kg live weight and subjected to standard carcass and meat quality evaluation. There was no effect of vitamin E supplementation on growth, carcass, or meat quality characteristics. Feeding 180,000 IU/kg of vit. D_3 for 9 d prior to slaughter produced a reduction ($P < .05$) in daily gain and gain:feed ratio. Serum calcium levels at slaughter were elevated ($P < .001$) for pigs supplemented with 90,000 and 180,000 compared to 1,000 IU/kg. Slaughter live weight ($P < .01$) and carcass weight ($P < .05$) were reduced for pigs fed the highest level of vit D_3 for 9 d prior to slaughter compared to the other vit. D_3 x time of feeding treatment combinations. Dressing percentage was similar across treatments. Pigs fed 180,000 IU/kg D_3 for 9 d generally had the lowest midline backfat thickness measurements; there were no consistent differences in carcass measurements between the other treatments. Pigs fed 180,000 compared to 1,000 IU/kg vit. D_3 had higher subjective muscle color and firmness scores, greater Hunter L* and a* values, and reduced drip loss, indicating an improvement in muscle color and water holding capacity. Pigs fed 90,000 IU/kg vit. D_3 for 9 d generally had similar Hunter L* and drip loss to those fed 180,000 IU/kg vit D_3. Relative to controls (1,000 IU/kg vit D_3), purge loss was reduced for pigs fed 90,000, but not 180,000, IU/kg vit D_3. These results suggest that feeding180,000 IU/kg vit. D_3 for 6 or 9 d or 90,000 IU/kg for 9 days prior to slaughter improves pork color and water holding capacity.

Key Words: Vitamin E and D_3, Growth and carcass, Meat Quality

118 Behavior of mice selected for high and low heat loss during light and dark photoperiods.

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The objective was to compare the behavior of high heat producing mice (MH) with low heat producing mice (ML) during light and dark photoperiods. These lines were developed from a common stock by selection for high versus low heat loss measured by direct calorimetry. The MH mice produce approximately 50/% more heat than the ML mice. The hypotheses were that both lines are more active during the dark and that MH are more active than ML mice. Fifteen MH and 15 ML 11-wk-old males were used. They were housed in six shoebox cages: three MH cages and three ML cages, with 5 mice per cage. Photoperiod was 12 h light and 12 h dark. Six behaviors were recorded by direct observation: rearing, climbing, feeding, exploring, resting, and grooming. Observations were made in four 30-min periods; two during the light and two during the dark. Behavior of each mouse was recorded during each minute of the observation periods. Data were analyzed by analysis of variance using the GLM procedure of SAS. We detected a significant main effect of line. The ML mice spent more time resting, and less time climbing than did the MH mice ($P<.05$). We also detected a line by photoperiod interaction ($P<.05$). The ML mice rested more during the light (46/%) than during the dark (28/%), but the MH mice rested less during the light (1/%) than during the dark (20/%). Rather than resting during the light, the MH mice increased the proportion of time spent climbing from 25/% during dark to 45/% during light. In conclusion, MH mice spend less time resting and more time climbing than do ML mice and this difference is exaggerated during the light phase.

Key Words: Behavior, Energetics

119 Fiber type composition of the muscles of the beef chuck and round.

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Thirty-eight muscles of the beef chuck and round were histochemically stained to characterize fiber type composition to facilitate optimal muscle use in value-added products. In an effort to sample beef carcass diversity, U.S.D.A. Select grade chucks and rounds (n=4 each) were chosen to represent two weight classes (250-295 kg and 363-410 kg) and two yield grades (1 and 3). Muscles were sectioned and stained with a serial staining procedure, which included a succinate dehydrogenase and an adenosine triphosphatase staining technique. Number, percentage, and cross-sectional area of β-red, α-white, and α-red muscle fibers were determined for each muscle. Weight did not significantly affect muscle fiber type ($P>.05$), probably because of limited sample numbers. Muscles containing greater than 40% β-red fiber numbers were classified as red; greater than 40% α-white were classified as white. All other muscles were classified as intermediate. Nine of twelve round muscles were white, including the semitendinosus, biceps femoris, rectus femoris, adductor, and the semimembranosus. The chuck muscles were red (10 of 26), intermediate (9 of 26), and white (7 of 26). These data indicate variable fiber type composition of most of the muscles of the beef chuck and round. Functional and biochemical traits of each muscle fiber class would be expected to create different processing characteristics, which influence optimal muscle use in value-added products.

Key Words: Beef Chuck, Beef Round, Fiber Type

NONRUMINANT NUTRITION

120 Added L-carnitine in sow gestation diets improves carcass characteristics of the offspring.

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Sows (n = 232) were provided either an additional 0 or 50 ppm of L-carnitine in the gestation diet and various aspects of sow and offspring performance were evaluated. Sows were fed a corn-soybean meal gestation diet (.7 % lysine, 1.0 % Ca, and .90 % P) with or without added L-carnitine from breeding until farrowing. Added L-carnitine had no effect ($P > .10$) in either the immediate or subsequent number of pigs born (12.7) or born alive (11.4) per litter. No differences were observed in pig weight at birth, weaning, or d 60 of age. Muscle fiber analysis of pigs (n = 28) sacrificed at birth indicated tendencies for a larger cross-sectional area of the semitendinosus muscle (128 vs 112 mm ^{2}; $P = .15$) , increased primary (slow-twitch, red) fibers, and a lower ratio of secondary (fast-twitch, white) to primary fibers in pigs from sows fed added L-carnitine during gestation. Carcass characteristics were recorded for an additional 1,236 offspring. No differences were observed in the hot carcass weight (87.7 kg), but loin depth and percentage lean were increased (59.4 vs 57.0 mm; 55.1 vs 54.5 %, $P < .01$) in offspring of sows fed additional L-carnitine during gestation. Feeding added L-carnitine during gestation had no effect on the number of pigs born. Improved carcass leanness is consistent with tendencies for increased muscle size and primary muscle fiber number. These responses might be due to improved nutrient utilization in the sow allowing for improved nutrient status of the developing fetus. More research is needed to determine the optimum level of L-carnitine to use in the gestation diet.

Key Words: L-carnitine, Gestation, Pig

121 Maternal and fetal growth and metabolic characteristics affected by increased feed intake from d 30 to 57 of gestation.

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The potential effects of maternal feed intake were evaluated by feeding either 1.81 kg/d (control, n = 6) or 7.00 kg/d (High Feed Intake (HFI), n = 4) of a gestation diet (.65% lysine, .9% Ca, and .8% P) from d 30 to 57 after breeding. Sows were subjected to surgery on d 57 of gestation and a total of 112 fetal pigs were bled and removed sequentially beginning at the ovarian end of one uterine horn. On d 57, HFI sows had gained more ($P < .01$) weight (41.2 vs 2.1 kg) than controls. Plasma from the jugular vein of the HFI sows prior to surgery (3 h post-prandial), and in the uterine vein and artery during surgery, had higher ($P < .05$) concentrations of IGF-I and urea nitrogen compared to control. However, no ($P > .10$) treatment effects were observed for sow plasma glucose or insulin concentrations. Fetal length, fetal weight, liver weight, and fetal body composition were not ($P > .10$) affected by treatments. Concentrations of glucose, IGF-I, and insulin in plasma from the umbilical vein and allantoic and amniotic fluids concentrations of glucose were not affected by treatments. Urea nitrogen was higher ($P < .05$) in fetal umbilical venous plasma, allantoic fluid, and amniotic fluid of fetuses from HFI sows compared to control sows. Litters from control sows demonstrated a negative relationship between fetal number and fetal weight (wt, g = -2.19 x fetal no + 122.45; $R^2 = .43$), but fetal weights from HFI sows

were not affected by fetal number ($R^2 = .14$). Therefore, high maternal feed intake increased IGF-I concentrations in maternal plasma and urea nitrogen was elevated in fetal blood and placental fluids, but other fetal characteristics were not affected.

Key Words: Fetal, Urea nitrogen, Gestation

122 Threonine requirement of the high-producing lactating sow.

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Reproductive performance is steadily increasing within the pork industry; logically, amino acid requirements need to be re-defined for sows with larger litters. The objective of this study was to determine the threonine requirement of the high-producing lactating sow, and determine the effect of lysine on this requirement. A total of 418 PIC C-15 sows were assigned randomly to treatment within parity groups (1, 2 and 3+) at d 110 of gestation. Lactation diets were formulated to contain .80 % total lysine (tLys) with .30, .35, .40, .45, .50, .55, .60 or .65 % total threonine (tThr) or 1.06 % tLys with .40, .45, .50, .55, .60, .65 or .70 % tThr. Litters were standardized to a minimum of 11 piglets within 48 h after farrowing and sows had free access to feed throughout lactation. Sow ADFI exceeded expectation, averaging 6.9, 7.4 and 7.2 kg/d for parity 1, 2 and 3+, respectively. Daily tLys intake was 57.6 g/d (46.8 g dLys/d) and 74.2 g/d (58.8 g dLys/d) for the low and high lysine group, respectively. Lysine intake did not affect sow or litter performance ($P > .10$). Sows gained an average of 4.8 kg in lactation; BW gain was maximized at .54 % tThr for all parity groups (quadratic; $P < .05$). Litter weaning weight (67.2, 68.0 and 66.3 kg for parity 1, 2, and 3+, respectively) and litter weight gain (2.49, 2.53 and 2.44 kg/d for parity 1, 2 and 3+, respectively) were maximized at .53 % tThr for all parity groups (quadratic; $P < .05$). Plasma urea nitrogen on d 10 and 18 was minimized at .54 % tThr ($P < .05$). Lysine levels in excess of 57.6 g tLys/d did not benefit sow or litter performance. The requirement for threonine to minimize sow tissue mobilization was 37.3, 40.0 and 38.9 g tThr/d (28.7, 30.8, 30.0 g dThr/d) for parity 1, 2 and 3+ sows, respectively. The threonine required to maximize litter performance was 36.6, 39.2 and 38.2 g tThr/d (28.2, 30.2, 29.5 g dThr/d) for parity 1, 2 and 3+ sows, respectively. Alternatively, the requirement can be expressed as 15.3 g tThr/kg (11.8 g dThr/kg) litter gain.

Key Words: Sows, Lactation, Threonine

123 Bioavailability of phosphorus in meat and bone meal varying in origin, particle size, and processing pressure for chicks.

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The bioavailability of P in meat and bone (MBM) was determined in chicks using MBM that varied in origin, particle size, and processing pressure. Newly hatched, male chicks were placed in batteries and fed a standard diet (23% CP). On d 3, 420 chicks (66 g mean BW) were allotted to 12 diets (5 pens of 7 chicks/pen). A corn-soybean meal-starch-basal diet (21% CP, 1.0% Ca, .52% total P, and .25% non-phytate P) was used. Graded levels (.05, .10, and .15% added P) of monosodium phosphate (MSP, Diets 2-4) were added to the basal diet. MBM (.15% added P) varying in origin (low-ash [23.1%] of pork origin, 50:50 blend, or high-ash [42.7%] of beef origin), particle size (6- or 12-mesh), and processing pressure (0, 30, or 60 psi beyond normal processing) replaced starch in the basal diet for Diets 5-12, respectively. Ca was maintained at 1.0% in all diets. Chick 14-d gains and feed:gains were: 279, 366, 455, 502, 500, 501, 487, 502, 476, 487, 483, 510 g; 1.45, 1.37, 1.31, 1.28, 1.20, 1.21, 1.27, 1.24, 1.34, 1.24, 1.26, 1.23. Tibia strength (6.98, 13.41, 23.41, 34.12, 27.65, 27.84, 27.28, 30.93, 26.19, 27.97, 26.94, 29.64 kg) and ash (28.4, 32.7, 37.4, 41.3, 38.5, 38.7, 38.9, 39.5, 38.2, 38.5, 38.8, 38.8%), along with growth rate, increased linearly ($P < .001$) with increasing levels of P from MSP. Addition of .15% added P from MSP compared to MBM improved bone traits ($P < .001$), but not growth ($P = .21$). The coarser MBM (6- vs 12-mesh) resulted in increased gain and bone traits ($P < .03$), and a higher processing pressure for MBM increased gain ($P < .02$) but not bone traits ($P = .21$). Bone traits were regressed on added P intake for each P source. Based on slope-ratio (MSP=100%) the bioavailability of P was 82, 83, 79, 90, 73, 82, 79, and 85% for the 8 MBM treatments, respectively. These results indicate that the availability of P in MBM is relatively high for chicks (82%). Extremes in MBM processing pressure and source had little effect on P availability, but particle size of MBM affected both growth and bone traits.

Key Words: Chicks, Phosphorus, Meat and Bone Meal

124 Limiting order of amino acids and the effects of phytase on protein quality in corn gluten meal fed to young chicks.

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An amino acid deletion assay and a slope-ratio growth assay were used to establish the limiting order of amino acids (AA), and to determine the effects of microbial phytase (MP) on protein utilization in corn gluten meal (CGM) fed to chicks during the period of 8 to 21-d posthatching. In assay 1, an AA-deficient cornstarch-dextrose basal diet containing 12% CP furnished by CGM was fortified with AA to fulfill the digestible AA ideal profile (Phe + Tyr, Leu, and Pro from CGM exceeded requirements) for 0- to 21-d-old chicks. Amino acids were then individually deleted, and all diets were fortified to 23% CP, with Glu varying as necessary. A Met-fortified 23% CP corn-soybean meal (C-SBM) diet was added to serve as a positive control. Each of the dietary treatments was fed to triplicate groups of five chicks. No differences ($P > .10$) were observed between the fully-fortified CGM basal diet and the C-SBM positive-control diet. The limiting order of amino acids established in CGM was 1) Lys, 2) Trp, 3) Arg, 4) Thr, 5) Val, 6) Ile, 7) His, 8) Met + Cys, and 9) Met. Glycine was not found to be deficient. In assay 2, graded levels of protein (8, 16, and 24% CP) furnished by CGM were fed in the presence and absence of 1200 U/kg MP to four groups of four chicks per treatment. Weight gain and gain:feed were then regressed on CP intake, multiple linear regression analysis was performed, and slope-ratio methodology was applied for graded levels of CGM protein fed with or without 1200 U/kg MP. Weight gain and gain:feed increased linearly ($P < .05$) as a function of protein intake, but MP supplementation had no effect ($P > .10$) on weight gain or gain:feed slopes. Additionally, MP supplementation had no effect ($P > .10$) on protein efficiency ratios at any level of CP. These results indicated that 1200 U/kg MP did not increase either CP or AA utilization in CGM for young chicks.

Key Words: Corn Gluten Meal, Phytase, Protein Quality

125 Effects of excess protein or methionine on the requirement for vitamin B-6 in chicks.

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Several 12-d growth assays were conducted to study the effects of excess protein and methionine(Met) on the B-6 requirement of chicks. A cornstarch, sucrose, soy protein isolate(SPI) basal diet was used in all assays. Comparisons of this diet with a B-6 free amino acid diet confirmed that the SPI basal diet contained no bioavailable B-6 activity. In assay 1, 224 male chicks were weighed and randomly assigned to 14 diets (4 reps/diet with 4 chicks/rep). Diets consisted of vitamin B-6 (from pyridoxine) levels of .2, .4, .6, .8, 1.0, and 1.2 mg/kg diet with 20% protein, and .2, .4, .6, .8, 1.0, 1.2, 1.4, and 1.6 mg/kg with 40% protein. Quadratic ($p<.01$) growth responses to B-6 occurred with both diets. At 20% protein, maximal growth was obtained at .63 mg/kg B-6, but at 40% protein, the requirement was increased to .91 mg/kg. In assay 2, 224 male chicks were weighed and randomly assigned to 14 diets (4 reps/diet with 4 chicks/rep). Vitamin B-6 was added to each diet in a design similar to that of assay 1, except that the B-6 levels ranged from .2 to 1.4 mg/kg with .2 mg/kg increments. Treatments 1 to 7 had no supplemental Met whereas treatments 8 to 14 had 1.0% added Met. The basal diet contained .2% DL-Met so that no chicks were Met deficient. Without excess Met, optimal growth was obtained at .73 mg/kg B-6, but 1% excess Met increased the requirement for optimal growth to 1.05 mg/kg B-6. It can be concluded that excess protein increases the vitamin B-6 requirement of chicks, and that the excess methionine component of protein is a principal contributor. It appears that the transsulfuration pathway together with the need for de novo methyl groups (for homocysteine remethylation) via serine hydroxymethyltransferase are major contributors to the B-6 requirement of chicks.

Key Words: Chicks, Vitamin B-6 Requirement, Excess Protein