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SYMPOSIA AND ORAL SESSIONS

Environment and Management I

M1 Performance and mortality rate of various broiler breeds reared in Ogun State after brooding stage to slaughter. A. A. Mako*¹, O. I. Abiola-Olagunju², O. A. Ogunwole², R. A. Hamzat³, O. K. Awobajo¹, A. O. Igboasanu¹, and R. O. Ettu¹, ¹Tai Solarin, University of Education, Ijebu Ode, Ogun State, Nigeria, ²Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria, ³Purdue University, West Lafayette, IN.

This study focused on performance and mortality rate of various breeds of broilers (Cornish, Plymouthrock, White Rock, Marshall, Arbour acre, Anak 2000, Ross, Rhode Island Red and Red Sussex) reared in Ogun State from after brooding stage to slaughtering. For purpose of this study, Ogun State was divided into four provinces namely; Egba, Egbado, Ijebu and Remo. Data were collected through the use of questionnaires. A total of one hundred and thirty (130) questionnaires were administered in each province making 520 Questionnaires in all. The collected data were analyzed with the use of simple percentage, analysis of variance and other statistic techniques. The result shows that there was significant differences ($P < 0.001$) in the mortality rate with Red Sussex and Marshall having the lowest value (0.08%) and White Rock having the highest value (2.20%). The performance also vary significantly ($p < 0.001$) with White rock recording the highest value of 3.00Kg and Cornish recording the lowest value of 1.72Kg. The result revealed that the major causes of mortality and poor performance of birds are type of breed, poor management on the farm in the area of feeding, hygiene, amongst others. The best breed of broiler with lowest mortality rate are Red Sussex and Marshall, while the best breed with the highest performance (weight at slaughter) is White Rock.

Key Words: performance, mortality rate, broilers, brooding stage, slaughtering

M2 Evaluation of alternative genotypes in Illinois for sustainable poultry production. L. Mejia*^{SC1}, P. L. Utterback¹, C. W. Utterback¹, C. M. Parsons¹, and J. L. Emmert², ¹University of Illinois, Urbana, ²University of Arkansas, Fayetteville.

Two experiments were conducted to evaluate the performance and quality of specialty poultry genetics for possible use in natural and organic markets. In both experiments males and females of two genotypes were used: a specialty slow-growing chicken (S) and the University of Illinois New Hampshire x Columbian crossbred chicks (NH x C). In experiment 1, a 40 d assay was conducted and a single diet was fed throughout the experiment. For Wk 0 to 3, the NH x C males and females had the highest ($P < 0.05$) weight gain and feed intake, but both genotypes were similar in feed efficiency. For Wk 3 to 6, the NH x C males had the highest weight gain, feed intake and feed efficiency ($P < 0.05$), whereas the S females had the lowest weight gain, feed intake and feed efficiency. Overall, the best growth performance occurred with NH x C males, and no differences were observed between S males and NH x C females. In experiment 2, an 83 d assay was conducted to evaluate weight gain, carcass yield and uniformity of S and NH x C chicks. Chicks were reared on litter in the same pen with a common diet. The NH x C males had the highest body weight and carcass yield ($P < 0.05$), whereas the NH x C females had the highest breast meat yield. Males of both genotypes had higher leg yield but lower frame yield ($P < 0.05$). NH x C birds exhibited lower standard deviation and CV values than the S birds, indicating a superior uniformity. These data indicate that the NH x C birds have better growth performance and uniformity than other slow growing genotypes, and thus may be useful in alternative production systems.

Key Words: alternative genotype, carcass yield, growth performance, uniformity

M3 Flushing procedures to prevent drug carryover during medicated feed manufacturing. A. Martinez*^{SC}, L. J. McKinney, K. C. Behnke, and E. A. E. Boyle, *Kansas State University, Manhattan.*

Carryover of medicated feed additives between batches of feed can potentially result in harmful drug residues in the edible tissues of food-animals. Flushing the equipment with an ingredient, such as ground grain, is one method used to remove any residual medicated feed from the system. It is generally recommended that the quantity of flush used be between 5 and 10% of the mixer's capacity. However, there is little data that supports this recommendation. Therefore, two experiments were conducted to 1.) determine the minimum quantity of flush material required to prevent drug carryover; and 2.) quantify the interrelationship between flush size and drug concentration. In Experiment 1, feed medicated with nicarbazin (Nicarb 25%[®]; 0.0125%) was manufactured and conveyed from the mixer, through a drag conveyor and bucket elevator, and into a finished product bin. The system was then flushed using ground corn in the amount of 2.5, 5, 10, 15, or 20% of the mixer's capacity (454.5 kg). Subsequently, a non-medicated diet was conveyed through the system and samples were collected and analyzed for nicarbazin. No significant ($P > 0.05$) differences were detected among the flush treatments, and all treatments were effective in preventing nicarbazin carryover to the non-medicated diet. In Experiment 2, feed medicated with three levels of monensin (Rumensin[®] 80; 100, 600, and 1,200 g/ton) was manufactured and handled in the same manner as in Experiment 1. The flushing treatments examined were: 1.0, 2.5, and 5% of the mixer's capacity. Samples of the non-medicated diet which followed each treatment were collected and analyzed for monensin. Both concentration of monensin in the medicated diet and sampling location were significant ($P < 0.05$), while flush size showed a high tendency ($P < 0.057$) to become a significant source of variation in monensin carryover. Collectively, these studies demonstrate that existing flushing guidelines exceed what is required to prevent carryover of medicated feed additives.

Key Words: feed manufacturing, medicated feed, drug carryover, contamination, flushing

M4 Immune response and *Salmonella* clearance in broiler chickens fed arginine, vitamin E, and prebiotics. X. Liu*^{SC1}, A. Byrd², K. Stringfellow¹, M. Farnell¹, J. Bautista-Ortega¹, and C. A. Ruiz-Feria¹, ¹*Texas A&M University, College Station*, ²*USDA, College Station, TX.*

Two experiments were conducted to evaluate the effects of arginine (ARG), vitamin E (VE), and mannanoligosaccharides (MOS) on the immune response and clearance of *Salmonella* in broilers. In each experiment, 1 d-old broiler chicks (n=160) were randomly distributed into 4 groups: CTL- (antibiotic-free diet), CTL+ (CTL- plus 40 mg/kg of bacitracin), AV (CTL- plus 0.8% ARG and 80 IU/kg VE), and AVM (AV plus 0.2% MOS). Birds were orally challenged with 1×10^6 CFU of a novobiocin- and nalidixic acid- resistant *Salmonella enterica* Serovar Typhimurium (ST) at day 7. Cecal populations of ST (\log_{10}) were determined in 10 birds / treatment at 3, 10 and 14 d after (Exp. 1) or 3, 7 and 14 d after challenge (Exp. 2). Blood samples were collected 5 and 9 d after challenge (Exp. 1) or 12 d after challenge (Exp. 2), and heterophils were isolated for *in vitro* determination of oxidative burst

by monocytes (MOB) and heterophils (HOB), and lymphocyte proliferation (LPr). Three d after challenge, birds in the AVM group had lower ST counts (0.8 ± 0.3 CFU) than birds in the CTL- (2.9 ± 0.5) group, whereas the AV group (1.5 ± 0.5) and the CTL- group (2.04 ± 0.5) were not different from the other groups. The ST counts were not different at d 10 or 14 in Exp. 1, or at any sampling time in Exp. 2. Five d after challenge, birds in the AVM and CTL+ groups had similar, but lower MOB than the CTL- MOB, whereas the HOB was lowest in the AVM group, whereas the LPr was not significantly affected by dietary treatment. Nine d after challenge, birds in the AVM group had the highest MOB, whereas birds in the AVM and AV groups had higher levels of LPr than the LPr in the CTL+ and CTL- groups. Twelve d after challenge (Exp. 2), birds in the AV and AVM group had higher HOB than the CTL- or CTL+ groups, and higher LPr than the CTL- group. Our results suggest that the combination of ARG, VE, and MOS, improve the innate immune response against a ST challenge, but more research is needed to fully understand all the variables that affect this response.

Key Words: arginine, immune response, lymphocyte proliferation, oxidative burst, *Salmonella*

M5 Reducing gangrenous dermatitis: How probiotics can play a role in commercial poultry. C. R. Wanek*^{SC}, J. L. McReynolds, J. A. Byrd, K. J. Genovese, S. E. Duke, and D. J. Nisbet, *USDA-ARS-SPARC-FFSRU, College Station, TX.*

Gangrenous dermatitis (GD) has become a major health problem among broiler flocks in the United States; resulting in high mortality, carcass condemnations and trimmed parts. Economic losses have been estimated to be as much as \$1.31 per affected bird. GD is associated with various aerobic and anaerobic bacteria; however, *Clostridium septicum*, *Clostridium perfringens* type A, and *Staphylococcus aureus*, as individual isolates or in combination are most often identified as the etiologic agents associated with disease. This disease has been associated with birds that have a compromised immune system, and occurs as a sequelle to disease produced by opportunistic pathogens. It has long been known that the gastrointestinal tract is composed of a wide array of bacteria that play crucial roles in animal health and performance, as well as some recent human food safety issues. The development of a healthy normal microflora: aids in colonization resistance, by competing for intestinal attachment sites, as well as increased stimulation of the immune system. In the present investigation PoultryStarTM was administered to commercial broilers on two replicate farms (A and B) periodically throughout the grow-out cycle. During grow-out standard production practices were followed with the exception of therapeutic antibiotic administration to the probiotic treated houses. Production parameters were measured (weight, mortality and processing weights) on a weekly basis. On both farms the probiotic treated house had ($P < 0.05$) lower mortality at the onset of disease, as well as an increase ($P < 0.05$) in body weight gain. These experiments suggest that the application of PoultryStarTM in this field trial significantly altered the onset of Gangrenous dermatitis; most likely by providing the birds with normal flora that contributed to the overall health and well being during a commercial GD field challenge.

Key Words: gangrenous dermatitis, *Clostridium*, chickens, probiotic

M6 Evaluation of probiotic administration on coccidiosis vaccination in broilers: Effects on performance parameters and oocyst output. A. E. Klein*^{SC1}, J. Lee¹, M. Farnell¹, L. Oden¹, S. Pohl¹, M. Mohnl², R. Beltran², G. Schatzmayr², C. Broussard³, S. Fitz-Coy³, and D. Caldwell¹, ¹Texas A&M University, College Station, ²Biomin GmbH, Herzogenburg, Austria, ³Intervet-Schering Plough Animal Health, Millsboro, DE.

Our laboratories recently reported that administering probiotic during coccidiosis vaccination may stimulate immunity and improve broiler performance during grow-out. The objective of this investigation was to evaluate coccidiosis vaccination (Coccivac[®]-B), with or without drinking water probiotic (Biomin[®] PoultryStar) administration, for protection against field strain *Eimeria* challenge during a 42 day pen trial. The trial consisted of a 2 X 2 factorial based design with vaccine and probiotic as experimental parameters. Straight-run broilers (n=1,800) were placed in 40 pens on built up litter. Probiotic was administered in the drinking water from day zero to day three, day eight to day 10, and then around feed changes. Field strain *Eimeria* were spray-applied to litter in each pen on day 14. Experimental parameters consisted of body weight gain, feed conversion, and oocyst output. Body weights in vaccinated broilers were reduced (P<.05) on day 28 compared to non-vaccinated broilers, but were not different across experimental groups at termination. Similarly, feed conversion was increased (P<.05) in vaccinated broilers during the grower phase compared to non-vaccinated broilers, but was improved (P<.05) in vaccinated groups during the finisher and withdrawal phases. Probiotic administration significantly reduced (P<.05) feed conversion during the withdrawal phase. Oocyst output (oocysts shed per gram in feces (OPG)) supported performance data throughout the trial. These data suggest that administration of a probiotic during coccidiosis vaccination may lead to improved vaccine efficacy and enteric health during broiler production.

Key Words: broilers, coccidiosis, vaccination, probiotic, performance

M7 Influence of diet on performance parameters in Coccivac[®]-D vaccinated replacement broiler breeders reared on new and used litter. L. A. Oden*^{SC1}, D. J. Caldwell¹, S. K. Pohl¹, A. E. Klein¹, S. Anderson¹, S. Young², C. Broussard³, S. Fitz-Coy³, L. Newmann³, and J. T. Lee¹, ¹Department of Poultry Science, Agrilife Research, Texas A&M System, College Station, ²Pilgrim's Pride Corporation, Pittsburg, TX, ³Intervet-Schering-Plough Animal Health, Millsboro, DE.

Two consecutive experiments were conducted to evaluate the effect of dietary composition, with respect to protein concentration and amino acid profile, on performance parameters in two genetic lines of replacement broiler breeders (line A and line B) through six weeks of age. In experiment 1, replacement breeders were reared on fresh pine shavings while in experiment 2, rearing occurred on used litter from the previous experiment. Dietary formulation was based on either breeder specific recommendations or formulations of a broiler integrator. All breeders were weighed weekly to determine average body weight and flock uniformity. On day 28, males of each genetic line were added to female pens to evaluate the effect of co-mingling on male performance. During experiment 1, differences were not observed for body weight in males or females of line A, however, flock uniformity was improved (P

≤ 0.05) in line A males fed the integrator diet. Increased body weight and improved uniformity of Line B females was observed with the breeder recommended diet. Co-mingling negatively impacted (P ≤ 0.05) male body weight regardless of genetic line. In experiment 2, diet impacted average body weight in line A males, line B males, and line B females, however no impact on final flock uniformity was observed. Line A males fed the breeder recommended diet had increased (P ≤ 0.05) body weight at termination. Line B males and females fed the breeder recommended diet had increased (P ≤ 0.05) body weight throughout the experiment. Similar to experiment 1, negative effects (P ≤ 0.05) on male body weight resulting from co-mingling were observed. These data indicate that co-mingling negatively impacts male body weight and that flock performance can be influenced by dietary composition depending on genetic line and gender.

Key Words: broiler breeder, protein, co-mingling, body weight, flock uniformity

M8 Evaluation of hydrolyzed yeast cell wall products on intestinal morphology and broiler performance during coccidia exposure. R. Van Wyhe*^{SC1}, R. Dalloul¹, M. Bedford², and A. McElroy¹, ¹Virginia Polytechnic Institute and State University, Blacksburg, ²Ab Vista, Marlborough, Wiltshire, United Kingdom.

The poultry industry is under pressure to discontinue the use of sub-therapeutic levels of antibiotics as growth promotants. One promising alternative is the use of yeast cell wall products which act on the intestine by promoting growth of probiotic bacteria, binding to bacterial attachment sites, or by aiding in immune response. A study was conducted to evaluate the intestinal response of broilers to hydrolyzed yeast cell wall (YCW) products during exposure to an environmental coccidial challenge. 3024 day-old Cobb 500 chicks were placed in pens (42 chicks/pen, 8 replicate pens) on litter seeded with coccidia and fed 1 of 9 diets. Dietary treatments were 1) control(C); 2) cell wall (YCW, C+0.1% YCW); 3)mannanoglycosaccharides (M, C+0.1% M); 4) glucans (G, C+0.1% G); 5) nucleotides (N, C+0.1% N); 6) peptides (P); 7) M+G (C+0.1% M+0.1% G); 8) P+N (P+0.1% N); and 9) all products (P+M+G+N, P+0.1% M+0.1% G+0.1% N). Body weight (BW) and feed intake (FI) were measured for 3 feeding periods of starter (d0-10), grower (d10-32) and finisher (d32-42) and cumulatively. At d21, 3 birds per pen were scored for intestinal coccidia lesions. At d10 and 21, 8 birds per treatment were selected for measurement of villus height (VH), crypt depth (CD), and villus height: crypt depth ratio in duodenum, jejunum and ileum. There were no significant differences between any of the diets for BW, FI or lesion score. On d10 and 21, VH in duodenum was significantly longer (P<0.05) in M fed birds as compared to birds fed M+G or P+M+G+N. In jejunum, VH in YCW fed broilers was shorter than in C fed birds at d10, but in contrast, longer at d21. In the ileum, YCW feeding resulted in deeper CD at d10 and shallower CD at d21 as compared to M, G, and M+G diets. While there were no significant differences in performance parameters, there were differences in intestinal morphology; however, these responses were inconsistent among intestinal sections. These results suggest that these yeast products did effect intestinal growth or recovery during the exposure to coccidia and may be section specific or have a limited time of effectiveness.

Key Words: broiler, mannans, glucan, intestine, yeast

M9 Effect of bismuth citrate, lactose and citric acid on necrotic enteritis in broilers. K. D. Stringfellow*^{SC1}, J. L. McReynolds², J. Lee¹, J. A. Byrd², D. Nisbet², and M. Farnell¹, ¹Texas A & M University, Department of Poultry Science, College Station, ²U.S. Department of Agriculture, Agricultural Research Service, FFSRU, College Station.

Clostridium perfringens – associated necrotic enteritis causes significant losses and increased morbidity in poultry. The objective of this study was to evaluate the effect of bismuth citrate and acidifiers on the development of necrotic enteritis in broilers. The first study was a dose response that evaluated the effect of bismuth citrate at 50, 100, or 200 ppm on intestinal colonization and lesion development associated with a *C. perfringens* challenge model. The second study evaluated bismuth citrate with the addition of dietary lactose or citric acid on intestinal pH and lesion development. For the third study, we determined if dietary lactose would enhance the efficacy of bismuth citrate on intestinal colonization and intestinal lesion development associated with *C. perfringens*. Study 1: Intestinal colonization of *C. perfringens* and intestinal lesions of the 100 and 200 ppm treatment group were significantly reduced when compared to birds fed 50 ppm or 0 ppm bismuth citrate. After feeding 50 ppm bismuth citrate, intestinal lesion development was reduced ($p < 0.05$) when compared to birds fed 0 ppm bismuth citrate in trial 1, but not in trial 2. Study 2: Dietary lactose and citric acid treatments failed to significantly enhance the protective effect of bismuth citrate on lesion scores. Study 3: A decrease ($p < 0.05$) in intestinal lesion scores occurred in birds fed 2.5% lactose with 100 ppm bismuth citrate, compared with the positive control group or dietary lactose group. There were no significant differences in bacterial populations. These data suggest that bismuth citrate with dietary lactose may promote gut integrity, subsequently reducing intestinal lesion development in broilers infected with necrotic enteritis.

Key Words: necrotic enteritis, chicken, bismuth citrate, lactose, citric acid

M10 Impact of dietary protein and litter temperature on commercial broilers. K. L. Ishee*^{SC1}, J. L. Purswell², L. Araujo¹, C. Araujo¹, C. D. Zumwalt¹, and M. T. Kidd¹, ¹Mississippi State University, Mississippi State, ²United States Department of Agriculture, Mississippi State, MS.

Energy to heat litter before and during brooding represents a large cost for broiler growers. Although improvements in house tightness and winterization procedures improve grower brooding efficiency, this experiment assesses the impact of starter dietary CP level and its ability to overcome issues with low brooding conditions, as measured by low litter temperature. Eighteen hundred d old Ross 708 chicks from a 37 wk flock were obtained from a commercial hatchery and placed into 36 pens (50 straight-run birds/pen). Each pen was equipped with one drinker line, one tube feeder, built-up pine shavings, and one infrared hanging brooder which dictated litter temperature. Dietary CP treatments in crumble form fed from 1-14 d were: 1) 22% CP; 2) 21% CP; 3) 22% CP; 4) 23% CP; 5) 24% CP; and 6) 25% CP (6 replications/treatment). Treatment 1 represented high litter temperature (124 F, first 32 h after placement under brooder) and treatments 2 through 6 represented low brooding temperature (average of 103 F, first 32 h after placement under the brooder). Brooding temperature was reduced thereafter but treatments were maintained until 14 d. Common pelleted feed was provided from 14-28, 28-35, and 35-41 d. Chicks brooded on high litter temperature and fed 22% CP had poorer overall feed conversion than birds fed 24 and 25% CP reared on low litter temperature ($P < 0.05$).

Other effects of brooding temperature did not occur. Results indicate that brooding temperature may have been too high in the experimental pen for the birds to migrate to their comfort zone. Birds fed 23% CP had improved tender yields ($P < 0.05$), but 24% CP was required to improve ($P < 0.05$) overall feed conversion. BW gain and other carcass traits at d 41 were not impacted by treatments.

Key Words: broiler, litter temperature, crude protein

M11 A comparison of embryonic growth between two breeds exhibiting different conductance eggshells. H. R. C. Evans*^{SC}, M. J. Wineland, and K. M. Mann, North Carolina State University, Raleigh.

Egg conductance may influence embryo growth and alter the way we need to incubate different breeds. Differences in egg components and embryonic growth between a high conductance and a low conductance breed were determined. 300 eggs from each breed, of the same breeder flock age and fed the same diet were numbered, weighed and set into a single incubator using a typical single stage incubation parameters at the PRS in Salisbury, NC. A group of eggs from each treatment were brought back to NCSU for evaluation of percentage yolk, albumen and shell weights. Embryos were sampled at d11, 14, 18 and 19 of incubation for embryo weight. Time of hatch was performed from d19 of incubation until hatch. At hatch, chick weight with and without yolk was determined, as well as heart weights. There were no significant differences in wet yolk, dry yolk or yolk as a percentage of initial egg weight. Dry albumen as a percentage of initial egg weight was significantly less in the high conductance breed, possibly indicating fewer nutrients in the albumen. Embryos without yolk were significantly larger as a percentage of initial egg weight in the high conductance breed at d11 and d19 of incubation, but there were no differences when chicks without yolks were examined as a percentage of initial egg weight at hatch. There was no difference in time of hatch. The low conductance breed demonstrated a significantly greater amount of yolk at hatch than the high conductance breed. Since there were no differences before incubation in yolk weight, the differences seen at hatch must be due to utilization of the yolk by the embryo during incubation indicating a possible increased reliance on anaerobic energy sources. Since there were no differences in shell thickness before incubation, the differences in conductance are due to the number or the diameter of pores in the eggshell. The embryos of the low conductance breed accelerated growth after internally pipping when they were able to increase their aerobic respiration and attain a similar percent chick of initial egg weight as the high conductance breed.

Key Words: incubation, conductance, embryonic development

M12 Eggshell bacterial contamination of non-washed and washed eggs from caged and cage-free hens. J. F. Hannah*^{SC1}, J. L. Wilson¹, N. A. Cox², L. J. Richardson², J. A. Cason², M. T. Musgrove², and R. J. Buhr², ¹University of Georgia, Athens, ²USDA-ARS Russell Research Center, Athens, GA.

This study was conducted to evaluate the microbiology of non-washed and washed table eggs obtained from caged and cage-free laying hens housed on either all shavings or all wire slat environments. Both Hy-Line W-37 white and Hy-Line brown strains were used. On each of four replication sample days (at 24, 28, 32, 36 wk of age), 20 eggs were collected from

each pen for bacterial analysis (n=120). Ten of the eggs collected from each pen were washed for 1 min with a commercial egg washing solution (50 C, pH 11), while the remaining 10 eggs were not washed prior to sampling the eggshell and membranes (crush-and-rub) for aerobic bacteria (APC), *Escherichia coli* (*E. coli*), and coliforms. Non-washed eggs produced in an all shavings environment had slightly higher bacteria numbers (APC 4.4 and coliforms 1.1 log₁₀ cfu/mL) than eggs produced on slats (APC 3.9 and coliforms 1.1 log₁₀ cfu/mL), which had significantly higher (P<0.05) bacteria numbers than eggs produced in cages (APC 3.2 and coliforms 0.7 log₁₀ cfu/mL). The washing of eggs from hens in cages, on shavings, and on slats significantly reduced APC counts by 1.1, 1.7, and 1.7 log₁₀ cfu/mL of rinsate, respectively. *E. coli* and coliform counts were not influenced by housing type and were not significantly reduced by washing. Laying hen strain had no effect on eggshell bacteria recovery levels. No significant differences were found in APC, *E. coli*, and coliform counts on eggs obtained from the three housing types following washing. These results indicate that eggshell bacteria levels are similar following washing for eggs from hens housed in these cage and cage-free environments.

Key Words: eggshell bacteria, egg washing, housing type, caged hens, cage-free hens

M13 Eggshell surface and deep bacteria recovered from non-sanitized and sanitized broiler hatching eggs. C. B. Stephens^{*SC1}, N. A. Cox², L. J. Richardson², J. M. Mauldin¹, and R. J. Buhr², ¹*University of Georgia, Athens*, ²*USDA-ARS Russell Research Center, Athens, GA*.

This study was conducted to evaluate the superficial and deep eggshell bacteriology of hatching eggs sanitized in a commercial hatchery. Two setting buggies of hatching eggs (5,040/buggy) were sanitized the day prior to placing the buggies into the setter for incubation. Eggs were either spray or foam sanitized with 1,200 ppm of Byotrol G5 (comprised of 4 quaternary ammoniums and 1 biguanide biocide attached to a polymer core) and allowed to air dry in the egg holding room for 15 min. The control buggies of eggs from the same breeder flocks remained untreated. Ten eggs were aseptically removed from each setting buggy on the day of treatment, placed into individual plastic bags, and transported back to the lab. Each eggshell was rinsed in 20 mL 1% buffered peptone for 1 min and the rinsate collected. The eggshell was then aseptically opened, the internal contents discarded, and a modified crush-and-rub of the eggshell and adhering membranes conducted. The eggshell surface rinsate and the crush-and-rub rinsate were evaluated for aerobic bacteria (APC), *Escherichia coli* (*E. coli*), and coliforms. For nonsanitized eggs the recovered APC values were lower at 3.1 log₁₀ cfu/mL for eggshell/membranes rinsates collected after the eggshell rinsates at 4.4 log₁₀ cfu/mL. From the eggshell rinsate and the eggshell/membrane rinsate of spray sanitized eggs the recovered APC values were similar at 3.8 and 3.7, log₁₀ cfu/mL of rinsate, respectively. From the eggshell rinsate and the eggshell/membrane rinsate from foam sanitized eggs the recovered APC values were identical 3.2 and 3.2 log₁₀ cfu/mL of rinsate, respectively. The recovery of *E. coli* and coliforms was not significantly affected by sanitization as determined by eggshell rinse or eggshell/membrane rinse. These results indicate that sanitization of hatching eggs by spray or foam significantly reduces the level of bacteria on the eggshell surface recovered in a rinse, but spray or foam sanitization did not alter the level of bacteria within the eggshell/membranes recovered in a crush-and-rub rinse.

Key Words: eggshell surface bacteria, eggshell and membrane bacteria, hatching egg sanitization, aerobic bacteria, biguanide

M14 Breeder age, egg storage, and rate of egg warming on broiler bone development and leg problems. P. E. Eusebio-Balcazar^{*SC}, E. O. Oviedo-Rondón, M. J. Wineland, H. R. C. Evans, J. Whitley, J. Jornigan, and C. M. Rhyne, *Department of Poultry Science, CALS, North Carolina State University, Raleigh*.

Broiler bone development can be affected by maternal background and stressful environment early in life. This study aimed to evaluate the effects of breeder age, egg storage time, and egg warm-up rate on bone development at hatch and leg health in broilers at 42 d. Fertile eggs from two breeder flocks of 33 and 57 wks of age were collected and stored for 2 wks, and again at 35 and 59 wks, eggs were collected and stored for 3 d. Prior to incubation these eggs were warmed up to temperature in one incubator over periods of either 2 or 18 hrs, and later incubated under the same profile. This arrangement of treatments resulted in a 2x2x2 factorial design with hen breeder age: old (O) or young (Y), egg storage, fresh (FR) or stored (ST), and warm up rates, fast (F) or slow (S), as main factors. A random sample of 10 chicks per treatment were collected at hatch, weighed, sacrificed and residual yolk determined. Both legs were dissected and shank and femur weights, lengths, thickness, and ash contents were obtained. Relative asymmetry (RA) and weight relative (%) to BW without yolk (BWY) of each leg section were calculated. A total of 1008 chicks were randomly placed in 72 floor pens (14/pen). At 42 d, chickens were individually inspected for crooked toes, valgus/varus deformities, hock burns, foot pad dermatitis, and gait scores. Results indicated that heavier BWY, higher femur ash content, lower thigh weight and RA of shank length were observed on O breeders compared with Y. Chicks coming from FR eggs had lower RA of femur weight compared with chicks from ST. Chicks had heavier femur relative weights, but lower ash content when egg warming profile was S compared with F. Three way interaction was observed for valgus, and egg storage by warming profile interaction was observed in gait score 1 at 42 d. Broilers from Y breeders and FR eggs had lower valgus incidence, independently of warming profile, compared with O, FR, F broilers (56 vs 78%). No differences were observed in the incidence of other leg issues. Breeder age, egg storage time and egg warming rate influenced bone development and leg problems in broilers.

Key Words: leg problems, breeder age, egg storage, incubation

M15 Impact of rate of egg warming on the embryo, hatchling and broiler performance in stored and fresh hatching egg. C. M. Rhyne^{*SC}, H. R. C. Evans, M. J. Wineland, and K. M. Mann, *North Carolina State University, Raleigh*.

The objective of this trial was to determine the effect of rate of egg warm-up prior to incubation upon embryo growth, energy metabolism and grow out performance for broilers from fresh or stored eggs. 1080 eggs were obtained from a young flock of hens when 33 weeks of age, stored for 2 weeks and again at 35 weeks of age and stored for 3 days. Eggs from the 2 storage periods of either 2 weeks (stored) or 3 days (fresh) were equally divided and placed in 2 different incubators with 2 different warm-up profiles (fast and slow). Fast profile eggs were warmed up to temperature over a period of 2 hours and slow profile eggs were warmed up to temperature over a period of 18 hours. After the eggs attained incubation temperature, the profiles were kept the same. Chicks were grown out and weighed at 3 week and 6 weeks. Heart rates were determined at 13 days of incubation. Chicks were examined at hatch, and liver and heart samples were taken from 10 chicks per treatment to determine relative organ weight and glycogen content. Body weight at

hatch as a % of initial egg weight demonstrated an interaction of storage treatment and rate of warm up. This difference appears to be the result of the significant differences in the low amount of residual yolk at hatch in the slow fresh chicks. The slow had significantly elevated heart rates. Relative heart weight was significantly greater for fresh versus stored and slow versus fast warm up although grams of glycogen per heart was reversed. Relative liver weights were significantly greater for fresh versus the stored eggs and the slow versus the fast warm up

and the grams of glycogen per liver were reversed. Body weights at 6 weeks were significantly greater in females if they came from eggs which were stored and increased slowly compared to the other treatments. Male broilers were significantly higher when warmed up fast compared to slowly.

Key Words: warm-up, incubation, glycogen, egg storage

Nutrition I

M16 Effect of feeding NuPro® at different time intervals on the performance of commercial broilers. M. C. Shivakumar¹, H. N. Narasimhamurthy¹, and H. V. L. N. Swamy*², ¹*KVAFSU, Bangalore, India*, ²*Alltech Inc., Guelph, ON, Canada*.

NuPro® (Alltech Inc.) is a yeast derived protein extracted from a specific strain, *Saccharomyces cerevisiae*¹⁰²⁶. The objective of the current trial was to determine the effects of feeding NuPro at different time intervals on the performance and economic returns of commercial broilers. The trial lasted from 0 to 42 days, tested 880 birds on deep litter, conducting 4 treatments, 10 replications per treatment and 22 birds per replication. Four diets used in the trial are: a control (corn-soybean meal), 2% NuPro for 7 days, 2% NuPro for 14 days and 2% NuPro for 42 days. Body weight gain, feed intake, feed efficiency, mortality, European Production Efficiency Factor (EPEF) and return on investment (ROI) were evaluated. Data were subjected to ANCOVA and means were compared using Tukey's multiple comparison test (SAS, P<0.05). Feeding NuPro for 14 days statistically increased feed intake as compared to Control birds. At the end of the trial, however, birds fed NuPro for 7 and 14 days consumed less feed than the Control. Weight gain was better in all the NuPro diets both on day 7 and 42 as compared to Control (P<0.05). Birds fed NuPro had lower FCR than the control birds on day 7 and 42 (P<0.05). This may be related to the role of the product in improving gut development and in turn the nutrient absorption. At the end of the trial, birds fed NuPro diets showed significantly less mortality as compared to control birds. Birds fed NuPro showed 37 to 68 better EPEF points has compared to control birds (P<0.05). Maximum profit (0.2 USD per bird) was obtained when NuPro was fed for 14 days, but maximum ROI (1:7.9) was obtained when fed for 7 days. To conclude, feeding NuPro enhanced broiler performance and economic returns. Though the best ROI was noticed when NuPro was fed for 7 days, it can be fed up to 14 days with significant economic benefits.

Key Words: broilers, yeast derived protein, functional nutrient, poultry, NuPro

M17 Effect of feeding NuPro® at different time intervals on immunity and meat quality of commercial broilers. M. C. Shivakumar¹, H. N. Narasimhamurthy¹, and H. V. L. N. Swamy*², ¹*KVAFSU, Bangalore, India*, ²*Alltech Inc., Guelph, ON, Canada*.

NuPro® (Alltech Inc.) is a yeast derived protein extracted from a specific strain, *Saccharomyces cerevisiae*¹⁰²⁶. The objective of the current trial was to determine the effects of feeding NuPro at different time intervals on the immunity and meat quality of commercial broilers. The trial lasted from 0 to 42 days, tested 880 birds on deep litter, conducting 4

treatments, 10 replications per treatment and 22 birds per replication. Four diets used in the trial are: a control (corn-soybean meal), 2% NuPro for 7, 14 and 42 days. One bird per pen was randomly allocated for studying the immune and meat quality parameters. Weights of heart, liver, spleen, bursa, thymus, gizzard, proventriculus and intestine were measured on day 7, 14 and 42 and expressed as % body weight. On day 42 weights of total dressed meat, breast, thighs, wings, drumstick and abdominal fat was measured and expressed as % body weight. Birds were vaccinated for Newcastle disease (ND) and antibody titers were measured on a weekly interval. Data were subjected to ANOVA and means were compared using Tukey's multiple comparison test (GLM of SAS, P<0.05). On day 7 birds fed NuPro had significantly higher bursa and spleen weight than Control birds. This effect carried on till the end of the experiment. Only on day 14 birds fed NuPro had higher intestinal weight than Control birds (P<0.05). There was no significant effect of treatments on total dressing % and weights of thigh, drumstick and wings at the end of the trial. However, feeding NuPro for 7 days significantly reduced abdominal fat content of birds as compared to birds on Control diet. Breast weight was significantly higher in birds fed NuPro for 14 days as compared to birds on Control diet. Birds fed NuPro for 14 and 42 days had higher antibody titers to ND as compared to birds on Control diet (P<0.05). To conclude feeding NuPro has the potential to improve immunity of birds and can also assist in the production of leaner meat. Further research is needed to evaluate the effect of NuPro on cell mediated immunity.

Key Words: broilers, yeast derived protein, functional protein, NuPro, poultry

M18 The effect of dietary N,N-dimethyl glycine (DMG) on technical performance, plasma metabolites and broiler ascites syndrome: A challenge study. I. D. Kalmar¹, J. Buyse², and G. P. J. Janssens*¹, ¹*Ghent University, Belgium*, ²*Catholic University of Leuven, Belgium*.

Introduction DMG is reputed to enhance oxygen supply at cellular level. The primary condition of ascites, being hypoxemia, constitutes a possible application of DMG as a feed additive in broiler rations in order to abate losses due to broiler ascites syndrome and to improve technical performance. The current study intended to investigate these potential benefits of dietary DMG.

Materials In total sixty four 14-day-old broiler hens (Ross-308) were reared in 16 pens of 4 birds each until 40 days of age. The birds were challenged with a low environmental temperature (15 °C) and a diet enriched with poly unsaturated fatty acids in form of corn oil in order to provoke ascites. To each pen, one of two test diets was randomly assigned for the whole trial period: a control diet or the same diet added