

feces, boot, wall, fan, and drag swabs, and animal feces. 90% of the isolates were made up of *S. typhimurium*, *S. hadar*, *S. typhimurium* var. *copenhagen*, *S. senftenberg*, *S. heidelberg*, *S. litchfield*, and *S. newport*. 129 (38.51%) of the isolates were sensitive to all antimicrobials tested, with 206 (61.49%) being resistant to one or more of the antimicrobials. 17.01% were resistant simultaneously to streptomycin and tetracycline, with 2.39% and 12.24% resistant to streptomycin and tetracycline respectively. 12.54% of the isolates were resistant simultaneously to ampicillin and ceftiofur. 8.06% were resistant to ampicillin alone.

None of the isolates were resistant to ceftiofur alone. Serotypes with high levels of resistance among isolates were *S. hadar* (93.55%), *S. heidelberg* (85.71%), *S. typhimurium* var. *copenhagen* (68.33%), *S. senftenberg* (55.55%) and *S. typhimurium* (43.86%). None of 5 isolates each of *S. litchfield* and *S. newport* were resistant to any of the 12 antimicrobials. None of the isolates were resistant to neomycin, nalidixic acid, ciprofloxacin, enrofloxacin or ofloxacin.

**Key Words:** *Salmonella*, broiler house, antibiotic resistance, environmental samples

## Tuesday, January 24

### Nutrition IV

#### Room: B315

##### **S-T135 Comparison of total and digestible amino acid formulation and methionine sources for two replacement pullets strains.**

D. Faria\*, L. Rombola, M. Rizzo, A. Santos, and H. Souza, *Universidade de Satilde Sao Paulo, Satilde Sao Paulo, Brasil.*

The objective of this study was to evaluate the effects of different feed formulation criteria and methionine (Met) sources on performance of two replacement pullets strains. A total of three hundred eighty-four birds were randomly assigned in a 2x2x2 factorial arrangement with main effects of bird strain (Hy-Line W36 and Hy-Line Brown), Met source (2 Hydroxy-4-(methylthio) Butanoic acid; HMTBA, 88% or DL Met, 99%) and feed formulation criterion (total or digestible amino acids) resulting in eight treatments with six replicates of eight birds each. The experimental diets were formulated using corn, soybean meal, wheat (4.5 to 5.0%), meat and bone meal (4.5 to 5.0%), and poultry viscera meal (4.5 to 5.0%) to contain 20.50% CP, 2,917 kcal ME/kg, 0.45% total Met and 0.37 digestible Met for starter phase, and 15.90% CP, 3,050 kcal ME/kg, 0.42% total Met and 0.37% digestible Met for grower phase. The chemical compositions of the ingredients and its digestible amino acids coefficients were previously obtained by analyses. The characteristics evaluated during starter (1-6 wk) and grower (11-16 wk) phases were intakes of feed (FI), Met (MI), lysine (LI), crude protein (CPI), and energy (EI), body weight (BW), weight gain (WG), and feed conversion (FC). As expected, Hy-Line Brown showed higher FI, MI, LI, CPI, EI, BW and WG than Hy-Line W36 pullets. The sources of Met and feed formulation criteria did not influence the performance characteristics, and the birds fed diets formulated based on total amino acids concept showed increased ( $P < .01$ ) amino acids intake, ranging from 10.58% to 13.53% and from 10.81% to 22.35% for Met and Lys, respectively. It was concluded the Hy-Line W36 and Hy-Line Brown replacement pullets showed satisfactory performance irrespective of feed formulation criterion and Met source.

**Key Words:** amino acid, grower, ingredient, replacement pullet, starter

**S-T136 Arginine:Lysine ratios in diets formulated based on total and digestible amino acids containing two sources of methionine for laying hens in the summer.** D. Faria\*, L. Rombola, M. Rizzo, A. Santos, and H. Souza, *Universidade de Satilde Sao Paulo, Satilde Sao Paulo, Brasil.*

The experiment was conducted to evaluate the influence of different Arginine:Lysine (Arg:Lys) ratios, feed formulation criteria, and methionine (Met) sources on performance and egg quality of layers from 25 to 41 weeks of age in the summer (average of 30 °C). A total of two hundred eighty-eight Hy-Line W36 layers were randomly assigned in a 2x3x2 factorial arrangement with main effects of feed formulation criterion (total or digestible amino acids), Arg:Lys ratio (0.9:1, 1:1, and 1.1:1), and Met source (2 Hydroxy-4-(methylthio) Butanoic acid; HMTBA, 88% or DL Met, 99%) resulting in twelve treatments with six replicates of four birds each. The experimental diets were isonitrogenous (18% CP) and isocaloric (2,850 kcal ME), and formulated using corn, corn gluten meal, soybean meal, and wheat to contain 0.88%, 0.47%, 0.19% or 0.78%, 0.42% and 0.17% of Lys, Met and Trp for total or digestible amino acids, respectively. Several characteristics of performance (feed intake, egg production, egg weight, egg mass, feed conversion, and body weight), egg internal quality (Haugh unit and percentages of albumen and yolk), and egg external quality (specific gravity, shell percent, and shell thickness) were evaluated. The results showed no influence of feed formulation criteria and Met sources on performance characteristics. However, there was a positive linear response ( $P < .01$ ,  $P < .05$  and  $P < .05$ , respectively) of Arg:Lys ratio on feed intake ( $Y = 0.069X + 81.243$ ), egg weight ( $Y = 0.07X + 48.35$ ), and egg mass ( $Y = 0.0955X + 39.51$ ). Egg quality characteristics were not influenced by the factors studied. It was concluded that increasing the Arg:Lys ratio can be beneficial for young laying hens under hot climate conditions.

**Key Words:** egg quality, hot climate, performance, pPoultry

##### **S-T137 Impact of feed ingredients and dietary protein level on microbial activity in the digestive tract of broilers.**

D. Hoehler\*<sup>1</sup>, A.J.M. Jansman<sup>2</sup>, C.M.F. Wagenaars<sup>2</sup>, and A. Lemme<sup>1</sup>, <sup>1</sup>*Degussa Corporation, Kennesaw, Georgia,* <sup>2</sup>*Wageningen UR, Animal Sciences Group, Lelystad, The Netherlands.*

Chicken diets have been supplemented with growth-promoting antibiotics for years. There are, however, increasing concerns regarding the use of those substances. Microbial activity and composition of microflora in the gastro-intestinal tract, intestinal health and mucosal function in broilers might be influenced by the choice of ingredients as well as by nutrient levels. Two experiments with male d old Ross 308 broilers following a 2 x 2 x 2 design were conducted using the experimental

factors dietary protein level (19% or 25% in the starter diets and 18% or 24% in the grower diets), fish meal inclusion, and carbohydrate source (corn, wheat). Exp 1 was conducted to investigate the effects on performance and microbial activity in the digestive tract; Exp 2 was performed to examine the dietary effects under conditions of a combined challenge with *E. acervulina* and *C. perfringens*. In Exp 1, 1024 chicks were assigned to 64 floor pens resulting in 8 replicates per treatment with 16 birds per pen. At d 28 four birds per pen were selected to obtain digesta from the terminal ileum and the caeca. The remaining birds were fed until d 35. In Exp 2, 1408 chicks were distributed to 64 floor pens. Each treatment comprised 8 replicates with 22 birds per pen until d 35. Birds receiving the wheat based diets showed a higher feed intake than those fed corn based diets. Inclusion of fishmeal resulted in an improved performance at a high dietary protein level but not at low dietary protein. Both high dietary protein and fish meal addition resulted in an increased digesta ammonia content indicating a higher microbial breakdown of protein. Choice of cereals had no consistent effect on ammonia concentrations. Data suggest that microbial activity in the digestive tract can be manipulated by dietary means. Treatments did not affect the response towards a combined challenge with *E. acervulina* and *C. perfringens*. Other factors, such as hygiene or stress might have a much larger impact on the development of these diseases.

**Key Words:** broiler, protein level, microbial activity, intestinal health

**S-T138 Growth performance and meat yield responses of Ross x Ross 708 broilers provided diets varying in amino acid density from 36 to 59 d of age.** W. Dozier<sup>\*1</sup>, M. Kidd<sup>2</sup>, A. Corzo<sup>2</sup>, J. Anderson<sup>3</sup>, and S. Branton<sup>1</sup>, <sup>1</sup>USDA/ARS Poultry Research Unit, Mississippi State, Mississippi, <sup>2</sup>Mississippi State University, Mississippi State, <sup>3</sup>Mississippi State University, Mississippi State.

This study examined growth responses and meat yield of broilers provided diets varying in amino acid density from 36 to 59 d of age. Two identical trials were conducted. In each trial, sixteen hundred and sixty-four Ross x Ross 708 chicks were randomly distributed into 32 floor pens (26 males and 26 females; 0.08 m<sup>2</sup>/bird) at one-d of age. All birds were fed common – high amino acid density diets to 35 d of age. Broilers were provided diets characterized as being high (H), moderate (M), or low (L) in amino acid density from 36 to 47 and 48 to 59 d of age. The diets were formulated to contain: H (19.8%, CP, 0.83%, TSAA, and 1.05%, Lys), M (18.2%, CP, 0.80%, TSAA, and 0.95%, Lys), and L (16.7%, CP, 0.75%, TSAA, and 0.85%, Lys) from 36 to 47 d and H (18.0%, CP, 0.78%, TSAA, and 1.00%, Lys), M (17.3%, CP, 0.75%, TSAA, and 0.91%, Lys), and L (16.0%, CP, 0.70%, TSAA, and 0.82%, Lys) from 48 to 59 d. Dietary treatments were HHHH, HHHM, HHHL, HHMM, HHML, and HHLL from 36 to 59 d of age.

Feeding the HHHH schedule improved (P=0.05) feed conversion by 3, 3, 4, 4, and 7 points compared with the HHHM, HHMM, HHHL, HHML, and HHLL, respectively. Dietary amino acid density did not affect growth rate, feed consumption, and the incidence of mortality. Decreasing amino acid density to HHLL feeding schedule increased (P=0.05) abdominal fat yield compared with HHHH and HHHM dietary schedules and reduced (P=0.05) total breast meat yield compared with HHHH, HHHM, HHMM, and HHML dietary schedules, respectively. As amino density decreased to the HHHM, HHMM, and HHML feeding schedules, breast meat yield of broilers was similar to birds fed the HHHH feeding schedule. Total breast meat yield was increased

(P=0.05) by 0.4, 0.4, 0.6, and 0.7% points as amino acid density was increased from HHLL to HHML, HHMM, HHHM, and HHHH feeding schedules, respectively. These results indicate that feeding low amino acid density diets to broilers from 2.0 to 3.9 kg adversely affects feed conversion and total white meat yield.

**Key Words:** amino acid, broiler, lysine, nutrient density

**S-T139 Growth performance and meat yield responses of Ross x Ross 708 broilers provided diets varying in energy and amino acid density from 42 to 56 days of age.** W. Dozier<sup>\*1</sup>, A. Corzo<sup>2</sup>, M. Kidd<sup>2</sup>, J. Anderson<sup>3</sup>, and S. Branton<sup>1</sup>, <sup>1</sup>USDA/ARS Poultry Research Unit, Mississippi State, Mississippi, <sup>2</sup>Mississippi State University, Mississippi State, <sup>3</sup>Mississippi State University, Mississippi State.

This study examined growth performance and meat yield responses of broilers fed diets varying in dietary AME and CP/amino acid (CP/AA) concentrations during 42 to 56 d of age. Nineteen hundred and twenty Ross x Ross 708 broilers were randomly allotted to 32 floor pens (30 males and 30 females; 0.09 birds/m<sup>2</sup>) at 42 d of age. Initial BW was equalized among the treatments (2,430±3 g). A 2 x 2 (Dietary AME and CP/AA) factorial treatment structure was employed. The main effect of dietary AME consisted of diets formulated to contain 3,220 and 3,310 kcal AME/kg. The main effect of CP/AA represented high (18.0% CP, 0.98%, Lys, and 0.83%, TSAA) and moderate (16.2% CP, 0.88%, Lys, and 0.75%, TSAA) CP/AA concentrations.

From 42 to 56 d of age, broilers fed diets formulated to 3,310 kcal ME/kg had improved (P=0.04) BW gain, feed consumption, and feed conversion (2.20 vs. 2.34) over birds provided diets to 3,220 kcal AME/kg. Increasing dietary CP/AA density from moderate to high concentrations reduced (P=0.009) feed consumption and feed conversion (2.30 vs. 2.23). Decreasing dietary AME increased (P=0.03) carcass yield and the converse occurred by increasing dietary CP/AA density (P=0.02). Broilers provided diets formulated to 3,220 kcal AME/kg with high CP/AA density optimized carcass yield leading to a dietary AME x CP/AA interaction (P=0.02). As dietary AME increased from 3,220 to 3,310 kcal AME/kg, abdominal fat weight and its proportion to the carcass increased (P=0.03). Increasing dietary CP/AA density from moderate to high increased (P=0.02) the amounts of total breast meat weight and yield (22.6 vs. 23.2%). These results indicated that broilers fed diets formulated to high CP/AA from 42 to 56 d increased total breast meat yield by 0.6% compared with birds fed diets containing moderate dietary CP/AA density. Furthermore, formulating diets to higher AME concentrations than currently being used in commercial practice is beneficial to improve feed conversion, but the cost of supplemental fat must be considered.

**Key Words:** AME, amino acid, broiler, lysine, nutrient density

**S-T140 The impact of methionine supply on the early development of broiler chicks.** R.L. Payne<sup>\*1</sup>, A. Lemme<sup>1</sup>, D. Jamroz<sup>2</sup>, and T. Wiertelcki<sup>2</sup>, <sup>1</sup>Degussa Corporation, Kennesaw, Georgia, <sup>2</sup>Agricultural University, Wroclaw, Poland.

Early nutrition of broilers is well-known to play a crucial role in their overall performance. Therefore, an experiment was conducted to inves-

tigate the effects of dietary Met supplementation on yolk sac protein resorption and growth performance of broilers from 0 to 14 d of age. Within 5 hours post-hatching, 390 Hubbard Hi-Y broiler chicks were equally allotted to 5 treatments, and each treatment was replicated 6 times with 13 chicks per replicate. The treatments were a basal diet deficient in Met+Cys (0.67%) or the basal plus 4 graded levels of total Met+Cys (0.70, 0.74, 0.79, and 0.85%) via DL-Met. The basal diet was formulated to provide 2,915 kcal of ME, and 1.17% Lys per kg of diet, and all other nutrients met or exceeded the NRC recommendations (1994). Baseline yolk sac composition and length and weight of the intestinal tract were established using 30 broilers on d 0. All chicks were weighed on d 1, 3, 5, 7, 10, and 14, and then 2 chicks per replicate were randomly selected for determining changes in the intestine and the yolk sac. On d 1 and 3, there were no differences ( $P > 0.05$ ) in growth rate among treatments, but from d 5 through d 14, body weight was increased ( $P < 0.05$ ) as broilers were fed increasing levels of Met+Cys. There were no differences ( $P > 0.05$ ) in feed intake on d 5, but on d 7, 10, and 14, feed intake increased with increasing levels of Met+Cys. The relative length and weight of the small intestine increased regardless of diet from d 0 to 3 and d 0 to 7, respectively. From d 0 to 5, weight, protein, and Met content in protein of the yolk sac decreased regardless of diet, but levels of other amino acids, such as Lys, did not change. The results of this experiment suggest that Met has a significant role in growth within the first few days after hatch, and that this role can have lingering effects on overall performance if optimum dietary Met levels are not provided in the starter feed.

**Key Words:** broiler, early nutrition, intestine, methionine, yolk sac

**S-T141 The effects of dietary energy and amino acid profiles on broiler performance.** R.L. Payne<sup>\*1</sup>, A. Lemme<sup>1</sup>, C. Kemp<sup>2</sup>, M. Kenny<sup>2</sup>, and C. Fisher<sup>2</sup>, <sup>1</sup>*Degussa Corporation, Kennesaw, Georgia*, <sup>2</sup>*Aviagen Ltd., Newbridge, Scotland*.

In many parts of the world, oils as dietary energy sources are often limited, which makes it difficult to formulate diets to contain recommended ME levels. The objective of this experiment was to determine if balanced amino acids (AA) should be adjusted based on the ME level of the diet. A total of 4,320 Ross 308 male broilers were equally allotted to 12 dietary treatments, and each treatment was replicated 4 times with 90 broilers each. The treatments were 4 levels of AA (70, 80, 90, and 100%) and 3 levels of ME (90, 95, and 100%) based on Aviagen recommendations (2002). The broilers were fed in three growth phases: starter (d 1 to 10), grower (d 11 to 32), and finisher (d 33 to 46), and the diets were provided as crumbles (starter) or pellets (grower and finisher). The 100% AA/100% ME starter, grower, and finisher diets were formulated to provide 1.27, 1.08, and 0.88% digestible Lys, 0.94, 0.82, and 0.69% digestible Met+Cys, and 3,010, 3,175, and 3,225 kcal of ME per kg of diet. The 90% ME diets were formulated to contain no oil source, and the lower AA diets were formulated by reducing the AA level by 10, 20, or 30% respectively. All other nutrients met or exceeded the Aviagen (2002) recommendations. Body weight was improved ( $P < 0.05$ ) in a non-linear fashion as AA levels increased regardless of ME level. Feed intake increased ( $P < 0.01$ ) as dietary AA increased within ME level, and feed intake of broilers fed 90 or 95% ME was increased ( $P < 0.01$ ) relative to those fed 100% ME. Feed efficiency, breast meat yield, and abdominal fat pad were not affected ( $P > 0.05$ ) by AA or ME levels. Data suggest that reducing dietary energy increased feed intake which thus resulted in increased amino acid intake reflected immediately in

body weight gain. Moreover, responses indicate, that dietary amino acid levels should not be reduced to the same extent as energy.

**Key Words:** amino acid, breast, broiler, energy, growth

**S-T142 Near Infra-red Reflectance spectroscopy for prediction of amino acids leads to cost savings in diet formulation.** J. Goodson<sup>\*1</sup>, J. Fontaine<sup>2</sup>, B. Schirmer<sup>2</sup>, and A. Jaeger<sup>2</sup>, <sup>1</sup>*Degussa Corporation, Kennesaw, Georgia*, <sup>2</sup>*Degussa AG, Hanau, Germany*.

NIRS calibrations used to predict amino acid levels in feed ingredients can be used to allow poultry feed formulators to reduce safety margins in formulation programs. Reduction of these safety margins for amino acids allows the production of feeds which meet animal requirements for protein and amino acids without supplying excessive levels. These calibrations also enable formulators to take advantage of alternative feed ingredients when traditional ingredients become high priced compared to other sources of nutrients. Currently calibrations are available to predict DM, CP, Met, Cys, Met+Cys, Lys, Thr, Trp, Arg, Ile, Leu, Val, His and Phe. Ingredients including barley, corn, corn gluten meal, distillers dried grains with solubles, feather meal, fish meal, lupine, meat meal, meat and bone meal, peas, poultry meal, canola meal, rice bran and hulls, sorghum, soybean meal, full fat soybeans, sunflower meal, tritcale and rye, wheat, wheat bran and middlings have calibrations. These calibrations are being used to assess seasonal variation and regional variation in nutrients provided by these ingredients. A large data base of new crop soybean meal samples (n=81) collected in the fall of 2004 show that there are important variations in CP as well as many important amino acid levels. A similar data set for new crop corn (n=123) demonstrates amino acid variation also. Application of this technology to soybean meal and corn enables formulators to use very precise amino acids values. Several example formulations have been prepared showing that savings can range up to \$19.00 per ton in a broiler starter feed when precise data on amino acid levels in corn and soybean meal are available. These savings represent the extremes, since in this case the highest and lowest levels of Met and Lys found in the corn and soybean meal sample set, were used. Under practical conditions in which the safety margin in formulation is adjusted it is reasonable to expect \$1 to \$2 per ton savings.

**Key Words:** NIRS, amino acid, formulation, variation, near infra-red

**S-T143 Potential of phase feeding in broiler chickens.** D. Hoehler<sup>\*</sup> and A. Lemme, *Degussa Corporation, Kennesaw, Georgia*.

Broiler nutritionists need to make decisions about the energy and nutrient content of feed during the grow-out period, and the length of time or amount each feed should be fed as part of the feeding program. Amino acid requirements (% of ME) decrease steadily with age. The NRC (1994) provided a single set of recommendations for both male and female broilers, and requirements are segregated into 3 periods: starter, 0 to 3 wk; grower, 3 to 6 wk; finisher 6 to 8 wk. This regimen does not correspond with the feeding regimen used in commercial systems, nor does it comply with current actual requirements. Optimum ileal digestible lysine level derived with a factorial approach decreases from 1.61% at d 1 to 0.87% at d 55. A commercial feeding regimen with the five following periods is suggested: starter I, 1 to 12 d (about 350 to 400 g

intake); starter II, 13 to 22 d; grower, 23 to 35 d; finisher I, 36 to 48 d; finisher II, >48 d. Recommended dietary ileal digestible lysine levels are 1.27, 1.09, 1.00, 0.95, and 0.89% for phases 1 to 5, respectively. Optimum digestible ratios of Met + Cys to Lys in phases 1 to 5 are 72, 74, 76, 77, and 79%; optimum digestible Thr to Lys ratios are 63, 64, 65, 66, and 67%. Suggested ME levels increase from 12.7 to 13.4 MJ/kg. We conducted a global broiler industry survey on phase feeding regimens. Number of feeding phases varied from only 2 in China to 5 in Bolivia. However, there is likely also a huge variation between companies depending on the production goal. As expected, ME levels increased with age, while lysine levels decreased. There exists a significant potential for further fine-tuning and optimizing ME and amino acid levels during the different grow-out phases. The most significant discrepancies between actual and theoretical amino acid levels exist during the first week of age, where actual levels are considerably lower than requirements in almost all countries. Effective phase feeding can minimize excess dietary protein and amino acids, thus reducing dietary costs per unit of weight gain or breast meat yield, along with reducing nitrogen excretions.

**Key Words:** broiler, phase feeding, amino acids, energy, requirements

**S-T144 Effects of reducing dietary protein on performance of White Leghorn layers during the first production cycle.** H.M. Yakout<sup>\*1</sup>, D. Hoehler<sup>2</sup>, and C. Novak<sup>1</sup>, <sup>1</sup>Virginia Tech, Blacksburg, <sup>2</sup>Degussa Corporation, Kennesaw, Georgia.

The use of low protein diets can have potential benefits on reducing nitrogen emissions as well as potential cost savings by reducing high cost protein sources. An experiment was conducted with 384 Hy-Line W36 hens which were randomly assigned to one of four dietary treatment groups. Corn-soy based diets varying in dietary protein supplemented with commercially available amino acids as follows: [1] 19% CP + Met (\$142.66/ton), [2] 17% CP + Met and Lys (\$136.09/ton), [3] 15% CP + Met, Lys and Thr (\$131.53/ ton), and [4] 13% CP + Met, Lys Thr and Trp (\$138.16/ton) were fed from 24 to 36 wks of age. Cage was considered the experimental unit (4 hens/cage), and each treatment was replicated 24 times. Overall, hens on diets 1, 2 and 3 consumed more feed (FI) than diet 4, 85.04, 84.80, 84.63 vs. 75.74 g/h/d, respectively. Egg production (EP) ranged from 91.79 to 85.75% for all dietary treatment with the highest producers fed diet 2. Egg weights (EW) performed similarly to EP as they were decreased (P = 0.01) from 55.21 g, to 52.20 g as dietary protein decreased from 19% to 13%, respectively. Egg mass (EM) was higher (P = 0.0001) when hens consumed diet 1 (50.12 g) 2 (49.71 g), or 3 (49.30 g) compared to diets 4 (44.75 g). Decreasing dietary protein reduced dry albumen percent, while increasing dry shell percentage. Feed conversion (FC), specific gravity (SG) and yolk solids were not affected by dietary treatments. Dietary treatments 1, 2 and 3 were statistically similar when evaluating production performance and egg components as compared with diet 4. No effects were found on FC, SG or yolk solids due to dietary treatments. Based on the information gathered in this trial, feeding the 15% CP diet with supplemental Met, Lys and Thr matched the EP and EM of the high protein diet. The use of such a diet in the field has the potential to save the poultry industry as much as \$11/ton based on the current study. Additional in house or field studies are needed to validate these findings.

**Key Words:** dietary protein, lysine, methionine, egg production, egg mass

**S-T145 MINTREX<sup>®</sup>Zn and MINTREX<sup>®</sup>Cu organic trace minerals improve intestinal strength and immune response to coccidiosis infection and/or vaccination in broilers.** J.D. Richards\*, T.R. Hampton, C.W. Wuelling, M.E. Wehmeyer, and J.J. Dibner, *Novus International, Inc., St. Charles, Missouri.*

MINTREX<sup>®</sup>Zn and MINTREX<sup>®</sup>Cu organic trace minerals are organic zinc and copper sources, respectively, with 2-hydroxy-4(methylthio)butanoic acid as the organic ligand. Both were tested for the ability to improve intestinal breaking strength (IBS) and immune response to a coccidiosis vaccination and/or challenge. In experiment one, Cobb 500 broilers were fed diets that were zinc deficient (35ppm), supplemented with 70ppm zinc sulfate, or 70ppm zinc sulfate + 35ppm organic zinc (MINTREX<sup>®</sup>Zn or zinc-methionine). Half of the birds were vaccinated with a 3-species (*Eimeria tenella*, *maxima*, and *acervulina*) coccidiosis vaccine (ADVENT<sup>®</sup> coccidiosis control) at hatch, and challenged (300,000 viable sporulated oocysts (VSO) *acervulina*/bird; 60,000 VSO *maxima*/bird; 20,000 VSO *tenella*/bird) on day 24. MINTREX<sup>®</sup>Zn and zinc-methionine both significantly increased IBS in vaccinated + challenged birds. Only MINTREX<sup>®</sup>Zn increased IBS in unvaccinated + unchallenged birds. Only birds fed MINTREX<sup>®</sup>Zn exhibited significantly improved post-vaccination antibody responses to two *E. tenella* antigens. In experiment two, broilers were fed a low copper (9ppm) diet, or a diet supplemented with 25ppm copper from copper sulfate, a copper proteinate, copper lysine, or MINTREX Cu. All birds were vaccinated (*E. acervulina*) and challenged (300,000 VSO *acervulina*/bird; 10,000 VSO *tenella*/bird). Birds fed MINTREX Cu exhibited significantly greater IBS than all other treatments. All organic copper sources significantly lowered *E. tenella* lesion scores versus the low copper diet, with scores of birds fed MINTREX<sup>®</sup>Cu numerically the lowest. Only MINTREX<sup>®</sup>Cu gave a significant improvement in anti-coccidial (MIC2 antigen) antibody response. Therefore, MINTREX<sup>®</sup>Zn and MINTREX<sup>®</sup>Cu provide significant immune and intestinal benefits.

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ADVENT<sup>®</sup> is a trademark of Viridus Animal Health, LLC, and is registered in the United States and other countries

**Key Words:** MINTREX<sup>®</sup>, zinc, copper, broiler, coccidiosis

**S-T146 An evaluation of MINTREX<sup>®</sup>Mn organic trace mineral as a source of manganese in broiler diets.** F. Yan\* and P. Waldroup, *University of Arkansas, Fayetteville.*

Manganese is an essential trace element for chickens and is typically added to broiler diets. An organic source of trace minerals, MINTREX<sup>®</sup>, has recently been introduced. It uses 2-hydroxy-4(methylthio)butanoic acid as the organic ligand in a ratio of 2:1 with zinc, copper or manganese. This study tested the bioavailability of the manganese chelate, MINTREX<sup>®</sup>Mn, compared to manganese sulfate and manganese dioxide in diets for young broiler chicks. Nutritionally complete diets were formulated based on nutrient specifications of top broiler producers. Each of the Mn sources was added at 0, 100, 200, 400, 600, and 800 mg/kg. Diets were adjusted for the amount of 2-hydroxy-4(methylthio)butanoic acid added from the MINTREX<sup>®</sup>Mn. All diets were fortified with 50 mg/kg Fe from ferrous sulfate, 100 mg/kg Zn from ZnSO<sub>4</sub>, and 10 mg/kg Cu from copper sulfate. Diets were fed in mash

form. Five male chicks (Cobb 500) were placed in each of 96 pens in battery brooders; six pens were assigned to each dietary treatment. Diets were fed from 1 to 20 d at which time BW and feed consumption were determined and birds killed by CO<sub>2</sub> inhalation. Tibia were removed from surviving birds, cleaned of adhering tissue, dried, and extracted as described by AOAC (1990). Pooled samples of fat-extracted dried tibia (pooled within replicate pens) were analyzed for bone ash and manganese content.

There were no significant differences among treatments for body weight, feed conversion, feed intake, mortality, or tibia ash. Significant differences in tibia Mn content were observed among source and level of Mn. Slope-ratio analysis of the response to the various products indicated that birds fed MINTREX<sup>®</sup>Mn had 14.28% higher levels of tibia Mn than those fed the sulfate form and 54.83% higher levels of tibia Mn than those fed the oxide form, indicating greater biological availability of the Mn from the MINTREX<sup>®</sup>Mn than provided by commonly used inorganic forms of Mn. Use of this product at adjusted dietary levels should reduce fecal excretion of Mn.

MINTREX<sup>®</sup> is a registered trademark of Novus International, Inc.

**Key Words:** broilers, manganese, organic minerals, trace minerals

**S-T147 The methionine (Met) activity of MINTREX<sup>®</sup>Zn, MINTREX<sup>®</sup>Cu and MINTREX<sup>®</sup>Mn in broiler starter diets is fully available for broiler chicks.** G.F. Yi\*, J.J. Dibner, J.D. Richards, M.E. Wehmeyer, and C.D. Knight, *Novus International, Inc., St. Charles, Missouri.*

MINTREX<sup>®</sup>Zn, MINTREX<sup>®</sup>Cu and MINTREX<sup>®</sup>Mn are organic trace minerals containing 16% Zn, 15% Cu, and 13% Mn, with 80%, 78% and 78% of 2-hydroxy-4-(methylthio) butanoic acid (HMTBA) as the organic ligand, respectively. The objective of this trial was to determine if the HMTBA content from these products was fully available as a Met source. Day old Cobb 500 male chicks (576) were allotted to 12 dietary treatments (Trt) in a completely randomized block design (6 pens/Trt, 8 chicks/pen) for 21 d. A total sulfur amino acid (TSAA) deficient diet containing 0.70% TSAA (Trt 1) was supplemented with 0.05, 0.10, 0.15, or 0.20% HMTBA (Trt 2-5; supplied by Alimet<sup>®</sup> feed supplement) to establish the standard Met response curve. Trt 6 was analogous to Trt 2 but added an additional 160 ppm Zn from ZnSO<sub>4</sub>•H<sub>2</sub>O, 80 ppm Cu from CuSO<sub>4</sub>•5H<sub>2</sub>O, and 160 ppm Mn from MnSO<sub>4</sub>•H<sub>2</sub>O. Trt 7-12 were the same as Trt 2 but supplemented with 40 or 160 ppm Zn from MINTREX<sup>®</sup> Zn, 20 or 80 ppm Cu from MINTREX<sup>®</sup> Cu, and 40 or 160 ppm Mn from MINTREX<sup>®</sup> Mn, respectively. For Trt 1-6, performance increased due to Met addition ( $P < .01$ ) but not to increasing inorganic trace minerals. Within each MINTREX<sup>®</sup> treatment (7-12) there was a linear increase in G:F ( $P < .01$ ) and for MINTREX<sup>®</sup>Zn and MINTREX<sup>®</sup>Mn a linear increase in gain ( $P < .01$ ). The linear prediction equation determined by the one-slope broken-line (BL) below the breakpoint and exponential (EXP) prediction equations for both gain and G:F were used to estimate the bioavailable Met intake from MINTREX<sup>®</sup>. Based on the BL, the average bioavailable Met activity from MINTREX<sup>®</sup> was 98% and 99%, for gain and G:F, respectively. The EXP indicated that the average bioavailable Met activity from MINTREX<sup>®</sup> was 105% and 126%, for gain and G:F, respectively. In conclusion, the growth responses to MINTREX<sup>®</sup> were consistent with the level of HMTBA in the molecule demonstrating that

it is fully available as a Met source for the broiler chick. (Alimet<sup>®</sup> feed supplement and MINTREX<sup>®</sup> are registered trademarks of Novus International, Inc.)

**Key Words:** MINTREX<sup>®</sup> Zn, MINTREX<sup>®</sup> Cu, MINTREX<sup>®</sup> Mn, methionine activity, broilers

**S-T148 Economics of B-Mannanase (Hemicell<sup>®</sup> Feed Enzyme) in turkey hens under varying energy levels.** M. Jackson\*<sup>1</sup> and G. Mathis<sup>2</sup>, <sup>1</sup>*ChemGen Corp, Gaithersburg, Maryland,* <sup>2</sup>*Southern Poultry Research, Athens, Georgia.*

Six dietary treatments consisting of four feeding programs (high, normal, low, and very low energy levels) varying by increments of 60 Kcal/kg ME and the two lowest ME programs with a target B-mannanase at 100 MU/ton were provided to 10 replicate pens with 19 Nicholas female turkeys per pen. Diets were corn-soybean meal based containing 4-6% poultry meal. All diets were assayed for proximate composition and B-mannanase activity. The feeding programs consisted of 5 diets provided from 0-3, 3-6, 6-9, 9-12, and 12-14 weeks of age. Liquid enzyme or water was applied to all pelleted diets. Body weight was determined at 0, 3, 6, 9, 12, and 14 weeks of age and feed consumption was determined between these ages. The normal level ME varied from 2954 Kcal/kg (1340/lb) at 0-3 weeks to 3400 Kcal/kg (1542/lb) at 12-14 weeks of age. Improvements in weight gain and feed conversion were observed with each increase in energy level demonstrating that the birds consistently responded to energy density. In the low and very low energy programs, B-mannanase improved feed conversion from 0-14 weeks by 3.7 and 1.7 points, respectively (NS) and improved final weights by 3.5% and 4.1% respectively ( $P < 0.05$ ). Using commercial feed ingredient prices reflective at the time of the study and a dressed meat value of \$1.10/kg (\$.50/lb), calculated margins (meat revenue minus feed cost) were determined. On a per-1000-birds-placed basis, B-mannanase increased margins by \$219.80 and \$122.23 when included in the low and very low ME feeding programs, respectively. The experiment revealed that B-mannanase improves turkey hen performance at varying energy levels and that the economic benefit may vary depending on the base energy program selected.

**Key Words:** turkeys, B-mannanase, energy density, economics

**S-T149 S-Statistical meta-analysis of data from four EU efficacy studies with B-mannanase (Hemicell<sup>®</sup> Feed Enzyme) in broilers.** M. Jackson\*<sup>1</sup>, E. Helmes<sup>1</sup>, and P. Medel<sup>2</sup>, <sup>1</sup>*ChemGen Corp, Gaithersburg, Maryland,* <sup>2</sup>*Imasde Agropecuaria, Napoles, Madrid, Spain.*

Four EU efficacy trials were conducted from 2003-2005, with similar protocol designs. For the meta-analysis, data were selected from trials where the recommended minimum dose of Hemicell<sup>®</sup> feed enzyme was applied to broilers on similar corn-soybean meal diets without the use of coccidiostats or antibiotics. The meta-analysis evaluated the effect of Hemicell<sup>®</sup> when added at a dose targeted to give around 79,000 U/kg feed. All studies had a negative control and a treated group containing the enzyme dosage at a target level. In each study, pens of male broilers were fed a starter feed from 0-21 and a grower feed from 22-42 days of age. Two studies used mash feeds, whereas the other 2 studies used

pelleted feeds. The goal of the meta analysis was to combine data from 4 studies and evaluate the enzyme product across all studies. Data were tested for homogeneity and pooled to enable a statistical meta-analysis, where  $P=0.05$  was considered significant. Data from the starter period indicated an improvement of 2.8% and 2.6% in growth and feed efficiency, respectively ( $P<0.01$ ). Growth and feed efficiency were improved by 4.9% and 3.8%, respectively during the grower period ( $P<0.01$ ). From 0-42d, Hemicell<sup>®</sup> improved growth and feed efficiency by 4.2% and 3.6%, respectively ( $P<0.001$ ). Also, a significant improve-

ment of 7.5% ( $P<0.001$ ) was observed for the European Production Efficiency Factor, 1-42 d (gain, g of survivors/(FCR\*10))\*(100 - % mortality). Mortality (mean 4.7%) was considered normal with no significant differences between control and treated birds. The meta-analysis supports the conclusion that Hemicell<sup>®</sup> Feed Enzyme is effective in broilers at the recommended dose of ~79,000 U/kg feed.

**Key Words:** broilers, B-mannanase, meta analysis, body weight, Feed conversion

## POSTERS

Monday, January 23

Room: 308-309

**S-P150 Initial proteomics analysis of differentially expressed proteins from ts-11 and F strain detected by Western blotting.** S.D. Collier\*<sup>1</sup>, G.T. Pharr<sup>2</sup>, S.L. Branton<sup>1</sup>, J.D. Evans<sup>1</sup>, and S.A. Leigh<sup>1</sup>, <sup>1</sup>USDA, Agricultural Research Service, South Central Poultry Research Laboratory, Mississippi State, Mississippi, <sup>2</sup>Mississippi State University, Mississippi State.

*Mycoplasma gallisepticum* (MG) is the causative agent of chronic respiratory disease in layer chickens. The MG vaccine strains that are approved and commercially available for use in layer chickens include F, ts-11 and 6/85. The MG vaccine strains ts-11 and 6/85 are safer than the F strain vaccine and they have little or no potential of spreading from bird to bird. However, ts-11 and 6/85 appear to be less efficacious than F strain. Results from studies suggest that the use of MG vaccine strain F in replacement flocks over a period of time results in the displacement of the original field strain. Kleven and colleagues (1998) showed that in pen trial studies the F strain displaced the virulent R strain, but ts-11 and 6/85 did not. Also reports of MG breaks in layer flocks previously vaccinated with ts-11 or 6/85 have resulted in revaccination of these flocks by F. The continued use of F strain in displacement and revaccination regimens necessitates the development of more rapid and sensitive field tests that will differentiate between wild-type and vaccine strains of MG. In the present study, ts-11 and F strain whole cell extracts were analyzed by Western blotting and proteomic methodologies. Differentially expressed bands were excised, in-gel digested with trypsin, and analyzed by mass spectrometry. The proteins were characterized as internal proteins and were predicted to be mostly involved in such cellular processes as carbohydrate transport and metabolism, energy production and conversion, posttranslational modification, protein turnover, chaperones and transcription and translation. The results of this study suggest that proteomics may aid in the characterization of proteins that could contribute to the development and improvement of serologic and DNA based MG diagnostic tests.

**Key Words:** western blotting, proteomics, MG, ts-11, F strain

**S-P151 Effect of an ultrabiotic on Salmonella typhimurium colonization and blood composition in turkeys experimentally challenged.** A. Koncicki<sup>1</sup>, B. Mazur-Gonkowska<sup>1</sup>, A. Krasnodebska-Depta<sup>1</sup>, and M. Contreras\*<sup>2</sup>, <sup>1</sup>University of Warmia and Mazury, Olsztyn, Poland, <sup>2</sup>Citrex Inc., Miami, Florida.

The effect on intestinal colonization and blood composition in turkeys experimentally challenged with ST and treated with a commercial

ultrabiotic (Citrex) in the drinking water was evaluated. Thirty healthy 6 week-old BUT turkeys were divided into 3 treatments and kept in isolated areas. The first group was non-treated and non-challenged (negative control), the second group was challenged by intubation into the crop with a bacterial suspension containing  $6 \times 10^9$  CFU/ml; and the third group was also challenged with ST and treated with Citrex (100 ppm) daily in the drinking water 24 hours before challenge and 7 days post challenge (PC). Seven days PC, five turkeys from the second and third groups were randomly separated from the rest and treated with Citrex for 14 days. At 1, 7 and 21 days PC, cloacal swabs for ST isolation were cultured. Seven days PC, swabs from internal organs were cultured for ST isolation and blood samples were tested for blood composition determination. Twenty one days PC, no ST was isolated from the group challenged and treated with Citrex, nor the negative control group. Seven days PC, the hematocrit, hemoglobin and white blood cells values detected in the negative control group and the group treated with Citrex were significantly higher than the values obtained in the group challenged with ST. Under the conditions of this experiment, the administration of Citrex in the drinking water avoided a permanent intestinal colonization with ST and eliminated the infection after challenge. The hematological results showed the effectiveness of Citrex in protecting against the deleterious effects caused by ST.

**Key Words:** Citrex, *S. typhimurium*, ultrabiotic, turkey, intestinal colonization

**S-P152 Comparison of in vitro inhibition of growth of Salmonella Typhimurium and Escherichia coli on broiler feed media by two sources of Bacillus subtilis.** A. Murry\*<sup>1</sup> and A. Hinton<sup>2</sup>, <sup>1</sup>University of Georgia, Athens, <sup>2</sup>Agricultural Research Service, USDA, Athens, Georgia.

In this study, a *Bacillus subtilis* isolate obtained from the fecal contents of adult male broilers was compared with a *B. subtilis* isolate (#10774) obtained from the American Type Culture Collection (ATCC) to evaluate their ability to in vitro inhibit the growth of *Salmonella* Typhimurium and *Escherichia coli*. The *B. subtilis* fecal isolates were recovered from broiler fecal droppings and identified using the MIDI Sherlock Microbial Identification System. For the inhibition assay, agar media composed of 7.5 % of a broiler starter or grower diet and 1.2 % agar were inoculated with 18-24 h cultures of *S. Typhimurium* or *E. coli*. Sterile filter paper disks were dipped in cultures of the *B. subtilis* isolates that were grown in Tryptic Soy Broth (TSB) for 24 hours at 30°C. The disks dipped in TSB without the *B. subtilis* isolates were used as con-