Htn; C. Ch, Ctn. BW, feed intake (FI) and conversion (FC)
were measured weekly. Colononic temperature (RT) and tissue hsp70 were
determined at 43 to 45 d of age during graded (T0, T1 [2h/35C], and
T2 [2h/35C]) HS. In 1 d old chicks both L and H incubation decreased
(P<0.01) BHSP, H increased (P<0.01) LHSP, and L increased (P<0.01) HHSP.
At 42 d with the exception of LHSP, only rearing temperature
influenced (P<0.01) hsp70. LI and Lh treatments decreased that HHSP
was increased for HI and lower for Ltn. BHSP did not change during HS
because brain temperature is more stable during HS and high constitu-
tive levels of hsp70 inhibit inducible hsp70. Pre-HS differences in BHSP
disappeared at T2. HHSP was lower (P<0.01) at T1 and was not influ-
enced by incubation or rearing treatments. LHSP was influenced by all
factors during HS. LHSP increased (P<0.01) with time (T1) suggesting
increased heat sensitivity in l-rearing temperature. Rearing temperature
was the most important factor affecting LHSP. L-incubated birds had
lower and h-reared birds had higher (P<0.05) RT before HS but not at
T1 and T2. RT increased more slowly in h-reared birds (2.2C vs. 2.5C
and 2.8C for l and tn birds, respectively). Incubation temperature did not
influence HS response at 42 d, but rearing temperature had vari-
able effects. H-incubated birds had lower (P<0.05) BW at all rearing
temperatures until 28 d. The h-rearing temperature reduced appetite
reflected by lower FI (P<0.05) and BW (P<0.01) at 42 d. At 42 d, FI
was higher (P<0.05) only for L-incubated birds. FC was not influenced
by incubation or rearing temperature.

**Key Words:** Broiler, Heat Resistance, hsp70, Incubation, Temperature

### 120 Protein and fat quality in poultry mortality silage preserved with different sources and levels of phosphoric acid. Y. Sungwaraporn*1, P. R. Ferket, and T. F. Middleton, 1 NC State University, Raleigh, NC USA, 2AgPro Vision, LLC, Ken-
nanvilles, NC USA.

Phosphoric acid is an effective preservative of poultry mortality
silage preserved with different sources and levels of phosphoric
acid. Y. Sungwaraporn*1, P. R. Ferket, and T. F. Middleton.

Phosphoric acid is an effective preservative of poultry mortality, but im-
purities in feed-grade sources of H3PO4 may adversely affect protein and
fat quality of the silage. Adult broiler carcasses were ground and then
subjected to one of 6 preservation treatments arranged as a factorial of
2 sources of H3PO4 (feed and food grade) and 3 levels of acidification
(2.76, 5.52 and 8.28% w/w). Following 15 and 45 d of storage at ca. 22
°C, the silages were evaluated for nutrient composition and the quality
of protein and fat. Silage DM, ash and P contents increased and CP
content decreased as the level of acidification increased (P<0.01)
In contrast to the food-grade H3PO4, Fe content of silages increased as the
level of feed-grade H3PO4 increased (P<0.01), which was associated with
reduced protein and fat quality. The pH stability of silage improved as the
level of acidification increased, especially in the food-grade H3PO4
silages (P<0.01). Using ≥5.52% H3PO4 decreased levels of selected bio-
genic amines. Significant treatment interaction effects were observed in
total biogenic amine content after 15 d, but only acidification level effects
were observed after 45 d of storage. In contrast to food-grade H3PO4,
preservation with the feed-grade source resulted in higher volatile ni-
trogen (VN) (3.037 vs 1.787, P<0.01) and lower fat oxidative stability
index (OBI) (16.87 vs 38.63, P<0.01). However, using ≥5.52% H3PO4
decreased both VN level and OSI (P<0.01), regardless of source. Acidifi-
cation ≥5.52% H3PO4 also reduced %FFA (2.971 vs 1.286 and 1.205,
P<0.01) after 15 d of storage, especially when the feed-grade source was used. There was no H3PO4 source effect on %FFA after 45 d of storage.
At 2.76% H3PO4, the food-grade source was a more effective preservative of
protein and fat quality, indicating adverse effects of metal impurities in
the feed-grade source.

**Key Words:** Poultry mortality, Phosphoric acid sources, Acid preservation, Protein quality, Fat quality

### 121 Poultry Production: A Model for Developing Interactive Web-Based Courseware. J. L. Emmert1, A. M. Shortridge1, and S. L. Sexton*1, University of Arkansas.

Over the last several decades many poultry science programs have merged
with other departments, but the poultry industry has undergone tremen-
dous expansion worldwide, leading to a growing interest among students
with regard to poultry production information. The objective of this project
was address the demand for information by developing two web-based
poultry production courses that cover management of broilers, turkeys,
breeders and layers. The internet was chosen as the platform because it
is asynchronous and may be accessed from any connected site around
the world. To be effective, web-based courseware must be theoretically
grounded and interlinked. Courseware-level and basic-level education-
courses often fail to meet these standards. During courseware
development the impact of instructional techniques and technologies
on interactivity and learning outcomes was explored. A content expert,
an instructional designer and a graphic artist carefully reviewed a variety
of instructional techniques to increase interactivity. Concept mapping
was chosen because it has been shown to be a superior learning tool
for enhancing the exchange of ideas and knowledge between instructors,
students and web-based content. A unique instructional interface was
established that includes threaded e-mail discussion, thought questions,
animation, hypertext, rollover interactions, video clips and concept map-
ping exercises. Initial results indicate that the integration of concept
mapping into web-based learning environments successfully increased in-
teractivity and learning outcomes. This project is an illustration of steps
that must be considered during development of web-based courseware,
including a description of 1) the learning theory upon which the final
courseware was based, 2) differences between distance and traditional
educational settings, 3) the preparation of content, including the visual-
ization of key concepts, and 4) computer interface issues.

**Key Words:** Distance Education, Web-Based Learning Environments, Poultry Production

### 122 Optimum Site for In ovo Amino Acid Injections in Broiler Breeder Eggs. Y. Ohta*1 and M. T. Kidd2, 1 Nippon Veterinary and Animal Science University, Tokyo, Japan, 180-8602, 2Department of Poultry Science, Mississippi State, MS 39762.

In ovo amino acid (AA) administration may increase chick BW at hatch,
but optimal AA in ovo injection site remains unclear. Three experiments
were conducted to evaluate the effect of differences in in ovo AA injec-
tion sites in broiler breeder eggs on subsequent hatchability and BW of
chicks. An AA solution, identical to the AA profile of the interior egg,
was injected into eggs with 13 mm or 19 mm 27 gauge needles in Ex-
periment 1. Non-injected eggs served as the control. Hatchability was
decreased (P<0.05) in eggs receiving AA injections with the 19 mm nee-
dle in comparison to the control and 13 mm injected groups. However,
BW of chicks increased (P<0.05) relative to pre-incubational egg weight
by AA injection with 13 mm needle. In order to evaluate the in ovo
location of AA injection from Experiment 1, India ink was injected into
eggs in Experiment 2 with a 13 mm or 19 mm needle. Immediately after
injection, the air cell end of egg shell was windowed in order to observe
the effect of injection site. The amount of injected India ink was higher
in the extra-embryonic coelom in eggs treated by both needles. However,
the amount of India ink in the extra-embryonic coelom was higher (P<
0.05) in the group injected with AA solution using a 19 mm needle. Treatments
in Experiment 3 consisted of control (non-injected eggs) or windowed
eggs. Windowed eggs received AA to the chorioallantoic membrane, the yolk,
extra-embryonic coelom, or amniotic cavity at Day 7 of incubation.
Hatchability was reduced, but chicks hatched when eggs were windowed
and when AA were injected into the yolk sac or extra-embryonic coelom,
but not the chorioallantoic membrane or into the amniotic cavity. These results suggest that the best AA injection site in ovo may be the yolk and extra-embryonic coelom.

**Key Words:** Amino Acid, In ovo, Egg, Injection site, Broiler Breeder

### 123 Impact of In ovo Amino Acid Administration on Embryo Growth and Egg Content Amino Acid Profiles

Y. Ohta*, M. T. Kidd†, and T. Ishibashi†, 1Japan Veterinary and Animal Science University, Tokyo, Japan, 180-8602, 2Department of Poultry Science, Mississippi State University, Mississippi State, 39762-9665.

Experiment 1 was conducted to determine the plasma amino acid (AA) profile of hatched chicks after in ovo administration of AA. Treatments in Experiment 1 consisted of: 1) control eggs (no injection); 2) 15 mmol sterile-distilled water injected eggs; and 3) eggs injected with AA solution suspended in 0.5 mL sterile-distilled water. Injections were administered into the yolk at Day 7 of incubation. At hatch, chicks were sacrificed, bled, and plasma AA concentration was determined. Plasma AA concentration of hatched chicks decreased (P < 0.05) when water was injected. In addition, all AA from eggs injected with AA, except Glu and Lys, were decreased (P < 0.05) at hatch as compared to control eggs. However, AA pattern was not affected by in ovo water injection, but the AA ratio to Lys was reduced by in ovo AA injection. Experiment 2 was conducted to evaluate whole internal egg AA concentrations over incubation time in the presence or absence of in ovo AA administration. Treatments in Experiment 2 consisted of: 1) control eggs (no injection); and 2) eggs injected with a AA solution at Day 7 of incubation. The AA contents of embryonic tissues were analyzed over time during incubation (Day 7, 14, and 19 of incubation). On Day 14 of incubation, there were no differences in AA contents of all tissues between the control group and the group injected with AA on Day 7 of incubation. On Day 19 of incubation, AA contents of embryonic tissues were analyzed. These results suggest that in ovo administration of AA may increase AA concentrations in chicken embryos and other egg contents.

**Key Words:** Amino Acid, In ovo, Egg, Plasma Amino Acid, Broiler Breeder

### 124 Effects of ultraviolet light exposure before incubation on chick hatchability and body weight.

L.F. Hatten, III*, D.R. Ingram†, M.B. Henderson*, and S.T. Pittman*, Louisiana Agriculture Experiment Station, Baton Rouge, LA/USA.

An experiment was conducted to determine the effects of exposing eggs to ultraviolet (UV) light prior to incubation. Broiler breeder eggs were treated with one of two intensities (52.9±1.5 μW/cm² or 105.6±3 μW/cm²) of UV light for either 10, 20 or 30 min. on the day prior to incubation. All eggs were set and candled on day 7 of incubation. Apparent early dead embryos and unhatched egg counts were determined. At hatch, each chick was individually weighed and chick weight to egg weight ratio was determined. All pips and unhatched eggs were recorded. Unhatched eggs were broken and day of mortality determined. The parameters measured in this experiment include percent fertility, percent fertile hatchability, percent total hatchability, egg weight, chick weight, percent early dead and percent late dead. The data were analyzed by Analysis of Variance and the 0.05 significance level was used in determining significance. The results of the experiment showed no significant effect of either of the intensities or any of the exposure times on the parameters measured.

**Key Words:** ultraviolet light, hatchability, body weight, broiler breeder eggs, chick weight

### 125 Effect of dietary protein on laying performance and egg quality of Pearl Gray Guinea Fowl.

R.V. Vo*, N.A. Adefope, A.A. Amenyenu, D. Wright, C.L. Fenderson, and S.H. Kilonson, Jr., Tennessee State University, Nashville, Tennessee.

One hundred and eight 36-week-old Pearl Gray guinea fowl were used in a completely randomized design to study the effect of dietary protein on laying performance and egg quality. Individual birds were weighed and randomly assigned to six treatment groups. Two replicates of 9 birds each were used in each group. Six isocaloric laying rations containing 25, 23, 21, 19, 17 and 15 percent protein were fed for three 28-day periods. Birds were kept in wire cages (30.5x45.7x45.7 cm) at one bird per cage. Feed and water were given at free choice. A lighting schedule of 16 hr light and 8 hr dark was provided. Results from this study indicate that dietary protein had a significant (P < 0.05) effect on laying performance. Average hen-day egg production were 74.5, 74.7, 74.2, 72.5, 62.3 and 54.4 percent for 25, 23, 21, 19, 17 and 15 percent protein-fed groups, respectively. Egg size was significantly (P ≤ 0.05) larger and egg albumen weight was heavier in groups fed high protein levels. Shell weight, yolk weight and shell thickness were not significantly (P > 0.05) affected by the various protein levels fed. No mortality was observed during the experimental period. Based on these results, Pearl Gray guinea fowl require a minimum level of 19 percent protein in laying rations for good egg production and egg size.

**Key Words:** Guinea fowl, Egg production, Egg size, Egg component, Shell thickness

### 126 The effect of dry litter and airflow in reducing Salmonella and E. coli populations in the broiler production environment.

C. L. Eriksson de Rezende1, E. T. Mallinson1, N.L. Tablante1, L. E. Carr*, A. Park1, R. Morales2, and S. W. Joseph1, 1University of Maryland, College Park MD / USA, 2Research Triangle Park, NC / USA.

Broiler farm management should include properly maintained / repaired watering devices and appropriate house ventilation practices for an optimal pre-harvest production environment. An effective strategy to prevent dripping water and spillage and to ensure a modest but continuous and uniform flow of air directly over the litter surface appears to create an unfavorable environment for enteric bacteria. Both qualitative and quantitative findings revealed that Salmonella contamination loci are not equally distributed in the broiler litter. Higher Salmonella and E. coli counts were detected in litter samples possessing water activity (Aw) and percent moisture content (MC) levels above 0.90 and 35%, respectively. At reduced Aw and MC levels, the numbers of viable Salmonella cells were low, further reflecting the importance of preventing excessively damp areas (e.g.,cake) in broiler litter. Additionally, litter surface airflow measurements suggested that those areas exposed to modest air velocities (100 to 150 ft/min or approximately 1.5 m/s) had drier litter and reduced E. coli populations.

**Key Words:** airflow, litter management, litter moisture, water activity, Salmonella

### 127 Interactive effects of raw soybeans and T-2 toxin on adult quail.

J. Grizzle1, C. Hernandez1, and A. Houston2, 1University of Tennessee, Knoxville, TN USA, 2Arrows Ames Plantation, University of Tennessee, Grand Junction, TN USA.

Southern populations of wild bobwhite quail have declined. In Tennessee, T-2 mycotoxin has been found on winter soybeans left for wild quail. The interactive effect of T-2 toxin and the trypsin inhibitor found in raw soybeans explain population losses. An experiment was conducted to determine effects of raw soybean consumption and exposure to T-2 toxin on mortality, body weight, and differential blood analysis of bobwhite quail. Nineteen week-old bobwhite quail were fed grower diets containing 0, 20, 40 or 60% raw soybeans for 8 weeks. At 27 weeks of age, diets were reformulated to support egg production, and light was increased to 16 hr/day to stimulate puberty. One week later, females were assigned to orally receive 0, 8, or 12 mg/kg body weight (BW) T-2 toxin over a 3 week period. Each soybean/T-2 toxin treatment consisted of 14-16 hens. Mortality, body weight change, and differential blood analysis data were collected during T-2 toxin exposure, and for 2 weeks later. Female exposure to 12 mg/kg BW T-2 toxin resulted in 33.3% mortality, which was more (P < 0.05) than hens exposed to 0 or 8 mg/kg BW (7.4% vs. 10.6%). Concomitant consumption of raw soybeans numerically increased (P > 0.05) mortality rate. Overall body weight gain was lowest (P < 0.05) among hens dosed with 12 mg/kg BW T-2 toxin (1.6 gm). Body weights were not changed by dietary soybeans during exposure to T-2 toxin, however during the recovery period, hens fed 60% raw soybeans lost 2.8 gm BW as compared to hens eating no soybeans who gained 11.9 gm (P < 0.05). Total white blood cell (TWBC) count was highest among hens exposed to 12 mg/kg BW T-2 toxin (34.9 x 10³/mm³). While TWBC increased among all birds, TWBC among hens fed 0 % raw soybeans did not (P > 0.05) change during the experiment (17.9 vs. 26.3 x 10³/mm³ for week 0 and 5 respectively). TWBC of hens fed raw soybeans increased (P < 0.05; 16.7 vs. 32.4; 17.1 vs. 32.7; 14.6 vs. 28.7 x 10³/mm³ for 20, 40 and 60% diets). Percent heterophils were highest (P < 0.05) among hens.
exposed to 12 mg/kg BW T-2 toxin (14.84 %) vs. 0 controls (11.43 %). Management of wild quail may require over-wintering of some other grain source than soybeans.

Key Words: Mycotoxin, Quail, Soybean

128 Studies on Polymorphonuclear Leukocytes in avian coccidiosis: 1. Effect of Eimeria tenella Infection Granulocytopenic Chickens. X Hernandez1,*, G Tellez1, and VM Petrone1, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

The importance of the immune response mediated by cells in Eimeria tenella (Et) infections, has been widely demonstrated. However, the behavior of the polymorphonuclear leukocytes (PMN) in these parasitosis has not been well studied. Male and female broiler were assigned to 4 groups of 12 chickens each: 1) control, 2) treated with 200mg/kg of body-weight of 5 fluorouracil (5-FU) as a single dose, 3) infected with 5,000 Et sporulated oocysts and 4) treated with 5-FU and infected with Et. The 5-FU was administered intravenously at the 17th day of age, 2 days later, the birds were infected with Et. A blood sample was taken from 10 birds of each group at 1,3,5,7,8 and 9 days PT to obtain the PMN/total leukocytes (LT) rate. Nine birds of each group were slaughtered 7 days post infection with Et to value the degree of cecal lesions and the amount of oocysts in the ceca. The PMN/LT ratios were similar among groups 2 and 4. A significative reduction was observed (P<0.05) on PMN/LT ratios of days 7 through 9 PI in the birds treated with 5-FU. The group that was infected only with the parasite, showed a biphasic increase on the PMN/LT ratios (P<0.05) at days 1 and 6 post inoculation, which could be related with the liberation of the sporoxozites from the oocyst for searching a host cell and with a great release of antigenic material that goes with a big tissue damage respectively. The final number of oocysts in the group treated with 5-FU and infected with the parasite, was highly significative (P=1.611-7) and the degree of cecal lesions was higher. These results show that although the PMN presence is not very important on Et infections, they do participate in primary infections and their absence enables the parasite reproduction in the host and that suggests that the PMN/LT increased ratios could be related with the phagocytosis of the asexual and extracellar stages.

Key Words: Eimeria tenella, Polymorphonuclear Leukocytes, 5 fluorouracil, Hematology, Granulocytopenic Chicken

129 Neonatal Immunoprophylaxis against a velogenic strain of Newcastle disease virus. J Alfaro1, T Fehervari1,*, VM Petrone1, and G Tellez1, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

The purpose of the current study was to investigate the effect of prophylactic treatment on one day old broiler chicks with soluble products contained in the supernatants obtained from splenic lymphoid cells cultures (5 x 106 cells/ml) stimulated with concanavalin-A (7.5 mg/ml) originating from immunized chickens with three doses of 108 CFU/ml of Salmonella enteritisid, (SE-ILK, S. enteritisid-immune lymphokines) against a challenge made with the velogenic Chimalhuacan strain of New- castle disease virus (NDV). At one day of age, chicks were weighed and injected intraperitoneally with 0.5 ml of SE-ILK at one-day old; thirty minutes later they were challenged with a dosage of 107.6 EID50/ml of NDV. Obtained results showed that SE-ILK administration was able to confer resistance to birds because: a) it significantly diminish infection severity by inhibiting appearance of clinical signs (p<0.001), lesions (p<0.005) and histopathological changes (p<0.005) suggesting Newcastle disease; b) it decreased NDV isolation rate from challenged bird organs (p<0.005); and c) it potentialized and even accelerated (p<0.005) primary response by antibodies in Leghorn chicks in the presence of a NDV infection

Key Words: Immunoprophylaxis, Broiler, Resistance, Salmonella enteritidis, Organ invation

130 T cells lymphokines confer protection to neonatal broiler chicks against Salmonella enteritidis. J Alfaro1, T Fehervari1,*, VM Petrone1, G Tellez1, and R Santiago*, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

Broiler chicks were treated prophylactically with the soluble products from concanavalin A-stimulated T-lymphocytes from Eimeria tenella-infected chickens in order to investigate the effect of such prophylactic treatment on organ invasion by Salmonella enteritidis. Chicks were randomly assigned in three groups: group a) experimental group (S. enteritisid-infected, treated); at one day of age chicks were injected intraperitoneally with E. tenella-immune lymphokines, and thirty minutes after the lymphokines injection all chicks were challenged with 105 colony-forming units of S. enteritidis; group b) positive control group (S. enteritisid-infected, not treated) and group c) the negative control group (S. enteritisid-not infected, not treated). At 24 hours post-challenge all chicks were humanely euthanized, and their liver, spleen and cecal tonsils collected. Isolation of S. enteritidis was attempted from these tissues. The treatment of chicks with lymphokines resulted in reduction of S. ente-ritisid isolation from liver-spleen (P<0.05) but not from cecal tonsils (P>0.05). These results demonstrate that the prophylactic treatment with E. tenella-immune lymphokines reduces the S. enteritidis organ inva- sion but not the intestinal colonization in neonatal broiler chicks.

Key Words: Immunoprophylaxis, Broiler, Resistance, Salmonella enteritidis, Organ invation

131 Lymphokines prophylactic use to increase the resistance in Leghorn chicks against a velogenic strain of Newcastle disease virus. J Alfaro1,*, G Tellez1, and VM Petrone1, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

One day old Leghorn chicks were prophylactically treated with lymphokines supernatants obtained from lymphocytes cultures proceeding from infected chickens with Salmonella enteritisid (SE-ILK, S. enteritisid-immune lymphokines). The objective of the current study was to in- vestigate such treatment effect in the presence of an infection with the velogenic Chimalhuacan strain of Newcastle disease virus (NDV). Supernatants were obtained from splenic lymphocytes cultures of immunized chickens with three doses of 108 cfu/ml of S. enteritisid and stimulated in vitro with concanavalin-A (7.5 mg/ml). Leghorn chicks were injected intraperitoneally with 0.5 ml of SE-ILK at one-day old; thirty minutes later they were challenged with a dosage of 107.6 EID50/ml of NDV. Obtained results showed that SE-ILK administration was able to confer resistance to birds because: a) it significantly diminish infection severity by inhibiting appearance of clinical signs (p<0.001), lesions (p<0.005) and histopathological changes (p<0.005) suggesting Newcastle disease; b) it decreased NDV isolation rate from challenged bird organs (p<0.005); and c) it potentialized and even accelerated (p<0.005) primary response by antibodies in Leghorn chicks in the presence of a NDV infection

Key Words: Immunoprophylaxis, Leghorn chick, Newcastle disease virus, Antiviral, Salmonella enteritidis

132 Studies on Polymorphonuclear Leukocytes in avian coccidiosis: 2. Effect of Eimeria tenella and Salmonella Infection in Cecal Polymorphonuclear Leukocytes from Leghorn Chicks. V.M. Petrone1,*, F Constantino1, P Pradal-Roa1, and X Hernandez1, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

Cellular inflammatory response in chicken has not been studied in de- tail, because avian granulocytes could not be distinguished clearly with hematoxylin and eosin (HE) staining method. Therefore, it is necessary to use histochemical techniques. Three experiments were carried out using 4 weeks old Leghorn chickens. Three groups of 80 chicks each were orally inoculated with 1) 105 viable Salmonella enteritidis, 2) 104 sporulated Eimeria tenella oocysts and 3) 108 viable Salmonella enteritidis and 104 sporulated Eimeria tenella oocysts. Tissue samples were taken and fixed in 10% neutral formalin in different times after treatment. In experiments 1), 2) and 3), cecal samples were taken at 4, 8, 12 h, and 1, 3, 5, 7, 14 days postinoculation (Pi). The samples were stained with HE in order to identify heterophils and eosinophils, Ziehl-Neelsen was used for mast cells and p-phenylene diamine dihydrochloride plus pyrocatechol was used for eosinophils. Birds of experiment 1) did not have change in
granulocytes number (P<0.05). The number of cecal mucosal and submucosal heterophils increased on days 5 and 7 Pi in experiments 2) and 3) (P<0.05). Meanwhile, cecal submucosal mast cells decreased in number on day 3 Pi in experiment 3). Cecal mucosal mast cells also increased between days 7 and 14 Pi in experiments 2) and 3). Eosinophils showed a increase on day 5 Pi in experiment 3). Heterophils and mast cells were seen during the acute inflammation process 12 h later E. tenella infection.

Key Words: Heterophil, Mast cell, Inflammation, Eosinophil, Polymorphonuclear granulocyte

133 Histologic Evaluation of Some Immune Organs in Chicken Embryos Inoculated with Herpesvirus and Avian Lymphokines. M. Ortiz1, C Tellez1, R.M. Petrone1, and T Fehervari1, 1Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autonoma de Mexico.

The aim of the present study was to evaluate the presence of lymphocytes and granulocytes in different stages of embryonic development and first posthatching day. The lymphocytes present in the bursa of Fabricius and thymus was evaluated using the histological analysis of the yolk sac, bursa of Fabricius, thymus, liver and bone marrow of 100 chicken embryos divided into groups and treated with: (I) Marek’s disease vaccine, (II) Marek’s disease vaccine plus lymphokines, (III) Lymphokines, (IV) Vaccine diluent. Group V was non-treated. Samples were taken on days 14 and 17 and 20 of embryonic development and first posthatching day. An increase in the number of lymphoid follicle was observed in the bursa of Fabricius of embryos inoculated with lymphokines compared to embryos comprised in all the other groups (p<0.05). In addition, a greater amount of granulocytes was found in yolk sac and liver of embryos treated with lymphokines than in all other groups embryos (p<0.05). In the bone marrow, no significant difference was observed amongst treated groups concerning the amount of granulocytes. Results suggest that administration of antigens or protein molecules at an early stage of embryonic development, increases granulopoiesis in the liver and yolk sac, and also increases the number of lymphoid follicles in bursa of Fabricius.

Key Words: Chicken embryos, granulocytes, lymphocytes, lymphokines, herpesvirus

134 Photoreceptor Density in the Retina of Commercial Egg-Type Laying Hens in Relation to Specific Performance Characteristics. V. C. Sampath1, D. A. Samuelson, and R. D. Miles, 1University of Florida, Gainesville, Florida / USA.

Within any flock of layers, the percentage egg production, following peak, declines as the laying cycle continues. The percentage egg production at any one point in time during the egg production cycle is a reflection of the birds laying above and below the flock mean. Also, when a flock of pullets enters production, there are birds that are early maturing and some late maturing. With this in mind, two experiments were conducted. In exp. 1, 18 commercial egg-type hens at 70 weeks of age were separated into two groups based on egg production. Nine hens with the best egg production (>80%) and 9 hens with low egg production (40-50%) were selected. In exp. 2, pullets entering egg production were separated into those maturing early and late. Seven birds per group were selected. All selected birds within each experiment were killed, and the right eye of each bird was immediately enucleated and placed into a cool phosphate buffered solution. The anterior chamber and vitreous were removed and the globes were filled with phosphate buffer solution followed by the extraction of the retina. Each retina was placed on gel paper and carefully spread with the photoreceptor side facing upwards and then fixed for microscopic mounting. The rods and cones (per µm²) were counted using Nomarski differential interference contrast microscopy at a magnification of 1000x, with the assistance of computer image analysis. The results indicated that there were no significant differences in rods/µm² (21 vs 20, respectively) or cones/µm² (77 vs 72, respectively) between birds coming into production early and birds coming into production late. There were no significant differences in rods/µm² between good and poor egg production hens (13 vs 11, respectively). However, when the density of the cones/µm² was determined in good vs poor egg producing hens, there was a significantly greater density (P<0.001) of cones (69 vs 45, respectively).

Key Words: retina, rods, cones

135 Genetic Characterization of Stress Responsiveness in Japanese Quail. F. M. Odeh1, L. L. Geagan1, and G. G. Cadd1, 1Department of Poultry Science, Louisiana State University Agricultural Center, Baton Rouge 70803.

Stress responsiveness of quail lines divergently selected for plasma corticosterone response to immobilization stress was investigated utilizing a diallel crossing scheme. Two quail lines divergently selected for 13 generations (HS= high stress and LS = low stress) were used to study corticosterone level of progeny produced from a di- allel cross. Unselected random bred (RB) quails were added as a control line. These lines (HS, RB, LS) were crossed in a 3 x 3 di-allel to produce 482 progeny that were immobilized and bled. Plasma corticosterone was assayed to estimate the quantitative genetic inheritance for stress responsiveness in the crosses. This paper presents the estimates to the following genetic effects: heterosis, average line effects, general and specific combining ability (GCA and SCA, respectively), reciprocal cross effects, maternal effects, sex-linkage effects and heterosis due to the sex chromosomes. In addition, the study is concerned with other genetic aspects and presents the estimates of heritability, additive genetic variance, and dominance deviation. In this study, GCA, maternal, and reciprocal effects were significant for the corticosterone levels for all the lines whereas SCA effects were insignificant. Reciprocal differences were large within HS x LS crosses and HS x RB crosses. There were non-significant differences in the means of corticosterone levels between males and females from all the crosses except that from LS x LS crosses. Additive sex linkage effects were specified and of much less importance than maternal effects. Heterosis effects within each line were low and most likely due to either the increase homozygosity of sex chromosomes or the increase of maternal effects within reciprocal crosses. Heritability, estimated from GCA for the corticosterone level, was 31, 19, & 13% for HS, LS, & RB lines respectively.

Key Words: Corticosterone, Stress, GCA, Heterosis, Japanese Quail

136 Examination of the Relationship Between the Daily Growth and Feed Intake Velocities of Individual Broilers. K.J. Vandegrift*, T.L. Cravener, and W.B. Roush, 1Penn State University, University Park, PA.

Examination of the Relationship Between the Daily Growth and Feed Intake Velocities of Individual Broilers. K.J. Vandegrift, T.L. Cravener, and W.B. Roush. Department of Poultry Science, Penn State University, University Park, PA 16802.

Previous studies have demonstrated that daily growth velocity (i.e. BW (d1+d2)-BW (d1)) of individual birds was oscillatory in nature (Roush, et al., 1988, and Roush and Wedman, 2000). The first objective of this experiment was to determine if feed intake velocity (FIV) was also oscillatory. Given this was true, the second objective was to examine the relationship between FIV and bodyweight velocity (BWV). Twenty-five Ross x Arbor Acre male broiler chicks were placed in individual brooder batteries at 1 day of age. At 20 d the broilers were moved to individual grower cages. A commercial starter feed (1410 ME and 22 % CP) and water were provided ad libitum for all 49 d. Birds were housed with 24 hour lighting in a temperature controlled environment. Daily BW, shank length, and feed intake were measured at 1100 for each of 49 d.

It was confirmed that daily BWV and FIV for individual birds were oscillatory. Regression analysis indicated the presence of r² values for the correlation between BWV and FIV was .61. Using a Kohonen neural network, the oscillatory BWV responses were clustered into three phases: 0 to 21 d, 22 to 30 d, and 31 to 49 d. The three phases for FIV were 0 to 21 d, 22 to 31 d and 32 to 49 d. Regression analysis (BWV vs. FIV) of phases 1, 2, and 3 revealed r² values of .77, .61, and .42, respectively. The 49 d relationship between shank length velocity and feed intake had an average r² of .02. The Kohonen neural network did not distinguish different phases for shank length velocity.

In conclusion, the mathematical relationship between BWV and FIV was divided into three phases with decreasing r² values over the phases. It is suspected that the decrease in r² values may be related to feeding the starter ration throughout the 49 d.

Key Words: Growth Velocity, Feed Intake Velocity, Neural Network, Cluster Analysis
137 Sex-differences in benzodiazepine receptor changes and corticosterone release after acute stress in broiler chicks. R. H. Marin*1, E. Benavidez2, D. A. Garcia2, and D. G. Satterlee1, 1 Department of Poultry Science, Louisiana State University, Baton Rouge, LA 70803, USA, 2 Catedra de Quimica Biologica, F.C.E.F.y.N. Universidad Nacional de Cordoba, Cordoba, Argentina.

The purpose of the study was to determine whether male and female broiler chicks show contrasting benzodiazepine receptor responses to an acute stressor and the relationship to adrenocortical response, if any. Birds were housed in 10 mixed-sex groups of 8 chicks. At 15 days of age, 1 chick was taken from a randomly-selected cage and immediately blood sampled (undisturbed controls). At the same time, another chick was taken from the same box and immersed up to its neck in warm water (partial water immersion, PWI) for 15 min before blood sampling. Forebrains were subsequently dissected for synaptosomal membrane preparation.

Gender was also determined during dissection. Plasma corticosterone levels were assessed by competitive protein-binding method. Benzodiazepine receptor densities were determined by radiolabeled receptor binding assay. Within the controls, there were no gender differences in plasma corticosterone (CS) levels or benzodiazepine receptor densities. Exposure to PWI significantly increased circulating CS levels in both sexes. The PWI-induced CS elevation was more pronounced in males than in females. Male, but not female, chicks also showed a significant stress-induced increase in benzodiazepine receptor densities. These findings showed a sexual dimorphism in acute, stress-induced benzodiazepine receptor expression and adrenocortical responses suggesting that broiler males are more stress-susceptible than females.

Key Words: Broiler chicks, Acute stress, Benzodiazepine receptors, Plasma corticosterone.

138 Heart and Breast Muscle Mitochondrial Dysfunction in Broilers with Pulmonary Hypertension Syndrome. Z. Tang*, M. Iqbal, D. Cawthon, and W. Bottje, Dept. of Poultry Science, Univ. of Arkansas, Fayetteville AR 72701.

This study was designed to determine function and site-specific defects in the electron transport chain (ETC) of heart and breast muscle mitochondria isolated from broilers with and without PHS. The respiratory control ratio (RCR, and index of ETC coupling) was lower in PHS mitochondria; however there were no differences between groups in the ADP/O (an index of oxidative phosphorylation). The activity of ETC Complex I (NADH ubiquinone reductase) was a) lower in PHS heart mitochondria compared to Controls, b) positively correlated with the RCR, and c) negatively correlated with the right ventricular weight ratio. Dichlorofluorescin fluorescence was used to detect H2O2, (an index of electron leak from the ETC), in mitochondria (provided pyruvate/malate as an energy substrate) with and without ETC inhibition. Basal H2O2 production was higher in PHS than in Control mitochondria. H2O2 production was elevated in both groups by rotenone and antimycin A, inhibitors of Complex I and III (cyt b562), respectively, but the incrementally higher in PHS mitochondria than in Controls. Myxothiazol (Q cycle inhibition) had no affect on H2O2 production in either PHS or Control mitochondria.

The results of this study indicate that mitochondrial dysfunction in PHS is associated with lower Complex I activity, and site-specific defects at Complex I and III (cyt b562) of the respiratory chain in heart and breast muscle mitochondria (Supported by US Poultry and Egg Assoc. and USDA-NRI #99-02123 to W. Bottje).

Key Words: Pulmonary Hypertension Syndrome, Heart and Breast Muscle Mitochondria, Broilers.

139 The Effects of Electrical Stimulation During Exsanguination on Tenderness and Cook Loss of Breast Fillets from Spent Hens Deboned at Two or Twenty-Four Hours. J. A. Dickens*, L. C. Lyon1, and R. J. Buhr1, Russell Research Center, Athens, GA.

Electrical stimulation of broiler carcasses during bleed out has been shown to affect the functional properties of breast fillets (Pectorales), but little work has been reported on spent hens. This study evaluated the effects of electrical stimulation on the objective texture and cook loss of hen meat deboned after 2 and 24 h post evisceration. Hens were electrically stunned, 15 V pulsed direct current and killed using commercial equipment. Birds were then either bled for 90 sec or allowed to bleed for 15 sec and then stimulated for 60 sec with 200 V alternating current, one sec on, one sec off for 60 sec during exsanguination. Carcasses were then scalped for 2.5 min at 56 °C, defeathered, eviscerated, and chilled in agitated ice baths at 1 °C for 2 h. When carcasses were removed from the chill the right fillet was deboned, weighed, vacuum-bagged and held at 4 °C for the next morning. The carcasses with the left fillet attached was held on ice for and additional 22 h. The next morning the left fillet was deboned, weighed, and vacuum-bagged in preparation for cooking. All fillets were cooked at 85 °C for 45 min, tempered to room temperature, drained, weighed, and then two adjacent 1.9 cm strips cut and trimmed to a thickness of 1.9 cm. Shear values were determined using a Warner-Bratzler shear device. Electrical stimulation resulted in 50% lower shear values for fillets deboned at 2 h (6.8 kg ± tender) compared to the non-stimulated fillets (13.8 kg ± tough). Cook loss was 1.8% less for stimulated fillets (22.6%) compared to non-stimulated fillets (24.4%). There were no significant differences in shear values or cook loss values for deboned fillets at 24 h.

Key Words: Spent Hens, Electrical Stimulation, Objective Tenderness.

140 Costs and Benefits of New and Proposed Food Safety Regulations in the Poultry Industry. Rimma Shiptsova*1 and H.L. Goodwin, 1 University of Arkansas.

This poster presents benefits and costs analyses of the USDA Food Safety and Information Service (FSIS) implementation of the regulatory HACCP procedures. The implementation began on January 27, 1998 in the poultry and poultry plants. A major unknown of these integrators has been the actual costs associated with preparation, implementation, monitoring, and production adjustments resulting from HACCP enforcement by FSIS. The USDA FSIS conducted only an ex-ante economic impact assessment of the pathogen reduction regulation that showed the projected benefits from reducing foodborne illness greatly exceed the costs to the industry of carrying out the regulatory requirements. The poster presentation will be based on results of three different industry surveys. Two of the surveys were sent to plant managers of the eleven firms participating in the HACCP Roundtable, an academic, governmental, and industry group which meets monthly to discuss issues related to HACCP implementation and monitoring. Responding plants represent over 25 percent of the industry and include Tyson Foods, Wayne Farms, Pilgrims Pride, Georges, and Simmons Foods. These surveys assess HACCP implementation costs in 1998 and 1999. The third survey was performed by the National Chicken Council on projected ingesta costs to examine a zero tolerance ingesta proposal. From HACCP cost surveys, total poultry industry costs of HACCP preparation, implementation, and monitoring were identified. The data was aggregated upon receipt to avoid revealing confidential information. An equilibrium displacement model was employed to analyze producer welfare losses with and without the substitution effect. The poster will present the unique primary data from poultry slaughter plants and welfare changes resulting from these costs. Real data shows that actual costs greatly exceed costs projected by the USDA/FSIS Center of Prevention Control. These data and results will be also presented to assess the benefits of the new regulation in terms of health human incidences from foodborne illness.

Key Words: Food safety, HACCP costs, Industry surveys


Differences in the in vitro inhibition of Listeria monocytogenes growth by 4 formulations of the herbal extract, Protecta, were determined. Cultures of L. monocytogenes ATCC #19932 were grown in Brain Heart Infusion (BHI) for 18-24 h at 37°C. Bacterial cells were harvested by centrifugation, and cell pellets were rinsed in peptone water. The rinsed cells were centrifuged, and the final cell pellet was suspended in fresh peptone water. A portion of the cell suspension was added to a Nephelometer culture flask, and a spectrophotometer was used to detect the optical density (OD) of the suspension. Peptone water was added to the flask to adjust the OD of the suspension to a value equivalent to a population of 108 cfu/ml. Solutions of Protecta 1, 2, 3a, or 3b were prepared by dissolving the extracts in distilled water. The Protecta solutions were filter sterilized and added to sterile BHI to produce final concentrations of 0, 0.005, 0.010, 0.015, or 0.020% (w/v) of each Protecta in the medium. The L. monocytogenes suspension was serially diluted and added to BHI/Protecta mixtures in test tubes to yield a final concentration of 105 cfu/ml. Aliquots of 0.1 ml of the inoculated BHI/Protecta mixtures were added to separate wells of
a Bioscreen honeycomb plate. The filled honeycomb plates were placed in a Bioscreen C Microbiology Reader, and the reader was programed to monitor changes in the OD of the cultures during a 48 h incubation period at 37°C. Analysis of results indicated that during incubation, there was a significant increase in the OD of L. monocytogenes cultures grown in BHI not supplemented with Protecta and in BHI supplemented with 0.005% of Protectas 1, 2, 3a, or 3b; 0.010% of Protectas 2, 3a, or 3b; or 0.015% of Protecta 3b. There was no significant change in the OD of cultures grown in BHI supplemented with concentrations >0.010% of Protecta 1, >0.015% of Protectas 2 or 3a, or 0.020% of Protecta 3b. Findings of this study indicate that when used at appropriate concentrations, each Protecta formulation can inhibit L. monocytogenes growth in vitro. The relationship between the inhibitory activities of the Protectas and their elemental composition; these results indicate that the effects are substantial and reproducible. The bacterial counts from the ionized surfaces were significantly less than for the non-ionized surfaces. The numbers of bacteria on stainless steel coupons were reduced with greater than 99% efficiency. The ESCS could have an impact on the microbial load in a poultry processing facility, and at least a portion of this effect would be through direct killing of the organisms. The ESCS does not produce measurable ozone and is non-chemical. The equipment cost for this technology in a poultry processing facility would probably be comparable to existing disinfection equipment and chemicals.

Key Words: Ionization, Biofilm, Stainless steel

142 Electrostatic Space Charge System Kills Bacteria on Surfaces. J Arnold1 and B Mitchell1,1 USDA/ARS, Richard Russell Research Center, 2USDA/ARS, Southeast Poultry Research Laboratory.

The use of bactericidal treatments that are safe and non-toxic will enhance food safety and reduce the impact of sanitation practices on the environment. Studies on air ionization have been drawing a great deal of attention because of biological aspects ranging from lethal effects on microorganisms to therapeutic effects. This new technology has shown potential to effectively reduce airborne and surface microorganisms. In this study, the approach utilizes a small chamber with an electrostatic space charge system (ESCS). The ESCS was used to transfer a strong negative charge to bacteria on stainless steel coupons at the base of the chamber. Bacterial populations from a poultry processing facility were collected, grown as biofilms on the coupons, and assessed for susceptibility to negative air ionization. Three groups were included in the study: coupons with bacteria that were ionized, coupons with bacteria that were not ionized, and negative controls (coupons without bacteria). Our results indicate that the effects are substantial and reproducible. The bacterial counts from the ionized surfaces were significantly less than for the non-ionized surfaces. The numbers of bacteria on stainless steel were reduced with greater than 99% efficiency. The ESCS could have an impact on the microbial load in a poultry processing facility, and at least a portion of this effect would be through direct killing of the organisms. The ESCS does not produce measurable ozone and is non-chemical. The equipment cost for this technology in a poultry processing facility would probably be comparable to existing disinfection equipment and chemicals.

Key Words: Listeria monocytogenes, Protecta, Herbal extracts, Antibacterial

143 Surface Characteristics of Finished Stainless Steel Related to Prevention of Bacterial Attachment and Biofilm Formation. D Booth1 and J Arnold, USDA/ARS, Richard Russell Research Center, Athens, GA 30605.

Prudent selection of materials used to manufacture food processing equipment is important because materials resistant to bacterial contamination will ultimately improve the safety of the food supply. In this study, stainless steel disks treated with a variety of finishes used in the poultry processing industry were analyzed for surface characteristics important for prevention of bacterial attachment and biofilm formation. Finishes on test disks included steel-ball burnished, glass-beaded, electropolished, acid-dipped, sandblasted, and unfinished. Individual disks were initially incubated with mixed bacterial cultures from chicken caras rinses, and culture growth was monitored by spectrophotometry. Control disks were incubated in sterile broth under the same conditions. Scanning electron microscopy (SEM) was subsequently used to determine bacterial numbers on disk surfaces. Atomic force microscopy (AFM) was utilized to analyze surface morphology, such as roughness, maximum depth, and center line average, and bearing ratio/area. AFM measurements obtained herein will aid poultry processing equipment manufacturers and processors in selecting surface finishes that are resistant to bacterial attachment and biofilm formation.

Key Words: Stainless steel, Biofilm, Atomic force microscopy

144 Filling and emptying of the alimentary tract of mealfed broiler breeder hens. R. J. Buhrl,1 J. A. Dickens1, and J. L. Wilson2,1 Russell Research Center, Athens, GA., 2University of Georgia, Athens, GA.

To evaluate the rate of alimentary tract filling and emptying following a single meal feeding, breeder breeder hens were processed successively over a two day period. Breeder hens from the same flock at 45 and 67 wk-of-age (3.4 and 3.9 kg body weight) were fed 133 g/hen at 06:00 and then cooled and processed after 2, 4, and 6 h. A duplicate set of hens remained in coops overnight and were processed the following morning at 08:00. The alimentary tract was excised following stunning, bleeding, scalding and defeathering. The tracts were separated and weighed in three segments; the crop, proventriculus and gizzard, and intestines (duodenum to vent; n = 6 / cooling time / age). On the day of feeding, peak crop weight was attained at 4 h (145 g) for the young hens and at 6 h (108 g) for the older hens. Peak weight for the proventriculus and gizzard was attained at 6 h for both age hens (76 and 81 g). Peak intestine weight was attained sooner at 2 h (173 g) for the younger hens and at 4 h for the older hens (209 g). The following morning tract segment weights did not differ among hens at any cooling time for the crop (12 g), proventriculus and gizzard (66 g), or intestines (152 g younger and 200 g older hens). Clearance of the crop and proventriculus readily occurred overnight while hens were held in coops without access to water. However, not until after 50 h off feed had the intestines appeared to have attained a minimum value (125 g young 162 g older hens). These results demonstrate that cooping breeder hens at 2, 4, or 6 h after feeding resulted in comparable alimentary tract clearance when processed the following morning. In addition, an average crop weight of 12 g was attained for hens in all groups when held in coops overnight. This finding suggests that when hens have crops that contain a significant amount of feed at processing, they were likely processed on the same day they were fed and cooled.

Key Words: Broiler breeder hens, Feed withdrawal, Alimentary tract, Cooping, Crop

145 Effect of cooling method, time and temperature on internal temperature of rapidly cooled shell eggs. A.J. Farr1, C.T. Pollet1, D. Carter1, and A.J. Hebert1,1 Poultry Science Department, LAES, LSU Ag Center, Baton Rouge, LA 70803.

Two experiments were conducted by placing shell eggs in either a blast freezer or cryogenic tunnel at temperatures ranging from -29C to -62C for short (minutes) time periods. Just laid eggs were washed in water of 45C for two minutes just prior to rapid cooling. Eggs were placed directly on a wire meshed moving belt located inside a carbon dioxide cooled cryogenic tunnel. Eggs were uncovered. Tunnel temperature was varied from -29C to -62C in increments of 5.5C. The speed of the belt was set to allow the eggs 2.4,6 minutes to travel through the tunnel at each temperature. The experiment consisted of ten eggs at each temperature (7) by time (3) setting, resulting in 21 treatments. Anode characterization was conducted by placing eggs in either the cryogenic system mentioned above or a blast freezer both set to -29C. Eggs remained in both systems for 2,4,6,8 minutes. The internal temperature of each egg was measured immediately after the time periods. The carbon dioxide tunnel (at -29C) cooled eggs to a lower internal temperature than the blast freezer (at -29C) when exposed for 4,6,8 minutes. Exposing eggs for two minutes did not adequately cool egg internal temperature. Eggs cooled for 4 and 6 minutes had significantly lower internal temperatures which plateaued upon reaching the -40C treatment. Ice crystals were observed for some of the treatments.

Key Words: Egg, Cooling, Cryogenic
Abstracts of Papers

146. Addition of corn oil or poultry oil to the diet of commercial layers will increase early egg size. R. H. Harms*, C. R. Bohnsack, W. D. Merkel, and G. B. Russell, University of Florida, Gainesville, Florida/USA.

An experiment was conducted with Hy-Line W36 hens. Diets were fed that contained zero, 2, 4, and 6% fat supplied by either corn oil (CO) or poultry fat (PF). The diets were not isocaloric, and were fed for 26 to 38 wk of age. One-half of the hens were maintained at 29.4°C. The temperature for the other one-half of hens was allowed to fluctuate from 4.4 to 29.4°C. The interaction of temperature X treatment was not significant for any measurement; therefore, results were combined. Egg weights were 56.6, 57.2, 58.4 and 58.7 g for hens receiving diets with 0, 2, 4 and 6% fat, respectively. The percentage of eggs weighing 56.7 g and more (large) was 47.9, 53.5, 66.9 and 72.6% for hens receiving 0, 2, 4 and 6% fat, respectively. Egg weight was 58.4 and 57.8 g, with 63.0 and 60.6% weighing more than 56.7 g for the CO and PF treatments, respectively. Feed consumption was 92.7, 92.7, 92.0 and 87.9 g, with daily energy intakes of 261, 267, 275 and 276 kcal/day for hens receiving diets with 0, 2, 4 and 6% fat, respectively. The addition of at least 4% fat to the diet is recommended to increase early egg weight.

Key Words: commercial layer, egg size, egg weight.

147. Influence of Calsporin on Commercial Leghorns. Syed S. Sohail*, Mary M. Bryant, and David A. Roland, Auburn University, Auburn, Alabama.

Antibiotic feed supplements is a major concern because of potential development of antibiotic resistant bacteria. Probiotics are being focused as alternate feed supplements for maintaining health and performance. Previous results indicate that Calsporin (a Bacillus subtilis originated probiotic) has a beneficial effect on broilers. Very little work has been done to determine the effect of Calsporin on hen performance. Three levels of Calsporin (0, 0.003 and 0.006%) with three levels of protein (15.02, 16.06 and 17.34) were fed to commercial Leghorns (n=1440; second cycle phase 1) as a 3 x 3 factorial for 10 wk. Egg production (EP), feed consumption (FC), egg production (EP), egg specific gravity (SG), egg shell strength (ESS), egg shell thickness (EST), and body weight (BW) were determined. A significant increase in EP, FC, and EW was observed as dietary protein was increased. A Calsporin x protein interaction (P < 0.01) was observed on SG. Calsporin (0.003%) increased SG at the two higher levels of protein but not at the lowest. Calsporin supplementation had no significant influence on EW, ESS, EST and BW. However, these results indicate that Calsporin has a significant effect in improving egg specific gravity.

Key Words: Bacillus subtilis, Egg specific gravity, Leghorns, Protein.

148. Effects of strain (Bovans; Hyline), lighting (regular; midnight feeding), body weight (light to heavy), and dietary electrolyte supplements (calcium chloride; sodium bicarbonate) on performance of caged, molted White Leghorn layers. L. R. Miner*, D. M. Hooge, and K. R. Cummings, 1 Southern States Cooperative, Richmond, VA, 2 Hooge Consulting Service, Inc., Eagle Mountain, UT, and 3 Church & Dwight Company, Inc., Princeton, NJ.

About 6,000 caged, molted White Leghorn (Bovans; BOV; Hyline W-36, HYL), 100 wk of age, were used in a 12-wk trial to evaluate effects of lighting (regular 17 hr, REG, vs 16 hr + 1 hr at midnight, MNF), body weight (5 categories at 20% increments, light to heavy), and dietary electrolyte supplements (calcium chloride; sodium bicarbonate). The percentages of eggs weighing 56.7 g and more (large) was 47.9, 53.5, 66.9 and 72.6% for hens receiving diets with 0, 2, 4 and 6% fat, respectively. Egg weight was 58.4 and 57.8 g, with 63.0 and 60.6% weighing more than 56.7 g for the CO and PF treatments, respectively. Feed consumption was 92.7, 92.7, 92.0 and 87.9 g, with daily energy intakes of 261, 267, 275 and 276 kcal/day for hens receiving diets with 0, 2, 4 and 6% fat, respectively. The addition of at least 4% fat to the diet is recommended to increase early egg weight.

Key Words: Bacillus subtilis, Egg specific gravity, Leghorns, Protein.


While much is known about the detrimental effect of vanadium (V) on egg albumen quality, a void exists in the literature about its effect on eggshell pigmentation. An experiment was conducted with broiler breeders to determine at what effect V would have on pigmentation of brown-shelled eggs. All eggs were collected from eight floor pens, each containing 11-15 breeder hens, for a baseline period of three days. Eggshell pigmentation was determined on each egg using a color machine vision system coupled with color analysis software. Following the baseline collection period three experiment diets were fed to the birds. A corn-soybean meal diet served as the control (0 ppm added V). Two other diets were supplemented with sodium metavanadate at concentrations to provide 50 and 100 ppm V, respectively. Two pens of birds served as control and the diets containing V were fed to three pens of birds each. Shell pigmentation was determined on each egg laid during the experimental period. Results indicated that there were no significant differences in luminosity during the baseline period. A significant increase in eggshell luminosity (less pigment) was observed for eggs collected from birds fed V in the diet compared to control eggs. These data confirm that, V, a common contaminant of poor quality phosphate sources, does have a bleaching effect on brown eggshells.

Key Words: Vanadium, Pigmentation, eggshells.

150. Influence of Avizyme on Performance of Commercial Leghorns. Syed S. Sohail*, Mary M. Bryant, and David A. Roland, Auburn University, Auburn, Alabama.

Previous results suggest that Avizyme influences nutrient utilization and hen performance. A study was conducted as a 3 x 2 x 2 factorial to determine the effect of Avizyme on energy utilization and hen performance. Three lysine (Lys) levels (0.75, 0.83 and 0.92%) with two energy levels (1282 and 1321 kcals ME/lb) and two Avizyme levels (0 and 0.075%) were used. Hyline W36 hens (n=1920; 20 hens/replicate) were randomly assigned to the 12 dietary treatments for 16 wk. Egg production (EP), feed consumption (FC), egg weight (EW), egg specific gravity (SG) and body weight (BW) were determined. A significant Lys x Avizyme interaction was observed on EP (P < 0.01). Avizyme (0.075%) increased EP, BW and Lys levels (0.75 and 0.83%) but not at the higher energy level (0.92%). An energy x Avizyme interaction was also observed on EP (P < 0.08). Avizyme increased EP at the lower energy level (1282 kcals ME/lb) but not at the higher energy level (1321 kcals ME/lb). A Lys x Avizyme interaction on FC (P < 0.07) suggested increased FC (P < 0.07) at lower levels of 0.75 and 0.83% Lys but not at the higher level (0.92%). Avizyme had no effect on EW or SG. A Lys x Avizyme interaction (P < 0.06) on BW showed increased BW at 0.83% Lys, but not at the lower (0.75%) or higher (0.92%) Lys level (P < 0.06). These results suggest that Avizyme has a beneficial effect on energy and Lys utilization of hens.

Key Words: Avizyme, Commercial Leghorns, Energy, Lysine.
**151 Effect of dietary supplementation with an enzyme complex (Avizyme®1500) containing amylase, xylanase and protease on performance and egg quality of commercial layers.** N. J. Gonzalez*, S. Cornejo, F. Jimenez, and G. Lorenzoni, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile.

Previous research has shown that Avizyme®1500-AZ1500(Finnfeeds), a feed enzyme blend containing amylase, xylanase and protease specifically designed for diets with corn and soybean meal improved egg production and feed efficiency of commercial layers. The present study evaluated the effect of AZ1500 on performance and egg quality of layers fed a corn, soybean meal and wheat bran based diet from 23 to 44 wk of age. Two hundred and eighty eight 23-wk-old hens (Dekalb Sigma) were randomly assigned to 72 cages of 4 hens each (235 cm²/bird) in a 2 x 2 factorial arrangement of treatments with 6 replications of 3 cages each, per treatment. The variables evaluated were two dietary levels of AMEn: 2800 or 2710 kcal/kg from 23 to 36 wk and 2750 or 2670 kcal/kg from 36 to 44 wk, with or without AZ1500 (0.075%). The lower energy level represented a 3% decrease in AMEn/kg. No energy by enzyme interactions (p > 0.05) were observed on performance. Neither the level of AMEn or enzyme supplementation affected egg production, feed consumption, egg mass, feed conversion or live weight (p > 0.05) for either period. On average, enzyme supplementation increased egg weight (p < 0.05) by 2.4% from 60.58 g to 62.02 g. An interaction (p < 0.05) was observed for specific gravity and shell thickness. Hens fed with the lower AMEn level without the enzyme supplementation, but increased when the enzyme was included in the diet. Regardless of the AMEn level, the enzyme improved egg yolk color (p < 0.05) from 8.81 to 8.97 (Chroma Meter TSS, UK). Other characteristics of egg quality, including Haugh units, yolk:albumen ratio, breaking strength, percentage of cracked, shell-less and dirty eggs, were not influenced by the treatments (p >0.05). Hens fed AZ1500 had a return above enzyme cost of US$0.12/bird mainly as a consequence of the improvement in egg weight.

**Key Words:** Avizyme, Enzymes, Layers, Egg Weight, Wheat Bran

---


Hybrid large white female turkey pouls (400) were randomized into 2 dietary treatment groups with 10 replicate pens each (20 pouls/pen) in a Virginia study, March to June. Stocking density was 0.186 m²/poult. Crumbled and pelleted corn-soy-poultry byproduct (4 to 5.5%) diets were used. Five-feed treatments were: 1) control (CON) with salt, and 2) sodium sesquicarbonate (SSC) at 0.3% with salt reduced. Sodium sesquicarbonate (30.4% Na) has equimolar bicarbonate and carbonate. Calculated sodium (Na) levels were equal by phases for each treatment, ranging from 0.14 to 0.20% at +0.015% increments. Chloride (Cl) levels were higher in CON diets, 0.31 to 0.37%, than in SSC diets, except that phase 1 feeds were equal in Cl (0.31%; then SSC diets had 0.19 to 0.23%). Ammonium Cl (66% Cl) was added at 0.212% to equalize Cl in the first SSC feed vs CON. Monensin was added at 79.2 (3 feeds), 72.6, and 59.4 mg/kg, and baricitracin-mld (BMD®) was added at 55 mg/kg (2 feeds) followed by 27.5 mg/kg (3 feeds). Built-up litter was covered with new wood shavings and stirred daily from 10 to 14 d to provide a disease challenge. Body weights at 14 wk approached (p<0.073) significance, but FCRs were not significantly different at 14 wk (2.566 vs 2.588 kg feed/kg body weight). Mortalities were replaced during the first wk (CON=4.00%; SSC=0.67%). Mortalities from 1 to 14 wk were 6.00% for CON, and 4.00% for SSC treatments (p=0.50). The carcass yields were similar to a previous trial, 8.64% for CON vs 8.67% for Na bicarbonate diets (0.25% added on top of regular feeds), using Nicholas turkey toms fed monensin (99 mg/kg) and BMD® (55 mg/kg) on built-up litter with coccdial inoculation via water [in press, J. Appl. Poultry Res., 2000]. In the present study, fecal moisture levels at 3 wk were lower for SSC than for CON turkeys (74.2 vs 76.1%; P=0.02). Fecal nitrogen, phosphorus, potassium, and Na levels did not differ at 3 wk (P>0.05). It was concluded that SSC at 0.30% with monensin improved body weight, feed conversion, and mortality, and at 3 wk lowered fecal moisture, of market turkey hens on built-up litter.

**Key Words:** Chloride, Monensin, Sesquicarbonate, Sodium, Turkey

---

**153 Effect of Dosage and Turkey Line on Changes in Jejunal Glucose Transport Associated with In ovo Peptide YY (PYY) Administration.** B.A. Colles1, J. Croom*1, L. Daniel1, V. Christensen1, and I. L. Taylor*, 1North Carolina State University, Raleigh, NC 27695, 2Medical University of South Carolina, Charleston, SC 29425.

Previous studies in our laboratory have demonstrated that in ovo administration of 600µg PYY/kg egg wt at d25 increases jejunal glucose absorption in British United Turkey (BUT) and Nicholas pouls. Other investigations have demonstrated that in ovo administration of the same dosage of PYY at d18 in broilers increase 7d BW (Colles et al. 1999, Poult. Sci.) and, at d25, increases 3d BW in BUT pouls. In Trial 1, 12 BUT and 19 Egg Line turkey eggs were treated with 600µg PYY/kg egg wt at d25. In Trial 2, 13 BUT and 7 Egg Line eggs were treated at d25 with 0, 300, 600 or 900µg PYY/kg of egg wt. In both trials, the excipient was 100µl of 1.025% NaCl, and treatments were injected into the air cell. At hatch, pouls were weighed and euthanized by cervical dislocation. Yolk sac, duodenum, jejunal, and ileal wt were recorded. Unstretched jejunal lengths were measured. Ring shaped 2mm mid jejunal segments were used to estimate active, passive, and total glucose uptake using 3H-3-O-methylglucose in the presence and absence of phlorizin. In both trials, BW at hatch did not differ with PYY treatment, regardless of line. In Trial 1, Egg Line pouls treated with 600µg PYY/kg egg wt demonstrated a 22% increase (p<0.03) in jejunal glucose active transport over their control group. In Trial 2, BUT pouls treated with 900µg PYY/kg egg wt had greater wet and adjusted jejunal (jejunal wt/BW) wts, longer jejunums and greater jejunal active glucose uptake compared to controls (405 vs 343µmol/min/mg wet tissue wt; p<0.05). No linear, cubic or quadratic effects were associated with PYY administration in either line. This study supports preliminary observations in pouls that in ovo PYY administration enhances jejunal glucose absorption in hatchlings. These data suggest that poult line may affect PYY dosage and the variation associated with its effect on jejunal glucose absorption.

**Key Words:** PeptideYY, Intestine, Glucose Absorption, Turkey

---

**154 The Ontogeny of Glucose Transport in BUT Turkey Poults and the Effects of In ovo Peptide YY (PYY) Administration.** J. DeCubellis, J. Croom*, B.A. Colles, V.L. Christensen, and L.R. Daniel, North Carolina State University, Raleigh, NC.

Previous studies in this laboratory have demonstrated that PYY administration to turkey pouls at d25 of incubation enhances intestinal Na-dependent active glucose transport. This study was designed to further characterize the ontogeny of glucose transport in embryonic and hatchling pouls and to investigate the effects of PYY on this process during development. In Trial 1, 20 BUT turkey eggs were randomly selected at days 20, 23, and 26 of incubation, as well as the day of hatch. Hatchlings were cervically dislocated and the body weight, jejunal length and jejunal weight were recorded. Jejunal glucose uptake was estimated by measuring H-3-O-methyl-D-glucose accumulation in 2mm jejunal rings in vitro. Jejunal O2 consumption was measured in vitro on jejunal rings using an O2 probe. In Trial 2, 40 BUT turkey eggs were randomly selected at days 20, 23, and 25 of incubation and injected via the air sac with either 0.9% saline or 0.9% saline plus 400µg PYY/kg egg weight. Embryos from each treatment were harvested on days 23, 26 and day of hatch. Measurements and analyses on jejunal tissue were conducted as in Trial 1. In both trials, embryonic weight and jejunal weight adjusted for body weight increased (p<0.05) with stage of incubation, while adjusted jejunal length decreased (p<0.001). Active and total glucose uptake and jejunal O2 consumption increased with age (p<0.05). The energetic efficiency of glucose uptake increased (p<0.05) between day 26 and hatch. In Trial 2, PYY failed to significantly affect body or jejunal weight, glucose absorption, or O2 consumption. PYY did, however, decrease the efficiency of glucose uptake at days 26 and at hatch (p<0.05). Unlike earlier investigations, this study demonstrates that in ovo PYY administration at 400µg/kg egg weight has little effect on jejunal function in BUT turkeys.

**Key Words:** Intestine, Ontogeny, PeptideYY, Glucose Transport

The Optibreed Avimate Sperm Quality Analyzer (SQA), Progeny Systems, San Diego California, was evaluated for its ability to detect the decay in sperm motility that occurs during in vitro storage of diluted turkey semen. Neat semen was collected from 25 parent stock turkey breeder males approximately 45 weeks of age. After measuring neat semen sperm concentration (spectrophotometrically), the neat semen was extended to a final dilution of 5 billion total sperm cells per ml using a commercial turkey semen extender, placed in open 50-ml Erlenmeyer flasks, and stored in a slush ice bath (approximately 0 deg C) with gentle agitation. The Sperm Quality Index (SQI), a relative measure of sperm motility, was measured using the SQA at a dilution ratio of 1:50 (semen:0.9% NaCl solution) for neat semen and 1:25 for diluted semen. The SQI, total sperm cell concentration, and live/dead ratio (nigrosin/eosin counter stain method) were made at 0, 1, 2, 4, 6, 12 and 24 hours post collection. All samples were observed microscopically and subjectively scored for motility (0=no motility, 1=less than 20% of sperm cells motile, 2=20%-40% of sperm cells motile, 3=40%-60% of sperm cells motile, 4=60%-80% of sperm cells motile, 5=near 100% of sperm cells motile with vigorous swirling in the sample). The SQA was able to detect the decay in sperm cell motility that occurs during in vitro storage of turkey semen. Results demonstrated that the SQA is a much more efficient, sensitive, and repeatable method of measuring sperm cell motility than subjective microscopic observation. The simplicity of the SQA/SQI method, ruggedness and portability of the equipment, the short test cycle (<1 minute), and its low cost per test suggest that the SQA can be used as a valuable quality control and diagnostic tool for monitoring turkey semen quality at the time of insemination.

Key Words: Turkey, Semen, Motility

156 Multi- or Single-Stage Incubation for High-Meat Yielding Broiler Strains? R. M. Hulet1, and R. Meijerhof2,

Penn State University, University Park, PA, 1Hybro B. V., Boxmeer, The Netherlands.

Historically, the broiler industry within the US and UK have utilized multi-stage incubation. The use of single-stage incubation in Europe has been used to more precisely meet the demands of the developing embryos. Our current incubation technology is based on heat production estimates from the classic plasmonic model.1,2 Recently, shell temperature has been used as a tool to monitor embryonic heat production. Field information has shown high embryonic shell temperature problems (39 to 40.5 C) when incubating high yielding broiler eggs with temperature ranges of three degree C for developing eggs within an incubator. Therefore, two trials were conducted to indirectly measure embryonic heat production of high yielding strains of broiler by monitoring carbon dioxide levels during incubation (0 to 18 days). Two trials were conducted using a single stage incubator containing 57,600 broiler eggs from a flock of broiler breeders (42 to 45 wk of age). The first and second trials were transferred at 16 and 18 days, respectively. The incubator was controlled as per the commercial manufacturers recommendations to determine egg conductance, thickness, and humidity were monitored at 15 minute intervals. A sample of 3600 eggs from 24 trays distributed evenly through the incubator was evaluated for moisture loss (7, 14, and transfer), chick weight (average, and percent of initial egg weight), stage of embryonic mortality at transfer and hatch, and hatchability of sellable chicks. Embryonic heat production was calculated by carbon dioxide production per fertile embryo. Maximal heat production was calculated as .14 .16 watt/egg for trial 1 and 2, respectively. Transferred Fertility and hatchability for trial 1 and 2 was 90.1 and 86.8, and 91.3 and 86.9 percent, respectively. Moisture loss for the two trials averaged 9.9 percent over 18 days. Carbon dioxide concentrations ranged from 330 ppm on day 1 to a maximum of 6800 ppm on day 18. With 44% increased heat production from high yielding broiler eggs during incubation, the selection of one temperature as in multi-stage incubation makes it infeasible to balance the critical temperature needs with the heat production of high yielding broiler embryos.

Key Words: Heat Production, Broilers, Single-Stage Incubation, Carbon Dioxide

157 Effect of enhanced CO2 levels during early incubation on hatch of turkey eggs. R.A. Ernst*, M.E. Delany, J.F. Thompson, L. Fuqua, J. Knutson, L. Sickafouose, and J. Casino, University of California, Davis, CA.

These experiments were conducted to test the hypothesis that enhanced CO2 levels during the first 7 days of incubation would improve the hatch of turkey eggs. Three test levels (0.3, 0.5 and 0.7% CO2) were compared to a control level of 0.1% CO2. Eggs were stored for 2 or 16 days at 55°F and 75% RH before setting. Eggs were incubated in machines with CO2 control for 7 days and then set intermingled in larger machines until hatch. Setters were set at 99.5°F and 56% RH; hatchers were set at 98.5°F and 70% RH. All clear eggs, dead embryos and eggs which failed to hatch were examined to determine the cause of death. The 16 day pre-incubation storage significantly reduced and delayed hatch as previously reported (P<0.0001). Enhanced CO2 levels had no significant effect on hatch of eggs stored for 2 days but improved 28 day hatch (P=0.04) of eggs stored for 16 days (65.7% vs. 77.8%). After 29 days, hatch of CO2 enhanced, stored eggs exceeded controls (74.7% vs. 77.8%) but this difference was not significant (P=0.264). It appears that CO2 enhancement during early incubation may improve poulty yield and hatch synchronization of turkey eggs stored for 16 days before setting.

Key Words: Hatch, Carbon Dioxide, Turkeys

158 Effect of reduced eggshell conductance and accelerated development upon the broiler embryo. M. J. Wineland*, V. L. Christensen, B. D. Fairchild, and W. E. Donaldson, NC State University, Raleigh, NC USA.

Conductance of hatching eggs from a flock is varied and determines gas exchange during the plateau stage of development. Additionally, temperature of the hatch cabinet influences embryonic development. Hatching eggs incubated for 17 days were used in a two by two factorial arrangement of two hatcher temperatures, 36.9 C (LT) or 38.0 C (ET) and two shell conductances, normal (NSC) or reduced (RSC). To create reduced shell conductance, approximately one third of the egg’s vertical axis was dipped into hot paraffin to occlude pores and reduce availability of respiratory gases. Embryos were sampled at external pipping and at hatch. The data were analyzed using the GLM procedure of SAS and the means determined to differ significantly (P<.05) were separated using Least Square Means. Data were sorted by stage of development. Heart weights were reduced during pipping when the embryos were incubated at ET but neither eggshell conductance nor the interaction of eggshell conductance with incubation temperature affected heart growth. Embryo livers during pipping grew faster when incubated in RSC eggs compared to NSC eggs. Neither the incubation temperature nor the interaction of eggshell conductance with incubation temperature affected liver weight. Yolk sac weighed more in the ET and RSC eggs compared to their respective controls, but the interaction of eggshell conductance with incubation temperature did not affect yolk sac weight. Eggshell conductance affected blood glucose concentrations and cardiac and hepatic glycogen in pipped embryos, with no effect of incubation temperature. RSC eggs increased cardiac and hepatic glycogen and decreased blood glucose concentrations compared to NSC eggs suggesting the embryos may be reacting physiologically to maintain their energy balance. When growth and energy balance were examined in the hatched chicks, no significant differences were noted in any of the measurements made. The data show clearly independent effects of temperature and conductance on embryonic and hatchling cardiac physiology.

Key Words: Incubation, Embryo, Eggshell conductance, Temperature

159 Conductance constant effects on embryonic and hatching cardiac physiology. V. L. Christensen*, M. J. Wineland, and B. D. Fairchild, NC State University, Raleigh, NC USA.

Eggshell conductance constant theory implies that three egg variables affect the growth and maturity of avian species at hatching. Eggshell conductance constants are a function of three measurements of, i.e., weight, length, and conductivity (G) and the resulting length of the incubation period (IP). The hypothesis was tested that the conductance constant could affect cardiac physiology of turkey embryos. Two strains of turkeys were tested (B and N) because the strains differ in EW, G and IP values as well. Eggs from both strains were exposed to different incubation conditions to result in two IP (Control and Short). Heart weight, glycogen, lactate, plasma glucose, lactate dehydrogenase (LDH) and creatine kinase (CK) were measured to determine effects on cardiac physiology.
Conductance constants resulted (P < 0.05) in clear changes in cardiac physiology as EW, G and IP interacted to affect cardiac growth, blood glucose, glycogen, lactate and LDH. Longer IP increased glycogen blood glucose, and lactate and elevated LDH during pipping and hatching and persisted until 3 d post-hatching. In conclusion, the length of the incubation period may be adjusted to result in optimal growth and maturity of heart at hatching.

Key Words: Incubation, Conductance constant, Embryo, Heart

160 Twelve-day ISA BROWN fertile egg storage under nitrogen or microaerophilic atmosphere effects on hatchability and chick quality. Jaquelin Sardán* and Ariel Rolón*1,2. 1 Universidad Mayor de San Simón, 2 Avicola Rolón.

Two trials were conducted using fertile eggs of ISA BROWN Breeders, ages 34 wk (Trial 1) and 52 wk (Trial 2), stored under nitrogen (N2 Atm), microaerophilic (CO2 Atm), or regular atmosphere (Control) for 12 days. Eggs were incubated and candled at day 14. Candled and non-hatched eggs were opened for embryonic staging. A random sample of chicks (n = 900) was used to assess navel quality. Trial 1 comprised all three treatments, whereas trial 2 compared only N2 Atm with Control. Hatch of fertile (HOF), Female hatch of fertile (FHOF), male hatch of fertile (MHOF) and staged embryo categories were analyzed using the GLM and Stepwise procedures. Data were previously transformed using arcsin/z to normalize data distribution. Chick navel quality was analyzed using the Chi square test. In Trial 1, CO2 Atm HOF and MHOF were lower by 5.5 and 3.8% with respect to Control, and lower by 6.6 and 2.3% with respect to N2 Atm. The decrease in hatchability of CO2 Atm treatment was due to a significant increase in early dead mortality. No differences were found between N2 Atm and Control. Chick navel quality in trial 1 was adversely affected by CO2 Atm treatment, with a lower frequency of optimum navel. In Trial 2, N2 Atm HOF and FHOF were greater by 4.3 and 3.7% with respect to Control. Greater HOF and FHOF in N2 Atm treatment was due to less embryonic mortality throughout the incubation period, with no statistical significance in any particular stage. No differences in navel quality were observed in Trial 2. It is concluded that CO2 Atm is not an adequate environment for storage of fertile eggs, since it increases embryonic mortality during the first 72 hours of incubation. The advantage of improving HOF and FHOF through the use of N2 Atm in trial 2 was not seen in trial 1. These results seem to indicate that N2 Atm helps improve embryo survival throughout the whole incubation process of eggs of older flocks (52 wk age), but not of eggs of younger flocks (34 wk age), stored during 12 days.

Key Words: Fertile Egg Storage, Nitrogen, Hatchability, Chick Quality

161 Comparison of Methods to Determine Campylobacter spp. Colonization of Broiler Flocks. N.A. Cox*1, N.J. Stern1, P. Fedorka-Cray1, J.S. Bailey1, M.T. Musgrove1, S.R. Ladely1, D.E. Cosby1, and S.E. Craven1. 1 United States Department of Agriculture, Agricultural Research Service.

In order to determine the effectiveness of on-farm interventions in broiler flocks it is necessary to assess the prevalence of Campylobacter spp. colonization. Thirty-two commercial broiler flocks were monitored by microbiological sampling using four sample types: fecal droppings, drag swabs, litter, and cecal drops. At 4, 6, and 8 weeks of grow-out, samples were collected and transported under refrigerated conditions to the laboratory within 24 h. Fecal and cecal samples were directly plated onto Campy-cefex agar. Drag swab and litter samples were enriched in Bolton broth for 24 h and then plated on to Campy-cefex agar. Positive colonies from representative plates were confirmed as Campylobacter spp. by observation of wet mount preparations under phase contrast microscopy and latex agglutination reaction. At 4, 6, and 8 weeks, the rate of Campylobacter spp. positive samples were as follows: fecal - 8.5%, 90.1%, and 96%; cecal - 12.5%, 59.6%, and 72.4%; drag swabs - 29.2%, 58.5%, and 72.2%; litter - 31.4%, 21.4% and 16.7%. Litter provided poorest recovery of Campylobacter spp. regardless of collection time. At 4 weeks, the highest prevalence was observed with drag swabs, but fecal samples allowed for greatest recovery of Campylobacter spp. at 6 and 8 weeks.

Key Words: Campylobacter, Drag swabs, Fecal droppings, Litter, Cecal droppings


One of 4 broiler hatcheries in a 1998 multi-state epidemiology study was identified as having extremely high Salmonella contamination (190/198, 96%) of its chick transport pads. The predominant serotype of Salmonella was positive on 13% of these pads and was found in samples from eggs, chicks, birds or from the farm environment. This study was conducted to determine if this hatchery continued to have high levels of Salmonella contamination of its transport pads and if so to determine the source of this contamination. Chick transport pads were found to be positive for Salmonella in 75% of the time transport after transport to the farm, 100% of the time in the hatchery after birds had been on them for 1 to 2 hours, 98% of the time from their holding area in the vaccination room, and even 85% of the time from the room the unused pads were stored in after receipt at the hatchery. Follow-up studies found that the Salmonella was being spread throughout the hatchery through the air as air from the vaccination room, hallway, storage room, hatch room and egg room were Salmonella positive 100%, 70%, 80%, and 70% of the time respectively. As a control, a similar study was conducted in a different commercial hatchery. From this hatchery Salmonella was only found from 13% of transport after birds were transported to the farm, from 7% of the unused pads in the storage area, and from 3% of the air samples collected throughout the hatchery. These findings identify the control of air handling and air movement within the hatchery as critical in the development of good production practices for the hatchery.

Key Words: Hatchery, Salmonella, Air, Transport Pads

163 Moisture content and water activity and their relationship to presence of levels of Salmonellae in drag swabs and broiler litter. J. deGraft-Hanson1, V. E. Bryd2, and L. E. Carr2. 1 University of Maryland. Princess Anne, MD. USA, 2 University of Maryland, College Park, Md. USA.

Drags swabs and litter in broiler houses were sampled and analyzed to determine the effect of moisture content (MC) and water activity (Aw) of litter on the presence of Salmonellae. Six each of drag swab and litter samples were collected at placement and approximately every two weeks during the life cycle of the flock and tested for the presence of Salmonellae. All samples were enriched in BPW, selectively enriched in TTH and RV broths and plated onto XLT-4, BGS and MLI agars. Presumptive positive colonies were biochemically screened, purified and serogrouped. Decimal dilutions from litter samples were enumerated in duplicate using XLT-4 agar. Litter MC was determined by drying at 101°C for 24 h and Aw determined in duplicate using an Aqualab model CX2 machine. MC ranged from 3.29 to 57.49% with Aw levels between 0.512 and 0.933. Drag swab samples tended to be positive as the flocks aged. Positive litter samples had levels of Salmonellae ranging from < log 1 CFU/g to >log 7.4 CFU/g. Positive litter samples tended to be from high MC and Aw samples. Drag swab samples were not always consistently positive with litter samples showing perhaps the effect of surface drying. Positive litter samples were more consistently from high MC and Aw samples indicating that these two parameters tend to encourage the proliferation of Salmonellae when present in the broiler house environment.

Key Words: Litter, Aw, Salmonellae


Salmonella serotypes were identified from 26 sample types in 32 broiler operations from 4 states across 4 seasons. A total of 10,740 samples were analyzed for Salmonella. Overall, 973 of 10,740 (9.1%) of the samples were positive for Salmonella. From all sample types there were 36 different serotypes identified. Twelve different serotypes were found on processed carcasses. Of these, S. Thompson was the most frequently identified serotype (29 isolates) followed by S. Maltose (4 isolates). Hatchery transport paper pads were the most frequently observed Salmonella positive sample, and 9 of 12 serotypes found on processed carcasses were also found on paper pads. However, the most frequent serotype found on paper pads, S. Senftenberg was found primarily in one hatchery and only infrequently on on-farm samples during grow-out. A subsequent in-depth study of this hatchery showed that the S. Senftenberg got on the
paper pads in the hatchery through the air and did not usually result in colonized chicks. S. Thompson, was the second most frequently observed serotype from the hatchery and was frequently observed in feces, litter and droppings. The presence of significant colonization of chicks likely occurred in the hatchery. S. Molade was not found in the hatchery or any on-farm samples, but it was noted in the pre-transport coop swabs suggesting that the chickens likely picked up this serotype during transport from the farm to the processing plant. There were 10 different serotypes identified from feed samples. However, on only one occasion was the same serotype found in the feed recovered from the final processed carcasses. All sample types had Salmonella and can potentially lead to colonization and contamination of broiler chickens, but the chicks and paper transport pads from the hatchery appeared to be the most frequent source of Salmonella.

Key Words: Broiler, Salmonella, Hatchery, Feed, Environment

165 Integrons, genetic elements responsible for acquisition of antibiotic resistance genes, and their prevalence among gram-negative enterics in poultry litter. D Rooney¹, M Reed¹, T Liu¹, C Hofacre¹, D White², and J Maurer¹, ¹Univeristy of Georgia Department of Avian Medicine, ²FDA, Laurel Maryland.

Integrons are a genetic element, 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 attI. An integrase gene, intI1, a signature of class 1 integrons, mediates this recombination event. Our hypothesis is that the integron serves as 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 Salmonella and Campylobacter. 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 were isolated from poultry litter on MacConkey agar. Isolated colonies were screened by Southern colony blot for intI1. The number of gram-negatives with intI1 increased over time during the lifetime of each flock from 24% at time of placement to 66% by week 4. Class 1 integrons were present among diverse number of genera, species and genetic types. PCR-ELISA was used to further characterize antibiotic resistance within the integron's attI integration site. Our results indicate that integrons are not confined to veterinary or human pathogens but are present among the normal microbiota of the poultry farm as well.

Key Words: integron, antibiotic resistance

166 Aquatize & Bacitracin in the Prevention of Necrotic Enteritis in Broiler Chickens Challenged with Clostridium perfringens and Administered Either COCCIVAC-B Vaccine or Salinomycin. James L. McNaughton* and Michael S. Roberts, Solution BioSciences, Inc., Salisbury, MD/USA.

Previous in vivo reports found Aquatize (called AQ - stabilized sodium chloride) ameliorated the effect of Salmonella enteritidis broiler infection, Bordetella avium turkey infection, and necrotic enteritis (NE) due to Clostridium perfringens (CP) in young broilers. In the present study, broilers were administered either salinomycin (called SAL - 66 ppm feed additive) or COCCIVAC-B (CVB) and challenged with CP to determine the effect of either AQ or bacitracin (called BA - 55 ppm feed additive from Bacitracin-MD) in the prevention of NE. The NE challenge model included: 200,000 Escherichia coli oocysts/bird on 3rd d and CP on 7th d post-hatch. Broiler male chicks (Ross x Cobb) were randomly placed at hatch into wire floor cages. Treatments included: infected control (non-medicated), CVB administered topically, AQ water treatment (0.05%/1:2000 dilution), feed medicated controls (SAL and BA), and combinations of either CVB or SAL with either AQ or BA. Each treatment was offered ad libitum to 8 replicate cages (5 birds/rep). Birds were weighed and sacrificed on day 21 (end of trial). Broiler chicks, serving as negative control, receiving no medication and infected with CP had significantly lower body weights, worse feed conversion, and lower lesion scores than all other treatment groups; therefore the model performed as expected. For the test groups without anticoccidials (either SAL or CVB), AQ alone significantly improved live performance and intestinal lesion scores as compared to BA alone. All criteria tested were significantly improved (P<0.05) using the combination of either SAL or CVB with either AQ or BAS as compared to anticoccidial programs alone. No significant differences (P>0.05) were observed between SAL and CVB treatments either with or without other medications. Even though AQ significantly (P<0.05) improved the effect of CP as compared to BA, either with or without anticoccidials (either SAL or CVB), both Aquatize and feed medicated bacitracin ameliorated the effect of necrotic enteritis due to Clostridium perfringens in broiler chickens when reared to 21 days of age. Additional control was found when an anticoccidial program was administered. Performance appeared to be equal when either SAL or CVB were administered.

Key Words: Clostridium, Necrotic Enteritis, Aquatize, COCCIVAC-B, Broilers

167 Characterization of antibiotic resistance genes in (Salmonella) isolated from commercial poultry operations. Karen A. Lijibijeke¹*1, C. Hofacre¹, T. Liu¹, and J. Maurer¹, ¹University of Georgia, Poultry Diagnostic Research Center.

The use of antibiotics in agriculture has been implicated as contributing to the emergence of drug resistance in food-borne human pathogens. Studies examining the link between antibiotic use and the emergence of bacterial resistance are important in light of the current regulatory climate. More information on antibiotic resistance in agriculture needs to be gathered in order to make rational decisions regarding future antibiotic usage in food production. Integrons are mobile genetic elements, involved in the dissemination of antibiotic resistance in gram-negative bacteria. This genetic element acquires drug resistance genes through the recombination of these genes into a specific integration site. The integrase gene, intI1, a signature of class 1 integrons, mediates this recombination event. This study uses PCR, southern blotting, and pulsed-field gel electrophoresis (PFGE) to "fingerprint" (Salmonella), isolated from two commercial poultry farms, and characterize their drug resistance genes in order to follow antibiotic resistance from the hatchery to the finished product. (Salmonella) isolates from chicken feces and litter were screened for class 1 integrons by southern blot using a DNA probe for intI1. Approximately 45% of isolates contain class 1 integrons. For (Salmonella) positive for intI1, the gene cassette present in class 1 integron was further characterized by PCR. Primers to 5' and 3' conserved sequences of the class I integron yield amplicons varying in size between 750 to 4,000 bp. The antibiotic resistance genes present in the integron gene cassette were identified by PCR-ELISA. The majority of antibiotic resistance gene cassettes identified with PCR-ELISA contained aminoglycoside-resistance genes. Sulfonamide resistance genes and beta-lactamases were also present in a few of the class 1 integrons in (Salmonella). When this study is complete, analysis of the data will provide insight into the ecology of drug resistance in commercial poultry operations.

Key Words: Salmonella, Antibiotic, Integron

168 Plasmid encoded arsenite resistance genes in avian pathogenic (Escherichia) coli. P. S. Gibbs*, R. E. Woolley, and J. J. Maurer, College of Veterinary Medicine, University of Georgia, Athens, GA USA.

A 56 kb plasmid, pWT3, was found in an untypable avian pathogenic (Escherichia) coli (APEC) isolate, V1. Sequence analysis of segments of pWT3 revealed the presence of a gene, (arsH), not found in (E. coli) before. Dot blot and Southern blot analysis found (arsH) in 11.8% of 300 avian (E. coli) isolates tested. In (Yersinia) (enterocolitica), (arsH) has been found necessary for arsenite resistance. However, (arsH) was not required for expression of arsenite resistance when arsenite resistance genes from (Thiobacillus) (ferrooxidans), including (arsH), were transferred to (E. coli). The function of (arsH) in APEC is currently being studied via mutagenesis of (arsH) in both experimental (E. coli) K12 strains, wild-type arsenite resistant (E. coli), and in APEC and nonpathogenic avian isolates. Arsenite resistance assays and the embryo lethality assays are being utilized to determine the resulting phenotypes of the mutagenized strains.

Key Words: APEC, Arsenite resistance, ArsH
169 Conservation of Core LPS of E. coli Isolated From Poultry - A Vaccine Target?. R. Mirabal1, M.D. Lee*, J.L. Maurer1, S.G. Thayer1, and D.G. White2. 1The University of Georgia, 2Food and Drug Administration.

Avian E. coli infections have been fought with antibiotics partly because the manufacture of a vaccine against them has been difficult. Avian isolates defy past vaccine approaches since they are mostly nontoxicogenic, poorly invasive, do not produce consistent adherens, and have hundreds of O-antigen (LPS) types. Nevertheless, due to the increased antibiotic resistance in human pathogens and its linkage to the use of similar drugs to treat animals, antibiotics may not be available in the future to treat many poultry infections. A vaccine may soon be needed. Amor et al. (2000) described five genetic types of core LPS in E. coli. Certain types appear to be more prevalent in human pathogenic isolates. If this finding is also true for pathogenic avian E. coli, a good approach to making a vaccine could target their most prevalent core LPS type. We used the PCR typing method described by Amor et al. (2000) to screen 68 avian isolates. We found that 84% of isolates collected from normally sterile sites (indicating pathogenicity) tested positive for either R-1 or R-3 core type. This finding suggests that these two core LPS types are prevalent in disease-causing avian E. coli. A vaccine targeting these core types may be a good way to prevent resistant poultry infections for which fluoroquinolones are currently the only effective treatment and may soon be banned for animal use.

Key Words: E. coli, vaccine, lipopolysaccharide

170 Rapid and Specific Detection of Campylobacter sp., Salmonella sp., and E.coli O157 with multiplex PCR-ELISA

- Yang Hong*, John Maurer, and Margie Lee, University of Georgia, Athens, GA, U.S.A.

A multiplex PCR-ELISA method was developed to identify Campylobacter sp., Salmonella sp., and E.coli O157 in a single multiplex PCR reaction. Salmonella invA, Campylobacter fimbriae, and E.coli O157 fimbriae genes were analyzed to design multiplex PCR primers. PCR products of unique sizes were detected. In the next step, biotin labeled oligo probes were designed to hybridize with the PCR products in the ELISA assay. Twenty-one strains of Campylobacter, 20 strains of Salmonella and 9 strains of E.coli O157 were included in the study. Multiplex PCR-ELISA proved to be a fast and sensitive method to identify those three common food borne pathogens.

Key Words: Multiplex PCR , ELISA, Probe


Detecting infected poultry flocks is an essential element in most current and proposed programs for controlling the egg-borne transmission of Salmonella enteritidis (SE) to humans. Although bacteriological testing procedures have predominated in most such programs in the United States, serological methods have also been used effectively in several other countries. The present study evaluated the sensitivity and specificity of detection of specific antibodies in the sera of experimentally infected chickens by a fluorescence polarization assay (FPA) using a tracer prepared from the O-polysaccharide of SE and an enzyme immunoassay (ELISA) using an SE flagellin antigen. In 2 trials, groups of specific-pathogen-free laying hens were infected orally with either 10⁶ or 10⁸ cfu of SE (phage type 13a) or with 10⁶ cfu of S. typhimurium. Serum samples were collected before inoculation and at 5 subsequent weekly intervals. Both assays detected a high percentage of hens infected with SE but also identified a substantial number of hens infected with S. typhimurium as seropositive. The FPA demonstrated both superior sensitivity and superior specificity in comparison to the ELISA. The FPA also offered advantages in terms of speed and methodological simplicity.

Key Words: Salmonella enteritidis, Serology, Fluorescence polarization

172 Application of nested-PCR as an initial screen for poultry or farm environments contaminated with Salmonella. E Bartlett†1, T Liu†1, C Hofacre2, S Sanchez3, and J Maurer1. 1Department of Avian medicine, College of Veterinary medicine, The University of Georgia, 2Athens Diagnostic lab, College of Veterinary medicine, The University of Georgia.

Isolation of Salmonella generally relies on culture enrichment and subsequent phenotypic screens for H2S-producing, non-lactose fermenters. Enrichment media including tetraphionate (TTB), Rapport and Selemit broth vary with regards to their ability to isolate Salmonella in environmental as well as food samples. Variability among these enrichment media is partly due to inhibition of certain Salmonella serotypes by the media. A second assay in TTB can improve our detection of Salmonella in samples. Unfortunately, this delayed enrichment requires additional screens on differential/selective media like XLT4 and Brilliant Green Agar and therefore increases the cost of isolation and detection for samples that still may be negative for Salmonella. We looked into the possibility of using PCR to streamline our current Salmonella enrichment protocol. Salmonella virulence gene invA was chosen as target for nested PCR since this gene is unique to Salmonella and uniform in its distribution among Salmonella serotypes. First pair of invA PCR primers allowed us to detect 10,000,000 CFU/ml of salmonellae in TTB. Incorporation of second, nested pair of PCR primers increased the sensitivity of PCR 1,000-fold. Nested PCR was used to screen primary TTB enrichments from poultry houses for Salmonella. We observed a strong positive correlation between PCR and culture. PCR will not only validate current enrichment procedures but it will also reduce costs and manpower necessary to the continued surveillance of Salmonella in live-stock and food.

Key Words: Salmonella, Nested-PCR, Sensitivity


A 49-d broiler floor pen study was conducted to compare the effects of 1 ppm Clicinax (Cl) withdrawal at d 28, 35, and 42 and 66 ppm salinomycin (Sal) withdrawal at d 28 on bird performance under conditions simulating commercial production. The starter diets were either nonmedicated (NM) or 66 ppm salinomycin + 50 ppm roxarsone (Rox). The starter (Days 0-16), grower (Days 17-35), and finisher with withdrawal (Days 35-49) diets in each treatment included 55 ppm bacitracin. Fifty 1-d-old chicks (25 male and 25 female) were randomly allotted to each of fifty pens in a floor pen facility. Ten pens were randomly assigned to each of the five treatments using a randomized complete block design. Birds were raised on built up litter naturally contaminated with Eimeria acervulina, E. maxima, and E. tenella. Weekly oocyst counts demonstrated that counts in the NM and Sal treatments increased to peaks at 3 and 4 to 5 weeks, respectively. The highest counts in the Cl treatments were on d 14 while the birds were still on Sal + Rox. Immediately after introduction of Cl in the grower diet oocyst counts dramatically decreased and remained low even after Cl withdrawal. At d 49, means for weight gain and feed conversion (fc) were improved (P<0.05) in the Cl treatments in comparison with the Sal and NM treatment. There were no differences in weight gain among the 3 Cl treatments, but feed conversion means in the Cl d 35 and d 42 treatments were improved (P<0.05) in comparison to Cl d 28. These results demonstrated that in anticoccidial shuttle programs involving withdrawal as early as 28 days, some slight performance loss may be expected. Due to the greater efficacy of Clicinax, the extent of the performance loss was substantially less in the Cl d 28 treatment in comparison with the Sal d 28 treatment.

Key Words: Clicinax, anticoccidial, chicken, coccidia

174 Anticoccidial Efficacy of the Feed Additive Cocci-Guard in Broiler Chickens. G. F. Mathis* and R. D. Walker2. 1Southern Poultry Research, Inc., 2Distributors Processing Inc.

Three coccidial challenge studies were conducted to evaluate the efficacy of the feed additive Cocci-Guard at 500 ppm. In all experiments, birds were placed in battery cages, 10 birds/cage, using a complete randomized block design with 3 cages/treatment. At approximately 12 days of age birds were orally challenged with a mixed culture of coccidia. Six days post challenge all birds were weighed and lesion scored. In experiment 1,
birds were challenged with Eimeria acervulina, E. maxima and E. tenella. The inoculum caused a heavy infection with 17% E. tenella mortality in the unmedicated, infected controls (NM). Cocci-Guard significantly decreased E. tenella mortality (6%), decreased lesion scores for all species, improved weight gains and improved feed conversions in comparison to the NM. There were no significant differences between Cocci-Guard and 66 ppm Salinomycin, 99 ppm Monensin, or 5 ppm Maduramicin. In experiment 2, Cocci-Guard was compared to the same ionophores which were combined with 50 ppm Roxarsone. The same strains and species of Eimeria were used but with a milder challenge. No birds died from coccidiosis. Cocci-Guard significantly decreased lesion scores for all species, improved weight gains, and improved feed conversions. There were no significant differences between Cocci-Guard and Salinomycin, Monensin or Maduramicin when the ionophores were fed in combination with Roxarsone. In experiment 3, birds were challenged with E. mitis/nivati, E. necatrix and E. brunetti. Cocci-Guard significantly decreased lesion scores for all species, improved weight gains and improved feed conversions in comparison to the NM. In summary, Cocci-Guard was efficacious against all six Eimeria species, with the strongest control being against E. tenella.

Key Words: Cocci-Guard, Anticoccidial, Ionophores, Roxarsone

175 In ovo administration of an experimental reovirus vaccine. Z.Y. Guo* and J.J. Giambrone, Auburn University, Auburn AL.

Avian reoviruses are an important cause of poultry disease worldwide and can induce viral arthritis, infectious preventriculitis, and malabsorption syndrome. The ubiquitous nature of reoviruses and their resistance to physical and chemical agents makes them difficult to prevent and control. Therefore, vaccination with attenuated live virus vaccines in broiler chicks, and/or a combination of live and inactivated vaccines in broiler breeder pullets is common. In ovo vaccination is becoming increasingly popular to control viral diseases such as Marek’s Disease and infectious bursal disease virus (IBDV) in broilers. Current reovirus vaccines are attenuated by passage in embryos and therefore are too virulent to be safely given to embryos. Experiments were initiated to examine the safety of a current reovirus vaccine complexed with antibody against reovirus. This immune complex vaccine technology is currently used in a commercial vaccine against IBDV. Different vaccine dilutions were mixed with undiluted serum for 1 hour prior to in ovo injection of 18-day-old SPF broiler embryos. Vaccine dilutions from full dose to 1/10000 were given. In all cases, the addition of serum to the vaccine delayed and reduced the incidence and severity of clinical disease induced by this reovirus vaccine. However, even the highest dilution of vaccine tested was still not safe (caused morbidity and mortality) given to SPF embryos by in ovo. Future studies will utilize a less pathogenic reovirus strain circular product for use by in ovo route.

Key Words: In ovo, Vaccination, Reovirus

176 A PEMS-associated reovirus causes alterations in liver and lymphoid organs in turkey poult. C. L. Hegen Peay*1, M. A. Qureshi1, K. A. Schat2, F. W. Edens3, P. S. Wakenell3, and P. H. O’Connell4, 1 North Carolina State University, Raleigh, NC, 2Cornell University, Ithaca, NY, 3University of California, Davis, CA.

The search for etiological agents associated with poulteritis and mortality syndrome (PEMS) has led to the isolation of novel viruses. In previous studies, we have reported the isolation of one virus, Cornell isolate, from fecal material of poults with PEMS. Recent studies suggest that this may be a reovirus. The objective of the current study was to investigate further the effects of this virus alone on immune and performance parameters of turkey poult. In two independent trials, commercial BUTA poult were placed in bubble-type isolation units on day of hatch with ad libitum access to sterile food and water. At 7 days of age, poult were inoculated orally with 1 ml of virus (10^5 TCID50) or sham inoculated. Body weights and organ weights were evaluated at 3, 6, 10 (both trials) and 20 DPI (only) days post-infection (DPI). Poults were examined for the presence of PEMS. No significant differences were observed in body weight or thymus weight between the treatment groups in the first trial. In contrast, spleen weight was enlarged significantly (P<0.05) whereas bursa (P<0.01) and liver (P<0.05) weights were decreased significantly in the virus poult at 6 DPI. The significant decrease in liver weight was also observed at 10 DPI (P<0.01). However, by 20 DPI, significant differences in organ weights between the treatment groups were not observed, suggesting a “recovery.” Virus was re-isolated from 10/10 fecal samples from virus poult at 3 and 6 DPI. However, at 10 and 20 DPI, virus was re-isolated from only 5/10 fecal samples from virus poult. No virus was re-isolated from control fecal material. Similar transient decreases in lymphoid organ weights were observed in virus poult in the second trial, including a significant decrease (P<0.01) in bursa weight at 6 DPI and a significant decrease in liver weight (P<0.01) at 3 and 6 DPI. As in the first trial, virus was re-isolated from 10/10 virus poult at 3 DPI, but was more difficult to detect at later time points. These results suggest that the virus is pathogenic to poult and compromises health and performance. Furthermore, because this virus causes organ weight alterations, it may contribute to increased susceptibility to opportunistic pathogens.

Key Words: PEMS, reovirus, turkeys

177 Concurrent Newcastle disease virus and Mycoplasma gallisepticum infection in a commercial turkey flock in eastern North Carolina. B. Santii1, S. Jennings2, and H.J. Barnes1, 1 North Carolina State University, 2Caroli’s Foods.

High mortality and severe respiratory signs in a tom turkey flock in North Carolina were investigated. Birds were 6 weeks of age when they developed clinical signs. An older flock on the farm showed similar signs just after this flock had been placed. Affected birds developed swollen sinuses, 3% daily mortality in the most affected house, and there was no response to antibiotic treatment. Extensive polyserositis typical of colibacillosis was observed at necropsy. Newcastle disease virus (NDV) was isolated from tracheal swabs and Eschericha coli was recovered from cultures of visceral organs. Attempts to isolate Mycoplasma gallisepticum (Mg) were not successful, however, PCR results were positive for the organism. Serological tests for Mg, Bordetella avium, and NDV were done. Only antibodies to NDV were demonstrated at 6 weeks of age. Antibodies to both NDV and Mg were detected two days after the onset of clinical signs. Markedly swollen sinuses were still present.

Key Words: turkey, Newcastle disease virus, Mycoplasma gallisepticum, Colibacillosis, poultry

178 Preliminary evaluation of the house fly, Musca domestica, as a candidate vector for the transmission of turkey coronavirus (TCV). D. Watson1, J. Guy2, D. Calibee3, and M. Stringham4, 1Department of Entomology, N. C. State University, 2College of Veterinary Medicine, N. C. State University.

Turkey coronavirus (TCV) is a debilitating enteric disease of turkeys and is sometimes found in association with another enteric disease of unknown etiology, Poult Enteritis Mortality Syndrome (PEMS). Insects may be involved in the epizootiology of TCV. The objective of this study was to examine the potential of adult house flies to transmit TCV virus (strain NC95) to healthy turkeys under laboratory conditions. Virus isolate NC95 is a highly infectious strain with low mortality. House flies were starved for 24 hr and fed turkey coronavirus in minimal medium (DMEM). The negative control flies were given DMEM only. Flies were dissected and their crops removed at one of two different time interval series: Trial 1 and 3 at 30 min, 3 hr, 9 hr and 12 hr; and, trial 2 at 30 min, 3 hr, 6 hr, 12 hr and 24 hr. The crop alone was selected because of its substantially different physiology in relation to the rest of the fly’s alimentary tract, and because house flies regurgitate their crop contents onto surfaces at frequent intervals. Extracted crops were homogenized and injected into turkey eggs for embryo propagation. Fluorescent antibody was used to determine the presence of TCV in the turkey embryos. House flies harbored TCV in their crops for up to 12 hours. However, no virus was detected in embryos injected with homogenate from flies at 30 min or 3 hr post-exposure intervals. Retention of turkey coronavirus in fly crops at 6, 9 and 12 hr intervals suggests that house flies can successfully transmit the virus for a relatively short period of time in the field. A second series of exposure trials will be conducted to confirm these preliminary results.

Key Words: House fly, Turkey coronavirus, Transmission
179 Origin and Evolution of GA98, a New Serotype of Avian Infectious Bronchitis Virus. Chang-Won Lee¹, Deborah Hilt, and Mark Jackwood, The University of Georgia.

Previously, we identified GA98, a new serotype of infectious bronchitis virus (IBV) which is closely related to the DE072 serotype of IBV genetically, but not antigenically. Herein, we analyzed the 421bp sequence of a hypervariable region of the S1 subunit of GA98 IBVs isolated between the years 1997 and 2000 to further examine the evolution of these viruses. Phylogenetic analysis of the deduced amino acid sequence on that region indicated that GA98 isolates from different regions of Georgia were the result of a single introduction of the S1 gene of the DE072 serotype progenitor. Most of the mutations were non-synonymous and had become fixed in a progressive manner. The evolutionary rate and mutation rate in HVR was calculated as 2.5% and 1.5% per year, respectively. This new serotype of IBV appears to be evolving very fast compared to other serotypes of IBV. We further determined the complete coding sequence of the S1 and matrix gene of seven isolates obtained from one farm. Together with virus neutralization data, it appears that GA98 arose from immune selection due to DE072 vaccine use. Reasons for this conclusion are discussed.

Key Words: GA98, Infectious bronchitis virus, Serotype, Virus neutralization

180 Increasing the spectrum of the hemagglutination inhibition (HI) test for infectious bronchitis virus antibody detection. M. Ruano¹, J. El-Attrache, and P. Villegas, Department of Avian Medicine, College of Veterinary Medicine, The University of Georgia, Athens, GA.

The enzyme neuraminidase was used to produce IBV-HA antigen in SPF chicken embryos from reference and field IBV isolates. Consistent and specific HI titers were elicited from homologous IBV antiseraum when both the field and reference strains of IBV were used. These titers correlated well with those found in the virus neutralization test in embryos. Cross-reactivity among IBV homologous antiseraurms and non-specific reactions with negative antiseraurms were observed when antigens with low and unstable titers were utilized. This HI assay can be used as an instrument to elucidate antibody variability against several serotypes of IBV in commercial flocks.

Key Words: Infectious bronchitis, Hemagglutination inhibition, Virus antibody detection

181 Studies on the Cultivation and PCR Assay for Duck Hepatitis B Virus. C. J. Wang¹ and J. J. Giambonne, Auburn University.

Hepadnaviridae are a family of DNA-containing viruses that include human hepatitis B virus (HBV) woodchuck hepatitis virus, and duck hepatitis B virus. Human hepatitis B virus is a worldwide important public health problem with carriers being at high risk of developing cirrhosis and hepatocarcinoma. Thus far, there exists only a few cell culture or laboratory animal systems that allow the testing of drugs or disinfectants for hepatitis B virus. Duck hepatitis B virus is very similar to human hepatitis B virus in its sensitivity to drugs and disinfectants. Therefore, it has been widely accepted as a safe surrogate for human hepatitis B virus research. In this study, we established several systems for DHBV cultivation including duck hepatocytes, duck embryonic hepatocytes, and freeze-thawed duck hepatocytes. PCR was used to determine the relative titer of duck hepatitis B virus DNA from infected duck serum and culture cells. We successfully propagated duck hepatitis B virus in all cell types used and relative virus DNA titers from embryonic, duck and freeze-thawed hepatocytes were 2*10 to 7/ml, 2*10 to 5/ml, and 2*10 to 3/ml, respectively. Nested PCR was also developed to detect DHBV DNA. This procedure increased the detection sensitivity one hundred fold compared with the traditional PCR. In addition, we also successfully inoculated DHBV viral serum into duck embryos to mimic natural congenital infection and produced a high titer of virus. In conclusion, the duck embryonic hepatocyte system was a good choice to cultivate duck hepatitis B virus, and can be applied as a system for disinfectant assays with human hepatitis B virus.

Key Words: Duck hepatitis B virus (DHBV), Polymerase Chain Reaction (PCR), Human hepatitis Virus (HBV)

182 Molecular characterization of glycoprotein E gene of infectious laryngotraechitis vaccine strains. Pinghua Liu¹, Sylva Riblet¹, and Maricarmen Garcia¹, ² University of Georgia.

Infectious Laryngotraechitis (ILT) is a severe acute respiratory disease of chicken caused by Infectious Laryngotracheitis Virus (ILTv). Live attenuated and modified vaccines were developed to control the disease. Our lab has developed a PCR-RFLP (Polymerase Chain Reaction-Restriction Fragment Length Polymorphism) assay of the glycoprotein E (gE) gene and has used it as an epidemiological tool to track outbreaks in the field. Using this PCR-RFLP, three patterns were observed with enzyme DdeI. Pattern A was observed for the Tissue Culture Origin (TCO) vaccines and one Chicken embryo Origin (CEO) vaccine. Pattern C, a combination of patterns A and B, was observed in five of six CEO vaccines. This suggests that mixed gE genotype exists within vaccine preparations. To further verify the existence of mixed gE genotypes, we have sequenced the entire gE gene of 10 vaccine strains and do find that there is mixed genotypes within vaccine preparations. The transmission of these genotypes in birds will be discussed.

Key Words: ILT, gE, PCR-RFLP, CEO, TCO

183 Effect of vaccination against IBDV on incidence and severity of proventriculitis in SPF leghorns. T.V. Dormitorio¹, J.J. Giambonne¹, F.J. Hoerl², T.F. Kelly², and S.B. Lockaby², Auburn University Auburn, AL, Alabama State Veterinary Diagnostic Laboratory Auburn, AL.

Recently, IBDV has been implicated in causing proventriculitis in broiler flocks from North Alabama. This disease results in poor feed conversion, weight reduction, and mortality. Two-week-old SPF leghorns were vaccinated with a commercial live virus vaccine containing both antigenic standard and variant IBDVs. At three-weeks of age birds were infected with either of two isolates (2054 or V1). Unvaccinated birds challenged with either isolate had a 60% incidence of proventriculitis (thickened and glandular pores indistinct). Vaccinated birds challenged with 2054 isolate had a reduced (20%) incidence of proventriculitis while those challenged with V1 isolate had a complete elimination of the disease sympotms. Chickens infected with control proventricular homogenates from uninfected SPF birds, did not show signs of proventriculitis, indicating that the homogenate by itself caused no disease. Bursal atrophy and weight reduction in 2054 and V1 challenged birds were consistent with IBDV infection. In addition, proventricular homogenates containing either virus isolate produced a 20% higher incidence of proventriculitis than bursal homogenates. This study showed that vaccination of young chickens with a commercial live vaccine containing standard and variant IBDV strains would reduce the incidence and severity of proventriculitis.

Key Words: Proventriculitis, IBDV, Vaccination

184 Isolation and identification of a US IBDV isolate with a vvIBDV molecular marker. A Banda¹, J El-Attrache¹, and P Villegas¹, Department of Avian Medicine, College of Veterinary Medicine, The University of Georgia, Athens, GA.

An infectious bursal disease virus (IBDV) was isolated from a commercial broiler farm that suffered from respiratory problems and poor performance. A 698 bp product encompassing the hypervariable region of VP2 gene was generated by reverse transcription - polymerase chain reaction (RT-PCR). Nucleotide sequence of this isolate was 98% similar to the standard challenge strain (STC). However, by deduced amino acid sequence, a residue of isoleucine was present at position 294 which is conserved in very virulent strains of IBDV (vvIBDV). The isolate produced subclinical disease with bursal atrophy when inoculated in specific pathogen free chickens and commercial broilers.

Key Words: Infectious bursal disease virus, poor performance, molecular marker, clinical and pathological study

185 Efficacy of In Ovo Administration of Infectious Bursal Disease Viral Vaccines. Joseph Giambonne¹ and Teresa Dormitorio¹, Auburn University.

In ovo vaccination against Marek’s Disease and infectious bursal disease viruses (IBDV) in commercial broilers in the United States (US) is common. Little information exists as to the efficacy of intermediate IBDV vaccines given in ovo. Experiments were initiated to determine efficacy of three commercially available live intermediate IBDV vaccines by in ovo...
route. Two nearly identical studies were done. The vaccines were given at half dosage at 18-days of embryonation to commercial broiler embryos, which had maternal antibody against IBDV. In both studies, in ovo vacci- nated embryos were challenged with either a virulent standard (APHis) or antigenic variant (Variant E) IBDV virus at 3 weeks (first study) or 5 weeks (second study) of age. In the first study, all vaccines produced at least 87 percent protection against the standard and 60 percent protec- tion against the variant challenge IBDV, as measured by bursal weight by body weight ratios. In the second study, percent protection against both viruses was significantly reduced in the older birds. All vaccines produced no more than 50 percent protection against the standard and 20 percent protection against the variant IBVDs. This study was the first to examine efficacy of three commonly used intermediate IBDV vac- cines given in ovo for protection against standard and antigenic variant IBDV challenge viruses.

Key Words: Chickens, In ovo, Vaccination, Infectious bursal disease virus

186 Microbiological Safety of a Dehydrated Poultry Meal Product . R.A. Norton1, J.B. Hess1, J.P. Blake1, and K.S. Macklin1, 1Auburn University, Auburn, AL, USA.

An alternative method of poultry carcass disposal, involving grinding and drying has been developed in Alabama. The present study was imple- mented to determine the microbiological safety of this recycled protein product. Individual carcasses were ground to a semi-fine consistency in a large modified meat grinder, transported to a sealed storage bin by conveyer and transported to a large drum dryer and dried according to a propriety procedure. The dried material was mixed with soybean meal (40-60) and spray treated with Termitex (Anatox Corp., Nacogdoches, TX), an FDA approved, formalin based feed treatment. Samples were transported to the laboratory and serially diluted with 0.5% Peptone. Differential media were used to quantify specific aerobic and anaerobic pathogens. Isolated bacteria were identified using specific tests appropri- ate for the genus and species. Overall the material was determined to be relatively free of bacteria. Although, bacterial pathogens were present, their levels were below the threshold for statistical significance (less than 250-500 cfu/g). Pathogens that were isolated included, Staphylococcus aureus, Staphylococcus sciuri, Klebsiella pneumoniae, Bacillus cereus. Of spore forming bacteria isolated, members of the Bacillus genus pre- dominated.

Key Words: Poultry meal, Pathogenic bacteria

187 Evaluation of the Role of Feline Aminopeptidase N as a Receptor for Infectious Bronchitis Virus. B. Miguel, G. T. Phayar, and C. Wang*, Mississippi State University, Mississippi State, MS.

Infectious bronchitis virus (IBV) is a coronavirus, and causes one of the most contagious respiratory diseases in poultry. While receptors for some coronaviruses have been identified, the receptor for IBV has not yet been determined. Feline aminopeptidase N (fAPN) has been shown to serve as a receptor for feline, canine, porcine and human coronaviruses. Our objectives were to determine if 1) feline cells were permissive for IBV, and 2) fAPN can serve as a receptor. Feline kidney cells (CCL-94) and baby hamster kidney fibroblasts (BHK-21) were infected with Arkansas serotype IBV and analyzed by indirect fluorescent assay, confocal mi- croscopy and end point titration in SPF embryonated eggs. The results showed that the feline cells were permissive to IBV but the hamster cells were not. To determine if feline APN serves as a receptor, the feline APN plasmid was transfected into the non-permissive baby hamster kid- ney cells and then infected with IBV. The data suggest that the feline APN molecule plays a role in IBV entry.

Key Words: infectious bronchitis virus, aminopeptidase, feline, receptor

188 Mortality and Horizontal Transmission by Salmonella gallinarum in Broilers Chicks. G.M. Nava*, J.C. Altaro, M.A. Juarez, and G. Tellez, Department of Producton Animal: Poultry, Faculty of Veterinary Medicine and Zootecnicas, UNAM.

One day old chicks are more easy to be infected because of this doesnt have a mature normal intestinal microflora (NIM) that could confer pro- tection against enteric pathogens. One of the most successful method of control salmonellae in poultry industry, is the process called “com- petitive exclusion”(CE). In order to show the effect of the prophylactic administration of defined CE culture (DCEC) to decrease mortality and horizontal transmission by Salmonella gallinarum (Sg)in broilers chicks, were designed two experiments: Experiment 1-160 chicks of 1 day old, were randomly assigned in two groups of 20 chicks each, with four repli- cates. Control group (A) that received orally 0.25 ml of physiologic saline solution (PSS), and group B that received orally 0.25 ml of DCEC prod- uct. The both groups were challenge orally with 0.25 ml of inoculum contained 10 millions of ufc of Sg/ml at 3 days of age. The prophylactic administration of DCEC reduce significantly (P < 0.001) the mortality in the treated chicks wit.

Key Words: Defined competitive exclusion, Salmonella gallinarum, Natural intestinal microflora, Broilers chicks, Horizontal transmission

189 Immunogenicity of three vaccine strains of New- castle disease virus given by nebulation. H. Mazija*1, I. Ciglar Grozdanic1, E. Pruker-Radovic2, S. Cajevec2, W.L. Ragland3, and W. L. Ragland3, 1Veterinary Faculty, University of Zagreb, Croatia, 2Pliva d.d., Zagreb, Croatia, 3Institute Rugjer Boskovic, Zagreb, Croatia.

Vaccination of day-old chickens against Newcastle disease (ND) by use of aerosol or spray of water suspension of the vaccine, particle size from 20-150 microns, is the most effective, but La Sota or even B1 strains can cause respiratory vaccine reactions, and milder strains like Ulster 2C are not appropriate for protection of chickens with inherited maternal antibod- ies. In areas with predominant vvNDV, lentogenic vaccine strains of ND virus are not sufficient for specific protection of poultry. The ultra- trasonic nebulizer SONOVAC 985, forming particles ranging between 2-5 microns in diameter, was used. Groups of 103, 105 and 105 day-old male chickens were vaccinated with lentogenic strains of ND viruses: ULSTER (A), LA SOTA (B), and QUEENSLAND-V4 (C). A control group of 105 chickens (K) was not vaccinated. Approximately one dose per chicken (106 EID50) was given during exposition time of 30 seconds. At weekly intervals up to 42 days, 15 chicks from each group were taken and challenged with velogenic Herts 33 strain of ND using 106 EID50 per chicken. All chickens of groups A (88%), B (98%), and D (75%) while 48% of unvaccinated controls survived the challenge infection throughout the 42 days. Nebulization did not cause any adverse effect on vaccinated chickens nor did maternal maternal antibodies (ELISA titre 3151) hinder the effect of the three vaccine ND strains. Quite contrary, it stimulate specific protection against pathogenic Herts 33 strain of ND virus. It seems that differences in tropism, because of the mode of vaccination, did not influence the immune response.

Key Words: Newcastle disease, Immunogenicity, Nebulization, Lentogenic strain


Body weight (BW) and uniformity of BW of broiler breeder replacements are critical characteristics impacting future flock production. Disease conditions affect these important parameters. This study demonstrated that nitarsone (Histotact) fed continuously at a level of 0.01875% pre- vented blackhead in broiler breeder replacement chickens. The data re- ported here are in regard to the effects that blackhead and medication with nitarsone had on BW and the uniformity of BW of broiler breeder replacement chickens. Healthy, newly-hatched female chicks from a commer- cial source were randomly placed into floor pens containing used litter. Treatments included: controls (non-medicated and non-infected), infected controls (non-mediated) and nitarsone treated birds (infected). Experimental feeds were offered at placement. On days 0 through 14 of the trial, birds assigned to the infected control and nitarsone treatments were challenged via the feed with eggs of Heterakis sp. carrying Histomonas meleagris. There were 8 pens of 80 chickens assigned to each treatment, providing 640 birds per treatment. Individual bird weights were measured on days 57 (end of trial). Feed but not water was re- stricted to Skip-a-day feeding began during week 3. Statistics describing the distribution of the population were calculated using the UNIVARI- ATE procedure of SAS (SAS Institute, Inc., Cary, NC, 1996). Weights of birds (mean, sum, median, upper quartile, lower quartile, and 95, 90, 10 and 5 percentile) at 57 days were greater (P < .05) for the control and nitarsone-treated birds, compared to infected control birds. The inter-quartile range, skewness, variance, standard deviation, standard deviation of the mean, and coefficient of variation for the weights of the
birds were lower \((P<.05)\) for the control and nitarsone-treated birds compared to infected control birds. Nitarsone prevented the negative changes in weight uniformity of broiler breeder replacement chickens caused by blackhead.\(^6\)

*Key Words:* Nitarsone, Blackhead, Chicken, *Histomonas*, Uniformity