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≤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 Cincias Agrrias e Veterinrias de Jaboticabal - Sao 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$^{0.75}$/day, k_g=0.66; 3.200 ER=93.74+0.67.MEI (R^2=0.97), MEm=140.96kcal/kg$^{0.75}$/day, k_g=0.67; 3.050 ER=88.65+0.67.MEI (R^2=0.96), MEm=131.78kcal/kg$^{0.75}$/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+2.909REp (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 + 1.799REp (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

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 phosphorous 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 analysized by one-way ANOVA and experiments were done in triplicate. Homocysteine was not toxic to macrophages at concentrations from $1x10^{-6}$ to $1x10^{-12}$ 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

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*[1], W. O. Herring[1], and C. J. Kaiser[2], [1]*University of Missouri, Columbia*, [2]*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 animal model. In addition to a random animal effect, the model included a fixed effect for contemporary group and a covariate for measurement age. Heritabilities for HCW, LMA, FAT, MARB, YWT, ULMA, UFAT, and UEE were .48, .45, .35, .42, .55, .29, .39, and .51, respectively. Genetic correlations between LMA and ULMA, FAT and UFAT, MARB and UEE, and HCW and YWT were .69, .82, .90, and .96, respectively. Additional estimates were derived from a six trait multivariate animal model, which included all traits except those pertaining to weight. This model included a random animal effect, a fixed effect for contemporary group, as well as covariates for both measurement age and weight. Heritabilities for LMA, FAT, MARB, ULMA, UFAT, and UEE were .36, .39, .40, .17, .38, and .49, respectively. Genetic correlations between LMA and ULMA, FAT and UFAT, and MARB and UEE were .58, .86, and

.94, respectively. The high, positive genetic correlations between carcass and the corresponding real-time ultrasound (RTU) traits indicate that RTU imaging may be feasible as an alternative to carcass data collection in carcass progeny testing programs.

1691   Genetic evaluations based on ultrasound of yearling beef cattle as related to carcass characteristics of commercially produced progeny. C.J.B. Devitt*[1] and J.W. Wilton[2], [1]*Beef Improvement Ontario, Guelph, Canada,* [2]*University of Guelph, Ontario, Canada.*

The objective was to define relationships between carcass measures of commercially produced cattle and sire genetic evaluations based on carcass trait ultrasound. Ultrasound measurements of yearling bulls tested in Beef Improvement Ontario (BIO)'s bull evaluation program were used to obtain genetic evaluations in the form of across breed comparisons (ABCs) for longissimus dorsi area, backfat thickness, and intramuscular fat. The BIO-LINK program offered by Beef Improvement Ontario was used to track carcass weight, percent lean yield, and marbling grade on commercial progeny. The ABC and carcass data included 891 progeny from 85 sires of 10 breeds with an ABC for at least one of the following: longissimus dorsi area, backfat thickness, and intramuscular fat. Since intramuscular fat has been measured only more recently, 493 progeny from 58 sires with intramuscular fat ABC were available. All sires had more than 3 progeny with carcass records. Sire ABCs were calculated using a single trait animal model, expressed as an across breed expected progeny difference, on an age constant basis. Accuracy of ABCs averaged 53, 45, and 39, for longissimus dorsi area, backfat, and intramuscular fat, respectively. Correlation using unadjusted progeny carcass data showed that progeny marbling was positively correlated to sire intramuscular fat ABC, at 0.31. Correlations of progeny percent lean yield with sire longissimus dorsi area ABC and sire backfat ABC were .32 and -.40, respectively. Correlations of progeny carcass weight with sire longissimus dorsi area ABC and sire backfat ABC were .31 and -.24, respectively. Regression of progeny marbling on sire intramuscular fat ABC was significant (P<.01), as were regressions of progeny carcass weight and percent lean yield on sire longissimus dorsi area and backfat thickness ABC. These results show that carcass measures of commercially produced progeny are significantly related to sire genetic evaluations based on ultrasound.

1692   Effects of amino acids and calcium levels on radiographic density and calcium excretion in broilers from 43 to 49 days of age. S. M. Baraldi-Artoni[1], C. S. S. Araujo*[1], L. F. Araujo[1], O. M. Junqueira[1], M. J. Q. Louzada[2], and N. K. Sakomura[1], [1]*Universidade Estadual Paulista - UNESP/Jaboticabal, SP - Brazil,* [2]*Universidade Estadual Paulista - UNESP/Araatuba, SP - Brazil.*

Male broiler Avian Farms (n=540) were used from 43 to 49 days of age were subjected to a 3x2 factorial design consisting of three levels of dietary amino acids (100,125 and 150% NRC, 1994) and two levels of dietary calcium (75 and 100% NRC, 1994) with a total of 6 treatments replicated three times per treatment. Radiographic density (mm Aluminium equivalent), tibia variables (tibia weight, tibia length, compact bone thickness and spongy bone thickness) and Ca excretion were evaluate. The AA analyzed were methionine, lysine and threonine. Diets and water were available free choice. Experimental diets were comprised primarily of corn and soybean meal and were formulated to be isocaloric and isoproteic. Requirement levels for AA were accomplished when necessary by adding crystalline AA. Total fecal output was collected for 72 h from days 47 to 49 to determine the treatment effect on Ca excretion. Percentage Ca excretion was calculated as grams of Ca in feces divided by grams of Ca consumed in the 72-h period. At 49 days, two broilers from each pen were slaughtered and the tibia left of the birds were collected and analyzed according to radiographic density (mm Aluminium equivalent). The AA or Ca levels unaffected radiographic density, tibia variables and Ca excretion. There were found interactions between the two factors. Acknowledgements: FAPESP for financial and technical support.

1693   Genetic variation between two tropically adapted *Bos taurus* breeds, the Romosinuano and the Senepol . R. A. Brenneman*[1], C. C. Chase, Jr.[1], T. A. Olson[2], D. G. Riley[1], and S. W. Coleman[1], [1]*USDA, ARS, SubTropical Agricultural Research Station (STARS), Brooksville, FL,* [2]*University of Florida, Gainesville.*

Twenty-eight microsatellite loci were used to estimate parameters of genetic variation between two tropically adapted *Bos taurus* breeds, the Senepol (n = 47) and the Romosinuano (n = 47), under evaluation at STARS. The Senepol was developed on St. Croix, U. S. V. I., as a cross reported to be between the Red Poll from England and the N'Dama from Senegal. The STARS Senepol herd was acquired through the importation of animals from St. Croix in 1982. The Romosinuano is a criollo breed remnant from the cattle left by the early Spanish missionaries in Colombia. The STARS purebred Romosinuano herd was acquired via embryo importation from Venezuela in 1996. Phenotypically, both are medium-framed breeds, light to medium red in color, polled, and adapted to the hot humid tropical climate of the Caribbean region. Visual phenotypic variation significantly overlaps between the two breeds. Animals from the respective STARS herds were selected by pedigree and sampled as breed representatives. The DNA samples were extracted from isolated buffy coats, amplified by PCR, electrophoresed on 6% polyacrylamide gels, and visualized with silver stain. Allele sizes were estimated relative to a 25 bp DNA stepladder electrophoresed concurrently with the amplified PCR product. Analysis was performed using GENEPOP with alleles coded by three-digit fragment size. Exact Hardy Weinberg tests calculated across all loci support each population to be in Hardy Weinberg Equilibrium (P < 0.001). The genetic differentiation detected between the populations was highly significant (P < 0.001). The number of effective migrants between populations was negligible (Nm = 0.325). The mean frequency of private alleles between the two populations was 0.134. Nei's standard distance (Ds) calculated for the two populations across all loci was 0.825. These population statistics confirm that regardless of phenotypic similarities, these Romosinuano and Senepol populations are distinct and genetically diverse.

1694   Estimates of genetic and phenotypic parameters of calf birth weight and calving difficulty in Limousin cattle. Adolfo Prez Mrquez[1], Francisco Ponce Medina[1], Juan Rodriguez Garca[1], Fulgencio Bueno Fierro[1], Hctor Gonzlez Garca[1], Abelardo Correa Caldern[1], Juan Guerrero Cruz[2], and Jess Trejo Castillo[3], [1]*Universidad Autnoma de Baja California,* [2]*University of California, Davis, Holtville,* [3]*Universidad Autnoma de Ciudad Jurez.*

Genetic parameters for birth weight and calving difficulty were evaluated in a herd, located in Samalayuca, a representative rangeland system in the desert region in northern Mxico. Progeny of 41 cows involving inheritance of Limousin (L) mated to sires Limousin were used. The objective was to estimate direct heritabilities for birth weight (BW) and calving difficulty (CD). Separate analyses for each trait used least squares mixed model, SAS (1989).The analytical model included: year of birth, age of dam, sex of calf, with date of birth as a covariate to adjust a common age as fixed effects; sire and residual as random components. Mean birth weight was 37.97 kg. Birth weight ranged from 36 kg in heifers 29 months old at parturition to 41.4 kg in mature cows 57 months old at parturition. Calving difficulty was subjectively evaluated categorically using descriptive scores (i.e., 1=no difficulty, 2=little difficulty by hand, 3=little difficulty with jack, 4=slight difficulty with a calf jack, 5=moderate difficulty with calf jack, 6=major difficulty with jack, and 7=Caesarean birth presentation). Calving difficulty was greater (P<.05) in heifers (17%) than mature cows (9.38%). The sex of the calf was the major source (P<.05) of variation in levels of calving difficulty for both heifers and mature cows. The estimated heritability values for birth weight and calving difficulty were .29 .07 and .05 .04, respectively. Breeders must consider birth weight and calving difficulty as important traits in their breeding programs.