

of lysine (+1.5%), methionine (+1.9%), tyrosine (+2.1%) and arginine (+2.5%), irrespective of the additive. Also, due to this microencapsulation, we observed a greater ( $P < 0.05$ ) population of Lactobacilli, whereas hemolytic E.coli counts were reduced ( $P < 0.05$ ). These data imply that in-feed bioactive proteins/peptides addressed as antimicrobials instead of antibiotics should be preferably microencapsulated against their gastric hydrolysis and for enhancing their efficacy along the small intestine of piglets.

**Key Words:** Piglets, Microencapsulation, Antimicrobials

**1661 Effects of dietary conjugated linoleic acid (CLA) on carcass characteristics and serum leptin and lipid profile of rabbits.** C. Corino<sup>1</sup>, V. Bontempo<sup>\*2</sup>, S. Magni<sup>1</sup>, and G. Pastorelli<sup>1</sup>, <sup>1</sup>University of Milan/Italy, <sup>2</sup>University of Molise, Campobasso/Italy.

A study was conducted to determine the effect of conjugated linoleic acid (CLA) synthesized from sunflower oil on growth, carcass characteristics, serum leptin and lipid blood profile of rabbits. One hundred and eight NZW rabbits, half male and half female, averaging 1.80 kg LW, allotted within weight and sex to a randomised complete experimental design, were fed ad libitum conventional pelleted diets supplemented with different fat: 0.5 % sunflower oil (C), 0.25 % sunflower oil and 0.25 % CLA (T1), 0.5 % CLA (T2). CLA oil contained 65 % CLA isomers (Conlino, Inc., Detroit Lakes, Minnesota 56502 USA). Thirty-six rabbits, 12 of each group, half males and half females, were slaughtered at three different slaughtering weight (age): 2.5 kg (76 d), 2.8 kg (90 d), and 3.1 kg (104 d). No effect of CLA supplementation was observed on ADG, FI, FE, dressing percentage, pH and meat colour. Perirenal fat weight decreased at the medium slaughtering weight ( $P = 0.089$ ) and it increased at the higher slaughtering weight ( $P = 0.01$ ). No effect was observed on interscapular fat. CLA supplementation reduced triglycerides and total cholesterol ( $P < 0.05$ ), and increased serum leptin concentration (2.02, 2.67 and 2.35 ng/ml, respectively, SEM = 0.194,  $P = 0.06$ ). A gender effect was observed on triglycerides with higher values in males than females ( $P < 0.01$ ). A similar effect was also found on leptin, but higher values were measured on females (2.57 vs 2.13 ng/ml,  $P = 0.06$ ).

## PSA Nutrition: Feed Regimens, Digestion, and Gut Morphology

**1663 Effects of protein levels on ostrich performance and carcass traits.** I. Cormier\*, M.R. Lefrançois, and R. Bergeron, Université Laval, Quebec, Quebec, Canada.

This study was conducted to assess the impact of a linear increase in dietary protein levels on performance, carcass quality and health of ostriches. Sixty-four unsexed crossed ostriches were raised in a greenhouse and fed ad libitum complete pelleted diets from 2 to 10 mo of age. Sixteen ostriches were randomly allotted four per pen to either one of four diets containing 18 to 23% CP for the starter (2 to 4 mo), 14 to 18% for grower (4 to 7 mo), and 12 to 15% for the finisher (7 to 10 mo). Except for protein levels, these diets supplied similar amounts of energy, fiber, lysine and methionine per kg of feed within each growing period. Body weight (BW), average daily gain (ADG), feed intake, feed efficiency (FE) were measured throughout the experiment. The ostriches' performance was recorded on a monthly basis. Carcass weight (CW) and yield (CY), viscera, heart and liver weights, meat cuts yields, and meat pH and color were also measured at the end of the trial. Carcasses were cut up into 12 meat parts according to the Canadian Ostrich Association chart and weighed. Meat pH was measured in the fan and inside the leg muscles 6 h post mortem. The Minolta color index (L, a\*, b\*) was used to assess meat color for these two carcass parts. Data were analyzed according to a complete block randomized design using protein level and body weight as the main factors. Mean live BW and CW were  $95.15 \pm 0.40$  kg and  $55.83 \pm 1.35$  kg, respectively. Cumulative ADG and FE were  $310 \pm 10$  g and  $0.160 \pm 0.003$ , respectively. Mean CY was  $57.20 \pm 0.74\%$ . Average meat pH was  $6.27 \pm 0.05$  for the inside leg and  $6.43 \pm 0.06$  for the fan. Total meat cuts yield was  $40.56 \pm 0.53\%$  of the carcass. Besides the worst oyster cut yield ( $P < 0.01$ ) for the third highest protein level, there was no significant differences ( $P > 0.05$ ) between dietary treatments for the measured variables. There were no leg problems and mortality could not be associated with specific dietary treatments. Our results suggest

Our data suggest that conjugated linoleic acid reduce fatness and total serum cholesterol in rabbits. Our data are also consistent with the hypothesis that CLA has the potential to inhibit atherosclerosis.

**Key Words:** Dietary conjugated linoleic acid, Rabbit, Serum lipid profile

**1662 Physiological adaptation to prolonged food restriction: a model study in growing rats.** Ewa Furstenberg<sup>\*1</sup>, <sup>1</sup>Warsaw Agricultural University, Warsaw, Poland.

Organisms subjected to chronic food restriction attempt to mitigate the effects of deficiency by a series of physiological and behavioral responses, which are considered as adaptation to the low energy intake. Adaptation to energy restriction is expected to occur at different levels i.e. growth, rate, body size and composition, as well as energy metabolism. Whether the animals are able to economize on energy by reducing basal metabolism and whether it is an adaptive process per se resulting in decrease in metabolic rate beyond that predicted for the change in body size and/or composition or it is only secondary to changes in body weight and its components is, however, still controversial. The present study was carried out in 48 young growing female and male rats (RF group), which at different body weights (60, 75, 90, 105g) were subjected to food restriction (FR) by feeding constant stipulated rations (14.2, 15.9, 17.7, 19.4 g of standard laboratory diet, ME=1474kJ/100g, respectively) from ad libitum until maintenance level (i.e. constant body weight). Control group (C, n=24) was fed ad libitum throughout the experiment. During the experiment all rats were subjected to at least 2 measurements of resting metabolic rate (RMR). At the end, anatomical and chemical composition of animals was determined. Main results showed that the animals adapted to progressing energy deficit primarily by reducing final body weight and decreasing body fat and that female rats were more sensitive to food restriction than male rats. With respect to energy metabolism, when RF rats were compared with ad lib controls, RMR (in absolute values or relative to body weight and metabolic body weight) was significantly depressed in male rats, however, in females RMR was increased. Higher RMR in RF females than in female controls could be attributable in part to higher protein body mass. These results highlight some of the important differences between male and female rats in their mode of adaptation to restricted feeding.

**Key Words:** energy metabolism, food restriction, sex

that growing ostriches can perform equally well across a wide range of dietary protein levels without negative impacts on performance, carcass quality and health.

**Key Words:** Ostrich, Protein, Carcass

**1664 Feeding program for broiler breeder hens based on the prediction equations of metabolizable energy requirements.** N.K. Sakomura\*, E.R. Freitas, C.B.V. Rabello, A.L. Santos, and O.M. Junqueira, <sup>UNESP</sup> Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal - São Paulo - Brasil.

The purpose of this study was to evaluate feeding programs based on prediction equations of metabolizable energy requirements for broiler breeder after 55 weeks old. Seven hundred forty broiler breeder females Hubbard Hy-Yield and eighty males Peterson 55 wks of age, were distributed in a randomized design with 4 treatments and 5 replications of 37 birds. The feeding programs were: 1- Feeding according to the lineage recommendation, 2- Energy reduction 2 kcal/bird/ day for each week, 3- Feeding according to UNESP (2000) equation:  $ME = W^{0.75}(192.76 - 6.32T + 0.12T^2) + 7.62G + 2.40EM$ , 4- Feeding according to NRC (1994) equation:  $ME = W^{0.75}(173 - 1.95T) + 5.50G + 2.07EM$ , where ME=energy requirement (kcal/bird/day), W=body weight (kg), T=temperature (°C), G=weight gain (g) and EM=egg mass (g). The energy reduction program provided 417 kcal/bird/day, 181g of body weight gain (BWG) and 63.5 % of egg production from 55 to 66 wks of age. The feeding based on lineage recommendation provided 428 kcal/bird/day, 230 g BWG and 64.0 %. The equations UNESP and NRC promoted more energy intake ( 447 and 484 kcal/bird/day ) consequently higher BWG ( 286 and 645g ) and similar egg production 63,6% and 61,3%, respectively. The feeding programs did not affect the

reproductive performance. According to the results, the energy reduction program promoted a good performance being possible the reduction of 2 kcal/bird /day for each week in the broiler breeder feeding after 55 wks of age. The equations UNESP and NRC promoted higher energy intakes than the lineage recommendation probably because of the body weight of birds that were above than the recommended one for lineage, providing the highest energy requirements of maintenance. The UNESP (2000) equation promoted better adjustment than NRC (1994) in the energy feeding for broiler breeder hens.

**Key Words:** Broiler breeder, Energy prediction equation, Feeding program

**1665 The effect of different energy and protein levels on the performance of W-36 Hy-Line laying hens .** M. Shahnazari<sup>\*1</sup>, M. Shivazad<sup>1</sup>, A. Kamyab<sup>1</sup>, and A. Nikkhah<sup>1</sup>, <sup>1</sup>University of Tehran, Animal Sci. Dept.

A factorial experiment was conducted to investigate the response of laying hens to various levels of dietary energy and protein. Varying levels of dietary energy (2700, 2800, and 2900 Kcal ME/Kg) each fed at four protein levels (14, 15, 16, and 17%) to 1152 laying hens at 27-32 and 32-40 week old. Birds were randomized into 8 cages, with each of the 12 experimental treatments consisting of 4 replicates. Egg production was not significantly affected by dietary energy, protein contents, or ME by protein interaction ( $P>0.05$ ). Even though, it tended to increase with increase in energy level. Dietary protein affected egg weight ( $P<0.01$ ), although there was no significant difference between protein levels. The egg weights with proteins ranging from 14, 15 and 17% was increased from 57.1 to 58.3 and 58.5 g, respectively. There was reduced FI as energy level of the diet was increased ( $P<0.05$ ). Daily FI was 2.5 g lower when dietary energy was raised ( $P<0.05$ ). Feed efficiency and feed per dozen eggs responded significantly to increasing dietary ME ( $P<0.05$ ). Financial returns were less for hens fed on 2900 Kcal ME/Kg and tended to decrease with increase in protein level. There was also energy effect ( $P<0.01$ ) on eggshell quality. Alterations in dietary ME concentration had no influence on body weight change, however, it was affected ( $P<0.01$ ) by protein levels. Dietary treatments did not exert any significant effects on the albumen index, cracked and soft-shell eggs and mortality ( $P>0.05$ ). Maximum hen-day egg production, FE, and lowest feed cost per Kg egg weight were obtained on the ration containing 2800 Kcal ME/Kg and 15% protein.

**Key Words:** Energy, Protein, Laying hens

**1666 Effect of formulation density and feed moisture type additives on broiler performance.** J.S. Moritz<sup>\*</sup>, K.J. Wilson, K.R. Cramer, R.S. Beyer, L.J. McKinney, and W.B. Cavalcanti, *Kansas State University, Manhattan, KS.*

Past research has illustrated that moisture added to corn soybean-based diets at the mixer can improve pellet manufacturing parameters as well as improve adjusted broiler feed efficiencies. Feed efficiencies were adjusted due to moisture additions creating a dilution of nutrients in the diets. Diets with added moisture illustrated higher pellet durabilities and subsequently greater potentials for broilers to utilize feed energy for growth compared to diets without added moisture. The objective of the current study was to determine the effects of moisture additives, diets of different nutrient densities and their combination on broiler performance. Treatments consisted of diets containing different moisture type additives (water/surfactant solution vs. water) and diets of different nutrient densities (NRC density vs. adjusted -high density). Negative control diets, which consisted of the two diets of different nutrient densities without moisture additives were also fed. All diets were fed in a pelleted form. Each of the six diets were fed to ten replicate pens of 45 male Cobb-Vantress broilers during the (3-6) week grower period. Broilers fed diets of adjusted -high density that included moisture additives of either type had significantly higher live weight gains and feed efficiencies compared to broilers fed NRC diets with moisture additives. Adjusted -high density diets that included moisture produced broilers with higher live weight gains ( $P = 0.0013$ ) compared to broilers fed either NRC or adjusted -high density control diets. Mortality percentages were not significantly effected due to diet type. These findings conclude that adding moisture to diets of adjusted -high density may

improve broiler performance above broilers fed diets formulated to NRC specifications with or without added moisture.

**Key Words:** Broiler Performance, Diet Density, Moisture

**1667 Whole wheat feeding and influence of initial body weight on broiler performance.** A. Golian<sup>\*</sup>, L.D. Campbell, and W. Guenter, *University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.*

Two experiments were conducted to evaluate whole wheat feeding in broiler chicken production. Initial body weight (Exp1) and fortification of dietary additives (Exp 2) were assessed as treatment variables and the same whole wheat feeding regimen (substitution of whole wheat in the control diet at a rate of 5, 15 and 30% for the periods 10-20, 20-30 and 30-40 days-of-age, respectively) was used in both experiments. The first experiment was a 2\*3 factorial design in which 5 replicate groups of 65 birds were fed a control diet or a whole wheat substituted diet and each diet included groups of chicks of low weight (40-44 g / bird), high weight (46-50 g / bird) or random weight. The second experiment was a completely randomized design in which 5 replicate groups of 65 birds were fed a control diet, a whole wheat substituted diet or a fortified whole wheat substituted diet. Whole wheat feeding affected chick body weight gain adversely in Exp 1 (1660 vs. 1945 g / bird) but not in Exp 2 (2405 vs. 2453 g / bird). Breast fillet, gizzard and abdominal fat pad weights as a percentage of body weight were adversely influenced by whole wheat feeding in both experiments. In Exp 1 feed intake and body weight were related to initial chick weight but initial chick weight did not affect chick uniformity (within 10% of the mean body weight) at 20 or 40 days-of-age. There was no interaction between diet type and chick weight groups. Overall feed intake was greater for birds in Exp 2 as compared to Exp 1 (101 vs. 88 g / bird) indicating that the beneficial effects of whole wheat feeding may be influenced by voluntary feed intake.

**Key Words:** Whole wheat, Initial body weight, broiler chicken

**1668 The performance of broiler chickens during and following of different feed restriction methods at an early age.** M. Houshmand<sup>1</sup>, A. Kamyab<sup>2</sup>, K. Yousefi<sup>3</sup>, and A. Taghipour Farshi<sup>\*4</sup>, <sup>1</sup>University of Yasouj, <sup>2</sup>University of Tehran, <sup>3</sup>Mobarak Andish Co., <sup>4</sup>Tehran Shaltouk Research Center.

**Abstract.** A total of 720 Ross chicks were grown in each of 24 separate floor pens until six weeks of age. In a completely randomized design experiment, the effects of energy and protein dilution, utilizing rice hull at 0, 10, 15, 20, 25, and 30%, during 6 to 12 days of age on broiler performance were examined. Metabolizable energy and crude protein content of the experimental diets were as follows: 3089, 2780, 2626, 2472, 2317, 2163 Kcal/Kg; and 21.45, 19.29, 18.23, 17.16, 15.02, and 16.1 percent, respectively. From 13 to 21 day of age a conventional starter and thereafter a finisher diet was used. During the period of study the chicks had free access to mash feed and water. The chicks were pens weighed periodically and feed intake were measured at the end of each phase feeding period on a pen basis as well. Between day 6 to 12, diet dilution increased feed consumption, reduced body weight gain, energy and protein intake ( $P<0.05$ ). Due to compensatory growth no significant differences ( $P>0.05$ ) among treatments in body weight were seen. Feed intake following feed restriction period was less for the birds received diluted diet as compared to control ( $P>0.05$ ). Meanwhile, FE was somewhat improved among the birds that were fed with diluted diets. Nevertheless, this difference was not statistically significant ( $P>0.05$ ). Diet dilution, had no significant effect ( $P>0.05$ ) on carcass composition, liver, and abdominal fat percentage at the slaughter age. In this experiment 20 and 25% dilution diets resulted in a slight increase in body weight gain and improved production efficiency.

**Key Words:** Diet Dilution, Broiler, Compensatory Growth

**1669 The effects of early skip-a-day feeding regimen on the performance of Ross male broiler chicken.** K. Yousefi<sup>1</sup>, A. Kamyab<sup>2</sup>, M. Houshmand<sup>3</sup>, and A. Taghipour Farshi<sup>\*4</sup>, <sup>1</sup>Mobarak Andish, <sup>2</sup>University of Tehran, <sup>3</sup>University of Yasoudji, <sup>4</sup>Telavang Co..

**Abstract.** This experiment was conducted to investigate the effects of an early skip-a-day feeding program on broiler chickens. The 720 day-old, mixed sex Ross chicks were fed a mash corn diet for the first 36 hrs and

then fed with a conventional starter diet (3089 Kcal ME/Kg and 21.45% CP) until 7 day of age. At this age, 4 floor pen of 30 birds each were randomly assigned to one of 6 dietary treatments. Treatment 1, control, involved in ad lib access to feed and the remaining treatments were subjected to a skip-a-day regimen from 7 to 13 days of age. During the restriction period, the restricted groups had access to water containing 2% sucrose. Starting day 14 to 21, chicks of 6 treatment groups were fed isocaloric diet containing of 20.45, 21.45, 25.27, or 31% CP. From 22 to 42 and 43 to 46 day of age all the treatments received commercial grower and finisher mash diet with 3090 Kcal ME/Kg, 19.32% CP and 3090 Kcal ME/Kg, 17.2% CP respectively. During the restriction period, weight gain of the restricted group was severely affected ( $P < 0.05$ ). Body weight gain over the 33 day of realimentation, was faster for the 21.45% CP treatment that resulted in compensatory growth. As expected, chicks that were subjected to skip-a-day feeding consumed less feed ( $P < 0.05$ ) compared with the control group. Likewise, their overall feed intake throughout the experimental period were also less than ad lib group ( $P < 0.05$ ). The feed conversion ratio of restricted chicks was greater during skip-a-day feeding period than that of control. On the contrary, their FE were significantly better ( $P < 0.05$ ) during the re-feeding period. Overall FE for skip-a-day group was not statistically different than ad-lib. group ( $P > 0.05$ ). At the end of study, GI tract weights of restricted chicks were not different from those of control ( $P > 0.05$ ). Mortality and leg abnormality in this experiment were little so, statistical analysis was not performed on these data.

**Key Words:** Skip-a-day, Broiler, Compensatory Growth

**1670 The effect of dietary 1,4-diaminobutane (putrescine) on the performance and gastrointestinal development of broiler chicks.** F.A. Santoyo\* and T.K. Smith, *University of Guelph, Guelph, Ontario, Canada.*

The mammalian polyamines: putrescine, spermidine and spermine, are thought to be important promoters of cell division, protein synthesis and cell growth. Protein, DNA and protein:DNA ratio reflect cell size and development and can be used as an index of chick intestinal growth rate. A total of 216 six day-old broiler chicks were fed corn and soybean meal-based diets containing 0, 0.1, 0.2, 0.3, 0.4 and 0.5% supplemental dietary putrescine (6 pens of 6 birds per diet) for 21 days. Feed consumption and growth ratio were determined weekly. At the end of the experiment, 12 birds fed each diet were killed and intestinal sections, liver, spleen and pancreas were excised and weighed and intestinal concentration of soluble protein and DNA were determined. Increasing dietary putrescine resulted in a significant quadratic response in average daily gain, which peaked with the feeding of 0.1% putrescine. The feeding of 0.5% putrescine was clearly toxic. Relative organ weights were not affected by diet. There was a significant linear correlation between duodenal soluble protein concentration and dietary putrescine concentration. Intestinal DNA concentrations were not affected by diet. It was concluded that dietary putrescine supplemented may promote duodenal development in broiler chicks but causes increased growth only when 0.1% supplemented putrescine is fed.

**Key Words:** Putrescine, Gastrointestinal tract, Protein:DNA

**1671 Effects of dietary supplemental Betaglucon on performance and blood components of broiler chicks.** S. H. Kim<sup>\*1</sup>, S. J. Lee<sup>1</sup>, K. H. Jung<sup>2</sup>, D. J. Yu<sup>1</sup>, S. Y. Park<sup>3</sup>, J. C. Na<sup>1</sup>, and K. S. Ryu<sup>3</sup>, <sup>1</sup>National Livestock Research Institute of Rural Development Administration, Daejeon, <sup>2</sup>Dawmajin biotech, Daejeon, <sup>3</sup>Dept. of Animal Resources and Biotech., Chonbuk National University, Chonju, Republic of Korea.

An experiment was conducted to investigate the dietary supplemental betaglucon on performance and intestinal microflora of broiler chicks. Three hundred sixty one day old broiler chicks were randomly replaced into floor pen with four treatments. Four levels of betaglu<sup>R</sup> (0, 0.05, 0.1, 0.2%) were added to basal diets. Weight gain, feed intake and feed conversion (FC) were measured for five weeks. Intestinal microflora was examined at third and fifth weeks old. Blood was collected from wing vein at three and five weeks old. Weight gain was no different for the first three weeks, but was significantly increased in 0.1 and 0.2% treatments for the rest two weeks compared to that of control ( $P < 0.05$ ). Feed intake was no different of all treatments. FC of chicks fed 0.1 and 0.2% betaglu<sup>R</sup> tended to improve but was not significantly different. No difference were found in *lactobacillus* spp., yeast, *salmonella* spp., *E. coli*

at three and five weeks old. Blood glucose, total protein, AST, ALT, cholesterol, urease, creatinin, Ca, Mg and P showed no difference of all treatments. Triglyceride, GPT, BUN, bilirubin and LDH were prone to increase in 0.1 and 0.2% betaglu<sup>R</sup> treatments.

**Key Words:** Betaglucon, Broiler chicks, Blood components

**1672 Influence of feeding *lactobacillus*, live yeast and its combination on the performance and intestinal microflora of laying hens.** S. H. Kim<sup>\*1</sup>, S. J. Lee<sup>1</sup>, D. J. Yu<sup>1</sup>, S. Y. Park<sup>2</sup>, J. C. Na<sup>1</sup>, C. H. Choi<sup>1</sup>, and K. S. Ryu<sup>2</sup>, <sup>1</sup>National Livestock Research Institute of Rural Development Administration, Daejeon, <sup>2</sup>Dept. of Animal Resources and Biotech., Chonbuk National University, Chonju, Republic of Korea.

A feeding trial was conducted to evaluate the influence of feeding *lactobacillus*, live yeast (Y) and its mixture (L+Y) on the performance and intestinal microflora of laying hens. Two hundred forty Isa brown hens were randomly allocated to six treatments. Control (no supplement), *Pichia farinosa* (Y), *lactobacillus crispatus* avihen1 (LC), *lactobacillus vaginalis* avihen2 (LV) isolated from hen's cecum, LC + Y, LV + Y were supplemented at 0.3% from 21 to 30 weeks of age (WOA). Viable microflora were added to meet  $10^6$  cfu *lactobacillus*/g Y and  $10^7$  cfu *lactobacillus*/g of feed. Egg production, egg weight, feed intake, feed conversion (FC) and egg qualities were periodically measured. Intestinal microflora and Fecal NH<sub>3</sub> emission were examined at the end of experiment. Egg production and daily egg mass of birds fed either of the microorganisms alone or in combination were significantly higher than control ( $P < 0.05$ ). Egg production and daily egg mass was especially in birds fed the Y diet. Egg weight and feed intake were not significantly different between treatments. FC improved in Y, LC, Y + LC treatments significantly compared to that of other treatments ( $P < 0.05$ ). Eggshell quality of all treatments was similar except Y treatment. Total *lactobacillus* spp. and anaerobes of ileum seemed to increase greater in LV, LV + Y, LC + Y than others. Total number of ileal and cecal yeast, anaerobes and *lactobacillus* spp. were constant from one to five WOA. Fecal NH<sub>3</sub> emission was significantly lower in LV, LV + Y and LC + Y than other treatments ( $P < 0.05$ ).

**Key Words:** Laying hens, *Lactobacillus*, Yeast

**1673 Influence of feeding various *lactobacillus* on performance and intestinal microflora of laying hens.** S. J. Lee<sup>1</sup>, S. H. Kim<sup>\*1</sup>, S. Y. Park<sup>2</sup>, D. J. Yu<sup>1</sup>, B. S. Kang<sup>1</sup>, J. C. Na<sup>1</sup>, C. H. Choi<sup>1</sup>, and K. S. Ryu<sup>2</sup>, <sup>1</sup>National Livestock Research Institute, Rural Development Administration, Daejeon, <sup>2</sup>Dept. of Animal Resources and Biotechnology, Chonbuk National University, Chonju, Republic of Korea.

The objective of this experiment was to investigate the influence of feeding various *lactobacillus* on performance, intestinal microflora and fecal NH<sub>3</sub> gas emission of laying hens. Three hundred sixty Isa Brown hens were raised with nine treatments of four replicates from twenty one to thirty two weeks of age (WOA). Treatments consisted of control, *Lactobacillus crispatus* avibro1, *Lactobacillus reuteri* avibro2, *Lactobacillus crispatus* avihen1, *Lactobacillus vaginalis* avihen2 at the levels of  $10^4$  and  $10^7$  cfu/g diets. Egg production, feed intake, egg weight and feed conversion (FC) were measured every four weeks. Egg qualities, intestinal microflora and fecal NH<sub>3</sub> gas emission were examined at the end of experiment. All *Lactobacillus* supplementation increased egg production and daily egg mass significantly compared to those of control ( $P < 0.05$ ), but were not statistically different between supplemental groups. Egg weight and feed intake also were not different between treatments. FC of birds fed *Lactobacillus* was significantly improved relative that of control ( $P < 0.05$ ). Eggshell breaking strength, thickness, density and Haugh unit were not significantly different. Total number of *Lactobacillus* spp. in the *Lactobacillus* supplemented group was significantly higher than control ( $P < 0.05$ ) in the ileum, but was not significantly different in the cecum. Total yeast and anaerobe numbers of both the ileum and cecum were not significantly different. Fecal NH<sub>3</sub> gas emission was significantly decreased in *Lactobacillus* supplemented groups ( $P < 0.05$ ) and showed no significant difference between  $10^7$  and  $10^4$  cfu/g diets.

**Key Words:** Laying hens, *Lactobacillus*, Performance

**1674 Influence of dietary supplemental live yeast on performance of laying hens.** S. J. Lee<sup>\*1</sup>, S. H. Kim<sup>1</sup>, S. Y. Park<sup>2</sup>, D. J. Yu<sup>1</sup>, J. C. Na<sup>1</sup>, C. H. Choi<sup>1</sup>, and K. S. Ryu<sup>2</sup>, <sup>1</sup>National Livestock Research Institute, Rural Development Administration, Daejeon, <sup>2</sup>Dept. of Animal Resources and Biotech., Chonbuk National University, Chonju, Republic of Korea.

A feeding trial was conducted to evaluate the influence of live yeast supplementation on performance and intestinal microflora of laying hens. One hundred sixty Isa brown hens were individually placed into wire cage with four replicates from twenty one to 30 weeks of age (WOA). Yeast was supplemented at 0, 0.1, 0.3, 0.5% corn-soy based diets containing 2800 kcal/kg ME and 16% CP. Egg production, egg weight, feed intake and feed conversion (FC) were measured. Egg qualities were examined at fifth and ninth weeks. Intestinal microflora, nutrient digestibility and fecal NH<sub>3</sub> were observed at the end of experiment. Egg production of birds fed 0.1 and 0.3% yeast was significantly higher than control and 0.5% yeast supplements (P<0.05). Daily egg mass of 0.3% supplemental groups was significantly increased compared to that of control (P<0.05). The average egg weight was not different. FC was significantly improved as dietary supplemental yeast increased (P<0.05). There were no significant differences in eggshell breaking strength, thickness, density and Haugh units at both 26 and 30 WOA. Viable *Lactobacillus* spp. in the ileum were significantly increased in supplemental yeast groups (P<0.05). However, total number of yeast and anaerobes were similar between the yeast supplemented and control groups. Total *Lactobacillus* spp. and yeast showed no difference in cecum of all treatments. Fecal NH<sub>3</sub> gas emission of birds fed yeast supplementation tended to decrease compared to that of control.

**Key Words:** Laying hens, Yeast, Performance

**1675 Influence of dietary supplemental various *Lactobacillus* on performance and fecal noxious gas of broiler chicks.** S. H. Kim<sup>\*</sup>, S. J. Lee, D. J. Yu, J. C. Na, S. Y. Park<sup>1</sup>, C. H. Choi, and K. S. Ryu<sup>1</sup>, National Livestock Research Institute, Rural Development Administration, Daejeon, <sup>1</sup>Dept. of Animal Resources and Biotech. Chonbuk National University Republic of Korea.

The objective of this study was to investigate the influence of feeding various *Lactobacillus* isolated from broiler and laying hens on fecal noxious gas and performance of broiler chicks. One thousand eighty one day old male broiler chicks were fed control, *Lactobacillus crispatus* avibro1(LCB), *Lactobacillus reuteri* avibro2(LRB), *Lactobacillus crispatus* avihen1(LCH) or *Lactobacillus vaginalis* avihen2(LVH) at the level of 10<sup>4</sup> and 10<sup>7</sup> cfu/g diet for five weeks. There were four replicates with thirty chicks per pen. Diets contained 3,100 kcal ME/kg diet and 22.0 20.0% CP for starting and finishing periods, respectively. Weight gain, feed intake, feed conversion (FC), and intestinal microflora were measured weekly. Nutrient digestibility and fecal noxious gas were examined at the end of experiment. Weight gain of chicks fed *Lactobacillus* tended to increase and were significantly higher than control at five weeks of age (P<0.05). Feed intake and FC were not statistically different between *Lactobacillus* treatments and control. Total *Lactobacillus* spp. of birds fed various *Lactobacillus* was significantly increased in the ileum at five weeks of age (P<0.05), but was not different in the cecum. The number of total yeast began to increase significantly in cecum and ileum from three weeks (P<0.05), whereas total number of anaerobes tended to increase at both intestine from one weeks of age. Litter moisture of chicks fed *Lactobacillus* was ranged from 27 to 30%, but was 38.3% in control. It decreased approximate 25% significantly in *Lactobacillus* treatments compared to that of control (P<0.05). Fecal NH<sub>3</sub> gas emission was significantly decrease in *Lactobacillus* treatments (P<0.05). Dry Matter(DM), protein and Ca digestibility tended to be higher in *Lactobacillus* treatments than control. Ca and P digestibility of chicks fed LCH showed significantly higher than control (P<0.05). Crude ash and fat digestibility tended to improve in *Lactobacillus* treatments. In conclusion, feeding various *Lactobacillus* improved the performance and reduced fecal noxious gas. The results of this experiment indicated that optimum *Lactobacillus* was thought to be more than 10<sup>4</sup> cfu/g diet.

**Key Words:** Broiler Chicks, *Lactobacillus*, Performance

**1676 A comparison of feeding *Lactobacillus* and Virginiamycin influence on performance and intestinal microflora of broiler chicks.** S. H. Kim<sup>\*</sup>, S. J. Lee, S. Y. Park<sup>1</sup>, D. J. Yu, B. S. Kang, C. H. Choi, and K. S. Ryu<sup>1</sup>, National Livestock Research Institute, Rural Development Administration, Daejeon, <sup>1</sup>Dept. of Animal Resources and Biotechnology. Chonbuk National University, Chonju, Republic of Korea.

This experiment was conducted to investigate the effect of feeding two types of *Lactobacilli* and Virginiamycin on performance, nutrients digestibility and intestinal microflora of broiler chicks. Seven hundred twenty one day old male broiler chicks (Abor Acres X Abor Acres) were randomly allocated into six treatments with four replications for five weeks. Control (no supplement), 0.5% Virginiamycin (VM), *Lactobacillus crispatus* (LC), *Lactobacillus reuteri* (LR), LC + 0.5% VM and LR + 0.5% VM were supplemented into basal diets, which contained ME 3,100 kcal/kg and CP 22.0, 20.0% for starting and finishing period, respectively. Weight gain, feed intake and feed conversion (FC) were weekly measured. Nutrients digestibility, intestinal microflora and fecal noxious gas were examined at the end of experiment. Weight gain of chicks fed *Lactobacillus* or VM was significantly higher than control (P<0.05). Feed intake increased significantly in those supplemental groups (P<0.05). FC of chicks fed *Lactobacillus* or VM was significantly lower than control (P<0.05). Digestibilities of crude protein, calcium, and phosphorus improved significantly in alone or combined *Lactobacillus* treatments (P<0.05). Whereas DM, crude fat and ash digestibility were not statistically different. Feeding *Lactobacilli* tended to increase the total *Lactobacillus* spp. in ileum at one and three weeks of age (WOA) and showed significantly higher in cecum than control at 5 WOA. Total yeast were not shown difference at 1 and 3 WOA, but significantly increased at five WOA (P<0.05). The ileal and cecal anaerobes were started to increase from the first WOA. Fecal NH<sub>3</sub> gas tended to decrease in *Lactobacillus* treatments compared to that of other treatments.

**Key Words:** Broiler Chicks, *Lactobacillus*, Virginiamycin

**1677 Survivability of "pelletable" strain of lactic acid producing bacteria in the new direct-fed microbial, Avi-Lution<sup>TM</sup>, in broiler diets and resulting changes in intestinal and cecal microflora associated with enhanced performance.** D. M. Hooge<sup>\*1</sup>, J. R. Corley<sup>2</sup>, D. Spangler<sup>3</sup>, P. Brown<sup>3</sup>, M. D. Sims<sup>4</sup>, and G. F. Mathis<sup>5</sup>, <sup>1</sup>Hooge Consulting Service, Inc., Eagle Mountain, UT, <sup>2</sup>Prince Agri Products, Inc., Quincy, IL, <sup>3</sup>Agri-King, Inc., Fulton, IL, <sup>4</sup>Virginia Scientific Research, Inc., Harrisonburg, VA, <sup>5</sup>Southern Poultry Research, Inc., Athens, GA.

Four broiler chicken pen trials (see also Sims *et al.*, Poultry Sci. 79(Supplement 1):126 and Hooge *et al.*, 2001, abstract 38, IPSF, Atlanta) were conducted in which post-pelleting survivability of the steam heat-stable strain of lactic acid producing bacteria in Avi-Lution<sup>TM</sup> (AVN) was determined. Commercial broiler strains used were straight-run Ross x Ross 308 (trials 1-3), Ross x Cobb (trial 3 also), and Ross x Arbor Acres (trial 4). The built-up litter pen trials varied in length from a minimum of 42 days to a maximum of 56 days during several different seasons of the year. Stocking density in three broiler tests was 0.062 m<sup>2</sup>/bird (Virginia) and in the fourth study 0.086 m<sup>2</sup>/bird (Georgia). In experiments 1, 2, and 4, a basal-control (non-medicated basal diets), an antibiotic-control (bacitracin-md in one test, and virginiamycin in two others), and AVN treatments (0.025, 0.05, 0.075%, or combination step-down program) were examined. In trial 3 with two strains of broilers, only an antibiotic-control treatment (bacitracin-md, then oxytetracycline) was investigated vs AVN using the 0.075, 0.025, 0.025% three phase, step-down program. Improvements (P<0.05) in weight and feed conversion ratio were demonstrated with AVN vs basal-controls and in some instances vs antibiotic-control diets as well. By microbial analysis of lumen contents of market-age broiler intestines (4 trials) and ceca (1 trial), it was found that AVN treatments in one or more cases significantly (P<0.05) lowered coliforms, *Campylobacter*, *Clostridia*, and *Salmonella*, and raised lactic acid bacteria (log cfu/g dry matter) vs basal-control or antibiotic-control diets. The direct-fed microbial was added at the mixer, and all feeds were steam pelleted (starter crumbled). The AVN 0.05% level provided 330 million microbes/kg complete feed. Based on 28 different samples of feed from the trials, survivability of AVN microbes through pelleting was 95.94% (range, 74.67 to 136.97%) by averaging study sample percentages, or 94.68% by dividing overall average recovered microbes by average theoretical number added (x 100

for %). The AVN survived pelleting and beneficially influenced intestinal and cecal microflora populations, accompanied by improvements in broiler growth and feed conversion similar or higher in magnitude to those achieved with antibiotics.

**Key Words:** Avi-Lution, Direct-fed microbial, Intestinal microflora

**1678 Effect of *Aspergillus* sp and bacterial phytase containing broiler diets on *Salmonella enteritidis* organ invasion in the broiler chick.** G Nava<sup>\*1</sup>, N Ledesma<sup>1</sup>, A Priego<sup>2</sup>, C Priego<sup>2</sup>, L Sutton<sup>3</sup>, and G Tellez<sup>1</sup>, <sup>1</sup>*Departamento de Producción Animal: Aves, Facultad de Medicina Veterinaria y Zootecnia, UNAM-Mxico*, <sup>2</sup>*Productos Químicos-Agropecuarios S.A. de C.V. Mexico*, <sup>3</sup>*PetAg Inc, Hampshire, IL 60140 USA*.

In the mature broiler the intestinal microflora (IM) is active in reducing the potential for many intestinal diseases. In the neonatal broiler chick, the IM is not sufficiently developed to offer sufficient protection from potential pathogenic invasion. Both enzyme (bacterial phytase) and prebiotic (*Aspergillus* sp) have been used to improve the IM of the broiler and enhance performance. A trial was conducted to determine the effects of adding 0.2% prebiotic, 0.04% enzyme and the combination on *Salmonella enteritidis* (SE) organ invasion in the broiler chick. This experiment employed a completely randomized design. All of the sorghum plus soybean (S/S) diets were isocaloric and isonitrogenous and consisted of four diets with two replicates of 30 birds each (n = 240). The four experimental diets were: 1). Control S/S diet; 2). Control plus prebiotic; 3). Control plus enzyme; and 4). Control plus prebiotic and enzyme. On day 9 and 19, ten broiler chicks from each diet were challenged with 10<sup>8</sup> CFU of SE. 24 hours post challenge liver and spleen tissues were collected aseptically and incubated for 24 hours at 37 C in tetrathionate enrichment broth. After incubation, the broth was streaked onto brilliant green agar plates, incubated for an additional 24 hours at 37 C, and examined for the presence of lactose-negative, SE colonies. The percentage of cecal tonsils invasion for SE at days 10 and 20 were virtually 100% confirming uniform inoculation with SE. The effects of the dietary additions (prebiotic and enzyme) significantly reduced subsequent liver and spleen SE invasion at days 10 and 20. The SE invasion of liver and spleen tissues in the 10 day-old chick was: 100, 55\*\*, 60\*\* and 80\* percent for diet one through four, respectively (\*P<0.05, \*\*P<0.01). The SE invasion of liver and spleen tissues in the 10 day-old chick was: 80, 40\*\*, 45\*\* and 65\* percent for diet one through four, respectively (\*P<0.05, \*\*P<0.01). The dietary addition of both the prebiotic and the enzyme demonstrated similar effects to "probiotics" in the improvement of the IM maturity to resist SE organ invasion in broiler chicks.

**Key Words:** Aspergillus meal, Phytase, Salmonella enteritidis

**1679 Energy and lysine for broilers from 44 to 55 days of age.** O. M. Junqueira<sup>\*1</sup>, L. F. Araujo<sup>1</sup>, C. S. S. Araujo<sup>1</sup>, D. E. Faria<sup>2</sup>, and N. K. Sakomura<sup>1</sup>, <sup>1</sup>*Universidade Estadual Paulista - UNESP/Jaboticabal - SP - Brazil*, <sup>2</sup>*Faculdade de Zootecnia e Engenharia de Alimentos - USP/ Pirassununga - SP - Brazil*.

One experiment was conducted to evaluate the performance and carcass yield of broilers at 55 days of age fed diets with different levels of metabolizable energy and lysine. Data from performance were weight gain, feed intake, energy intake, lysine intake, caloric conversion and feed conversion. For carcass, it was used data from output carcass, breast weight, wings (wing and over wing), legs (thigh and drumstick), back, head + neck, foot and abdominal fat. The experimental design was a factorial 3x3, involving 3 levels of metabolizable energy (3,200; 3,400 and 3,600 kcal ME/kg and 3 lysine levels (0.95%; 1.05% and 1.15%). No interaction was found between the two factors. Nevertheless, increasing the levels of metabolizable energy resulted in improvement of weight gain (745g; 841 g and 910 g, respectively) and feed intake was found to be higher in broilers receiving the diets with 3,200 and 3,600 kcal ME/kg. Overall performance was not affected by the lysine levels. The feed conversion values were: 2.69, 2.42 and 2.14 from diets with 3,200, 3,400 and 3,600 kcal ME/kg, respectively. Carcass and breast yields were increased with the increment of energy and lysine in the diets. Acknowledgements: FAPESP for financial and technical support Proc. 97/03561-9.

**Key Words:** Broilers, Lysine, Metabolizable Energy

**1680 Dietary supplementation of a blend of galactosidase, galactomannanase and amylase(Endopower<sup>®</sup>) improves energy utilization and intestinal development in broilers.** C.W. Kang<sup>\*1</sup>, S.K. Kim<sup>1</sup>, I.H. Chang<sup>1</sup>, S.K. Kwan<sup>1</sup>, and B.J. Jang<sup>2</sup>, <sup>1</sup>*Konkuk University, Department of Animal Science*, <sup>2</sup>*College of Veterinary Medicine*.

An experiment was conducted to investigate influences of a multi-enzyme complex compound(Endopower<sup>®</sup>) supplementation to corn-soybean meal diet on energy utilization and intestinal development in broiler chicks. Endopower<sup>®</sup> is a feed grade enzyme blend of  $\alpha$ -galactosidase, galactomannanase and  $\alpha$ -amylase designed for corn-soybean meal diet. Three hundred sixty 3 d old male broiler chicks(Ross) were randomly housed in 12 pens in an environmentally controlled room and assigned to 4 treatments applying a 2x2 factorial arrangement of two energy levels(3100 and 2980 kcal TME<sub>n</sub>/kg diet) with 0 or 0.1% of Endopower<sup>®</sup> in the diet. There were no significant differences in feed intake or feed conversion among the treatments. The enzyme supplementation resulted in greater body weight gain(P<0.05) in the lower energy diet group, indicating the enzyme was very effective in improving energy utilization. However, the birds fed the high energy diet with 0.1% Endopower<sup>®</sup> did not produce additional weight gains compared to the birds fed the high energy without the enzyme diet. The enzyme supplementation reduced relative abdominal fat weights(% BW). The relative intestinal length(cm/BW) of the low energy without Endopower<sup>®</sup> diet group was lower than those of the others. Although the relative weights of jejunum and ileum(% BW) were similar, the duodenum weights(% BW) of the high energy groups were heavier than those of the low ones. The villi of birds fed the diets without Endopower<sup>®</sup> were shortened and thickened compared to those of 0.1% Endopower diet groups regardless of energy level. The results demonstrated that dietary Endopower<sup>®</sup> improved energy utilization and intestinal development and reduced abdominal fats in broiler chicks.

**Key Words:** Endopower<sup>®</sup> Enzyme, Energy, Intestinal Villus

**1681 Effect of Kemzyme<sup>®</sup> on apparent metabolizable energy and ileal digestible energy of wheat and barley samples with differing AME values in broiler chickens.** R. R. Carter<sup>\*1</sup> and V. Ravindran<sup>2</sup>, <sup>1</sup>*Kemin Industries (Asia) Pte Limited, Hornsby, NSW, Australia*, <sup>2</sup>*Massey University, Palmerston North, New Zealand*.

This study assessed the impact of dose rate of a xylanase/ $\beta$ -glucanase based liquid enzyme (Kemzyme<sup>®</sup>) on the apparent metabolizable energy (AME) and ileal digestible energy (IDE) of two wheat samples and two barley samples from different geographical origin during 1999/2000 harvest season. A total of 196 male Ross broiler chicks of uniform body weight were used and distributed into 48 groups (pens) of four birds each. Assay diets contained 95.9% of the test grain and were supplemented with 150 or 200 g/t of enzyme. Each diet was fed to four pens for seven days from day 25 post-hatching. Total collection of excreta was carried out for AME determinations and chromic oxide marker was used for the calculation of IDE. The AME of wheat A was increased from 12.55 MJ/kg DM to 13.56 (+8%) and 13.81 MJ/kg DM (+10%) with 150 g/t and 200 g/t of Kemzyme<sup>®</sup>, respectively, while wheat B was increased from 10.8 MJ/kg DM to 13.48 (+25%) and 13.15 MJ/kg DM (+22%). The IDE of wheat A was increased from 12.01 MJ/kg DM to 12.93 (+8%) and 13.14 MJ/kg DM (+9%) with 150 and 200 g/t of Kemzyme<sup>®</sup>, respectively, while wheat B was increased from 10.05 MJ/kg DM to 12.46 (+24%) and 12.48 MJ/kg DM (+24%). Significant effects were observed for grain origin (p $\leq$ 0.05) and enzyme addition (p $\leq$ 0.001). The AME of barley A was changed from 12.98 MJ/kg DM to 13.34 (+3%) and 12.91 MJ/kg DM for 150 and 200 g/t of Kemzyme<sup>®</sup>, respectively, while barley B was increased from 10.92 MJ/kg DM to 12.17 (+11%) and 11.92 MJ/kg DM (+9%). The IDE of barley A was increased from 11.33 MJ/kg DM to 11.88 (+5%) and 11.83 MJ/kg DM (+4%) with 150 and 200 g/t of Kemzyme<sup>®</sup>, respectively, while barley B was increased from 9.8 MJ/kg DM to 10.82 (+11%) and 10.79 MJ/kg DM (+10%). Significant effects were observed for grain origin (p $\leq$ 0.001) and enzyme addition (p $\leq$ 0.05). In summary, Kemzyme<sup>®</sup> significantly increased the cereal AME and IDE values with the greatest AME response associated with lower energy grains. No advantage was recorded from the higher enzyme dose rate.

**Key Words:** Digestibility, Enzyme, Small grains

**1682 Kemzyme C/S<sup>®</sup> brand for broilers supplementation and its effects on commercial broiler performance.** L. Lewis, A. Lamptey, M. Smith, J. Murphy, and P. A. Welch\*, *Kemin Americas, Inc.*

This study evaluated the use of a corn/soybean meal enzyme product, KEMZYME C/S<sup>®</sup> brand for Broilers (KCS), on 49 day broiler performance and yield in a commercial setting. Twenty-eight hundred and eighty Cobb x Cobb male and female broiler chicks were randomly assigned and reared separately, in 48 floor pens. Chicks were allowed ad libitum access to feed and water. All birds received starter diets from d 1-15, grower diets from d 16-29, and withdrawal diets from d 30-49. Diets consisted of corn, soybean meal, meat and bone meal (5%), poultry fat, minerals, and vitamins to meet nutrient requirements for each stage of growth. Treatment diets were either unsupplemented control or KCS enzyme supplemented at 125g/tonne. Enzyme was applied using an AGR International (AGR) post-pelleting system. Dose post-pelleting was verified; however, final active concentration may have been affected by processing conditions. Birds and residual feed were weighed at 49 days and yield determinations were made the following day. No significant differences in weight (avg. 2.23 kg), feed conversion (avg. 1.84) or mortality (3.65%) were observed between enzyme supplemented and control treatments. A subpopulation of birds was randomly selected for yield determinations: liveweight (avg. 2.43 kg), front halves (avg. 37.26%), pectoralis major (avg. 14.51%), pectoralis minor (avg. 3.32%), and wings (avg. 7.93%) were not affected by treatment for either male or female birds. Combined and female WOG and hind half were not affected by enzyme supplementation. However, WOG and hind half yield was improved by 0.84% and 0.48%, respectively, for KCS supplemented male broilers. Although soybean meal concentration in diets was diluted by meat and bone meal, economically viable yield enhancements were detected due to supplementation with KEMZYME C/S<sup>®</sup> brand for Broilers.

**Key Words:** Enzyme, Corn Soy Diets, Meat Yield

**1683 Release of water insoluble arabinoxylans from rye bran by ferulic acid esterase and pancreatin.** Z. Zhang\*, R. R. Marquardt, and W. Guenter, *Department of Animal Science, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.*

Arabinoxylans crosslink with protein through ferulic acid (FA) to form a complex water insoluble structure of cell wall in rye or wheat grain. Many studies have indicated that the release of water insoluble arabinoxylans (WIA) by non-starch polysaccharide enzymes in the animal gut is associated with an enhanced digestibility of nutrients in the grains. The objectives of this study were to determine (1) if rye bran could be used as a model material for selecting enzymes that are able to open the cell wall structure, and (2) whether ferulic acid esterase (FAE) and pancreatin (PC), a preparation high in proteases, could release WIA from rye bran in vitro. Three studies were carried out. In the first study, rye bran was subjected to treatment with FAE and PC. The results demonstrated that these enzymes enhanced the release of total pentoses from rye bran. Moreover, the log viscosity of the extraction solutions was significantly increased following PC treatment (1.23 times,  $P < 0.05$ ) but was significantly decreased by the FAE treatment (3 times,  $P < 0.05$ ). This latter effect was attributed to the presence of xylanase activity in FAE preparation. The results also showed that the increased viscosity induced by PC could be dramatically reduced by xylanase, but not  $\beta$ -glucanase or PC, and that FAE enhanced the release of ferulic acid into the media. Overall, these studies demonstrated that (1) both arabinoxylans and FA were released by FAE, and (2) that arabinoxylans were also released by PC. Collectively, these results suggest that endogenous enzymes can interact synergistically with other exogenous enzymes to open the structure of the cell wall of cereal grains in the animal gut, thereby facilitating digestion of nutrients such as protein and starch. In addition, these studies also suggest that the bran of grains can be used in conjunction with certain specific enzymes as a model system for studying the mechanism by which enzymes digest cell wall material.

**Key Words:** Water Insoluble Arabinoxylans, Exogenous and Endogenous Enzymes, Rye Bran

**1684 Prediction of wheat viscosity by near infrared spectroscopy and development of AviNIR calibration.** J. V. Holm<sup>1</sup> and M. Hruby<sup>2</sup>, <sup>1</sup>*Danisco Cultor, Brabrand, Denmark*, <sup>2</sup>*Finnfeeds Int. Ltd, Marlborough, Wiltshire, United Kingdom.*

Grain quality variation contributes greatly to increased variability in broiler performance. Previous research has shown that wheat viscosity, caused by soluble non-starch polysaccharides, correlates closely with wheat feeding quality in terms of AME and broiler performance. Additionally, carbohydrases (e.g. xylanases, beta-glucanases), through its action on soluble non-starch polysaccharides, reduce grain/diet viscosity. Timely and correct evaluation of wheat quality contributes to prediction of a specific enzyme amount (dose) required for a maximum economic return. Chemical viscosity evaluation method (Avicheck<sup>®</sup>) has been used for some time as a basis for wheat quality evaluation. However, the increase in near infrared spectroscopy (NIR) use in the milling and feeding industry and its potential for a rapid determination of chemical constituents of feed ingredients was a decisive factor to evaluate wheat viscosity also through NIR. In the current study, 700 samples of wheat, collected in Europe, North America and Australia during the harvest years of 1999 and 2000, were used to generate an NIR linear calibration equation for nutritive value of wheat measured through the grain viscosity evaluation. Prediction of viscosity was accurate. Coefficient of determination ( $r^2$ ) was 0.75 for wheat viscosity. This NIR wheat viscosity calibration (AviNIR) covers wheat samples with viscosity of up to 14 cPs, which is more than 95% of all wheat samples screened by Finnfeeds Int. Ltd. during 1996 and 2000 through the chemical viscosity measurement method. On average, the standard deviation between chemical determination of viscosity and NIR was 1.3 cPs. It is concluded, that NIR can accurately estimate the viscosity value of wheat, which contributes greatly to the nutritive value of this grain.

**Key Words:** Reflectance Spectroscopy, Wheat, Viscosity

**1685 Cell wall polysaccharidase<sup>1</sup> and proteolytic<sup>2</sup> enzyme combinations may enhance the *in vitro* carbohydrate and protein hydrolysis from toasted and untoasted soybean meal.** I. Ouhida, J. Galobart\*, J.F. Perez, and J. Gasa, *Universitat Autònoma de Barcelona.*

Water insolubles (WI) extracted from untoasted vs. toasted (85 and 125°C) soybean meals, were used as substrates to screen the carbohydrase activity of a number of cell wall degrading enzymes. Soybean meal WI yield was 44 vs. 61 and 68%DM<sup>-1</sup> of the original sample showing the decreasing solubility with the heat treatment of proteins (59 vs. 44 and 36%) and carbohydrates (41 vs. 28 and 22%, at 0, 85 and 125°C respectively). Incubations were performed at 40°C for 12h with cellulase, pectinase, and xylanase as single enzymes or each one combined with protease. Despite differences between substrate composition from toasting, no significant differences were observed on the enzymatic hydrolysis. Carbohydrate hydrolysis, measured as free monosaccharides, was significantly higher for pectinase (7-9%) and cellulase (9-12%) than xylanase (4-5%) or protease (2-3%). Simultaneous incubations of cell wall enzymes with protease interacted significantly with pectinase (20-22%) and cellulase (12-16%) but not xylanase (4-5%). Single incubations of pectinase and cellulase showed similar proteolytic activities than protease on toasted-85°C SBM (6.0 and 9.7% vs. 7.0% released amino acids, respectively) and higher than xylanase (1.8%). Simultaneous combination of pectinase or cellulase with protease showed an additive effect on protein hydrolysis (10.4 and 11.7%). *In vitro* results suggest an interesting potential of combining cell wall carbohydrases (pectinase and cellulase) and proteolytic enzymes on the hydrolysis of soybean cell wall polysaccharides and proteins. These findings should be confirmed *in vivo* by cell wall polysaccharidase supplementation. <sup>1</sup>Biopectinase NKP, Biocellulase A Con. and Bioxylanase 10P; <sup>2</sup>Bioprotease 120P from Qwest International Ireland.

**Key Words:** Soybean carbohydrates, Enzymes, *In vitro* activities

**1686 Effect of Kemzyme<sup>®</sup> on egg production and economics with prior adjustment of wheat and barley AME levels.** R.R. Carter\*<sup>1</sup> and R.J. Hughes<sup>2</sup>, <sup>1</sup>*Kemin Industries (Asia) Pte Limited, Hornsby, NSW, Australia*, <sup>2</sup>*Pig and Poultry Production Institute, University of Adelaide, Roseworthy, Australia.*

This study evaluated a xylanase/ $\beta$ -glucanase based dry enzyme included in a laying hen mash diet at 600 g/t. Hyline laying hens were housed at 5 birds per cage in a thermostatically controlled layer shed with a 16 hour light program. There were 12 replicates per treatment, i.e. 2 adjacent cages containing a total of 10 birds. Birds received the trial

diets from 42 to 50 weeks of age. The wheat and barley levels were fixed at 55% and 15% for both treatments. The wheat and barley AME values were each increased by 6% for the enzyme treated diet from control values of 12.7 and 11.6 MJ/kg DM, respectively. While the diet nutrient specifications for both diets remained the same, the effects of increasing the cereal AME values on the enzyme diet formulation compared with the control diet were: increased wheat brand/pollard from 2.99% to 6.24%, reduced tallow from 2.55% to 0.4%, reduced soybean meal from 7.25% to 6.63%, reduced meat meal from 8.3% to 7.8%, and reduced diet cost by A\$7.29 after including the enzyme cost. Prior feed formulation adjustment for the assumed energy utilization effect of the enzyme resulted in the following non-significant differences ( $p \leq 0.05$ ) in production parameters over the 8 week period. The control versus enzyme treatment results were: 86.5% and 87.9% for eggs/100 hen days, 2.15 and 2.18 for g feed/g egg, 63.2 g and 62.6 g for egg weight. The economic impact on 100,000 laying hens over the 8 week period of the combined egg production (assuming a value of A\$1.20/dz eggs) and feed utilization advantages is A\$9,624.20 due to the inclusion of the enzyme.

**Key Words:** Enzyme, Small grains, Egg production

**1687 Effect of diet metabolizable energy level on performance and energy metabolism of broilers.** N.K. Sakomura\*, C.B.V. Rabello, F.A. Longo, O.M. Junqueira, K. Watanabe, and K. Pelcia, *UNESP Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal - São Paulo - Brasil*.

This study was conducted to evaluate the effect of diet energy level on performance, maintenance energy requirement and efficiency of energy utilization for protein and fat deposition. Two hundred-eighty-eight Ross male broilers aged 21 days were distributed at 3 levels metabolizable energy (ME) (3.050, 3.200 and 3.350 kcal/kg) and 3 feeding levels (*ad libitum*, 75% and 50% of *ad libitum* intake), with 4 replications of 8 birds each. Energy retention in carcass was determined based on body composition at the beginning and end of experimental period. The relationship of ME intake (MEI) and energy retained (ER) was used to determine maintenance energy requirements (MEM), energy efficiency above maintenance ( $k_g$ ) and energy efficiency for protein ( $k_p$ ) and fat retention ( $k_f$ ). In order to determine the MEM and  $k_g$  were elaborated the following equations for each ME level: 3.350 ER=87.05+0.66.MEI ( $R^2=0.97$ ), MEM=131.12kcal/kg<sup>0.75</sup>/day,  $k_g=0.66$ ; 3.200 ER=93.74+0.67.MEI ( $R^2=0.97$ ), MEM=140.96kcal/kg<sup>0.75</sup>/day,  $k_g=0.67$ ; 3.050 ER=88.65+0.67.MEI ( $R^2=0.96$ ), MEM=131.78kcal/kg<sup>0.75</sup>/day,  $k_g=0.67$ . The  $k_p$  and  $k_f$  for each ME level were determined by the slope inversion of the equations: 3.350 MEI=81.34+0.816.REF+2.909.REP ( $R^2=0.97$ ),  $k_f=1.23$  and  $k_p=0.34$ ; 3.200 MEI=147.15+1.443.REF+1.485.REP ( $R^2=0.97$ ),  $k_f=0.69$  and  $k_p=0.67$ ; 3.050 MEI=128.17+1.233.REF + 1.799.REP ( $R^2=0.96$ ),  $k_f=0.81$  and  $k_p=0.56$ ; The body weight gain (g) obtained were: 2058a, 2030ab and 1893b, feed conversion: 1.66a, 1.77ab and 1.88b, body fat composition (%): 38.92, 35.31 and 39.21 and breast yield (%): 33.7, 35.0 and 34.2, for 3350, 3200 and 3050 kcal ME, respectively. The 3200 kcal ME level promoted higher  $k_p$  and lower  $k_f$  and better performance and carcass quality than 3350 and 3050 ME levels of broiler diets from 21 to 42 days old.

**Key Words:** Energy efficiency, Energy level, Maintenance energy requirements

## ASAS/ADSA Breeding and Genetics: Genetic Parameters and Breeding Strategies

**1690 Utilization of ultrasound data from designed progeny testing programs for calculation of carcass trait expected progeny differences.** D. J. Kemp\*<sup>1</sup>, W. O. Herring<sup>1</sup>, and C. J. Kaiser<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Eli Lilly and Company, Indianapolis, IN.

Carcass measurements for weight (HCW), ribeye area (LMA), 12-13 rib fat thickness (FAT), and marbling score (MARB), as well as live animal measurements of weight at the time of ultrasound (YWT), ultrasound ribeye area (ULMA), ultrasound 12-13 rib fat thickness (UFAT), and ultrasound predicted percentage ether extract (UEE) were taken on 2855 Angus steers. The average ages for steers at the time of ultrasound and at slaughter were 391 and 443 d, respectively. Genetic and environmental parameters were estimated for all eight traits in a multivariate

**1688 Effect of two sources of sodium on performance and electrolyte balance in broilers.** Sultan Mahmood\*, R. Ahmad, and S. Hassan Raza, *Dept. of Poultry Husbandry, University of Agriculture, Faisalabad, Pakistan*.

Traditionally, sodium chloride is used as source of sodium in poultry rations. Its supplementation demands great care because any imbalance may lead to depressed performance. This study was conducted to compare the effects of sodium chloride and sodium bicarbonate on broilers' performance, nutrient digestibility, chemical composition of meat and blood chemistry. Five experimental rations having 0,25,50,75 and 100 % supplementation from these two sources were prepared and fed to 150-day-old broiler chicks for 42 days in a completely randomized design. The data on feed intake, weight gain, water consumption, feed efficiency and blood chemistry were recorded. The analysis of data revealed that the use sodium chloride increased the water consumption significantly (201 10.5 vs. 179 10.4 ml/bird daily,  $p < 0.05$ ) whereas sodium bicarbonate significantly increased the weight gain (48.14 5.23g/bird/day,  $p < 0.05$ ), improved the efficiency of feed utilization and deposition of calcium and phosphorus in the broilers. The digestibility of protein was significantly better ( $p < 0.05$ ) in the broilers using sodium bicarbonate than those of the groups fed rations supplemented with sodium chloride, however, dry matter and ether extract digestibility remained unaffected due to the treatments. Blood pH was found significantly higher ( $p < 0.05$ ) in the broilers using rations supplemented with sodium bicarbonate. However, sodium and chloride contents of the blood were not affected. It was also observed that sodium bicarbonate favored the calcium deposition in the head of femur whereas the phosphorus contents deposition remained unaffected. None of the treatments exerted any effect on dressing percentage and breast and thigh meat yield.

**Key Words:** Broiler, Sodium feeding, Nutrient digestibility

**1689 The effects of homocysteine on the avian macrophage *In Vitro*.** F. McCorkle\* and J. Paquette, *Central Michigan University*.

Homocysteine is an amino acid that has been linked with cardiovascular disease when found in high concentrations in the blood of man. This study looked at the effect of homocysteine on avian macrophage functions, using MQ-NCSU cells. All data was analyzed by one-way ANOVA and experiments were done in triplicate. Homocysteine was not toxic to macrophages at concentrations from  $1 \times 10^{-6}$  to  $1 \times 10^{-12}$  M. (88.9% for  $10^{-6}$  M vs 90.4% for controls) Macrophages adherence was significantly reduced at all concentrations tested (130 cells at  $10^{-12}$  M vs 290 cells for controls). The ability of MQ-NCSU macrophages to phagocytize sheep red blood cells (SRBC) and *Escherichia coli* (*E. coli*) was not affected by homocysteine (28.7% at  $10^{-12}$  M vs 27.0% for controls). The average number of particles taken into the macrophages was not affected by homocysteine (1.26 *E. coli* at  $10^{-8}$  M vs 1.24 for controls). Homocysteine was not cytotoxic and although does inhibit adherence, it does not affect phagocytosis of SRBC or *E. coli*.

**Key Words:** Homocysteine, Macrophage