

TMR treated with a fibrolytic enzyme product (Promote, Agribands Intern., St. Louis, MO). The objectives were: 1) determine whether enzymes improve DMD or NDFD, and 2) establish whether increased digestibility was due to feed-treatment effect or an enhancement of the hydrolytic capacity of the ruminal fluid. Two cannulated lactating Holstein cows were fed a sequence of four TMR: no enzymes (-E), enzymes added to the concentrate portion of the TMR (C+E), enzymes added to the supplement portion of the TMR (S+E), or enzymes added to the premix portion of the TMR (P+E). The same cows served as rumen fluid donors, which was composited by diet. Fresh, unground TMR was incubated in vitro for 12 or 48 h. At 12 h, when rumen fluid from the respective diets was used, -E showed the lowest DMD (41.2^a), followed by S+E (43.2^{ab}), C+E (44.7^b), and P+E (44.8^b). However, there were no differences ($P > 0.05$) among treatments for NDFD at 12 h (20.08±12.0). There was no effect of treatment ($P > 0.05$) at 48 h for DMD (59.83±3.8) or NDFD (40.88±9.3). When the -E TMR was incubated with the various inoculates, there was no improvement in its DMD or NDFD at 12 or 48 h. We did not test the effects of incubating the enzyme-treated TMR in ruminal fluid from cows fed -E. This study indicates that fibrolytic enzymes increase DMD during the early stages of digestion. However, enzyme supplementation has no effect on feed digestibility at longer incubation times, which may indicate that enzymes improve rate, rather than extent, of digestion. Enzymes must be in physical contact with the feed to improve digestibility.

Key Words: Enzyme, Digestibility, in vitro

155 The effect of different levels of yeast culture inclusion in the concentrate diet on calf performance. R.J. Fallon*¹ and B. Earley¹, ¹Teagasc.

The recent banning of a number of in-feed antibiotic digestive enhancers within the European Union has generated the need to find suitable non-antibiotic alternatives. Yeast culture (YeaSacc 1026) as a supplement has been evaluated in several growth studies in calves, steers and bulls. There is however, little information available on the optimum level of YeaSacc 1026 for inclusion in the calf concentrate ration. The aim of this study was to determine the optimum level of YeaSacc 1026 inclusion. The following experiment was undertaken using 80 Friesian male calves (average initial weight of 54 kg) to determine the optimum inclusion rate of YeaSacc 1026 in a barley soyabean meal ration. Calves were allocated at random to 1 of 4 treatments: 1) 0, 2) 0.625, 3) 1.25 and 4) 2.5 kg YeaSacc 1026 per tonne of ration. The concentrate ration was available ad libitum throughout the 84 day experimental period and the calves were offered 25 kg of calf milk replacer by bucket over the initial 42 day period. Calf liveweight gain in the period 1-42 days was 0.58, 0.65, 0.65 and 0.68 (s.e.d 0.029) kg/d for treatments 1 through 4, respectively. The corresponding liveweight gain for the period 1 to 84 days were 0.84, 0.92, 0.92 and 0.89 (s.e.d 0.026) kg/day, respectively. Concentrate intake (1 to 42 day) were 25, 29, 30 and 31 (s.e.d 2.1) kg, respectively the corresponding values for the period 43 to 84 days was 129, 138, 138 and 140 kg. It was concluded that the inclusion of 0.625 or 1.25 kg of YeaSacc 1026 per tonne of ration increased calf liveweight gain by 5 kg in the period 1 to 84 days.

Key Words: Yeast Culture, YeaSacc, Calves

156 The effect of different levels of YeaSacc 1026 inclusion on the lifetime performance of cattle offered an ad libitum concentrate ration. R.J. Fallon*¹ and B. Earley¹, ¹Teagasc.

The recent banning of a number of in feed antibiotic digestive enhancers within the European Union has generated the need to find suitable non-antibiotic alternatives. Yeast culture (YeaSacc 1026) as a supplement

has been evaluated in several growth studies in calves, steers and bulls. There is however, little information available on the optimum level of YeaSacc 1026 for inclusion in the diet on the lifetime performance of bulls offered an ad libitum concentrate diet. The aim of this study was to determine the optimum level of YeaSacc 1026 inclusion. The following experiment was undertaken using 80 Friesian male calves (average initial weight of 54 kg) to determine the optimum inclusion rate of YeaSacc 1026. Calves were allocated at random to 1 of 4 treatments: 1) 0, 2) 0.625, 3) 1.25 and 4) 2.5 kg YeaSacc per tonne of ration using individual bulls as the experimental unit. The concentrate ration consisted of rolled barley, soya bean meal plus minerals and vitamins was available throughout the 329 day experimental period. The crude protein content was 168 g/kg to 12 weeks and 151 g/kg there after. In addition the animals were offered a fixed daily allowance of straw (80g/kg of concentrates). Bull liveweight gain in the period 1 to 168 days was 1.11, 1.14, 1.20 and 1.15 (s.e.d 0.022) kg/day from treatments 1 through 4, respectively. The corresponding liveweight gains for the period 169 to 329 days were 1.32, 1.36, 1.34 and 1.36 (s.e.d 0.043) respectively. The corresponding concentrate dry matter intakes were 548, 562, 583 and 565 for the period 1 to 168 days and 1122, 1161, 1208, 1143 for the period 169 to 329 days. The corresponding carcass weights were 233, 239, 242 and 239 kg. It was concluded that the 1.25 kg/tonne inclusion rate for YeaSacc 1026 resulted in a response in the 1 to 168 day period, but was not significant

Key Words: Yeast Culture, Cattle, Dose Response

157 The effects of feeding a fungal extract (Amaferm) to ewes 60 days prepartum through weaning on milk protein, fat, lactose and yield. S. L. Campbell*, S. P. Jackson, A. D. Herring, M. L. Galyean, and D. R. Niemann, Texas Tech University Lubbock, TX/US.

The objectives of this study were to determine differences in milk protein, fat, lactose and milk yield in ewes either fed whole corn and CSM (control) or the same diet plus Amaferm (AMF), which contains the fungal extract *Aspergillus oryzae*. Sixty-two Rambouillet ewes from ages 3 to 7 yr. were randomly assigned to four pens, and treatments were randomly assigned to each pen. Milk protein, fat, and lactose were measured in milk samples taken at parturition (time 0), 6 h and every 12 h thereafter for the first 36 h and additionally at 3 wk and 6 wk. Milk yield was measured at 3 and 6 wk postpartum. Milk yield was not affected by treatment at the 3 or 6 wk milking time. Milk protein decreased linearly through lactation. Percent milk protein was 11.63, 10.99, 9.19, 7.06, 6.38, 5.12, and 5.12 at time 0, 6 h, 12 h, 24 h, 36 h, 3 wk, and 6 wk, respectively. Percent milk fat increased from 8.50 at time 0 to 9.69 at 6 h, then decreased to 8.75 by 36 h., and 5.06 at 3 wk., but increased to 5.34 by 6 wk postpartum. Percent milk lactose increased linearly through lactation (3.28, 3.54, 3.90, 4.33, 4.46, 5.37, and 5.31 at time 0, 6h, 12 h, 24 h, 36 h, 3 wk, and 6 wk, respectively). There were no differences in milk protein between ewes fed AMF or the control diet over the entire lactation, but there was a trend at 6 h, suggesting the control group had a slightly higher milk protein content ($P = .06$) than the AMF group. Ewes on AMF had higher milk fat than ewes on the control diet at 0 h. ($P = .004$) and 3 wk ($P = .02$) and tended to have higher milk fat at 6 h ($P = .10$). Milk lactose was lower in ewes consuming AMF at 6 h. ($P = .02$) and tended to be lower at 12 h ($P = .08$) than for ewes in the control group. In this study, Amaferm addition to the diet did not affect milk yield, but it increased milk fat and decreased milk lactose at certain stages of lactation.

Key Words: Amaferm, Sheep, Lactation

PSA Environment and Management: Broilers

158 Impact of Aflatoxin in the feed on Coccidial infection in broiler chicks. V.G. Stanley¹, D. Spiller*¹, W. Kruger², and A. Sefton³, ¹Prairie view A&M University, ²Texas A&M University, ³Alltech, Guelph Canada.

An experiment was conducted to examine the effects of aflatoxin on male broiler chicks infected with *Eimeria acervulina*. The experimental design was a 2 x 2 factorial, consisting of two levels of aflatoxin (0; 3 mg/kg) and two levels of coccidia (0; 500,000 oocysts/chick). Chicks

were fed an aflatoxin-treated or non-aflatoxin-treated diet (control) from 1 d of age through 28 d of age. At 14 d of age, the chicks were infected with *Eimeria acervulina*. At 14 d post-infection the effects of treatments were assessed on weight gains, relative organs (liver, pancreas, gizzard, proventriculus, heart and cecal) weights, and gross lesion scores. Blood was collected for serum chemistry values, and enzyme activities. Weight gain in chicks fed the aflatoxin-treated diet infected with *E. acervulina* was significantly lower ($P < .05$) than the control by 26.8 percent. Chicks fed an aflatoxin-treated diet had a 20.46 percent

reduction in weight gain, whereas those infected with the coccidia only had 19.12 percent reduction in weight gain. Combined effects of aflatoxin and coccidiosis significantly increased the relative weight of the liver, gizzard, and the serum concentration of triglycerides. The toxicity of aflatoxin and coccidiosis was expressed mainly through decreased serum concentration of uric acid, albumin, total protein, cholesterol and the activity of alanine aminotransferase. Significant increase in relative cecal weight was seen in both aflatoxin and coccidiosis treatments. Intestinal lesion scores were observed in both groups, but were more severe in the chicks fed aflatoxin and later infected with coccidia. It was concluded that coccidial infection was intensified by the presence of aflatoxin in the feed.

Key Words: Chicks, Aflatoxin, Coccidiosis

159 The impact of methionine source on poultry fecal matter odor volatiles. C. Chavez^{*1}, T. P. Niemeyer¹, P. L. Reynolds¹, R. A. Russo¹, R. E. Lacey², and J. B. Carey¹, ¹Department of Poultry Science, Texas A&M University, College Station, TX, ²Department of Agricultural Engineering, Texas A&M University, College Station, TX.

Trials were conducted using straight run broiler chicks raised in battery cages. Chicks were randomly distributed into 3 replications of 4 treatment groups with 16 birds per pen. The treatment groups were dry methionine hydroxy analogue (52% methionine activity), sodium methionine aqueous solution (45.9% methionine activity), liquid methionine hydroxy analogue (89% methionine activity), and no supplemental methionine (control group). All diets were formulated to contain 3,135 Kcal ME/kg, 23% crude protein, 0.8% total methionine activity and otherwise met NRC nutrient requirements. Diets were fed *ad libitum* from day 1 to termination of the study (5-6 weeks). Feed consumption and feed conversion were measured daily and all birds were weighed weekly. There were no significant differences in body weight, feed consumption, and feed conversion among the treatments in any trials. All excreta was collected in litter pans lined with aluminum foil. Weekly, litter pans for each pen were individually transferred to a separate room for odor volatile analysis. A Cyranose 320[®] (Cyranose Sciences, Inc., Pasadena, CA) electronic nose was used to capture 3 to 4 air samples from various locations for each pan of broiler excreta resulting in a total of 10 air samples from each treatment group. All data taken from the Cyranose 320 were evaluated using principal component analysis and indicated that there were significant differences in volatiles in the broiler excreta for all treatment groups. These data indicate that different methionine sources may result in the production of different odor related compounds in broiler excreta.

Key Words: Methionine, Broiler excreta, Odor

160 Impact of Farm Management Practices on the Microbial Profile of Processed Broilers. Marcos Sánchez^{*1}, Wade Fluckey, Mindy Brashears, Eva Wallner-Pendleton, Marcela Tamayo, Adriana Aguilar, and Shelly Mckee, ¹University of Nebraska-Lincoln, Lincoln, NE.

Bacterial loads on birds coming into the processing plant impact the presence of pathogens on processed broilers. Conditions during growout including farm management practices, water source and environmental parameters were investigated. Four farms were tested every 3 months over a 1 year period. Farms were evaluated based on survey data and microbial testing. Farm surveys examined building and age condition, litter management, house ventilation, routine sanitation between flocks, biosecurity measures, bird density, bird strain, vaccination history, incidence of disease and mortality, growing season temperatures, water source and water system conditions. In addition, airflow readings, ammonia levels, water activity, relative humidity and house temperature were determined for each house tested. Drag swab (DS) samples of litter and ceca samples from birds were aseptically obtained to determine levels of pre-harvest contamination with pathogens. Sampling locations were determined by differentiating between wet and dry areas of the litter based on water activity readings. DS and ceca samples were tested for *Salmonella*, *Campylobacter*, aerobic populations, coliforms and generic *E. coli*. Results suggested that water activity in the litter, airflow in the poultry house and water source appeared critical to controlling microbial levels on the farm. Open pond water as a drinking source for birds was correlated to higher levels of *Salmonella* and *Campylobacter* on the farm and in the processing plant. DS and ceca

samples obtained in areas of high Aw on the farm had higher bacterial populations and a higher incidence of pathogens. High numbers of pathogens on farms were equated to a higher incidence of *Salmonella* and *Campylobacter* on broilers when sampled during processing. These data suggest that improving environmental conditions and management practices may enhance the safety of birds supplied to the processing facility.

Key Words: Poultry farm management, *Salmonella*, *Campylobacter*

161 Estimation of the growth potential of six commercial strains of broiler chickens. M. J. Zuidhof^{*1}, D. Eisenbart¹, Z. Wang¹, and G. Hinse², ¹Alberta Agriculture, Food and Rural Development, ²University of Alberta.

In order to model the growth of any animal, there must be an appropriate description of the type of animal being grown. A study was conducted to determine the growth potential of six strains of commercial broiler chickens. Gompertz growth parameters were determined for males and females of each strain. An assumption of the Gompertz model is that the birds must be able to achieve their genetic potential for growth. Therefore utmost care was taken to ensure that ideal environments were provided. Careful attention was spent to ensure appropriate temperatures, pen hygiene, nutrition, and other potential environmental constraints to growth were eliminated. A total of 984 (82 males and 82 females) of six strains of broilers were placed at 0 d of age and reared to 16 wk. Every week from 0 to 8 wk, and every second week thereafter, two birds closest to the mean body weight of each strain by sex combination were dissected and carcass composition was determined on the plucked empty (feed removed from gut) carcasses by chemical analysis. Gompertz parameters are reported as asymptotic weights (Wmax) and rates of maturing (b) expressed in the units g and d⁻¹, respectively. Body weight asymptotes ranged from 2679 to 2950 for the females (b = 0.0461 and 0.0427, respectively) for females, and from 3385 to 3811 (b = 0.0417 and 0.0396, respectively) for males. Protein asymptotes ranged from 341 to 393 g in females and 466 to 514 in males (b = 0.0493, 0.0396, 0.0446 and 0.0423, respectively). Fat asymptotes ranged from 17.7 to 21.7% of the mature weight asymptotes in females, and from 13.9 to 16.2% in males.

Key Words: Gompertz, Growth model, Broiler strains

162 Temperature gradients in trailers transporting broilers under Canadian winter conditions. T.D. Knezacek^{*}, G.P. Audren, H.L. Classen, E.M. Barber, T.G. Crowe, and S. Stephens, University of Saskatchewan, Saskatoon, SK, Canada.

Five commercial scale broiler transport trailers, using Anglia Autoflow modules, were monitored under Canadian winter conditions to investigate the development of horizontal and vertical temperature gradients during transportation. Five evenly distributed stacks of modules were each equipped with nine data loggers recording the temperature and relative humidity of the microenvironment at one-minute intervals. In one stack of modules, loggers were placed in each of the top, middle and bottom rows of crates to determine the vertical temperature gradients. Horizontal temperature gradients were recorded in each of these rows by placing loggers in the center of the middle crate and at the extreme edges of the outside crates. Temperature heterogeneity was found among modules in all loads with average temperatures ranging from -2 to 18, -4 to 19, -4 to 18, -4 to 21, and -2 to 26 C for journey lengths of 155, 171, 152, 184, and 229 minutes and ambient temperatures of -7, -11, -13, -10, and -9 C, respectively. Temperatures within the modules increased 5-35 C above ambient recordings due to low levels of passive ventilation on the tightly tarped trailers. Loggers along the rear outside edges of the trailer recorded temperatures closest to ambient conditions, indicating that air entered in this area. Horizontal temperature gradients, from tarp to tarp, and vertical temperature gradients between the roof and floor of the trailer were generated. However, the degree of variation was dependent upon the ventilation configuration, which was altered according to ambient temperature. In conclusion, the results suggest that passively ventilated transport trailers expose broilers to less than optimum microenvironments, with the greatest imposition occurring along the rear outside edges of the trailer.

Key Words: Broiler, Transportation, Temperature Gradients

163 Effect of cyclic heat stress on voluntary water consumption, Efficiency of feed utilization and thyroid activity of broiler chicks. Miriam ELDeeb*¹ and A. Abou-Elmagd², ¹College of Agriculture, ²College of Vet. Medicine.

The effect of cyclic heat stress temperature (24-35-24°C) on voluntary water consumption and efficiency of feed utilization as well as microscopic structure of thyroid gland were studied in broiler chicks growing on litter from hatch till 6 wk-old. Results indicated that heat stress chicks markedly increased ($P \leq .01$) voluntary water consumption (ml/kg BW^{0.75}) over the control during growing period (3-6 wk-old). Water:feed ratio indicated higher ($P \leq .01$) ratio for birds subjected to 7h. daily heat stress 35°C at both periods; 3 and 6 wk-old. Body weight of chicks subjected to heat stress was significantly ($P \leq .01$) lowered by about 24.6% at 6 wk-old. Consequently, overall reduction in body gain during exposure to heat stress was about 25.2%. The depression in body gain of broiler were 5 and 42g/ bird/ 1°C from 24-35°C at 3 and 6 wk-old, respectively. Also, feed consumption were reduced in heat stress birds by about 10.3 and 48.5g/ bird/ 1°C above the control at 3 and 6 wk-old, respectively. Hence, feed conversion ratio was significantly ($P \leq .01$) decreased clearly at 6 wk-old. The percentage of abdominal fat was significantly ($P \leq .05$) reduced in birds subjected to heat stress. Neither, RBC count nor Hb was affected by heat stress. Furthermore, total moisture and expressible fluids in breast muscles; pectoralis major and minor were not influenced by heat stress treatment. Microscopic examination and morphometric measurements revealed remarkable decrease in the thyroid activity after 6 week exposure to the heat stress compared with the control group. The reduction in thyroid activity was represented by significant increase in the area percentage of follicular colloid in treated group (24.1 ± 3.07) than that in control group (6.9 ± 3.35), and decreased in follicular epithelium percentage in treated group (36.5 ± 5.46) compared with control group (68.6 ± 7.15). Additionally, the area percentage of the large follicles significantly increased ($P \leq .01$) as well as the area percentage of small follicles significantly decreased ($P \leq .01$) at end of the experiment in comparison with that in the control group. In conclusion, heat stress exposure resulted in lower activity of the thyroid gland that may be responsible for lower performance of broiler chicks.

Key Words: broiler chicks, heat stress, thyroid activity

164 Sources of Salmonellae in typical Delmarva broiler operations. J. deGraft-Hanson*, E. LaBreque, A. Dorsey, A. Evangelista, R. Porreca, and L. Baker, *University of Maryland, Princess Anne, Md. USA.*

Two typical broiler houses on Delmarva were sampled every two weeks beginning at placement and continuing to processing. The objective was to determine animate and inanimate sources of salmonellae in the grow-out system. Samples collected included feed, litter, drag swabs, drinking and outside standing water, beetles, flies, flying insects, boot swabs, feces from chickens, animals, wild birds and chick pads. All samples were pre-enriched in BPW, selectively enriched in TTH and RV broths, isolated on XLT4, MLIA and BGSA, screened biochemically on TSI and serogrouped for confirmation. When chick pads were positive there was a tendency for the flocks to be positive throughout the life cycle as evidenced by positive litter, drag swabs and chicken feces. Beetles and flies were also positive on occasion. Outside samples that were positive were water, mud, animal and bird feces. Of an average number of 70 samples per visit positive samples ranged from 0 to 88%. When chick pads were negative, flocks usually had low levels of salmonellae. The higher the number of positive chicken feces the more the positive samples taken inside the houses. Negative inside samples at placement indicated effective cleaning of houses between flocks. In the processing plant, crates and carcasses were positive with carcasses ranging from 0 to 96%. Both pre and post chill water were usually negative.

Key Words: Broiler houses, Processing plant, Salmonellae

165 The effect of adding ozone into an intensive broiler production unit on performance, mortality, ammonia levels, and bacterial levels as compared to a non-ozone treated environment. K. Schwan*, H. L. Classen, A. A. Olkowski, E. M. Barber, and C. Riddell, *University of Saskatchewan, Saskatoon, SK Canada.*

Ozone (O₃) is an unstable and reactive molecule that can readily oxidize many organic and inorganic substances. As a consequence, it is also known to be an effective biocide. For these reasons, the use of ozone in a commercial poultry unit could potentially offer two advantages: a reduction in ammonia due to oxidation, and a lower environmental bacterial population. This experiment studied the effect of adding atmospheric ozone (target level of 0.05 ppm) to rooms housing broilers. Broilers (three rooms of five replicate pens, each containing 110 birds) were grown in either a normal environment or an environment with added ozone. Ozone levels were monitored once daily in each pen subjected to ozone. Bird weight and feed consumption were examined on a pen basis at 21 and 40 d of age; mortality was collected daily, and necropsies were performed. Total aerobic bacteria colonies from air samples were plated and counted at 11, 19, and 34 d of age, as well as enterobacteriae at 34 d. Environmental ammonia levels were measured at 15, 20, 28, 32, and 38 d. The addition of ozone caused a near-significant decrease ($P=0.06$) in ammonia levels at 38 d (12.7 vs 25.7 ppm) and total bacterial count at 19 d (142 vs 225 colonies/plate; $P=0.09$). A significant improvement in mortality corrected gain to feed ratio was noted in the ozone-treated birds (0.553 vs 0.535). Birds exposed to ozone grew significantly slower (1.255 vs 1.353 kg gain), ate less (3.695 vs 3.953 kg), and had a higher mortality (11.46 vs 7.33%) and condemnation percentage (10.36 vs 3.39%) than normal environment broilers. These major increases in morbidity and mortality of the ozone-subjected birds make the use of this gas unacceptable for use in a commercial broiler unit, and raise serious health issues for both producers and birds.

Key Words: Ozone, Toxicity, Broiler

166 A Demonstration of Sand as an Alternative Bedding in Commercial Poultry Houses. G.W. Malone*¹, M. Salem¹, D.J. Hansen¹, and M.K. Eckman², ¹University of Delaware, Georgetown, DE/USA, ²Auburn University, Auburn, AL/USA.

Masonry-grade sand (S) is being compared to pine shavings (PS) as an alternative bedding material in paired-house farms under Delmarva production practices. Initial bedding depth was 3.8 cm (S) and 7.6 cm (PS) on 1 paired-house broiler farm, and 8.9 cm (S) and 10.2 cm (PS) on 2 paired-house roaster farms. Following cake removal, no additional bedding has been added since starting this demonstration on the broiler and roaster farms in February and June 2000, respectively. Production parameters (body weight, feed conversion, livability, condemnations, production cost); coccidial lesions and litter oocyst counts; litter quality (gram-negative bacteria, darkling beetle population, temperature, moisture and water activity); and air quality (ammonia and total dust) have been monitored on all farms. Based on the 9 paired-house observations (5 broiler flocks and 2 roaster flocks on 2 farms) to date, initial bedding type has had no consistent influence on most litter quality, air quality and bird performance parameters. However, there are several significant ($P < .05$) treatment effects. For proprietary reasons, all results are reported as the percentage deviation from the control (PS) value. Compared to PS houses, S houses averaged 85% fewer darkling beetles and the litter surface (top 2.5 cm) moisture was 53% and 23% less during the first and last week of production, respectively. Since the moisture determination was a gravimetric procedure, part of these differences can be explained by S having an initial 9-fold higher bulk density than PS. Although total dust was 18% greater in the S houses, birds processed from S houses had 30% fewer total condemnations. Other trends that approached significance ($P < .07$) included; S houses having 2% warmer litter temperatures and 26% higher atmospheric ammonia concentrations during the first week, and 14% higher body weights at market age compared to the PS houses. Although promising, the suitability of S as an alternative bedding for Delmarva production practices can not be fully assessed until a minimum of one year's data is available from these paired-house farms.

Key Words: Broiler, Litter, Sand

167 Effects of density and perch availability on aggressive behavior in broilers. Inma Estevez*, Rosemary Pettit-Riley, and Estelle Russek-Cohen, *University of Maryland*.

Aggressive interactions can both divert energy from growth and potentially reduce well-being of domestic animals. However social behavior, particularly aggressive interactions, has been poorly studied in broiler chickens, perhaps due to the relatively low occurrence as compared to laying hens. Aggressive behavior has been reported to change with varying stocking density. It has also been suggested that perch availability may reduce aggression by providing a place for threatened individuals to retreat. To test the hypothesis that the frequency of aggression in broilers will change with changing stocking density and availability of perches within the environment, groups of broilers were observed from 2 to 6 weeks of age. Both the type of aggression and the pen region in which the interaction occurred were recorded. Birds were housed at densities of 10, 15 and 20 birds/m² corresponding to group sizes of 45, 67 and 90 birds, respectively. In a nested design the birds within each density treatment were assigned to one of the following perch treatments: Horizontal (three 0° perches), 10° angled (three 10° angled perches), mixed angle (one 0° perch, one 10° angled perch and one 20° angled perch) and control (no perches). Results indicate that levels of aggression per bird decreased ($P < 0.05$) with increasing stocking density from 10 to 15 birds/m² (but not from 15 to 20). The main effect of perch treatment was significant for the frequency of threats ($P < 0.05$), but only approached significance for other types of aggression ($P = 0.0584$). Aggression peaked early during week 3 ($P < 0.05$), a result similar to those reported in other studies examining aggression in broilers. Aggressive interactions occurred more frequently in those regions of the pen that were either open or contained perches, rather than in the regions around the feeder or drinker. Results indicate that levels of aggression are dependent on stocking density, and that perch design influence the frequency of aggressive interactions.

Key Words: Broilers, Density, Aggression

168 Effectiveness of a terpene-based product as a broad-spectrum antimicrobial. Julio L. Pimentel*¹ and W. Douglas Waltman², ¹G.V.D. Corporation, ²Georgia Poultry Laboratory.

Two in vitro studies were developed in order to determine the effectiveness of a terpene-surfactant based product (Amibaf). In the first study, seven microorganisms, *E. coli*, *S. typhimurium*, *P. mirabilis*, *P. aeruginosa*, *S. aureus*, *C. albicans*, and *A. fumigatus* adjusted to 10⁵ organism/ml were incubated in BHI broth containing the terpene product diluted at 1:500, 1:1000, 1:2000, 1:4000, 1:8000, 1:16000, 1:32000 and 1:128000. Three replicates of each series of dilutions were used for each microorganism. After adding 0.5 ml of test organisms, tubes were incubated at 35-37 °C for 18-24 hours, growth onto blood agar was observed after incubating for an additional 18-24 hours. The results showed that the terpene product has a broad-spectrum inhibitory or killing activity. *E. coli*, *P. mirabilis*, *S. aureus* and *C. albicans* (yeast) were all inhibited at 1:1000. *S. typhimurium* was inhibited at 1:500 and *A. fumigatus* (fungi) at 1:13,000. In a second study the objective was to determine the inhibitory effect of various dilutions of terpenes against *E. coli* over time. The terpene product was diluted to 1:500, 1:1000, 1:2000, 1:4000, 1:8000, 1:16000, 1:32000 and 1:64000 in BHI and tested at 30, 90, 150 and 450 min. The product was also diluted in saline at the same concentration and tested at 60, 120, 180 and 480 min. At each respective time, 0.5 ml of each dilution was spread onto MacConkey agar plate an incubated overnight at 35-37 °C. The results showed an inhibitory effect of terpenes in broth and saline. In BHI *E. coli* was killed at 1:500 and 1:1000 after 30 min, growth was reduced at 1:2000, 1:4000, 1:8000 and 1:16000 after 90-min incubation. There was a greater effectiveness in saline, *E. coli* was killed at 1:500 after 60 min, at 1:1000 and 1:2000 showed a dramatic reduction at 60 min. After 480 min *E. coli* was completely killed in the 1:500, 1:1000, 1:2000 and 1:4000 dilutions and reduced at 1:8000. The results show that the terpene product has antimicrobial properties and can have several uses in the animal industry because of its GRAS status.

Key Words: Terpenes, Antimicrobial, Biocide

169 Strain and age effects on skeletal growth in two commercial broiler strains. I. Toure*, J. Nixon, and M. Lilburn, *The Ohio State University/OARDC*.

Selection for growth and yield traits in broilers have had positive effects on traits of economic importance but not all aspects of growth and development have been enhanced. There is considerable data in the literature on various aspects of skeletal development in modern broilers but much of the data incorporates measurements with the tibia but not the femur. In the present experiment, broiler chicks from two commercial strains were killed at multiple ages throughout growth for carcass and skeletal measurements. The tibia and femur were removed from each bird for length, width @50% of length, and dried wt determination. The absolute length and width of each bone continued to increase through the entire study (49 d) and there were significant strain differences throughout the study, although the magnitude of these changes varied with age. At 21 d, there were significant strain differences in tibia length ($P \leq .012$) and femur length ($P \leq .014$) but only the tibia length differences carried through to 36 d. At the latter age, however, there were significant differences in both tibia width ($P \leq .011$) and femur width ($P \leq .022$). The data suggest that while there are acknowledged differences in growth and yield characteristics between commercial broiler strains, there are differences in the support structure (i.e. skeleton) as well. These changes in relative support need to be further studied, particularly as bone breakage continues to be of concern in broilers reared to heavier body weights.

Key Words: Broiler, Tibia, Femur

170 Artificial neural network prediction of the weight gain and feed conversion of broilers raised under a range of environmental temperatures. T. L. Cravener*¹, W. B. Roush¹, J. D. May², and B. D. Lott², ¹The Pennsylvania State University, Department of Poultry Science, University Park, PA 16802-3501, ²USDA, ARS, South Central Poultry Research Laboratory, Mississippi State, MS 39762-5367.

Data describing the effects of altering environmental temperature (T) on the BW gain (BWG) and feed conversion (FC) of male and female broilers were gathered over 3 trials. Previously, May et al., (1998; Poultry Sci. 77(Suppl. 1):4) analyzed the data and calculated regression equations (REG) for BWG and FC for both genders. The same data inputs (BW and T) were used in the current study to predict BWG and FC with Artificial neural networks (ANN). Chicks were reared in a common environment until 3 wk of age. At 3 wk they were randomly assigned to 1 of 10 environmental chambers. Each chamber was maintained at a constant T throughout the study; with the T in the 10 individual chambers ranging from 12 to 30 C in two degree increments. Dewpoint was maintained at 18 C and relative humidity was $\leq 82.9\%$. BWG and FC were calculated on a wky basis for 4-7 wk. NeuroShell[®] Predictor software was used to train the four ANN. The REG and trained ANN were placed in a spreadsheet. The difference between the actual value in the database and either the REG or ANN prediction was calculated. The absolute differences were statistically analyzed for significance using a paired t-test. ANN prediction of FC resulted in higher training R² values than BWG. Females tended to have higher R² values than males. The ANN training R² for predicting BWG was 0.83 for females and 0.72 for males. The ANN training R² for predicting FC was 0.91 for females and 0.84 for males. When predictive ability was compared, the ANN predicted more accurately ($P < 0.05$) than the REG. ANN prediction of BWG and FC is a successful alternative to REG and may allow a manager to make critical decisions concerning scheduling and feed inventory requirements on a timely basis.

Key Words: Artificial Neural Networks, Environmental Temperature, Broiler Performance