

were: Chorettime, Lubing, Plasson, Val, and Ziggety. Higher average maximum temperatures for the SU (32 C) versus the SP (28 C) trial, made the trials significantly different (SD) and therefore were analyzed separately. While no SD were found in BW (kg) during the SP trial, drinker D significantly reduced 42d BW (2.32) in comparison to the A (2.44), B (2.42), C (2.41), and E (2.44) systems. No SD in overall FC or percent mortality were found between treatments for either the SP or SU trial. During the SP and SU trials, no SD in twenty-four hour FI was found between drinker systems for weeks 1, 3 and 4. During week 2 for the SP trial, nipple system B and D had less FI than nipple system A. During week 5 for the SU trial, nipple system D had less FI than A, B, and E. Twenty-hour WU was less for birds on system D for weeks 2, 3, and 4 in both SP and SU trials, and also in week 5 for the SU trial, than for birds on system A, B, C, and E. Broiler growth and performance was not related to measured flow rate of the drinkers for SP and SU trials.

**Key Words:** nipple drinker, flow rate, broiler, growth, water use

**S-M82 Effect of antioxidants (Vitamin C, Vitamin E, and Selenium) and feeding programs during the production period on broiler breeder fertility and hatchability.** J. Brake\*, H. Romero-Sanchez, P. Plumstead, N. Leksrisompong, and M. Wineland, *North Carolina State University, Raleigh.*

Two experiments were conducted to evaluate an antioxidant additive package and two sources of selenium on broiler breeder fertility and hatchability. From 0 to 21 wk all broiler breeders received the same starter and growing diets in a blackout rearing facility. Birds were photostimulated at 21 wk of age when they were moved into the production facility. At 21 wk birds were placed in 12 pens which were randomly assigned to either a High or Normal antioxidant content diet, in Experiment 1. In Experiment 2, a 2x2 factorial design evaluated the interaction between males with the largest comb (LC) and smallest comb (SC) height with either organic selenium (selenomethionine (SeMe)) or inorganic selenium (sodium selenite (NaSe)), in a 16 pens facility. All males were weighed individually at 4, 8, 12, 16, 20, 24, 26, 28, 32, 40, 48, 56, and 64 wk of age. Percentage fertility and embryo mortality were evaluated on either a weekly or biweekly basis.

In Experiment 1, the High antioxidant level significantly increased fertility on an overall basis. After 38 wk of age, there was a dramatic decrease in fertility that was less pronounced for the High antioxidant group. However, after the male feed allocation was increased at 54 wk of age

the differences due to antioxidant level tended to disappear. In Experiment 2, the LC group showed a consistently higher BW. The LC males receiving NaSe exhibited a significantly lower fertility during early production that was related to a significantly heavier BW, suggesting that early maturing males (LC) were slightly underfed after photostimulation and that SeMe had a nutrient sparing effect that allowed them to maintain high fertility even when they did not gain BW in a consistent manner. However, during the late production period NaSe elicited better fertility and hatchability.

**Key Words:** antioxidant, selenium, broiler breeder, feed program, energy requirement

**S-M83 The behavior of laying hens on an alfalfa crumble molt diet.** C. Dunkley\*<sup>1</sup>, J. McReynolds<sup>3</sup>, K. Dunkley<sup>1</sup>, W. Kim<sup>1</sup>, T. Friend<sup>2</sup>, L. Kubena<sup>3</sup>, D. Nisbet<sup>3</sup>, and S. Ricke<sup>1</sup>, <sup>1</sup>Texas A&M University, College Station, <sup>2</sup>Texas A&M University, College Station, <sup>3</sup>USDA, ARS, Food and Feed Safety Research Unit, College Station, Texas.

The induction of molt by way of feed deprivation has been continually frowned upon by animal welfare advocates on grounds that it is cruel and inhumane. With this in mind we conducted a study to evaluate the behavior of laying hens on an alfalfa molt diet (ALC) during a 9 day molt and compared them to the behavior of full-fed (FF) and feed withdrawal (FW) hens. We allowed the hens to acclimate in the houses in two-tier battery cages for two weeks after which they were administered the diet or removed the feed in the case of the FW hens. The hens were kept in three individual rooms so that their behavior would not be influenced by the other treatments. The rooms were fitted with cameras which were connected to a Digital Multiplexer Recorder. The hens were evaluated for a number of behaviors including; non-nutritive pecking, feeder, drink, walk, preening, head-movement, aggression, standing and sitting. From day 7 through 9, the ALC hens spent significantly ( $P \leq 0.05$ ) less time performing non-nutritive activity than the FW hens, the time spent was not different significantly from the FF hens. The ALC hens spent 50.59% of their time in nonnutritive activity while the FW hens spent 73.22% of their time involved in the activity. No aggression was observed in the ALC and FF treatments. The ALC hens spent an equivalent amount of time preening as the FW hens (16.71 and 16.4% respectively on day 7). The FW hens began shedding feathers on day 8 of the molt while the ALC hens initiated shedding on day 10.

**Key Words:** molting, welfare, behavior, laying hens

## Monday, January 23 Processing & Products II Room: B315

**S-M84 Psychrotrophic bacteria and yeasts on broiler carcasses washed with electrolyzed oxidizing water or chlorinated water using an inside-outside bird washer.** A. Hinton Jr\*, J. Northcutt, D. Smith, M. Musgrove, and K. Ingram, *Russell Research Center, Athens, Georgia.*

Research was conducted to determine the effect of acidic, electrolyzed oxidizing (EO) water and chlorinated water on the populations of psychrotrophic bacteria and yeasts on processed broiler carcasses. Carcasses were sprayed for 5 sec at 80 psi with tap water, chlorinated

water, or EO water in an inside-outside bird washer (IOBW). Washed carcasses were then stored at 4°C for 0, 3, 7, or 14 d, and the microbial flora of the carcasses was sampled using the whole-carcass-rinse (WCR) procedure. Populations of psychrotrophic bacteria and yeasts in the carcass rinsates were enumerated on microbiological agar media. Results indicated that immediately after spraying the carcasses, significantly fewer psychrotrophs and yeasts were recovered from carcasses sprayed with chlorinated water or EO water than from carcasses sprayed with tap water and that significantly fewer yeasts were recovered from carcasses sprayed with EO water than from carcasses sprayed with chlo-

rinated water. Populations of psychrotrophic bacteria and yeasts increased on all carcasses during refrigerated storage, but after 14 d of storage significantly fewer psychrotrophic bacteria and yeasts were recovered from carcasses sprayed with chlorinated water than from carcasses sprayed with tap water. Moreover, significantly fewer of these microorganisms were recovered from carcasses sprayed with EO water than from carcasses sprayed chlorinated water. Psychrotrophic bacterial isolates included *Pseudomonas* spp. and enteric bacteria while yeasts isolates included *Candida* spp. and *Trichosporon beigeli*. Findings from the present study indicate that EO water can effectively be used with IOBWs to decrease the population of spoilage bacteria and yeasts on processed broiler carcasses.

**Key Words:** spoilage microflora, broiler carcasses, electrolyzed water, chlorinated water, inside-outside bird washer

**S-M85 Organic acids placed in the cloaca to reduce *Campylobacter* contamination of broiler skin during defeathering.** M.E. Berrang\*, D.P. Smith, and A. Hinton Jr., *USDA, ARS, Athens, Georgia.*

*Campylobacter* numbers on broiler carcasses can increase dramatically during defeathering due to leakage of contaminated intestinal contents in the feather picking machine. Food grade organic acids have been shown to be effective in killing pathogenic and spoilage bacteria associated with poultry processing. Placement of organic acids into the cloaca prior to defeathering was tested to determine if numbers of *Campylobacter* that escape and contaminate broiler breast skin during automated feather removal could be decreased. Twelve mL of one molar acetic acid, lactic acid or propionic acid was placed into the cloaca of broiler carcasses before scald; water was used for control carcasses. *Campylobacter* numbers on breast skin were measured by sponge sampling after scald (before defeathering) and again after defeathering. Regardless of acid, *Campylobacter* numbers on the breast skin of treated carcasses increased from an average of log 0.39 to an average of log 2.28 due to feather picking. However, this was significantly less than that observed in water treated controls which increased from log 0.53 to log 4.01 before and after defeathering, respectively. Placement of food grade organic acids in the cloaca of broiler carcasses may be useful as a means to reduce the impact of automated defeathering on the microbiological quality of carcasses during processing.

**Key Words:** broiler, *Campylobacter*, defeathering

**S-M86 Detection of *Salmonella* from naturally contaminated chicken carcass rinse samples using the automated BAX PCR system.** J.S. Bailey\*<sup>1</sup>, M.E. Berrang<sup>1</sup>, and J.M. Cox<sup>2</sup>, <sup>1</sup>*USDA-ARS-BEAR, Russell Research Center, Athens, Georgia,* <sup>2</sup>*The University of New South Wales, Sydney NSW, Australia.*

The automated BAX system, a technology based on the polymerase chain reaction (PCR) was compared to the standard USDA cultural method for detection of *Salmonella* in chicken carcass rinse samples. After overnight enrichment at 37°C of 30mL of rinse with 30mL buffered peptone water (BPW), a 50µL aliquot was taken into the BAX system, and processed according to manufacturer's instructions. BPW enrichment (0.5mL and 0.1mL respectively) was enriched selectively

overnight at 42°C in Rappaport-Vassiliadis medium and Hajna™ tetrathionate broth, then each streaked for isolation to brilliant green sulfa agar and modified lysine iron agar. Presumptive isolates were confirmed using biochemical tests and latex agglutination. Of the 360 broiler carcass rinses tested, from 16 commercial processing plants, the BAX yielded 213 positive results while conventional enrichment and plating detected the bacterium in only 193 samples. Based on comparison of paired data, the BAX yielded 181 true positive, 135 true negative, 32 false positive and 12 false negative results. The false-negative results are definitive as salmonellae were isolated by culture. The false-positive results are much harder to interpret. No salmonellae were isolated from the same enrichment used in the BAX analysis, even though that BPW enrichment was further enriched in two different selective broths, and they were plated to different agar media. This suggests that the BAX false positives are indeed false-positives. However, the sensitivity of the PCR may be sufficient to yield a positive result even though the numbers of salmonellae present may not be detected by culture, or salmonellae present in the BPW enrichment may have been lost during selective enrichment. Thus, at least some of these BAX-positive results may represent true positives, with culture yielding false-negative results. Despite the differences in results, there was 94% agreement based on paired positive data between BAX and culture, indicating BAX is suitable as a rapid method for the detection of *Salmonella* in chicken carcass rinses.

**Key Words:** *Salmonella*, BAX, carcass rinse, broiler

**S-M87 Microarray gene expression of breast muscle from chickens fed low crude protein diets.** C. Ashwell\*<sup>1</sup>, E. Oviedo-Rondón<sup>1</sup>, S. Clemente-Hernández<sup>2</sup>, and F. Salvador<sup>2</sup>, <sup>1</sup>*North Carolina State University, Raleigh,* <sup>2</sup>*Universidad Autónoma de Chihuahua, Chihuahua, México.*

Crude protein (CP) levels have been shown to affect live performance and Pectoralis major development in multiphase dietary regimes. Specific genes including insulin-like growth factor I (IGF-I) and myostatin have been associated with muscle development. Low CP diets (LCPd) can support average performance when supplemented with synthetic amino acids (AA). This project focused on evaluating the expression of genes, previously associated with muscle development, in broilers fed diets formulated with varying CP levels, but including all essential AA at constant or under minimum recommended levels for ileal digestible ideal protein, by supplementation of synthetic lysine, methionine, threonine, tyrosine, arginine, isoleucine, valine, and glycine. Cobb-500 chickens were placed under simulated commercial conditions, and fed diets that had either standard commercial CP level (StCP) or reductions of up to 3 percentage points in each dietary phase. Combinations of StCP or LCPd were offered in each one of the 4 dietary phases, for a final factorial set of 16 feeding treatments at 42 d. Tissue samples were collected and frozen at 36 d of age for further analysis. Breast muscle samples from the fixed-StCP and fixed-LCPd treatment groups were subjected to microarray analysis in order to identify differences in gene expression. This analysis indicated significant effects on the expression of genes in several classes including, energy metabolism, differentiation, growth, and apoptosis. These differences in gene expression in the fixed-LCPd treatment group in relation to the fixed-StCP group, may, in part, explain the variation in performance associated with dietary CP levels.

**Key Words:** gene expression, microarrays, low protein diets, broilers

**S-M88 Impact of zinc and copper propionate supplementation on broiler growth performance and white meat yield.** V. Sewalt\*<sup>1</sup>, F. Valdez<sup>1</sup>, and K. Christensen<sup>2</sup>, <sup>1</sup>*Kemin Industries, Inc., Des Moines, Iowa*, <sup>2</sup>*OK Farms, Fort Chaffee, Arkansas*.

A broiler research trial was conducted at a commercial research facility. Four houses were filled with 15,600 day-old broiler chicks each, each house receiving one of the following treatments: 1) Control corn/soy diet, 2) Control + 40 ppm Zn from a zinc amino acid complex (Availa® zinc, ZinPro), 3) Control + 40 ppm Zn from zinc propionate (KemTRACE™ Zn, Kemin Industries) and 4) Control + 40 ppm zinc propionate + 10 ppm Cu from copper propionate (KemTRACE™ Cu, Kemin Industries). Animals were sampled weekly in four random groups of 100 birds of which individual weights were recorded. In parallel, the whole-house experiment was mirrored simultaneously with a pen experiment, in which each of the four treatments were assigned to 8 temporary pens, with 2 pens/treatment allotted to each house in a randomized complete block design (n=8). In both experiments, zinc propionate improved weight gain over the control (P<.01) throughout the feeding trial, without affecting FCR. The improved weight gain with zinc propionate resulted in higher final live weight at the processing plant and improved carcass characteristics including a 0.5% increase in white (breast + tenders) meat yield over the control. No improvements over the control could be observed with supplemented zinc amino acid complex. Contrasting the two Zn sources resulted in better growth and yield advantage for zinc propionate over zinc amino acid complex (P<.01), which is likely due to a difference in bioavailability. Performance of birds appeared to benefit most from zinc propionate supplementation in early production phases (through 17 days, P<.01), but that advantage was maintained through finishing. Cu added to Zn appeared to benefit growth in late grower and finisher phases.

**Key Words:** organic zinc, zinc propionate, broiler performance, growth, yield

**S-M89 The effect of a combination of xylanase, amylase, protease and phytase on the performance of broiler chickens.** A. Cowieson\*<sup>1</sup>, O. Adeola<sup>2</sup>, and D. Singh<sup>3</sup>, <sup>1</sup>*Danisco Animal Nutrition, Wiltshire, United Kingdom*, <sup>2</sup>*Purdue University, West Lafayette, Indiana*, <sup>3</sup>*Poultry Research and Development Centre, Queensland, Australia*.

A total of 2,208 broiler chicks were used in two growth experiments (8 treatments and 12 replicate pens in each experiment) to assess the effects of xylanase, amylase, protease and phytase in corn-based diets. A positive control diet was formulated containing adequate nutrient concentrations. In addition, a negative control diet was formulated to contain approximately 150 kcal/kg, 0.13%, 0.12% and 1 to 2% less ME, P, Ca and amino acids respectively than the positive control and two further negative control diets that contained 40 or 80 kcal/kg more ME respectively than negative control 1. A further four dietary treatments were made by supplementing each of the four negative control diets with a combination of xylanase, amylase, protease and phytase, resulting in eight dietary treatments in a four by two factorial arrangement. The scale of the removal of energy, P, Ca and amino acids from the positive control diet was determined using least square models based on in vivo data for both the xylanase/amylase/protease cocktail and for phytase and it was predicted that performance of birds fed on negative

control 1 would be returned to that of those fed the positive control. In both experiments there was a significantly poorer performance between birds fed negative control 1 and those fed on the positive control. The poorer weight gain and feed conversion ratio could be attributed in part to a reduced (P<0.05) intake of digestible energy, P, N and amino acids associated with birds fed the negative control diet. Supplementation of the negative control diets with the enzyme combination returned performance to that of the positive control in both experiments. These data indicate that exogenous xylanase, amylase, protease and phytase can be used successfully in a strategically-formulated low nutrient density diet to maintain performance to that of birds fed on a nutritionally adequate diet.

**S-M90 Evaluation of the effect of a new probiotic product on broiler performance and cecal microflora composition and metabolic activities.** K. Mountzouris\*, H. Beneas, P. Tsirtsikos, E. Kalamara, and K. Fegeros, *Agricultural University of Athens, Athens, Greece*.

The increasing resistance of microbes to antibiotics, worldwide, has resulted to a high demand for alternative products to antibiotics used in animal nutrition as growth promoters.

The aim of this work was to investigate the efficacy of a new multi-strain probiotic product (Biomim®PoultryStar, Biomim GmbH) in broiler nutrition. The product comprised two *Lactobacillus* strains, one *Bifidobacterium* strain, one *Enterococcus* and one *Pediococcus* strain. Four hundred, one day old, male Cobb broilers were allocated in 4 experimental treatments for 6 weeks. The experimental treatments were: C (corn-soybean basal diet), PFW (basal diet contained 1g/kg probiotic + probiotic administered in water for the first 4 weeks), PF (basal diet contained 1g/kg probiotic) and A (basal diet contained 2.5 mg avilamycin/kg). Each treatment had five replicates of 20 broilers.

Overall, body weight treatment A (2314 g) was significantly higher (P=0.05) than treatments C (2216 g) and PF (2198 g) but did not differ from treatment PFW (2276 g). There were no differences regarding overall feed consumption between treatments. Overall feed conversion ratio in treatment A (1.73) was significantly better (P=0.05) than treatment C (1.81). Treatments PFW (1.77) and PF (1.79) were not different from A.

The cecal microflora of probiotic treatments PFW and PF had significantly higher (P=0.05) concentrations of bacteria belonging to *Bifidobacterium spp*, *Lactobacillus spp* and Gram positive cocci respectively, compared to treatments C and A. In addition, probiotic treatments PFW and PF had numerically higher VFA concentrations and significantly higher specific activities of A-galactosidase and B-galactosidase compared to C and A.

In general, the examined probiotic product administered in feed and water (PFW) displayed a growth promoting effect similar to Avilamycin (A). In addition it modulated the composition and to an extent the activities of the cecal microflora in both treatments that was administered.

**Key Words:** probiotics, cecal microflora, broiler chicken, microbial enzymes

**S-M91 The use of a defined probiotic product (Biomini<sup>®</sup> Poultrystar) and organic acids to control salmonella enteritidis in broiler chickens.** A. Berchieri<sup>1</sup>, E. Sterzo<sup>1</sup>, J. Paiva<sup>1</sup>, C. Luckstadt<sup>3</sup>, and R. Beltran<sup>\*2</sup>, <sup>1</sup>*Faculty of Agricultural and Veterinarian Science, Jaboticabal, Brazil*, <sup>2</sup>*Biomini USA, San Antonio, Texas*, <sup>3</sup>*Biomini Deutschland GMBH, Germany*.

Background: Contaminated poultry meat and eggs from Salmonella sp. continues to be a major concern for consumers. As a result finding ways to reduce or prevent Salmonella contamination at all stages of the supply chain has been a major focus for many research organizations worldwide. Producing a low pH (acidic) environment in the gut has been known to promote an adverse effect on the growth of pathogenic bacteria in the gut. By supplementing the diet with probiotics or acids these strategies have also shown to promote growth.

Objective: To test the efficacy of a defined probiotic product, an acidifier as well as the combination to control Salmonella enteritidis (SE) in broiler chickens.

Design and Setting: 5 groups, 18 birds per group were weighed, randomly allocated and reared in cages at isolation units. The groups consisted of the following:

A: ACIDIFIER (3 kg / t of feed)  
 B: ACIDIFIER (3 kg / t of feed) + Biomini<sup>®</sup> PoultryStar (20 g/1000 birds)  
 C: Biomini<sup>®</sup> PoultryStar (20 g/1000 birds)  
 D: NEG CONTROL  
 E: POS CONTROL (0.1 ml SE culture containing 1.0 x 10<sup>6</sup> CFU /ml)

All broiler chickens were kept on dry litter and water and feed was given ad libitum. The recommended manufactured dose of the probiotic was 20g/1000 heads (via drinking water) for the first three days and the acidifier was mixed into the diet at 3 kGS per ton of feed. Seventy-two hours after oral application of tested products the chicks were challenged with SE, orally inoculated with 0.1 ml of SE per bird, which contained 1x10<sup>6</sup> CFU/ml. At days 3, 5, 7, and day 10, three birds were sacrificed from each group to measure for cecal colonization of Salmonella enteritidis.

Results: Birds that received the probiotic alone as well as the group that received the combination of the probiotic and the acidifier differed significantly then the control group.

Conclusions: Our findings suggest that by combining the use of an acidifier and Biomini<sup>®</sup> PoultryStar in the diet, the risk of Salmonella sp. infection in broilers could potentially be reduced and could help safeguard the health of consumers.

**Key Words:** *Salmonella* enteritidis, probiotic, organic acids, nutrition

## Tuesday, January 24 SCAD (Avian Diseases) II Room: B312

**S-T92 Evidence for immunodeficiency affecting outcome of avian infectious bronchitis virus infection.** H. Toro<sup>\*1</sup>, V. van Santen<sup>1</sup>, and F. Hoerr<sup>1,2</sup>, <sup>1</sup>*Auburn University, Auburn*, <sup>2</sup>*Alabama State Veterinary Diagnostic Laboratory, Auburn*.

This study was aimed at understanding the causes for the failure of adequate protection against infectious bronchitis virus (IBV) in vaccinated chickens. We investigated genetic, phenotypic, and pathogenicity characteristics of two locally obtained IBV isolates (98/4614 and 00/7149), which exhibited Ark-type restriction fragment length polymorphism. In addition we evaluated the effects of viral immunodeficiency on IBV outcome of infection. The S-1 gene sequence analysis confirmed that both IBV isolates were similar to Ark serotype strains at both the nucleotide and amino acid levels. Heterologous neutralization indices obtained from cross neutralization tests between IBV field isolates and the reference ArkDPI reference strain reached values similar to homologous reactions, demonstrating a high antigenic relatedness between them and with the ArkDPI vaccine strain. The inoculation of isolates 98/4614 or 00/7149 into SPF chickens caused mild respiratory signs. The histopathological findings in the trachea and larynx were consistent with the clinical signs, with birds showing mild hyperplasia and lymphocytic infiltration in the mucosa. Assessment of the influence of immunodeficiency was performed using chicken anemia virus (CAV) and infectious bursal disease virus (IBDV) in SPF chicks. One group was infected with CAV and IBDV at day 7 of age and subsequently inoculated with IBV isolate 98/4614 at day 15 of age. Another group was inoculated at day

15 with IBV 98/4614 only. Tracheal and nasal swabs lasted longer in the immunodeficient group. Samples of trachea showed higher IBV genome concentrations in the immunodeficient chickens. In lachrymal fluid IBV genomes were detected until day 28 after IBV inoculation while in immunocompetent birds IBV genomes were no longer detectable after day 14 post IBV inoculation. The local specific IgA response in lachrymal fluid was earlier and higher in immunocompetent chicks. These experimental results corroborate epidemiological evidence indicating that immunosuppression is most likely playing a role in the outcome of IBV infection in the field.

**Key Words:** infectious bronchitis, immunosuppression, chickens

**S-T93 The decay of maternal antibody to infectious bursa disease virus in cockerel chick.** F.O Ajasin<sup>\*1</sup>, A.M Raji<sup>1</sup>, and C.O Aiki-Raji<sup>2</sup>, <sup>1</sup>*Federal College of Animal Health and Production Technology, IAR&T, Moor Plantation, Ibadan, Nigeria*, <sup>2</sup>*University of Ibadan, Ibadan, Nigeria*.

Infectious bursa disease (IBD), was first reported in Nigeria in 1973, also known as Gumboro disease is a viral infection that causes lymphoid degeneration of the bursa of fabricius and subsequent suppression of the humoral immune response of immature birds causing substantial economic losses. The major method of prevention is by vaccina-