506 Environmental effects on pig performance, meat quality, and muscle characteristics. J. G. Gentry*, J. J. McGlone, M. F. Miller, and J. R. Blanton, Jr., *Texas Tech University, Lubbock, TX*.

The objective of this experiment was to determine the effect of diverse production systems that cause increased exercise on pig performance, muscle characteristics, and their relation to pork quality measures. Birth and rearing conditions were evaluated (n = 48 barrows). Pigs were farrowed either in indoor crates or outdoor huts. At weaning, indoor-born and outdoor-born pigs were randomly allotted to indoor (concrete-slatted flooring, 1.2 m^2/pig) or outdoor (alfalfa pasture, 212 m^2/pig) pens for finishing. Pigs were slaughtered using commercial practices. Muscle samples were removed within 1 h postmortem from the longissimus lumborum (LL) and the semimembranosus (SM) and stained histochemically to identify type I, IIA, and IIB/X muscle fiber types. Loins were collected from each carcass, aged for 14 d, and evaluated for color, sensory panel attributes, and Warner-Bratzler shear force (WBS). Pigs born outdoors had a greater ADG at d 28, 56, and 112 after weaning ($P < 0.05$) than pigs born indoors. Pigs reared outdoors had a higher ADG (2.2 vs 1.9 ± 0.11 kg/d, $P = 0.01$), but also a higher Gain:Feed (0.41 vs 0.37 ± 0.04; $P = 0.01$) than pigs reared indoors. Pigs reared outdoors were fatter (2.4 vs 2.1 ± 0.04 cm; $P = 0.01$) at the last rib and had loins with a higher (4.5 vs 3.4 ± 0.4; $P = 0.02$) a* values than pigs reared indoors. No differences were detected in sensory traits or WBS values. Birth by rearing environment interactions were not significant for most measures. Pigs reared outdoors had a higher ($P < 0.01$) percentage of IIA fibers (LL: 16.4 vs 12.4 ± 0.9%; SM: 23.6 vs 15.7 ± 1.2%) and a lower ($P < 0.05$) percentage of IIB/X fibers (LL: 64.2 vs 68.3 ± 1.2%; SM: 57.9 vs 67.3 ± 0.9%) than pigs reared indoors. Pigs reared outdoors had a smaller cross sectional area for type I (3516 vs 4187 ± 130 μm^2; $P = 0.003$) and IIA (4237 vs 5159 ± 271 μm^2; $P = 0.02$) fibers in the SM than did pigs reared indoors. Production systems that include increased exercise levels or other features of an outdoor system may alter the size and type of individual muscle fibers which impact pork quality measures such as color.

Key Words: Pigs, Environment, Meat quality

507 Growth and meat quality of finishing hogs supplemented creatine monohydrate and a high glycemic carbohydrate 30 d pre-harvest. C. A. Stahl*[1], M. L. Linville[1], G. K. Rentfrow[1], G. L. Allee[1], and E. P. Berg[1], [1]*University of Missouri-Columbia*.

Crossbred market barrows (n = 32; 75 kg) were blocked by weight and randomly allotted to one of eight pens (4 replications per pen, 2 pens per treatment) within a self-ventilated finishing facility. A 7 d acclimation period was provided prior to the initiation of the 30 d feeding trial. All animals were provided *ad libitum* access to both water and feed via a water nipple and a single two-holed feeder, respectively. Test diets included of a control (basal diet), and three treatment groups consisting of creatine monohydrate (CMH; basal diet supplemented with 0.55% creatine monohydrate), dextrose (DEXT; basal diet supplemented with 2.1% dextrose), and CMH + DEXT (COMBO; basal diet supplemented with 0.55% CMH and 2.1% dextrose). Formulation of those supplements added to the basal diet were calculated estimating 20 g per pig per d CMH, 75g per pig per d dextrose, and the combination of both. Average daily gain on test (control=0.75, CMH=0.77, DEXT=0.73, and COMBO=0.74 kg/d), fat depth (control=2.3, CMH=2.6, DEXT=2.6, and COMBO=2.2 cm), and hot carcass weight (control=79.3, CMH=76.7, DEXT=77.4, and COMBO=78.6 kg) were not affected by dietary treatment. A strong linear trend (P = 0.07) was observed for loin muscle area (LMA) gain on test as determined via real-time ultrasound comparisons of d 0 and d 30 measurements at the 10th rib. COMBO pigs had a greater ($P < 0.05$) LMA increase during the 30 d feeding period (COMBO = 4.24 cm^2 vs Control = 1.0 cm^2 increase). No significant differences ($P > 0.05$) in pork quality were detected among treatment diets.

Key Words: Pork, Creatine, Carbohydrate

508 The effect of alpha lipoic acid on shelf life and Warner-Bratzler shear force values of fresh pork. T. B. Schmidt*, C. A. Stahl, D. L. McNamara, G. K. Rentfrow, and E. P. Berg, *University of Missouri*.

The objective of this trial was to determine the affects of supplemental alpha lipoic acid (ALA) to finishing swine from 95 to 117 kg BW on the shelf stability and palatability of fresh pork. Fifty-four commercial hybrid pigs were randomly allotted to one of three treatments: a control group compared to supplemental ALA at 8 (ALA8) or 16 (ALA16) mg per kg of final market weight (117 kg). Upon reaching 117 kg BW, pigs were delivered in two groups to a commercial packing plant that utilizes CO_2 stunning. All pigs were humanely harvested and carcasses were blast chilled for 15 minutes, then chilled for 20 h at 4°C. Hams and loins were collected on-line, wrapped, boxed, and delivered the same day to the University of Missouri Meats lab. Upon arrival, the semimembranosus (SM) was removed from the ham and a 2.54 cm thick steak was removed from both the SM and the longissimus (LD) for use in a 7 d simulated retail display. Chops were evaluated on day 0, 1, 4, and 7 for CIE L*, a*, and b* values. An additional loin piece was weighed and stored for 20 days at 2°C to simulate domestic distribution. After 20 d storage, loin pieces were removed from their packaging, weighed, and chops cut, packaged and evaluated after 7 d of simulated retail display. Additional LD chops were evaluated for Warner-Bratzler shear force (WBS) and pH at 1 and 20 d postmortem. Treatment had no affect (P > 0.05) on WBS or pH. A linear decrease (P = 0.03) was detected for L* values recorded on the posterior end of loins measured 1 d postmortem, suggesting that as ALA dose increased, L* decreased, however, a linear trend (P = 0.097) observed at the blade end revealed L*-values increased with ALA dose. There was a day affect for shelf life, however, treatment or treatment*day was not significant for L*, a*, b*, chroma (color saturation), or hue angle (true red). SM purge loss increased with ALA dose in a linear trend (P= 0.047). The antioxidant affects of ALA fed at 8 or 16 mg per kg BW did not result in improved fresh pork quality.

Key Words: Shelf Life, Lipoic acid, Pork Quality

509 The affects of alpha-lipoic acid on beef longissimus bloom time. G. Rentfrow*[1], M.L. Linville[1], C.A. Stahl[1], K.C. Olson[1], and E.P. Berg[1], [1]*University of Missouri*.

The objective of this study was to evaluate the influence of the unique antioxidant alpha-lipoic acid (ALA) on strip loin steak bloom time. Thirty-six Simmental steers were supplemented with 0 (Con), 8 (1X), 16 (2X), or 24 (3X) mg/kg BW for 21 d prior to harvest. ALA was mixed with a paraffin carrier as a rumen protectant and top-dressed over a standard finishing diet. Steers were humanely harvested at the University of Missouri abattoir. After a 24 h chill (4°C), the right longissimus lumborum was removed from each carcass, one 2.54-cm thick steak was removed from the anterior portion, and color measurements (CIE L*, a*, b*) were taken immediately with a Hunter Lab Miniscan XE Plus standardized to a black and white tile. Color measurements were taken every three minutes for a 93-minute period; hue angle (true red) and chroma (color saturation) were then calculated. The 3X treatment had the highest (P < 0.0001) L* value (Con=30.5, 1X=30.4, 2X=30.9, 3X=34.5), while the 2X treatment had the lowest (P < 0.0001) hue angle (Con=41.1, 1X=41.3, 2X=40.8, 3X=41.5). However, ALA had no significant affect (P > 0.05) on a* values, b* values, or chroma. During bloom time the L* values did not significantly change (P > 0.05) over the 93-minute period. The a* values increased for six minutes, then leveled after nine minutes (P < 0.0001). A similar trend was followed for b* values, hue angle, and chroma which increased for nine minutes, then leveled after twelve minutes (P < 0.0001). There was no significant treatment by bloom time interaction (P > 0.05).

Key Words: ALA, bloom time

510 Adaptations in muscle fiber characteristics and effects on meat quality traits induced by rearing conditions in pigs. G. Bee*, *Swiss Federal Research Station for Animal Production.*

The aim of this research was to determine whether outdoor free-range versus indoor confinement rearing affects meat quality and muscle fiber characteristics in pigs. This study used 12 gilts and 12 barrows from six Large White litters. Each litter was equally split between rearing indoors (I) in individual pens (2.56 m^2) and rearing outdoors (O) from December to March on a fallow arable plot of land (9200 m^2). Both groups had free access to the same grower-finisher diet that met Swiss nutrient requirement estimates. At slaughter, samples from the longissimus (LM), the light (STL) and dark (STD) parts of the semitendinosus and the rectus femoris (RF) were obtained from the right side of all pigs. Muscle fibers were stained and classified as SO, FOG, or FG. Fiber area and distribution were determined for each muscle. In addition to carcass characteristics, pH_i, pH_u, Minolta L*, a*, b* values, drip loss, glycolytic potential (GP), and i.m. fat of each muscle were assessed. The O-pigs had lower ADG (795 vs 938 g) and leaner carcasses (58.4 vs 56.2%; $P < 0.01$). Rearing conditions did not affect i.m. fat content of the ST, but i.m. fat was lower in the LM (19. vs 2.4%) and higher in the RF (1.6 vs 1.4%) of O-pigs ($P < 0.01$). The GP of all muscles was higher ($P < 0.07$) and pH_u of all muscles was lower ($P < 0.01$) in the O-pigs. In the LM of the O-pigs, but not in the other muscles, L* values (47.2 vs 48.8) were lower and drip losses (2.1 vs 1.8%) were higher ($P < 0.01$). The SO fibers of the LM (2430 vs 2936 μm^2) and STL (2703 vs 3558 μm^2) tended to be smaller ($P < 0.09$) in the O-pigs compared to I-pigs. Rearing conditions had little affect ($P > 0.05$) on STD and RF fiber area. In the O-pigs, LM and RF had more FOG (LM: 26.0 vs 20.8%; RF: 39.7 vs 32.0%) and fewer FG (LM: 62.3 vs 68.4%; RF: 56.2 vs 62.9%) fibers, while STL had fewer SO (3.3 vs 6.6%) fibers compared to I-pigs ($P < 0.05$). SO, FOG, and FG fiber distributions were correlated with L* (-0.29, -0.38, and 0.41), a* (0.37, 0.44, and -0.50), b* (0.17, 0.29, and -0.28), and GP (-0.36, -0.34, and 0.42). These results suggest rearing pigs outdoors increases aerobic capacity of glycolytic muscles, but has little concomitant influence on meat quality traits.

Key Words: Pigs, Muscle fibres, Meat quality

511 Effect of sex and slaughter weight on performance and carcass quality of pigs. J. Peinado[1], M. Cortes[1], A. Fuentetaja[2], R. Lazaro*[3], and P. Medel[1], [1]*Imasde Agropecuaria, S.L., Madrid, Spain,* [2]*Copese, S.A., Segovia, Spain,* [3]*Universidad Politecnica de Madrid, Spain.*

A total of 240 Pietrain*Large White x Landrace*Large White pigs, 60.5 ± 6.2 kg of initial BW, were used to study the influence of slaughter weight and sex on productive performance and carcass quality. There were six treatments arranged factorially, with three sexes (castrated males, castrated females, and entire females) and two slaughter weight (114 and 122 kg). Males were castrated at birth and females at 35 kg BW. Each treatment was replicated four times and ten pigs housed together formed the experimental unit. All the animals received *ad libitum* access to a common feeding program of three diets based on barley, wheat, and soybean meal with 2,295 kcal NE/kg and 9.7 g/kg lysine from 60 to 75 kg, 2,415 kcal NE/kg and 7.1 g/kg lysine from 75 to 85 kg, and 2,415 kcal NE/kg and 6.7g/kg lysine from 85 kg to slaughter weight. Castrated pigs ate more (2,484 vs 2,189 g/d; P<0.05) and grew faster (746 vs 675 g/d; P<0.05) than entire females, but no sex effect was found for feed conversion. Carcass dressed yield was not affected by treatment. Castrated pigs had more shoulder and less loin yield than entire females (15.2 vs 14.8% and 6.88 vs 7.26%, respectively; P<0.05) but ham yield was not affected by sex. Castrated pigs had more P_2 and *gluteus medius* fat than entire females (24.54 vs 21.54 mm, and 21.14 vs 18.45 mm, respectively; P<0.05). Fat thickness at the *gluteus medius* was greater in pigs slaughtered at 122 kg than in pigs slaughtered at 114 kg (20.9 vs 19.5 mm; P<0.05). When slaughter weight increased from 114 to 122 kg the percentage of entire females showing a fat thickness greater than 20 mm at the *gluteus medius* increased from 24 to 46% (P<0.05) but no differences were observed for castrated males or females. It was concluded that castrating females and increasing final weight improve carcass and meat quality of pigs destined to the industry for cured products.

Key Words: Fattening pigs, Performance, Carcass quality

512 Effect of breed, sex and final weight on performance and carcass quality of lambs. J. Peinado[1], P. De Miguel[2], G.G. Mateos*[3], and P. Medel[1], [1]*Imasde Agropecuaria, S.L., Madrid, Spain,* [2]*Grupo Carnico Magnus, S.A., Zamora, Spain,* [3]*Universidad Politecnica de Madrid, Spain.*

A total of 480 lambs, 16.2 ± 0.6 kg of initial BW, were used to study the influence of breed, sex, and slaughter weight on productive performance and carcass quality under intensive feeding conditions. There were eight treatments arranged factorially with two breeds (Castellana vs Merino), two sexes (female vs male), and two slaughter weights (26 vs 31 kg). Each treatment was replicated six times and ten lambs housed together formed the experimental unit. All the animals received a common feeding program of two diets based on barley, wheat, and soybean meal with 1,703 kcal NE/kg and 18.3% CP for the first 10 d of trial, and 1,703 kcal NE/kg and 16.7% CP thereafter. Lambs were supplied *ad libitum* access to wheat straw. No significant differences were found between breeds for any of the productive parameters studied. Males ate more (1,018 vs 978 g/d; P<0.01), grew faster (319 vs 264 g/d; P<0.01), and had better feed conversion (3.20 vs 3.72 g/g; P<0.01) than females. Lambs slaughtered at 31 kg ate more and grew faster than lambs slaughtered at 26 kg, but feed conversion was impaired (1,042 vs 953 g/d; 298 vs 285 g/d, and 3.53 vs 3.39 g/g for feed intake, daily gain, and feed conversion; P<0.05). Carcass dressed yield was greater for Merino than for Castellano lambs (48.0 vs 46.7 %; P<0.01), for females than for males (47.7 vs 47.0 %; P<0.01), and for lambs slaughtered at 31 kg than for lambs slaughtered at 26 kg (47.5 vs 47.1%; P=0.05). *Longissimus* depth at the thirteenth rib was greater for Merino than for Castellano lambs (1.39 vs 1.15 cm; P<0.01) and for lambs slaughtered at 31 kg than for lambs slaughtered at 26 kg (1.32 vs 1.22 cm; P<0.05). Fat thickness at the thirteenth rib was greater in females than in males (2.94 vs 2.31 mm; P<0.01) and in 31 kg than in 26 kg BW lambs (3.04 vs 2.21 mm; P<0.01). It was concluded that sex, breed, and final weight have to be considered when attention is given to carcass quality in fattening lambs under intensive feeding conditions.

Key Words: Lambs, Performance, Carcass quality

513 Relationship of live animal performance to meat color and carcass characteristics of milk-fed veal calves. D.A. Vermeire*[1] and W.R. Henning[2], [1]*Nouriche Nutrition Ltd.,* [2]*Pennsylvania State University.*

Meat color and carcass muscling are important determinants of value of veal carcasses. The objective of this study was to determine the relationship between performance of veal calves and meat color and carcass characteristics in order to more effectively manage milk-fed veal calves. Male Holstein calves (n=164) were fed for 129 d, as milk-fed veal. Calves were weighed on d 1, 42, 89, and 129 at the farm, and blood samples collected during wk 1, 2, 4, 6, 8, 10, 12, 14, 16, and 18. Pearson correlations and linear regressions between variables were computed using linear models of Statistix version 7.0. Live weight ± SE for d 1, 42, 89, and 129 were 43.15 ± 0.30, 76.31 ± 0.43, 145.58 ± 0.98, and 212.77 ± 1.47 kg, respectively. Gain:$feed^{-1}$ for d 1 to 42, 42 to 89, and 89 to 129 were 0.757, 0.629, and 0.548, respectively. Hot carcass weight averaged 128.41 ± 0.97 kg with length of 96.33 ± 0.20 cm. Longissimus area (REA) averaged 49.67 ± 0.44 cm^2. Live weight on d 1 was poorly correlated with d 1 to 129 live weight gain (0.007, P>0.35), REA (0.041, P>0.60), yield (-0.040, P>0.60), packer grade (-0.054, P>0.50), or color of flank, breast, or longissimus (<0.10, P>0.30). Live weight gain, d 1 to 129, was positively correlated with yield (0.345, P<0.001), REA (0.515, P<0.001), packer grade (-0.400, P<0.001), and carcass color as measured by the Minolta chromameter for cold flank (a*, 0.191, P<0.02, L*, -0.161, P=0.053), longissimus (a*, 0.314, P<0.001, b*, 0.367, P<0.001). Correlation of live weight gain with cold flank b* and cold longissimus L* were not significant (P>0.05). Hematocrit and hemoglobin were poorly correlated with live weight gain with the exception of blood samples collected during wk 10. REA was poorly correlated with blood chemistry variables measured. We conclude that carcass REA and yield are more closely related to live weight gain, rather than initial calf weight. Live weight and live weight gain were not highly correlated with carcass color. Blood variables related to iron status were not predictive of animal performance or carcass weight, length, or REA.

Key Words: Veal, Meat Color, Carcass Characteristics

514 Relationship of blood chemistry to meat color of milk-fed veal calves. D.A. Vermeire*[1] and W.R. Henning[2], [1]*Nouriche Nutrition Ltd.*, [2]*Pennsylvania State University*.

Color of veal meat is a major determinant of value received by veal packers. Standard veal industry practice in the U.S. is to collect blood samples from each calf during weeks 4, 6, or 8 to predict carcass color, then sample approximately 10 percent of groups every 2 to 4 weeks. The objective of this study was to determine the relationship between blood chemistry of veal calves during the starting, growing, and finishing periods and meat color of veal carcass in order to more effectively manage milk-fed veal calves. Male Holstein calves (n=164) were fed for 129 d as milk-fed veal. Calves arrived at veal facility when they were approximately 3-6 days old. Blood samples were collected during weeks 1, 2, 4, 6, 8, 10, 12, 14, 16, and 18 via jugular veinipuncture and analyzed for hematocrit (hct), hemoglobin (hgb), red blood cells (RBC), white blood cells (WBC), mean corpuscular volume (MCV), and platelets (plt) using Baker System 9110-Plus blood analyzer. At harvest, carcass color was determined by visual appraisal and by using Minolta chromameter on hot breast and flank, and on cold breast, flank, and longissimus (ribeye). Pearson correlations and linear regressions between variables were computed using linear models of Statistix version 7.0. Correlation between hot flank color, and cold ribeye color was 0.659 ($P<0.001$), 0.037 ($P>0.65$), and 0.266 ($P<0.001$) for Minolta a*, b*, and L*, respectively. The correlation between visible color scores for hot flank and cold ribeye was 0.327 ($P<0.001$). Blood chemistry (hct, hgb, MCV, and plt) from samples collected during weeks 10, 16, 18 were highly correlated to cold flank and ribeye color using Minolta a* and L* values. Although there was high degree of variation during week 1 (CV = 21%), hct (and also hgb, MCV, or plt) had moderate correlations to cold flank (0.210, $P<0.01$ for a*, -0.205, $P=0.011$ for L*) and ribeye color (0.195, $P<0.02$ for a*, -0.146, $P<0.10$ for L*). We conclude that blood samples taken during weeks 1, 10, 16, and 18 could more accurately predict meat color than the industry standard practice of collecting blood samples during weeks 4, 6, and 8.

Key Words: Veal, Meat Color, Blood Chemistry

515 The effects of steroidogenic growth promotants on steer performance, carcass quality, tenderness, and intramuscular lipid content. L.B. Smith*, C.A. Daley, C.L. Cooley, and A.M. Early, *College of Agriculture, California State University, Chico*.

Black Angus-crossed steers (n = 100; 362 kg) were used to study the effects of androgenic and estrogenic growth promotants on beef carcass quality, yield grade, tenderness, and conjugated linoleic acid (CLA) levels relative to intramuscular lipid deposition. The steers were randomized and allotted into one of four treatment groups to receive an implant as follows: (1) control, no implant. (2) Synovex-S (20 mg estradiol benzoate + 200 mg progesterone) (3) Compudose (17 β-estradiol) (4) Revalor-S (24 mg estradiol + 120 mg trenbolone acetate). Following the implanting, the steers were fed a high concentrate diet and were finished in a period of 135 days. The Revalor-S treated cattle had increased ($P < 0.001$) average daily gain in comparison to the control cattle. Longissimus area and carcass weight were not different among treatments ($P > 0.05$). Implants reduced ($P < 0.05$) the amount of intramuscular fat/gram of tissue as compared to the control. The reduction in fat was not dependant upon the type of implant used, both androgenic and estrogenic implants reduced intramuscular fat to approximately the same degree. The proportion of fatty acids, including CLA, was not different between treatments when evaluated per gram of fat extracted. However, a reduction ($P < 0.05$) in CLA was detected in implanted cattle when evaluated as 100 g tissue per gram of fat extracted. External fat was not different ($P > 0.05$) among treatments. No differences ($P > 0.05$) were found in Warner-Bratzler shear force values among implant treatments. Quality and yield grades were not affected ($P > 0.05$) by the treatments. Consumers will receive less intermuscular lipid and CLA/serving when they consume beef from cattle implanted with commercially available implants.

Key Words: Implants, Carcass-quality, CLA

516 *In vivo* inhibition of nitric oxide synthase increases post-slaughter lactate production and improves tenderness in ovine *Longissimus thoracis et lumborum*. J.J. Cottrell*[1,2], F.R. Dunshea[2], M.B. Mc Donagh[2], and R.D. Warner[1,2], [1]*Victoria University, Werribee, Victoria, Australia.*, [2]*Natural Resources and Environment, Werribee, Victoria, Australia*.

The aim of this experiment was to determine the effects of nitric oxide (NO) on post-slaughter muscle metabolism and meat tenderness. Nitric oxide synthase (NOS) was inhibited by a bolus i.v. injection of L-arginine methyl ester hydrochloride (L-NAME). Forty Border Leicester x Merino lambs (ca. 42 kg) were randomly assigned to a 2 x 2 factorial design with the respective factors being L-NAME injection (0 or 30 mg/kg at 135 min pre-slaughter) and exercise (0 or 15 min pre-slaughter). Exercise was conducted on individual lambs in a small paddock in the presence of a stock handler. Control lambs were moved from individual pens to abattoir (approx. 200 m) in a small flock. Plasma glucose immediately pre-slaughter was reduced by L-NAME, particularly in exercised lambs as indicated by the interaction. Plasma lactate increased with exercise, but was unchanged by L-NAME. *Longissimus et thoracis lumborum* (LTL) lactate at 5 min, but not 24 h post-slaughter, was increased in exercised animals, particularly in LTL from lambs injected with L-NAME. These data suggest that L-NAME did not change total LTL glycogen, but rather increased the rate of postmortem glycolysis. L-NAME decreased LTL Warner-Bratzler shear force (WBSF). In conclusion, LTL NOS activity increases with exercise and inhibition of NOS with L-NAME accelerates glycolysis and improves tenderness. *Supported in part by Meat and Livestock Australia.*

L-NAME, mg/kg (L)	0	0	30	30			P-value	
Exercise (E)	no	yes	no	yes	SED	L	E	LXE
Plasma								
Glucose, mM	3.4	8.1	3.2	6.1	0.74	0.06	<0.001	0.09
Lactate, mM	2.9	11.1	2.1	11.0	1.96	0.75	<0.001	0.80
LTL								
Lactate- 5 min, g/100g	1.3	1.6	1.0	1.9	0.19	0.75	<0.001	0.03
Lactate-24 h, g/100g	6.1	5.8	6.1	6.0	0.21	0.43	0.20	0.41
WBSF, kg/cm^2	8.2	9.2	6.6	8.1	0.89	0.04	0.07	0.68

Key Words: Nitric oxide, Muscle metabolism, Meat quality

517 Mutation in turkey alpha-RyR genomic DNA. W. Chiang*, J. Linz, M. Maile, and G. Strasburg, *Michigan State University*.

Pale, soft, exudative (PSE) meat has become a serious quality problem in the turkey processing industry in a manner reminiscent of the PSE problem in pork. There is general agreement that genetic and environmental factors contribute to the incidence of this problem. Pigs susceptible to porcine stress syndrome (PSS) or malignant hyperthermia (MH) are genetically predisposed to yield a higher incidence of PSE pork as a result of a mutation (R615C) in the ryanodine receptor (RyR1). This mutation is associated with higher calcium release rates that accelerate glycolysis, resulting in rapid, early-postmortem pH decline, protein denaturation, and loss of protein functionality. Likewise, there are at least twenty mutations in RyR1 associated with human MH; nine of these mutations are clustered between residues 35 and 615. Avian muscle comprises two RYR isoforms: αRyR and βRyR, which are homologous to mammalian RyR1 and RyR3, respectively. Based on the similarity in development of porcine and turkey PSE meat, we hypothesized a mutation exists in turkey αRyR which predisposes birds to the development of PSE meat. Analysis of the αRyR cDNA covering amino acids 376 to 614 (human sequence) revealed two cDNA variants. One is homologous to the mammalian RyR1 sequence in this region, whereas the other is characterized by the absence of 81 bp. The 81-bp deletion results in the loss of 27 amino acid residues corresponding to Ser-416 to Ser-443. Analysis of the turkey αRyR genomic DNA sequence suggests that there are two αRyR alleles which differ by the presence or absence of the 81 bp domain. These data suggest that the absence of the 81 bp in the αRyR cDNA sequence is the result of a mutation. Comparison of the genomic DNA sequences of human RyR1 and turkey αRyR over amino acid residues 376 to 479 also suggests that intron 12 of the human sequence is absent in the turkey αRyR gene. The significance of the deletion in αRyR function and its relationship to muscle food quality are under investigation.

Key Words: Ryanodine Receptor, PSE, Turkey

518 Phospholipids and plasmalogens as precursors of flavor in beef. S. Lorenz*[1], P. Schieberle[2], K. Ender[1], and K. Nuernberg[1], [1]*Research Institute for the Biology of Farm Animals,* [2]*Deutsche Forschungsanstalt fuer Lebensmittelchemie*.

Fatty acids are known precursors of several characteristic flavor compounds of meat. (E,E)-2,4-decadienal, nonanal or 1-octen-3-one originating from different precursor fatty acids have been confirmed as character impact odorants of, e.g., stewed beef juice. But there is another important characteristic odorant detected in stewed beef juice. The branched aldehyde 12-methyltridecanal (12-MT), smelled tallow and beef-like, is bounded in plasmalogens. The major objective of this study was to develop a method for the determination of 12-MT in plasmalogens using high-performance liquid chromatography (HPLC). A second objective was to estimate the fatty acid composition of the phospholipids and plasmalogens using gas chromatography. The HPLC procedure for 12-MT based on the formation of 2,4-dinitrophenylhydrazones of carbonyl compuonds. After purification the derivates can be separated with an HPLC system with acetonitrile-water on RP-18 silica gel column. The fatty acid composition was carried out on a 100 m CP Sil-88 column with hydrogen as carrier gas. Ten (group A: pasture, n = 6; group B: concentrate, n = 4) German Simmental cattle were used in the investigation. The phospholipids of the longissimus were separated into different classes using thin layer chromatography. The major classes of beef muscle were phosphatidylcholine (PC) and phosphatidylethanolamine (PE). The PC content was significantly ($P < 0.05$) higher in group B (245 mg) to 264 mg / 100 g muscle (group A). The amount of PE showed with 151 mg (group A) and 142 mg/100 g muscle (group B) no significant difference. The aldehyde composition of both PC and PE was estimated using HPLC. The major aldehydes are hexadecanal and octadecanal. The different feeding system led to significant ($P < 0.05$) changes of both aldehydes in the class of PE. Octadecanal, e.g., increased from 3.3 mg (group B) to 4.7 mg / 100 g muscle (group A). However, lower chain aldehydes (C10 # C14) could be identified, too. PC showed the highest amount of 12-MT with 17.1 μg (group A) and 13.0 μg / 100 g muscle (group B). There was no significant difference between the groups.

Key Words: phospholipid, beef, aldehyde

Nonruminant Nutrition
Amino Acid and Protein Nutrition

519 Foundations for current knowledge of protein and amino acids for swine. W. Pond, *Cornell University, Ithaca, NY.*

The present knowledge of protein and amino acid (AA) requirements in swine is based on a continuum of research spanning nearly a century. Hanson (J. Anim. Sci. 17:1029-1057, 1958) reviewed 50 years of progress in the early understanding of protein and AAs in swine nutrition. McCollum and Steenbock in 1912 and Osborne and Mendel in 1914 set the stage for the concept of essential AAs when they reported that zein (the major protein of corn) supported rat survival, but not growth, and that the addition of missing AAs promoted growth. In the 1930s, W.C.Rose reported the AAs required for rat growth; this formed the basis for the flood of research in the 1950s which established that the growing pig requires the same 10 AAs as the growing rat. Early methods to establish AA requirements of swine were focused mainly on measurements of growth and N-balance. The concepts of AA imbalance and of interactions among AAs and between AAs and other nutrients emerged during the 1950s and 1960s. More recent studies refined estimated AA requirements for growth, gestation and lactation. Other refinements, such as ileal digestibility and the concept of ideal protein, based on optimum ratios of AAs, were also made possible by the efforts of earlier investigators. The advent of inexpensive crystalline AAs for addition to feeds marked yet another major advance in efficient protein utilization. The future of AA and protein research and its application promises even more exciting discoveries.

Key Words: Amino acids, Protein, Swine

520 Whole body and hindlimb protein breakdown is differentially altered by feeding in piglets. M.C. Thivierge*[1&2], H.V. Nguyen[1], J.A. Bush[1], A. Suryana[1], R. Orellana[1], C.W. Liu[1], D.G. Burrin[1], F. Jahoor[1], and T.A. Davis[1], [1]*USDA/ARS Children's Nutr. Res. Ctr., Dept. Pediatr. Baylor Coll. Med., Houston, Texas* , [2]*FSAA, Universit Laval, QC, Canada*.

The neonatal period is characterized by a high rate of muscle protein accretion, which is due, at least in part, to an elevated rate of skeletal muscle protein synthesis in response to feeding. However, little is known about the regulation of protein breakdown by feeding during the neonatal period. To determine the feeding-induced response of protein breakdown at the whole body level and across the hindlimb, overnight-fasted 28-day-old pigs (n=6) were infused for 7 h with [1-13C]phenylalanine and [ring-D4]tyrosine during an initial 4 h fasting period and a 3 h refeeding period. Refeeding was achieved by continuous intraduodenal infusion of an elemental diet. Plasma samples were obtained simultaneously from the carotid artery and the vena cava; blood flow of the caudal aorta was recorded using ultrasonic flow probes. The results indicate that refeeding increased whole body phenylalanine flux (+92%), phenylalanine oxidation (+300%), and whole body protein synthesis (+81%). Refeeding decreased whole body protein breakdown (-45%); protein breakdown represented 28% of whole body flux in the refed state. Phenylalanine hydroxylation to tyrosine increased with refeeding (+7-fold). In the hindlimb, refeeding increased the utilization of phenylalanine for proteins synthesis (+233%) and this was associated with an increase in blood flow (+20%). However, refeeding did not alter protein breakdown in the hindlimb. The ratio of hindlimb protein breakdown over hindlimb phenylalanine flux indicates that muscle protein is mobilized during the fasting period but that protein degradation accounts for only 30% of hindlimb flux during the refeeding. Thus, the results show that proteolysis is more sensitive to feeding at the whole body level than in the hindlimb in 28-day-old piglets. Furthermore, the protein anabolic response to feeding in the hindlimb is driven primarily by a stimulation of protein synthesis.

Key Words: Proteolysis, Hindlimb, Piglets

521 Low protein diets can be fed to gestating sows without adverse effects. S. Möhn*, D. J. McMillan, and R. O. Ball, [1]*University of Alberta, Edmonton*.

Reducing dietary protein content can reduce the N excretion of pigs. Performance should not be affected if low protein diets are supplemented adequately with free amino acids. We tested the effect of supplemented low protein diets on the performance of 80 sows during their second and third parity. Sows were offered isoenergetic barley-based diets containing either 14.8 % crude protein (CP, group HP) or 12.0% CP with added lysine and threonine (LP). At allocation, breeding body weight (BW) and back fat (BF) were similar for HP and LP. Litter size and weight in the first parity were similar for LP and HP. At similar daily feed intake (LP: 2.23 0.03 kg, HP: 2.25 0.02 kg), weight gains during pregnancy were similar in LP (55.9 1.1 kg) and in HP (55.4 1.2 kg). BF when 40 d or 95 d pregnant were similar in LP (19.7 0.5 mm and 19.6 0.4 mm, respectively) and HP (19.3 0.5 mm and 19.2 0.3 mm, respectively). At breeding for the third parity, BW in LP was lower (180.3 2.2 kg) than in HP (186.8 2.5 kg, $P = 0.05$), but BF was similar (LP: 17.0 0.4 mm, HP: 17.0 0.4 mm). By day 40 of the third parity, BW was similar in LP (202.4 1.7 kg) and HP (205.0 2.2 kg). At similar daily feed intake (LP: 2.47 0.03 kg, HP: 2.51 0.03 kg), weight gains during the third pregnancy were slightly greater ($P = 0.098$) in LP (66.4 1.4 kg) than in HP (62.7 1.6 kg). BF when 40 d or 95 d pregnant were similar in LP (17.8 0.4mm and 18.5 0.3 mm, respectively) and HP (17.7 0.4 mm and 18.5 0.3 mm, respectively). Parity had no effect on N excretion determined in 6 animals per group. Urinary N to creatinine ratio showed that N excretion in LP was lower ($P = 0.04$) by 28.7% compared to HP during early pregnancy. During late pregnancy, N excretion was similar for HP and LP. Overall, N excretion tended to be lower ($P = 0.08$)by 19.4% in LP compared to HP. Our results indicate that low protein diets can be used successfully for pregnant sows because they promote the same growth rate as conventional diets while reducing N excretion. Funding was provided by Alberta Pork, AARI and Degussa AG.

Key Words: Sows, Gestation, Protein intake