

PSA-Environment and Management-Breeder and Incubation

265 Heavy tom strains fed low calcium and phosphorus diets supplemented with phytase 1. Growth performance and carcass yield. R. M. Hulet*, P. H. Patterson, and T. L. Cravener, *Department of Poultry Science, The Pennsylvania State University, University Park.*

Nicholas, BUTA-B6 and BUTA-T2 strains (A, B, and C) were reared in a total of 24 floor pens (0.309m²/bird) and fed commercial diets until 19 wk of age. The basal feeding program (calculated analysis) included a pre-starter (0-3 wk; 28.3% CP; 1.51% Ca; 1.04% tP), starter (3-6 wk; 27.8% CP; 1.50% Ca; 1.03% tP), grower-I (6-9 wk; 24.5% CP; 1.48% Ca; 1.00% tP), grower-II (9-11 wk; 22.5% CP; 1.39% Ca; 0.92% tP), finisher-I (11-14 wk; 18.9% CP; 1.15% Ca; 0.72% tP), and finisher-II (14-19 wk; 17.4% CP; 1.04% Ca; 0.64% tP). From 11-14 wk half the birds were fed a diet 15% lower in Ca and P (LCP) compared to the control birds (CON). From 14 - 19 wk half the birds were fed a diet 30% lower in Ca and P (LCP) compared to the CON birds. Both diets were supplemented with 0.06 % phytase from 11- 14 and 14 - 19 wk. Dietary treatment did not affect feed intake (FI), feed conversion (FC), 19 wk body weight (BW) or overall mortality. BW at 14 wks and overall BW gain (BWG) were significantly greater for birds fed CON diets. Dietary treatment did not affect processing weight (wt) or wt as a percent of the bled carcass wt. However, LCP diets did result in significant feed savings on a /kgcarcass(CON, .431 versus LCP, .419)and/kg breast basis (Con, 1.857versusLCP,1.749). BW at hatch and wk 3, 6, 9, 11, 14, and 19 were significantly affected by strain, with the C strain males having greater BWG than males from strain A or B. Cumulative FI was significantly different, with the C strain birds consuming more feed than birds from either strain A or B. Overall FC and mortality were not affected by strain. Processing wt was significantly affected by strain, with the wt of the carcass, neck, wing, and breast being greater for C strain carcasses. No difference in processing yield (% of carcass wt) was found for strain. The results suggest that diets 15 and 30% lower in Ca and total P, supplemented with phytase, resulted in similar growth performance and carcass yield and were cost efficient in comparison to CON fed birds. Strain C males were significantly heavier than strain A and B males for much of the study.

Key Words: Turkey, Phosphorus, Strain

266 Heavy tom strains fed low calcium and phosphorus diets supplemented with phytase 2. Impact on litter total P, soluble P and bone integrity. P. H. Patterson*¹, R. M. Hulet¹, T. L. Cravener¹, P. Y. Hester², P. J. Kleinman³, and A. N. Sharpley³, ¹*Department of Poultry Science, The Pennsylvania State University, University Park,* ²*Department of Animal Sciences, Purdue University, West Lafayette, IN,* ³*USDA-ARS, University Park, PA.*

Nicholas, BUTA-B6 and BUTA-T2 strains were reared in a total of 24 floor pens (0.309m²/bird) and fed commercial diets until 19 wk of age. The basal feeding program (calculated analysis) included a pre-starter (0-3 wk; 28.3% CP; 1.51% Ca; 1.04% tP), starter (3-6 wk; 27.8% CP; 1.50% Ca; 1.03% tP), grower-I (6-9 wk; 24.5% CP; 1.48% Ca; 1.00% tP), grower-II (9-11 wk; 22.5% CP; 1.39% Ca; 0.92% tP), finisher-I (11-14 wk; 18.9% CP; 1.15% Ca; 0.72% tP), and finisher-II (14-19 wk; 17.4% CP; 1.04% Ca; 0.64% tP). From 11-14 wk half the birds were fed a diet 15% lower in Ca and P (LCP) compared to the control birds (CON). From 14-19 wk the LCP birds were fed a diet 30% lower in Ca and P compared to the CON birds. Both diets were supplemented with 0.06% phytase from 11-14 and 14-19 wk. Litter water extractable P (WEP) increased during the study from 0.30, 0.48, 2.33, 3.22, 3.66 and 6.04g/kg of litter, respectively, at 3, 6, 9, 11, 14, and 19 wk. From 3 to 19 wk litter total P (TP) and Ca levels increased 2-fold, however, litter WEP was 20-fold greater at 19 wk. Litter WEP from LCP, CON treatments was 3.18, 4.04g/kg (P = 0.2060) at 14 wk and 5.84, 6.25g/kg (P = 0.2863) at 19 wk, respectively. Humerus bone mineral density (BMD) for LCP, CON birds was 0.368, 0.336 g/cm² at 14 wk (P = 0.0617) and 0.371, 0.371 g/cm² at 19 wk. Femur BMD for LCP, CON birds was 0.324, 0.317 g/cm² at 14 wk (P = 0.3844) and 0.372, 0.378 g/cm² at 19 wk (P = 0.6053). There was no difference in litter WEP, TP or Ca levels or humerus or femur BMD between tom strains (P > 0.05). Dietary P levels and costs were reduced by the LCP treatments compared to CON. Litter TP and WEP were reduced 5.8 and 6.6% in the LCP pens

compared to CON at the end of the study. No adverse effect of the LCP diets was observed on tom live performance or bone integrity.

Key Words: Turkey, Litter, Phosphorus

267 Examining if the hole created by egg injection improves late embryonic survival. B. L. Kumpula* and G. M. Fasenko, *Department of AFNS, University of Alberta, Edmonton, AB, Canada.*

The objective of this study was to determine if the hole produced by egg injection at 18 days of incubation has an effect on egg shell conductance and late incubation embryonic mortality. Broiler hatching eggs (n=864) from a Ross 308 flock at two ages (Trial 1 34 wk and Trial 2 42 wk) were incubated in a single stage incubator. At 7 and 14 days of incubation, all eggs were candled, eggs with non-viable embryos removed and broken open to assess fertility, and if fertile, approximate day of embryonic death. At transfer (18 d) half the eggs (Hole - n=432) had a hole made in the shell at the large end of the egg using an 18-gauge needle to simulate egg injection. The needle was inserted to a maximum depth of 2 mm. No injectables were deposited through the needle into the egg. The other half of the eggs (No Hole) were transferred without a hole being made. Twenty-four groups of 18 eggs represented the experimental unit. At 21 d (Trial 1) and 21.5 d (Trial 2) all saleable chicks were counted and any unhatched eggs opened so that hatchability production parameters could be calculated. Concurrently with the hatchability trials, the egg shell conductances of Hole and No Hole eggs (n=15 per treatment) were determined. The data were analyzed using the GLM procedure of SAS, all percentage data were transformed using Arc-sine transformations prior to analysis, and probability was assessed at P #8804 0.05. As expected, the conductance of the Hole (16.0 ± 0.4) versus No Hole (14.8 ± 0.4) eggs was significantly greater (P = 0.0420). However, number of culled chicks, hatchability, and embryonic mortality, including late incubation mortality were not influenced by the increased conductance created by the hole (late mortality Hole = 8.5 ± 1.7; No Hole = 8.3 ± 1.7; P=0.9494). This data indicates that the increased gas conductance provided by the egg injection hole does not reduce late embryonic mortality as was hypothesized. Future studies should focus on effects of the egg injection hole on eggs with poor shell conductance, and on the potential effects on post-hatch survival and growth.

Key Words: Embryo Survival, Egg Injection, Egg Shell Conductance

268 Effect of hatch pull time, protein and methionine on bobwhite quail performance. J. P. Blake*, J. B. Hess, and W. D. Berry, *Auburn University, Auburn, AL.*

Limited information exists concerning management and nutritional requirements for commercially produced bobwhite quail. An experiment investigated the effects of delayed placement after hatching on livability and performance. Bobwhite quail eggs (500) were incubated on two consecutive days and all hatchlings were removed on the 25th day and identified as either early (ES) or late (LS) set of eggs. Bird numbers were c.a. 54 birds/pen with 8 reps/set. In addition, 4 reps/set were offered a top-dressed feed supplement (Oasis) for three days post-hatch. Birds were fed a 26% corn-soybean meal starter diet containing 2,811 kcal/kg ME. Brooding temperature was 35 C (95 F) for the first week and reduced 2.8 C (5 F) weekly through four weeks of age. Results indicate that LS hatchlings (day 0) were significantly (P<0.0001) heavier as compared to ES hatchlings (6.95 vs. 6.15 g/bird). However, by 7-d of age ES birds were significantly (P<0.001) heavier than LS birds (17.60 vs. 15.31 g/bird). This effect carried through to the 28th day, where ES birds were significantly (P<0.01) heavier than LS birds (85.54 vs. 81.85 g). Bodyweight gains exhibited a similar pattern where ES birds exhibited greater period or overall gains than LS birds. Feed consumption was also significantly greater (P<0.01) for the ES versus LS birds during the 28-d experimental period (173.5 vs. 167.0 g/bird, respectively). Using a feed scattered additive had a slight influence on reducing early mortality (P<0.10) and reducing feed requirements (P<0.05) from 0-14 days posthatch. At four weeks of age birds were congruently assigned to one of four nutrient regimens: 22% CP/0.50% met; 22% CP plus methionine; 18% CP/0.41% met; 18% CP plus methionine resulting in an increased methionine level of 0.12 and 0.09% for the 22 and 18% diet, respectively. No differences in bodyweight, bodyweight gain, feed

consumption, or feed efficiency occurred due to treatment. Qualitative feather scores obtained at termination of the experiment at ten weeks of age indicated that the 18% CP plus methionine group had a significantly lower ($P<0.05$) score as compared to the other treatments.

Key Words: Bobwhite Quail, Incubation, Protein

269 Influence of light intensity and handling on live and processing performance of male broilers. R. J. Lien*, J. B. Hess, S. R. McKee, B. A. McCrea, and S. F. Bilgili, *Auburn University, Auburn, AL.*

To determine effects on live and processing performance, broilers were subjected to step-up lighting of either bright or dim intensity, and either no handling or handling by the legs or wings to evaluate susceptibility to deep pectoral myopathy and deep thigh bruising. Male broilers (Ross 508) were placed in 12 light-tight rooms (90 per room). Step-up lighting (23L:1D, 1-9 d; 12L:12D, 9-16 d; 14L:10D, 16-23 d; 17L:7D, 23-30 d; 20L:4D, 30-37 d; and 23L:1D, 37-51 d) was provided. Six rooms were provided a light intensity of 15 footcandles (FC) (bright). The other 6 were provided an intensity of 0.5 FC to 9 d and 0.1 FC thereafter (dim). Birds were gently handled by the body during weighings at 9 and 23 d. At 23 d, birds in each room were randomly divided into 3 equal groups, assigned to either no handling, leg handling, or wing handling treatments, and marked accordingly. At 37 and 44 d, leg and wing handling birds only were each held for 20 s by their legs or wings and then weighed. At 51d, all birds were gently handled by the body as they were quickly and carefully weighed. Relative to bright light, dim light increased BW by 5% from 23 to 51 d and total feed consumption per bird from 30 to 51 d by 4%; however feed conversion was unaffected. Handling did not influence BW. Uniformity was not influenced significantly by treatments. Mortality averaged 3.6% and was unaffected by treatments. Since carcass and parts yields were consistently the same in the two intensity treatments, differences in live weights carried over through processing. Therefore, lean carcass, wing, leg, breast fillet, tender, and total breast weights were all increased by dim light. Leaf fat weights did not differ between lighting treatments, but fat yield was greater due to bright light. Handling did not affect carcass and parts weights or yields. Providing 0.1 FC throughout most of the growing period increased BW and feed consumption, which resulted in greater carcass and parts weights without any impact on feed conversion or parts yields.

Key Words: Broiler, Light Intensity, Handling

270 Impact of genotype, growth profile and photostimulation age on the reproductive efficiency of female broiler breeders. R. A. Renema*¹, M. J. Zuidhof², and F. E. Robinson¹, ¹*University of Alberta, Edmonton, AB, Canada,* ²*Alberta Agriculture, Food and Rural Development, Edmonton, AB, Canada.*

A 3 X 4 X 2 factorial design trial, with 3 broiler breeder strains, 4 target BW profiles and 2 photostimulation (PS) ages was performed to test the impact of strain and growth profile on sexual maturation traits. A total of 560 pullets from each strain (Hubbard Hi-Y, Ross 508, and 708) were housed in 24 pens. The BW profiles separated at 3 wk and converged at 32 wk of age as follows: STANDARD (approximates mean target BW profile of breeder strains used); LOW (12 wk BW target = 25% lower than STANDARD followed by rapid gain to 32 wk); MODERATE (12 wk BW target = 150% of STANDARD followed by lower rate of gain to 32 wk); and HIGH (12 wk BW target = 200% of STANDARD followed by minimal growth to 32 wk). Birds were photostimulated at 18 or 22 wk. Twelve birds per interaction were individually caged at 17 wk and monitored for egg production and fertility traits to 58 wk. The BW profiles converged at 32 wk and were similar thereafter. The LOW growth profile delayed onset of lay, particularly in 18 wk PS-age birds. There was no effect of growth history on initial egg weight. However, an 18 wk PS-age resulted in production of 16.0 small eggs (<52 g) compared to 7.9 in 22 wk birds. A settable, 52 g egg weight was reached earliest by STANDARD birds (26.7 wk of age). Prime laying sequence length was reduced by 7.0 eggs, on average, in MODERATE and HIGH birds (mean = 15.0 d) compared to other profiles ($P<0.0001$). The 18 wk PS-age birds yielded 8 more eggs (170) than 22 wk PS-age birds, with no effect on unsettable eggs. On average, total egg production was similar among growth profile treatments. However, Ross 708-HIGH hens under-performed (138 eggs) compared to the other profiles (mean = 166.3). Alternatively, Ross 508-HIGH birds laid the same number of

eggs as Ross 508-STANDARD birds (mean = 178.7). Feeding profiles affected egg production traits differently among strains, with little effect of PS-age.

Key Words: Broiler Breeder, Growth Curve, Egg Production

271 Relationship of physical traits at hatch with growth traits to 14-d of age in male chicks of selected parent stock and pure line products. F. E. Robinson*¹, N. J. Wolanski¹, R. A. Renema¹, G. M. Fasenko¹, V. L. Carney², and B. Fanher², ¹*University of Alberta, Edmonton, AB, Canada,* ²*Aviagen, Huntsville, AL.*

Current commercial boiler breeder products are the result of specific strain crosses. This trial measured the relationship between chick morphology and quality with early male growth traits. Chicks of 8 strains (specialized and commercial lines) (110 birds/strain) were wing-banded and weighed at hatch. Chick length, shank length, navel score and abdominal score (for yolk-sac retention) were recorded. Fifty chicks/strain were dissected and breast muscle and yolk sac weighed. Remaining chicks of each strain were divided among 2 pens and reared under commercial conditions. At 14-d of age, 50 randomly selected chicks were dissected to assess the impact of strain on BW, frame size, breast muscle, and residual yolk-sac. The d0 chick weights varied, averaging a high of 40.6 g in Strains 1, 2, 4, and 9, 38.7 g in Strains 3 and 6, and a low of 37.1 g in Strains 7 and 8. Their abdominal score (range of 1-3) correlated with actual yolk-sac weight ($r=0.50$; $P<0.0001$). Once residual yolk sac (range of 5.8 g [Strain 4] to 3.0 g [Strain 8]) was removed, variability in chick weight dropped from 4.2 to 2.4 g among Strains. Yolk-sac weight did not impact rate of BW-gain to 14 d. Strains 1 and 4 (mean yolk-sac weight of 14.5%) grew fastest and slowest, respectively, with an identical breast muscle yield at d14 (12.0%). Residual yolk at d14 was low (0.04 [Strain 8] to 0.43 g [Strain 1]), but with a similar profile to d0 values. Both shank length ($r=0.43$) and chick length ($r=0.38$) at d0 correlated better with d14 BW than initial chick weight did ($r=0.34$). The BW:shank ratio and BW:length ratio at d0, which may adjust for some strain or size differences, were no better correlated with d14 BW than d0 BW was (mean $r=0.33$). Good navel condition at hatch was linked with improved relative growth to 14 d ($P=0.009$), while red hocks did not affect growth ($P=0.29$). This trial demonstrated variability in the effect of chick traits on early growth patterns in current stocks.

Key Words: Chick Quality, Growth Rate, Strain Variation

272 Growth potential and carcass characteristics of eight strains of broiler breeder stocks. M. E. Rustad*¹, F. E. Robinson¹, R. A. Renema¹, M. J. Zuidhof², and V. L. Carney³, ¹*University of Alberta, Edmonton, AB, Canada,* ²*Alberta Agriculture Food and Rural Development, Edmonton, AB, Canada,* ³*Aviagen, Huntsville, AL.*

Over the past 30 years there has been an increase in genetic progress of growth rate and breast meat yield of broiler stocks. This has led to the development of market specific strains which provide challenges for managing breeder stocks. This trial was carried out to determine the relative growth and breast yield potential of commercial and specialized broiler lines to aid in development of effective weight management strategies. Eight strains of broiler pullets (12 birds/strain) were placed in eight pens (96 birds/pen). Birds were provided ad libitum access to feed and water, and given a constant 23L:1D of light. Weekly pen weights were taken from 0 to 84 d. At 42d and 84d, six birds from each strain were removed from each pen and assessed for external fleshing traits, processed, and weights of the P. major, P. minor, and fatpad were determined.

At 6 wk and 12 wk, the heaviest strain was Strain 1 (2.59kg & 5.24kg) and the lowest was Strain 4 (1.78kg & 3.66kg). Strain 4 birds had the highest % breast muscle at both testing periods (12-wk: 27.3% of the live BW). Strain 3 and 6 were the lowest yielding strains at 6 and 12wk (20% of live BW). At 6 & 12 wk strain 3 showed the smallest breast depth (1.3 & 2.2mm). Strain 4 showed the lowest % fat pad (1.82% of live BW), while Strain 3 was the highest (4.30%). Strain 1 had consistently higher values for chest girth, keel and shank length than all other strains, but ranked fourth in breast yield (24.2%). Because strain 4 show the highest percentage of breast yield with the smallest frame size and a large breast width, this indicates that these birds are increasing breast muscle in adding width rather than by linear growth of the keel. This trial demonstrated the variability of breast muscle deposition, growth

patterns, fat deposition and carcass traits of differing broiler breeder genotypes.

Key Words: Broiler Growth, Breast Muscle Yield, Strain Variation

273 The effects of supplemental enzyme (AVIZYME 1502) and phytase (PHYZYME) on phosphorus nutrition in broiler breeders. M. S. Lilburn*¹, A. Mitchell², and E. E. M. Pierson³, ¹Ohio State University, Wooster, ²Growth Biology Lab, USDA, Beltsville, MD, ³Danisco Animal Nutrition, St. Louis, MO.

Broiler breeder pullets were fed diets with two levels of phosphorus and supplemental amylase or phytase or the combination. A Control diet was formulated to contain 0.40 available phosphorus with no added enzymes. A second series of diets were formulated to contain 0.30% available phosphorus with either supplemental PHYZYME (phytase), supplemental AVIZYME (avizyme) or PHYZYME plus AVIZYME (combination). Pullets were restrict fed beginning at 14 days of age. At 6 weeks, 12 pullets per dietary treatment were put into individual cages in Petersime growing batteries. The pullets were put in the cages on an off-feed day. They were individually fed 72 grams of the respective diets and excreta was collected from individual pullets over the next 48 hours. The phytase and combination diets resulted in a significant drop in total excreta dry matter (Control, 17.6 gm; phytase, 16.7 gm; avizyme 17.7 gm; combination, 16.5 gm). All three enzyme treatments resulted in a significant drop in excreta phosphorus concentration but this was expected as available phosphorus was also lower in these treatments (Control, 17.6 mg P per gm excreta; phytase, 14.5; avizyme, 15.1; combination, 13.1). Total phosphorus output was as follows: Control, 311 mg P; phytase, 243 mg P; avizyme, 267mg P; combination, 215 mg P. In conclusion, the use of low available phosphorus diets together with supplemental phytase and the combination of phytase resulted in a linear decline in total excreta phosphorus output by restrict broiler breeder pullets

Key Words: Broiler Breeders, Phosphorus, Phytase

274 Detection of *Campylobacter* and *Salmonella* in the mature and immature ovarian follicles of late-life broiler breeder hens. N. A. Cox¹, J. S. Bailey¹, L. J. Richardson*¹, R. J. Buhr¹, K. L. Hiatt¹, D. E. Cosby¹, J. L. Wilson², G. R. Siragusa¹, D. V. Bourassa², and M. T. Musgrove¹, ¹USDA-ARS, Russell Research Center, Athens, GA, ²Department of Poultry Science, University of Georgia, Athens.

Campylobacter and *Salmonella* are known to cause acute bacterial gastroenteritis in humans. Poultry products have been implicated as a significant source of these infections. Four trials were conducted to determine if *Campylobacter* and *Salmonella* spp. exist naturally in the mature and immature ovarian follicles of late-life broiler breeder hens. Broiler breeder hens ranging from 60-66 weeks of age were obtained from four different commercial breeder operations. For each trial, the hens were removed from the commercial operation and held overnight at the University of Georgia processing facility. The hens were euthanized, de-feathered and aseptically opened. To reduce the possibility of cross-contamination between samples, the mature and immature ovarian follicles were aseptically removed, then the ceca. Individual samples were placed in sterile bags, packed on ice and transported to the laboratory for evaluation. Overall, *Campylobacter* was found in 5/43 immature follicles, 9/35 mature follicles and 30/43 ceca. *Campylobacter* was found in at least one of each sample type in each of the four trials. *Salmonella* was found in 0/43 immature follicles, 1/35 mature follicles and 8/43 ceca. In this study the recovery rate of *Salmonella* from late-life broiler breeder hen ovarian follicles was relatively low. However, the recovery rate of *Campylobacter* from the hen ovarian follicles was reasonably high suggesting that these breeder hens could be infecting fertile hatching eggs. Determining how *Campylobacter* contaminated these ovarian follicles and how many chicks may become colonized from this source are the next steps in helping to elucidate a better understanding of this ecology and control of *Campylobacter* in poultry production.

Key Words: *Campylobacter*, *Salmonella*, Ovarian Follicles

275 The effect of daily photoperiod on growth of commercial broilers. 1. Body weight and breast yield. M. S. Lilburn*, Ohio State University, Wooster.

The broiler industry has successfully used daily photoperiod as a tool in the control of growth related anomalies ranging from leg disorders to ascites. There is an increasing trend, however, to impose restricted photoperiods at increasingly younger ages and this may have negative effects on other aspects of live production. Eggs were purchased from an integrated company that was experiencing excessive 7 and 14 day mortality. Each egg was weighed at set (n=1060 eggs) and transfer (19 days). Moisture loss at 19 days was 11.75% and shell weight determined on a random sample of eggs was above 9% of egg weight. At hatch, chicks were equally divided among two light controlled rooms. In Room A, the daily photoperiod was 24 hours through 4 days of age and then decreased to 16 hours on Day 5. In Room B, the photoperiod was decreased to 23 hours on Day 5. All the birds in each room were weighed at 7, 14, 21, and 28 days of age. On days 42 and 43, half the birds in each photoperiod were weighed and processed for pectoralis major and minor breast muscle determination. The sex of each bird was visually determined and recorded. The 23 hour photoperiod resulted in a significant increase in body weight at 14,21 and 28 days of age. At processing, the 23 hour photoperiod resulted in significantly heavier body weight (2605 vs 2555 gm) and increased weight of the pectoralis major (197 vs 189 gm). The males weighed 2826 gms versus 2337 gm for the females with corresponding pectoralis major weights of 213 and 174 gms. In summary, a reduction in daily photoperiod from 24 to 16 hours at a very young age resulted in a significant reduction in body weight from 14 through 42 days of age. The proportional reduction in body weight was less than the proportional reduction in relative weight of the pectoralis major breast muscle.

Key Words: Photoperiod, Growth, Broilers

276 The effect of daily photoperiod on growth of commercial broilers. 2. Feeding behaviour. K. Huffman* and M. S. Lilburn, Ohio State University, Wooster.

Two experiments were conducted with broilers to study the effects of different photoperiods on feed intake behaviour during the first hour of the daily photoperiod. Twenty broiler chicks were randomly allotted, at a day of age, to litter floor pens (4.64 m²) in each of two light controlled rooms. The pens were arranged in observation groups of three pens, two pens with chicks (A,B) on either side of an empty observation pen There were three observation groups in each room. At 4 days of age, the daily photoperiod in one room was decreased from 24 to 16 hr beginning at 0900 hrs. In the second room, the daily photoperiod was decreased to 22 hrs beginning at 1300 hrs. This allowed each room to be observed on the same day and weekly observations were done on Monday, Wednesday, and Friday of each week beginning at 7 days of age. The first hour of the daily photoperiod was divided into 10, 6 minute periods. The number of chicks feeding was visually determined in Pen A (4 to 5 min) and Pen B (5 to 6 min) during each of the 10 observation periods. The data for each week was the average of the three observation days X two pens per day (n=6 total observations per week per room). Experiment 2 was conducted to increase the number of replicate pens observed per week. The data was analyzed using the Proc GLM procedure of SAS. The main effects tested were experiment, photoperiod, age (week) and the interactions of experiment X week and photoperiod X week. In both treatments, the greatest feeding activity occurred during the first 6 minutes of the daily photoperiod. There were significantly more birds eating in the 22 hr treatment during the initial 6 minute observation period (16 hr = 7.4; 22 hr = 8.9; P < .002) and these numbers were almost halved during the second observation period (16 hr = 4.3, 22 hr = 4.7; P > .05). During each of the remaining 8 observation periods, there were significantly more birds from the 16 hr treatment consuming feed (range 4.1 to 4.8) than in the 22 hr treatment (range 2.4 to 3.4). There were significant experiment effects for most of the observation periods but no consistent experiment X week or photoperiod X week interactions

Key Words: Feed Intake, Photoperiod, Behaviour

277 The effect of daily photoperiod on growth of commercial broilers. 3. Skeletal development. M. S. Lilburn*¹ and A. Mitchell², ¹Ohio State University, Wooster, ²Growth Biology Lab, USDA, Beltsville, MD.

Broiler starter diets from three commercial feed mills (same company, different locations) were fed to day-old Hubbard Hi-Y broiler chicks along with a Control diet manufactured at Ohio State University. The analyzed calcium levels were as follows: Source 1, .76% ; Source 2, .97% ; Source 3, .81% ; Control, .98%. Each of the diets was fed to 5 replicate pens of broiler chicks in Petersime battery brooders in each of two light controlled rooms. In Room A, the chicks were exposed to a 24 hr photoperiod from 0 to 4 d and 22 hr from 5 to 21 d whereas in Room B, the photoperiod was decreased to 16 hr at 5 d of age. At the end of the study, each chick was weighed and the tibia and femur were removed for length, width @ 50% of length, defatted dry weight and bone mineral content. Chicks exposed to 16 hr of light weighed significantly less than those chicks exposed to 22 hr (706 vs 747 g; P < .0001). The 16 hr photoperiod also resulted in a significant decrease (P < .01) in all bone measurements: tibia wt, 1.58 vs 1.78 g; tibia length, 6.34 vs 6.48 cm; tibia width, 5.8 vs 6.0 mm; femur length, 4.82 vs 4.93 cm; femur width, 6.7 vs 7.1 mm. Tibia and femur bone mineral content and bone mineral density were significantly greater in birds fed the Source 2 and Control diets compared with birds fed the Source 1 and Source 3 diets. These same bone mineral measurements were consistently higher in the 22 h. photoperiod though the differences were not always significant. In conclusion, variability in commercial starter diets combined with early photoperiod restriction may have a negative effect on skeletal development in broilers.

Key Words: Bone, Photoperiod, Calcium

278 Spatial disparity of ammonia flux within a broiler house at one and 21 days of age. D. M. Miles*¹, P. R. Owens¹, D. E. Rowe¹, and S. L. Branton², ¹USDA-ARS, Waste Management and Forage Research Unit, Mississippi State, MS, ²USDA-ARS, Poultry Research Unit, Mississippi State, MS.

Ammonia concentrations greater than 25 ppm in broiler houses have been linked to emaculated birds. The objectives of this study were to measure ammonia and other gas fluxes in a commercial broiler house and assess any spatial variabilities. Application of these findings include the development of optimum sampling methods as well as the identification of characteristics of modern tunnel ventilated houses that contribute to gas emissions. Researchers hypothesize that litter age, moisture, pH, temperature, and airflow patterns affect gas flux values and these parameters vary spatially. Ammonia, nitrous oxide, carbon dioxide, methane, and carbon monoxide were measured using a photoacoustic multigas analyzer along with flux boxes. Samples (n=36) were collected systematically throughout the house along a set grid. Twenty-eight flocks had been grown on the litter prior to the summer flock sampling with chicks in the house at one (placement) and 21 (mid-growout) days of age. At one day of age during half-house brooding, average NH₃ flux was 498 mg/m²-hr for the brood area and 372 mg/m²-hr for the vacant end of the house with peak areas near the middle of the cool cell end (where airflow is not well established) and near the north side wall (an area of high litter moisture, 37%). At 21 days of age, litter temperatures were reversed from those at chick placement and were greater near the fan end of the house. Both ranged from about 25.6 to 31.9 C. Litter pH was greater in the nonbrood half of the house at placement and mid-growout. Average NH₃ flux for the mid-growout was 136 and 310 mg/m²-hr for the brood and fan ends. A peak area for NH₃ flux in mid-growout was evident approximately 7 m past the midpoint of the house (towards the fans) and correlated to high pH (8), high litter moisture (33%), and high CO₂ flux (12500 mg/m²-hr). The spatial variability of these parameters demonstrates that increased NH₃ flux relates to high litter moisture as well as greater litter temperatures and CO₂ flux and NH₃ flux decreases on average from placement to mid-growout.

Key Words: Ammonia, Broiler, Emissions

PSA Immunology

279 Salmonella vaccination programs in broiler breeders. I. Humoral and mucosal immune response. A. Rolon*¹, J. S. Bailey², P. S. Holt², C. L. Hofacre³, J. L. Wilson², D. E. Cosby², L. J. Richardson², and N. A. Cox², ¹Department of Poultry Science, University of Georgia, Athens, ²U. S. Department of Agriculture Russell Research Center, Athens, GA, ³Department of Avian Medicine, University of Georgia, Athens.

Although vaccination against *Salmonella* has been used more frequently in broiler breeders in recent years, there is a paucity of information in the literature demonstrating the immunological response of treatments that combine live and autogenous killed cell vaccines. The present research was designed to assess the immunological response that was generated by three vaccination protocols. Treatment vaccines consisted of a live Aro-A mutant commercial *Salmonella* Typhimurium (ST) vaccine and an autogenous killed vaccine consisting of a pool of *Salmonella* serovars Berta, Heidelberg, and Kentucky prepared by a commercial company. Four groups of 250 Cobb x Cobb breeder chicks were vaccinated as follows: A) 2 live (day 1 and 21) and 2 killed (day 77 and 126); B) 3 live (day 1, 21, and 77) and 1 killed (day 126) and ; C) 2 killed (day 77 and 126); and D) untreated controls. To assess humoral and mucosal immune response, samples of serum (SER), crop lavage (CL), gut lavage (GL), hatchling serum (HSER), and egg yolk (EY) were tested to measure IgA and IgG. ELISA for IgA and IgG on *Salmonella* Enteritidis and *Salmonella* Typhimurium lypopolysaccharide (SELPS and STLPS) as capture antigen were conducted. Overall, immunological response was stronger on STLPS than SELPS. IgA of SER, CL and GL as well as IgG of CL were short-lived peaks after first killed vaccine. Strong GL IgG after first live and both killed vaccine events were measured with the killed response enduring longer. SER IgG responses were observed after killed vaccine events, and lasting throughout 40 wk of age. HSER and EY IgA were negligible, and IgG comparable among all treatments throughout time. These results show that killed antigen is vital in eliciting adequate IgG inserum and gut. Live vaccination with Aro-A mutnat

ST vaccine enhances gut IgG and possibly aids in conferring adequate immunity during the breeder's first weeks of life.

Key Words: *Salmonella*, Vaccination, Immune Response

280 Salmonella vaccination programs in broiler breeders. II. Resistance to challenge under a multiple marker strain model. A. Rolon*¹, J. S. Bailey², P. S. Holt², C. L. Hofacre¹, J. L. Wilson², D. E. Cosby², L. J. Richardson², and N. A. Cox², ¹University of Georgia, ²U. S. Department of Agriculture.

Resistance to *Salmonella* challenge of breeders and their chicks under three vaccination programs was assessed. Vaccine protocols combined a live Aro-A *Salmonella* Typhimurium (ST) vaccine and an autogenous 3-serovar killed vaccine. Treatments combined: 2 live and 2 killed or 3 live and 1 killed vaccines delivered at 1 d and 3, 11 and 17 wk of age; 2 killed vaccines given at d 77 and 126; and a non-vaccinated control (C). Breeders were gavaged with 10⁷ cells of a 3-strain cocktail (*Salmonella* Enteritidis (nalidixic acid resistant, Nal-SE), Typhimurium (rifampicin resistant, Rif-ST) and Thompson (ampicillin resistant, Amp-STH)), at wk 3, 6, 10 18 and 22. Chicks from eggs laid at wk 29, 34 and 40 of breeder age (BA) were challenged at one day-of-age. Chicks were divided in two groups per treatment, one given a commercial competitive exclusion culture (CE), and both were challenged with 10⁷ cells of a Nal-SE + Rif-ST+Amp-STH cocktail and kept in isolation units for one and two wk. Ceca and Liver-Heart-Spleen (LHS) samples were cultured for each marker strain on BGS + antibiotic (Nal, Rif, or Amp) plates and colonies counted after 24h incubation. Log₁₀ data were analyzed under a factorial design. Breeder *Salmonella* counts showed significant differences between (live) vaccinates and non-vaccinates at 3 and 6 wk challenges. By 10 wk, there were no discernible difference in *Salmonella* level in challenge and control chicks, indicating protection by (1d and 3 wk) live vaccines had diminished at this time. All programs reduced breeder *Salmonella* counts compared to controls at 22 wk. Chick *Salmonella* counts showed little consistency between vaccine treatments. At 34 and