

and dimensions were measured on "as is" raw basis with one half of each L* category which was repeated after freezing (4 days at -20C) and thawing (3 days at 4C). L* of the freeze-thawed fillets decreased from the fresh-raw state which equivalently occurred with each category. Absolute raw weights of representatives from each class were equivalent; however, the weight losses associated with thawing progressively increased with L* at the time of deboning and correlated with their decrease in dimensions ($r=0.587, 0.403, 0.372$, for length, width and depth, respectively). Fil-

lets with the highest L* values from a common population originate with broilers having most favorable growth early in development and as a proportion of live weight at 56 days when marketed. Ultimately, these fillets experience the greatest changes in L* values with subsequent handling as well as weight loss and alteration in dimensions.

Key Words: Breast meat, Broiler processing, Fillet quality

Environment and Management - Meat Bird Production

80 Influence of lighting program, light intensity and feed energy level on live performance, carcass fat and parts yields of female broilers. R. J. Lien^{*1}, J. B. Hess¹, K. M. Downs², S. F. Bilgili¹, and W. A. Dozier III³, ¹Auburn University, Auburn, AL, ²Middle Tennessee State University, Murfreesboro, TN, ³University of Georgia, Athens, GA.

To determine effects on growth, carcass fat and processing yields, broilers were grown with either long or step-up lighting programs, either bright or dim light intensities, and either high or low feed energy levels in a 2X2X2 factorial arrangement. A total of 1680 day-old female broilers (Ross 508) were placed in twelve light tight rooms which were each divided into two pens (70 chicks/pen). Three rooms were provided 23L:1D (long) with intensity of 2 FC (bright). Three rooms were provided long lighting with intensity of 1 FC during wk 1, 0.5 FC during wk 2, and 0.25 FC during wk 3-8 (dim). Three rooms were provided step-up lighting (23L:1D during wk 1, 12L:12D during wk 2, 14L:10D during wk 3, 16L:8D during wk 4, 18L:6D during wk 5, 20L:4D during wk 6, and 23L:1D during wk 7-8) with bright intensity. Three rooms were provided step-up lighting with dim intensity. One pen per room was provided starter (22% CP), grower (20% CP), finisher (18% CP), and withdrawal (16.5% CP) feeds containing 1400, 1417, 1433, and 1450 kcal ME/lb (low) while the other was provided feeds containing 1450, 1467, 1483, and 1500 kcal ME/lb (high), respectively. Relative to long days, step-up lighting reduced both BW and cumulative consumption from 7-2% from 2-5 wk. However, final BW (7.53 vs 7.46 lb) and consumption (15.84 vs 15.65 lb) of step-up birds were numerically greater while feed conversion was unaffected (2.10). Compared to bright, dim light increased BW from 4-3% from 2-5 wk and cumulative consumption from 5-1% from 2-8 wk. However, feed conversion was unaffected. Feed energy did not affect BW. However, in relation to high, low energy increased both cumulative consumption and feed conversion by about 2% at 6 and 8 wk, and 7 and 8 wk, respectively. Mortality averaged 3.2% and was unaffected by treatment. Uniformity was unaffected by treatment at 1 and 5 wk. However, relative to low, high energy decreased uniformity at 7 wk. Carcass fat was unaffected by treatment. Parts weight and yield data indicated step-up and dim lighting may decrease breast meat in favor of less desirable parts.

Key Words: Broiler, Lighting program, Light intensity, Feed energy

81 Lighting program effects on broiler performance and heat production. A. Beker^{*1}, A. Beker¹, S. L. Vanhooser², and R. G. Teeter¹, ¹Department of Animal Science, Oklahoma State University, ²Oklahoma Animal Disease Diagnostic Laboratory, Oklahoma State University.

An experiment was conducted to evaluate influences of three lighting programs A (23L:1D), B (12L:12D) and C (1L:1D) on broiler performance and heat production (HP) throughout the growth cycle. Birds were reared on standard poultry diets in metabolic chambers with controlled lighting starting at seven days of age until they were 49 days old. Indirect calorimetry was utilized to measure HP. There was no significant difference ($P < 0.05$) in feed consumed (g), gain (g) or feed conversion ratio at three weeks of age (starter phase). In the grower phase (3-5 weeks of age) there was a lower ($P < 0.05$) body weight gain (908 g) for the birds on C than those on the A (940 g) or B (964 g) lighting programs. Feed conversion ratio was lower ($P < 0.05$) for the B (1.52) lighting schedule than the A or C programs (1.60 and 1.65). In the finisher phase (5-7 weeks of age) birds on B consumed more feed (2363 g) and gained more weight (1189g) than A or C at 2193 and 2168 g feed and 1028 and 976 g, respectively. Accordingly, overall feed conversion ratio (FCR) at 7 weeks of age for birds on the 12L:12D lighting program (2.03) was significantly lower ($p < 0.05$) than that for A and C lighting schedules (2.17 and 2.30). Final bird body weight was 2613, 2423, and

2290 g for the 12L:12D, 23L:1D, and 1L:1D respectively. Bird heat production was reduced ($P < .01$) during the dark phase and was related to FCR. Results suggest that lighting cycles significantly influence broiler performance and energetic efficiency.

Key Words: Energy, Feed efficiency, Lighting

82 Effect of heat stress on growth and organ enzyme activities of broiler chickens. H. Y. Tabiri^{*1}, K. Sato², K. Takahashi², M. Toyomizu², and Y. Akiba², ¹Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Canada, ²Graduate School of Agricultural Sciences, Tohoku University, Sendai, Japan.

A study was conducted to determine the effect of chronic heat stress on growth performance and enzyme activities in plasma, liver and kidney of broiler chickens. Two-week-old male broiler chickens (Ross strain) were reared at of 24 C (control group) and 36 C (heat stress). A third group was kept at 24 C and fed on the same amount of feed consumed by the heat stress group (pair-fed). Birds were fed ad libitum on semi-purified diet containing 200g CP/kg and 13.39MJ ME/kg. Twelve birds (6 replicates with two birds per cage) were assigned to each treatment room. At the end of the 2 weeks experimental period, blood was drawn from the birds by cardiac puncture for plasma GOT and GPT analysis. They were then killed; liver and kidney were removed for the determination of glutamate pyruvate transaminase (GPT) and glutamate oxaloacetate transaminase activities (GOT). Heat stress significantly reduced body weight gain, feed intake and feed conversion efficiency compared with the control group but there was no difference between the heat stress and the pair-fed groups. Plasma GOT was significantly increased compared with both the control and pair-fed groups. In the organs heat stress decreased liver GPT and increased GOT significantly. On the other hand, in the kidney, heat stress significantly increased GPT and decreased GOT compared with the pair-fed group. Results of the present study shows that heat stress per se did not impact growth rate of two to four weeks old broiler chickens but it altered the biochemical functions of the liver and kidney. This may imply that between two and four weeks of age plasma and organ GPT and GOT of broiler chickens are more sensitive to heat stress per se than growth performance.

Key Words: Heat stress, Broilers, Organ, GPT, GOT

83 Reduction of heat stress in broiler chickens exposed to high ambient air temperatures by means of convective cooling. M. A. Mitchell^{*1}, P. J. Kettlewell², R. R. Hunter¹, and D. A. Sandercock¹, ¹Roslin Institute, Roslin, Midlothian UK EH25 9PS, ²Silsoe Research Institute, Silsoe, Beds, UK MK45 4HS.

During road transportation broiler chickens are exposed to a number of concurrent stressors the major threat to productive efficiency and welfare being attributable to thermal stress. Recent studies have suggested mechanical ventilation of commercial vehicles might reduce the risk of heat stress by both removal of heat and water vapour and by direct convective cooling of the birds. The present study has therefore examined the effects of defined air movement (0 and 1.0 ms^{-1}) upon thermoregulatory responses and deep body temperature control at a range of air temperatures ($T_a = 24-40^\circ\text{C}$ and $\text{RH} = 50-70\%$) in broilers ($n=6$ in each group) during an exposure period of 1 hour in a controlled climate, wind tunnel calorimeter. Respiratory frequency (f) was measured by thorax plethysmography and respiratory evaporative water loss (REWL) by gravimetric analysis. Rectal temperature (T_b) was recorded throughout. REWL was linearly related to T_a ($p < 0.01$). Significant linear relationships were also demonstrated between REWL and T_b and f ($p < 0.01$). An air velocity of 1.0 ms^{-1} significantly reduced ($p < 0.05$) the proportional increases in f and REWL in response to increasing T_a in comparison with still air.

As the linear relationships between Tb and the respiratory parameters were unaltered by air movement it is proposed that the beneficial effects of this forced ventilation regime are through direct convective cooling and a reduction in deep body temperature. Convective cooling thus reduces the requirement for respiratory evaporation and therefore improves water conservation in addition to decreasing hyperthermic stress. The air movement induced reduction in thermal polypnea will also avoid excessive acid-base balance disturbances. It is proposed that air movements consistent with those achievable on mechanically ventilated commercial transporters will potentially improve productivity and welfare during journeys undertaken in hot conditions.

Key Words: Broiler, Thermal stress, Ventilation

84 Atmospheric oxygen level effects on performance and ascites incidence in broilers. A. Beker^{*1}, S. L. Vanhooser², J. H. Swartzlander¹, and R. G. Teeter¹, ¹*Department of Animal Science, Oklahoma State University,* ²*Oklahoma Animal Disease Diagnostic Laboratory, Oklahoma State University.*

Two studies were conducted using commercial male broilers to examine atmospheric oxygen (AO) effects on chick performance and propensity to develop ascites. In the first study five AO concentrations (12, 14, 16, 18, 20.6%) were examined in calorimetry chambers for 2 weeks with incoming air diluted with nitrogen to provide the desired AO. Day 14 BW, BW gain, feed consumption, and gain-to-feed ratio decreased ($P < 0.01$) as oxygen (O₂) concentration declined from 20.6 to 12%. The BW at 14 d of age was 138 g for the lowest atmospheric O₂ level compared to 371 g for 20.6% O₂. Growth depression appeared related to feed consumption. Ascites heart ratio (AHR), ascites score (AS), right ventricular mass (RVM), and hematocrit (HCT) all increased ($P < 0.01$) as the level of O₂ concentration decreased. Blood HCT appeared to be the most sensitive indicator of physiological change. These results suggest that 19.6% atmospheric O₂ is the minimal allowable level for housing birds through 2 wk of life without consequences. Data from the study, when birds were housed at 4 AO (from 12 to 20.6%) for 12 h suggests that consequences occurred later in life. At 42 d of age chicks exhibited reduced BW and elevated AHR. Caution must be utilized to assure that AO exceeds 19.6% throughout the chick's life, as even short-term reductions appear to be potentially long lasting. Stress consequences such as cold stress would be expected to raise the 19.6% value.

Key Words: Ascites, Hematocrit, Oxygen concentration Threshold

85 Pellet quality effects on broiler efficiency, growth, and palatability. D. O. Skinner-Noble^{*1}, L. J. McKinney¹, and R. G. Teeter¹, ¹*Department of Animal Science, Oklahoma State University.*

Three experiments were conducted to evaluate pelleting influences on broiler growth, feed efficiency, and feed palatability. In Experiments 1 and 2, birds from Strain A were reared to 42 d of age, and then feed conversion ratio (FCR) was measured in a sample of the population from 43 to 50 d of age. In Experiment 1, pelleting enhanced growth and feed efficiency compared to mash. Pelleted treatments with less than 40% pellets decreased weight gain and feed intake. In Experiment 2, birds fed 40% or 20% pellets had reduced weight gains, reduced feed intake, and reduced water intake compared to birds fed 80% pellets. Birds fed 80% pellets had lower (better) FCR than birds offered 40% pellets, with birds fed 20% pellets intermediate. Experiment 3 was conducted to examine the effect of strain and previous experience with feed form on choice of pelleted or mash feed. Forty male broilers from two strains (20 from Strain B and 20 from Strain C) were reared to 18 d on a broiler starter diet in mash form. At 18 d of age, birds were fed a broiler grower diet in either mash or pellet form. When birds were 40 d of age, they were fasted overnight in preparation for a short (52 h) FCR test. While birds were in FCR cages, they were continuously offered both pellets and mash. Birds were observed three times (of 10 observations each) to measure behavior patterns related to Strain and feed form experience. When offered a choice of pellets or mash, birds preferred the feed they had previously been offered. Behaviors were generally not affected by strain or feed form experience. Results of these experiments indicate that feed form affects palatability, that birds may resist a change in feed form, and that broilers prefer to consume feed in a familiar form.

Key Words: Pellet quality, Feed efficiency, Palatability

86 Response of turkey toms fed antibiotic-free diets supplemented with either Mannan Oligosaccharide (MOS) or SynermaxTM. R. M. Hulet^{*1} and T.L. Cravener¹, ¹*Pennsylvania State University.*

Research was conducted to evaluate the growth and feed conversion (FC) of turkey toms fed a control (CT), MOS (MOS; 0.1 %) and SynermaxTM (SM; 1.0 %) supplemented diet to 14 wk. Nine hundred and ninety toms were randomized into 3 dietary treatments with twelve pens each. The feeding program (Calculated Analysis) included a Pre-starter (0-28 d; 31.3 % CP; 7.1 % EE), a Starter (29-42 d; 24.5 % CP; 5.6 % EE), a Grower I (43-70 d; 25.9 % CP; 8.2 % EE), a Grower II (71-84 d; 18.3 % CP; 6.4 % EE), and a Finisher (85-98 d; 17.0 % CP; 6.6 % EE) diet. From 14-28 and 71-98 d, either MOS or SM diets resulted in significantly higher BW than CT diets. For example, at 98 d, MOS and SM birds were 3.3 and 3.0 % larger ($P \leq 0.0036$) than CT birds, respectively. MOS diets resulted in a significantly higher BW than either CT or SM during days 14-42. Cumulative mortality (7.32 %) for MOS supplemented birds was improved by diet ($P \leq 0.08$) when compared to the CT (13.49 %) or SM supplemented toms (15.66 %). The results suggest a positive role in increased growth performance for probiotic-supplemented turkey tom antibiotic-free feeding strategies.

Key Words: Probiotics, Turkey, MOS, SynermaxTM

87 Measurement of annual litter production and nitrogen mass balance of broilers reared on rice hull litter. C. D. Coufal^{*}, C. Chavez, P. L. Neimeyer, and J. B. Carey, *Texas A&M University, College Station, Texas.*

Large amounts of broiler litter must be disposed of from broiler facilities each year. Concerns have arisen regarding the amount of litter, caked litter and ammonia produced on an annual basis from such facilities. Data currently available does not accurately estimate annual litter and ammonia production rates from modern broiler rearing facilities utilizing rice hull litter. Therefore, a study was conducted under simulated commercial broiler rearing conditions to more accurately measure litter and caked litter production, as well as perform a nitrogen mass balance for the entire facility. Broiler chicks and feed were obtained from a commercial integrator, and 8 consecutive flocks were raised on recycled rice hull litter over a period of one year. Caked litter was removed from each pen after the removal of each flock. Management practices were followed to simulate commercial conditions. Samples and weights of all birds, feed and litter entering and leaving the facility were collected. All samples were analyzed for moisture and total nitrogen content. Cumulative litter production expressed as g of dry matter/kg of marketed broiler (g/kg) significantly ($P < 0.05$) decreased with each additional flock reared on the litter from 745.5 g/kg to 220.3 g/kg. Cumulative caked litter production varied from flock to flock due to seasonal influences, resulting in an annual rate of production of 61.6 g/kg. Caked litter nitrogen (dry matter basis) varied little for flocks 2 through 8 (3.59 to 3.80%), but significantly increased to 4.51% after flock 9. Percent litter nitrogen after each flock significantly increased between flock 2, 3 and 4 (2.53, 2.74 and 3.15%, respectively), but did not differ for flocks 4 through 9 (3.15 to 3.35%). Reduced nitrogen retention by the litter after flock 4 resulted in greater nitrogen loss through ammonia and dust with each subsequent flock. Cumulative annual nitrogen retained in the litter and caked litter was 6.86 g/kg and 2.4 g/kg, respectively. Cumulative annual nitrogen lost to the environment as dust and ammonia was calculated at 13.4 g/kg.

Key Words: Broilers, Rice hulls, Litter, Nitrogen, Mass balance

88 Impact of dietary supplemental methionine sources on sensory measurement of odor related compounds in broiler excreta. C. Chavez^{*1}, C. D. Coufal¹, P. L. Niemeier¹, J. B. Carey¹, R. E. Lacey¹, R. K. Miller¹, and R. C. Beier², ¹*Texas A&M University, College Station, TX 77843,* ²*USDA/ARS Southern Plains Research Center.*

An experiment was conducted to detect differences of odor related compounds in broiler excreta by a trained human descriptive aroma attribute sensory panel. All excreta were collected in litter pans lined with aluminum foil. All trials consisted of 5 treatment groups with 3 replications and 13 randomly distributed straight run broiler chicks per pen reared in battery cages. The treatment groups consisted of no supplemental methionine (control group), sodium methioninate aqueous solution, dry methionine hydroxy analogue, liquid methionine hydroxy analogue, and

DL-methionine. The methionine activity of each methionine source was 45.9, 52, 88, and 98% respectively. Starter and grower diets were formulated to contain 0.5%, and 0.38% methionine activity, respectively (except control group, 0.35% methionine activity). No significant differences were observed in body weights, feed consumption or feed conversion among the treatments. Broiler excreta were collected at week 4, 5, and 6 for 24 hours to be analyzed by the trained sensory panel (7 people). Each panelist was given 25 g of manure heated at 27C for 5 minutes for sensory analysis. The thirteen odor attributes utilized to determine differences in broiler excreta by the trained sensory panel were ammonia, dirty socks, wet poultry, fermented, rotten fruit, hay, musty wet, sharp, sour, urinous, rotten eggs, irritating, pungent, and nauseating. Panelist marked intensities for each attribute ranging from 0=none and 15=extremely intense. Each panelist was given 2 replications of each treatment group in a random order each week (total of 10 samples per week). All data were evaluated by analysis of variance using the GLM procedure of SAS. The data indicated that ammonia, wet poultry, rotten fruit, musty-wet, sharp, and pungent differed ($P < 0.05$) across treatment groups. These findings demonstrate that supplemental methionine sources significantly influences odor related compounds in broiler excreta.

Key Words: Sensory, Odor, Methionine, Broilers, Excreta

89 In-house composting of catastrophic poultry mortalities: An educational opportunity. G. W. Malone^{*1}, N. T. Tablante², and L. E. Carr², ¹University of Delaware, ²University of Maryland.

Composting of poultry mortalities is a widely accepted method of carcass disposal. Various configurations of bin systems have been used for

disposal of routine mortalities. Outside, windrow composting has also been used for disposal of catastrophic events such as major heat losses. However, economical, biosecure, and acceptable methods for disposal of catastrophic poultry mortalities due to highly pathogenic diseases are limited. With support from the US Poultry and Egg Association, a demonstration was implemented to evaluate, demonstrate and perfect in-house composting as an option for disposal of catastrophic mortality events. Processing plant dead-on-arrival were used to simulate a whole-house depopulation of market age birds with a highly infectious disease. The following combinations of composting variables were studied; bird size (broiler vs. roaster), carbon source (litter vs. sawdust) water (added vs. no water), and carcass type (whole vs. shredded). During the first 2-week primary heat, all treatments achieved temperatures conducive to virus inactivation and only one treatment produced marginally acceptable compost. The poultry industry and select agencies personnel were invited to observe the construction of the in-house windrows and turning of the piles within the house. All procedures, labor, time, equipment, material requirements and estimated cost were documented. Photographs and documentation of the in-house process are being compiled for production and distribution of an educational compact disk. The educational value of conducting this demonstration will be discussed. Additional technical details of the composting treatments will be reported in subsequent presentations.

Key Words: Carcass disposal, Catastrophic mortalities, Carcass composting

Genetics

90 Effects of selection for increased breast yield on growth and performance of female Japanese quail. J. M. Reddish^{*}, K. E. Nestor, and M. S. Lilburn, *The Ohio State University/OARDC.*

The objective of this study was to determine the effect of selection for increased breast yield on growth and performance of female Japanese quail in a short term selection experiment. The hypothesis is that selection for increased breast yield in female quail will be of low heritability and will negatively affect characteristics of reproduction. Quail used in this experiment originated from a random bred control (RBC) population of Japanese quail. For each generation, three separate hatches were raised and at 4 weeks of age measurements of body weight were recorded. Body weight and *Pectoralis major* muscle data from female quail in hatch three were used for selection. Selection scheme was maternal family selection based on *Pectoralis major* weight with adjustment for BW differences by covariance analysis. Selected female quail were then paired with RBC male quail to reproduce the next generations. Selection for *Pectoralis major* muscle in maternal Japanese quail lines made slight increases in the absolute weight of the *Pectoralis major* muscle without subsequent increases in BW. Comparisons were made between the selected line (SEL) and the RBC for days to first egg, BW at first egg, first egg wt. There were no significant differences between the SEL and RBC lines for any of the measured traits. Average *Pectoralis major* weight in the SEL line in generation 1 was 11.6 g and 12.9 g in generation 5. The maternal selection scheme for breast yield in female Japanese quail did appear to increase the weight of the *Pectoralis major* muscle.

Key Words: Japanese quail, Selection, Yield, Muscle, Reproduction

91 Effect of hypobaric hypoxia on ascites resistant and susceptible lines and their reciprocal F1 crosses. 1. Production parameters and ascites mortality. H. O. Pavlidis^{*1}, J. M. Balog², L. Stamps¹, G. R. Huff², W. E. Huff², N. C. Rath², C. R. Cisar², G. Tellez¹, and N. B. Anthony¹, ¹University of Arkansas, Fayetteville, AR, ²PP&PSR/ARS/USDA, Fayetteville, AR.

Tremendous advances in genetic selection, nutrition and management have allowed poultry producers to grow market broilers in record time. However, it is believed that the rapid growth rate, better feed conversion and heavy body weight of the modern broiler has led to a predisposition of the birds to develop injurious metabolic diseases. While the etiology of ascites syndrome is multi-factorial, there appears to be a strong genetic

component. Over the past 7 years, our laboratories have used sire-family selection on a commercial elite line base population to produce an ascites resistant (RES) and an ascites susceptible (SUS) line of broilers. After seven generations of selection, the RES line exhibits < 22% ascites mortality while the SUS line has > 86% ascites mortality. To determine the genetic factors involved in ascites susceptibility, reciprocal F1 crosses of the RES and SUS lines were produced. The objective of this trial was to determine the effects of hypobaric exposure on pure-lines RES and SUS, and their reciprocal F1 crosses (RS, SR). Four hundred and eighty vaccinated, pedigreed broiler chickens (40 groups of 12 birds) were randomly assigned to cages in either a hypobaric chamber (simulated 2900 m above sea level) or a matching local altitude chamber (390 m above sea level). Individual bird weights were collected on Day 0, 14, 28 and 42. Mortalities were necropsied daily to determine cause of death. On Day 42, birds were sacrificed, scored for ascites, and BW, liver, spleen, and split heart weights were obtained. Ascites mortality differed between lines, with the SUS line having the highest, the RES line having the least, and the RS and SR lines having intermediate ascites incidence. The number of days to death were highest for the RES (37 ± 1), with the RS (32 ± 1) and the SR (32 ± 1) intermediate and the SUS survived the shortest number of days (19 ± 1) ($P = 0.0001$). Significant positive heterosis for BW was observed in the F1 crosses at 14, 28, and 42 days of age, and there were no BW differences between RS and SR. No pure line differences were observed for BW at these same ages. Supported in part by U.S. Poultry & Egg. (# 285) and Cobb-Vantress, Inc.

Key Words: Ascites susceptibility, Genetic selection, Hypobaric, Reciprocal crosses, Broilers

92 Effect of hypobaric hypoxia on ascites resistant and susceptible lines and their reciprocal F1 crosses. 2. Gut development. G. Tellez^{*1}, J. M. Balog², H. O. Pavlidis¹, W. E. Huff², G. R. Huff², N. C. Rath², L. Stamps¹, A. M. Donoghue², B. M. Hargis¹, and N. B. Anthony¹, ¹Department of Poultry Science, University of Arkansas, Fayetteville, Arkansas, 72701, ²USDA-ARS-PPPSRU University of Arkansas, Fayetteville, Arkansas, 72701.

Genetic selection based on rapid growth rates, better feed conversion and heavy body weight for broilers has led to a predisposition to ascites in broiler populations. Sire-family selection was applied to a commercial elite line to produce divergent lines of ascites resistant (< 22% ascites mortality, RES) and ascites susceptible (> 86% ascites mortality, SUS) broilers. In a continuing effort to determine the genetic factors associated