

**74 Myofibrils isolated from red and white porcine muscles respond differently to pH.** B. C. Bowker<sup>\*1</sup>, D. R. Swartz<sup>2</sup>, A. L. Grant<sup>1</sup>, and D. E. Gerrard<sup>1</sup>, <sup>1</sup>*Purdue University, West Lafayette, IN*, <sup>2</sup>*Indiana University Medical School, Indianapolis, IN*.

The pH-dependent ATPase activity of myofibrils from muscles varying in fiber type is thought to modulate postmortem muscle metabolism. The objective of this study was to determine the effects various conditions, simulating postmortem conditions, have on myofibrillar ATPase activity of red semitendinosus (RST) and white semitendinosus (WST) porcine muscle. The ATPase activity of myofibrils was measured at 39°C, 10-4 M Ca<sup>2+</sup>, and pH ranging from 5.0 to 7.5 at 0.25 unit intervals. To test if decreased pH irreversibly alters myofibrillar ATPase activity, activity was measured using myofibrils incubated 90 min at 39°C at pH 7.0, then pH 5.0 or 6.0, and back to pH 7.0. Maximum activity was at approximately pH 7.0 with WST myofibrils exhibiting greater ( $P < .0001$ ) ATPase activity than RST myofibrils (0.621 vs. 0.445 nmole Pi/mg protein/min). Activity of both RST and WST myofibrils declined from maximum rates to approximately zero between pH 6.25 and 5.5. Activity declined to half-maximal levels at pH 5.95 in both RST and WST myofibrils. After incubation at pH 5.0, activity was not recovered in RST or WST myofibrils. Following incubation at pH 6.0, ATPase activity recovered to a higher ( $P < 0.05$ ) percent of maximum activity in RST than WST myofibrils. These data suggest that postmortem muscle pH and muscle fiber type affect overall myofibrillar ATPase activity and that low pH may irreversibly alter myofibrillar proteins causing a loss in ATPase activity, with this pH sensitivity being more pronounced in WST than RST.

**Key Words:** Myofibrils, ATPase activity, pH

**75 Relationship between muscle fiber type and pork quality traits of pigs selected for leanness and growth efficiency.** C.R. Kerth<sup>\*</sup>, A.A. Helm, D.L. Kuhlert, L.B. Cagle, L.K. Blair-Kerth, and W.R. Jones, *Auburn University, Auburn AL*.

Progeny from the sixth generation of Duroc pigs selected for leanness and growth efficiency or a control line of pigs maintained from the base population were tested to determine the relationship between muscle fiber types and muscle quality traits. Random samples of pigs from each genetic line with mixed sexes ( $n = 31$ ) were slaughtered at 114 kg. Longissimus muscles were measured for postmortem pH at 0.5, 1, 2, 3, 4, and 22 to 24 h postmortem. Chops were removed to determine Hunter L\*, a\*, and b\* values, drip loss, water holding capacity, and fiber typing. Muscle fiber type samples were stained for acid-stable ATPase activity to determine muscle fiber type. Correlation and regression analyses were conducted to determine the relationship between muscle fiber type and muscle quality traits. No significant correlation existed ( $P > 0.05$ ) between muscle fiber type and percent drip loss, Hunter a\* and b\* values, percent moisture, or postmortem pH at 0.5, 1, 2, 3, 4, and 22 to 24 hours. Genotype did not affect ( $P > 0.05$ ) mean fiber type percentage. Hunter L\* values were negatively correlated with slow-twitch oxidative (SO) fiber types ( $r = -0.39$ ) and positively correlated with fast-twitch glycolytic (FG) fiber types ( $r = 0.49$ ,  $P < 0.05$ ). No correlation existed ( $P > 0.05$ ) between percent free water and SO or FG fiber types. However fast-twitch oxidative, glycolytic (FOG) fiber types were negatively correlated ( $r = -0.40$ ) with percent free water and positively correlated with percent bound and immobilized water ( $r = 0.40$  and  $0.40$  respectively,  $P < 0.05$ ). Regression analysis showed that percent FG muscle fiber types accounted for 23.8% and SO muscle fiber types accounted for 14.9% of the variation in Hunter L\* ( $P < 0.05$ ). The percentage of FOG fiber types accounted for 16.1% ( $P < 0.05$ ) of the variation in percent free water. These data indicate that a relationship exists between muscle fiber type and objective muscle quality traits of pigs selected for increased leanness and growth efficiency.

**Key Words:** Muscle Fiber Type, Water-holding, Muscle Color

**76 Variation in color and pH measurements throughout boneless pork loins.** C. L. Lorenzen<sup>\*1</sup>, J. L. Norman<sup>1</sup>, G. K. Rentfrow<sup>2</sup>, C. A. Stahl<sup>2</sup>, E. P. Berg<sup>2</sup>, and M. R. Ellersieck<sup>3</sup>, <sup>1</sup>*Food Science and Engineering Unit*, <sup>2</sup>*Animal Sciences Unit*, <sup>3</sup>*Department of Statistics, University of Missouri - Columbia*.

Color is an extremely important consideration for merchandising pork both domestically and internationally. The objective of this study was to characterize the changes in color and pH throughout the length of the boneless pork loin. Center cut boneless pork loins ( $n = 93$ ) were obtained commercially and segmented according to NPPC color standards assessed at the sirloin face of bone-in loins. Treatment 1 included NPPC color standards 1 and 2; treatment 2, standards 3 and 4; and treatment 3, standards 5 and 6. Loins were cut into 2.54 cm chops and allowed to bloom for at least 10 min. Hunter color L\*, a\*, b\* values and pH measurements were taken on all chops in the loin starting at the sirloin end. Treatment affected ( $P < .05$ ) all measures of color. Hunter color L\*, a\*, and b\* values for chops differed ( $P < .05$ ) by position of chop in the loin. All regression equations used to predict color values were polynomial with R<sup>2</sup> values of 0.71, 0.87, and 0.95 for L\*, a\* and b\*, respectively. A treatment by position interaction ( $P < .05$ ) existed for pH values with treatment 3, sirloin end being the highest and treatment 1, blade end the lowest. The center of the loin is typically merchandized as the high-value, high yield portion of the loin most popular with consumers. This study indicates that there is variation in color and pH throughout the loin; therefore, a single measurement at the end of the loin may not accurately predict the color of pork in the portion of the loin that creates retail demand.

Treatment	L*-	a*-	b*-
1	58.17 <sup>a</sup>	6.35 <sup>b</sup>	15.18 <sup>a</sup>
2	51.48 <sup>b</sup>	6.99 <sup>ab</sup>	14.27 <sup>b</sup>
3	45.55 <sup>c</sup>	7.36 <sup>a</sup>	12.77 <sup>c</sup>

<sup>a,b,c</sup>Means within a column lacking a common superscript differ ( $P < .05$ )

**Key Words:** Pork, Color, pH

**77 In-home consumer acceptance of boneless pork loins varying in color.** J. L. Norman<sup>\*1</sup>, C. L. Lorenzen<sup>1</sup>, C. A. Stahl<sup>2</sup>, G. K. Rentfrow<sup>2</sup>, E. P. Berg<sup>2</sup>, and H. Heymann<sup>1</sup>, <sup>1</sup>*Food Science and Engineering Unit*, <sup>2</sup>*Animal Sciences Unit, University of Missouri - Columbia*.

The objectives of this study were to determine the effects of color and light reflectance on Warner-Bratzler shear force values and (or) on consumer preferences for pork. Center-cut boneless pork loins ( $n = 60$ ) were divided into three groups based on NPPC color standards. Treatment 1 included NPPC color standards 1 and 2; treatment 2, 3 and 4; and treatment 3, 5 and 6. Loins were cut into 2.54 cm chops. Two chops obtained from the center section of each loin were used to determine Warner-Bratzler shear force, Hunter color L\*, a\*, b\*, and pH values. The "in-home" portion of this study consisted of two three-week repetitions where consumers prepared, consumed, and evaluated specific pork chops. Chops were allotted randomly for both treatment and week of repetition. Consumers used a nine-point sensory hedonic scale for the attributes overall likeness, tenderness liking, juiciness liking, and flavor liking; where 1 = dislike extremely and 9 = like extremely. A total of 47 households completed both repetitions of the study. Hunter color L\*, a\*, b\*, and pH measurements differed ( $P < .05$ ) by treatment. L\* means were 57.01, 50.24, and 45.54 for treatments 1, 2, and 3, respectively. Warner-Bratzler shear force values were not affected by treatment ( $P > .05$ ), but the percentage cook yield of dark pork was 3.5 % higher than light pork ( $P < .05$ ). Consumers detected differences in juiciness and tenderness liking ( $P < .05$ ) due to treatment. Warner-Bratzler shear force values were negatively correlated with a\* and b\* values ( $P < .0001$ ;  $r = -0.295$  and  $-0.314$ , respectively). Neither, Warner-Bratzler shear force values nor consumer preferences were affected ( $P > .05$ ) by color grouping or light reflectance.

**Key Words:** Pork Quality, Tenderness, Light Reflectance

## 78 Muscle glycogen and lactate content and pork quality traits as affected by available dietary carbohydrate in pigs. G. Bee\*, <sup>1</sup>Swiss Federal Research Station for Animal Production.

The aim of the study was to determine whether muscle glycogen content and pork quality traits could be modified by availability of carbohydrates in the diet. Biopsy samples of longissimus (LM) from 48 Swiss Large White pigs (25 gilts; 23 barrows) weighing 70 kg were collected, and the glycolytic potential (GP = 2[(glycogen + glucose + glucose-6-phosphate) + lactate] was determined to vary from 111 to 187  $\mu\text{mol/g}$  wet weight. At 90 kg pigs were moved into individual pens and assigned (blocked by GP and sex) to be fed 2.8 kg of a diet either high (H) or low (L) in available carbohydrate up to 104 kg. Pigs were fasted over night (15 h) before slaughter. Glycogen and lactate content were determined in samples of LM (predominately glycolytic) collected 30 min and 24 h after stunning, and in samples of the dark part of the semitendinosus (ST, oxidative muscle) collected 24 h after stunning. Measurements of pH were carried out in the LM 30 min and 24 h after slaughter. Hunter L\*, a\*, b\* values and drip losses were assessed the day after dissection. Overall glycogen and lactate levels 24 h postmortem were higher in the LM compared to the ST (19.5 vs. 11.5  $\mu\text{mol/g}$ ; 95.4 vs. 74.8  $\mu\text{mol/g}$ ;  $P < 0.05$ ). Diets did not affect pH, color, drip losses, or glycogen and lactate concentrations of the LM. The diets affected the glycogen content of the ST in gilts (H: 14.7 vs. L: 9.2  $\mu\text{mol/g}$ ) but not in barrows. Lactate concentrations in the ST were also higher in pigs fed the H diet (H: 76.3 vs. L: 73.4  $\mu\text{mol/g}$ ;  $P = 0.03$ ). Compared to diet L, Hunter L\* values tended to be lower (H: 42.6 vs. L: 43.6;  $P = 0.07$ ) in the ST of animals fed diet H, and b\* (H: 6.8 vs. L: 5.6;  $P < 0.05$ ) and drip losses (H: 4.8 vs. L: 3.1%;  $P \leq 0.05$ ) were higher in gilts but were unaffected in barrows. Hunter L\*, a\*, b\* and drip losses were positively correlated with glycogen (0.36; 0.34; 0.57; 0.59;  $P < 0.05$ ) and lactate content (0.36; 0.28; 0.34; 0.27) in the ST, whereas the correlations were not significant in the LM. In conclusion, dietary treatment affected quality traits of the ST, but not of the LM muscle, and the effects were more pronounced in gilts than barrows.

**Key Words:** pigs, glycolytic potential, pork quality

## 79 Influences of nutritional levels on porcine muscle development and meat quality. Daiwen Chen\*, Keying Zhang<sup>1</sup>, Zhuyu Hu<sup>1</sup>, Feiyun Yang<sup>2</sup>, and Zuohua Liu<sup>2</sup>, <sup>1</sup>Institute of Animal Nutrition, Sichuan Agricultural University, PR.China, <sup>2</sup>Academy of Swine Research of Chongqing, PR.China.

This study was to investigate the growth models of pigmeat traits at high (HL) and low (LL) nutritional levels. Landrace x Rongchang barrows (n = 90) with 18 kg bodyweight (BW) were randomly allotted into two treatments with 3 replicates each. Pigs were fed with diets containing DE 14.2 MJ/kg and CP 18%, 15.5% and 13.2% for the stage of 18-50, 50-80 and 80-100 kg, respectively (HL) or diets with DE 12.1 MJ/kg and CP 15.5%, 13.2% and 11.2% for each stage (LL). For each replicate, 3 pigs were killed at 20, 35, 50, 80 or 100 kg BW to examine meat measurements. Quality traits were measured at 45 min postmortem. The amount (kg) of lean deposition increased linearly with BW ( $= 0.4156 + 0.3299 \text{ BW}(\text{kg})$ ,  $R^2 = 0.9997$ ,  $P < 0.001$ ), but didn't vary with nutritional levels ( $P > 0.05$ ). There were no differences for color score of longissimus muscle (LM) among treatments. LM area, lean percentage (LP) in carcass, intramuscular fat (IMF) content and water loss (WL) of meat after 5-min pressure under 35-kg force responded quadratically to BW (x, kg) ( $P < 0.001$ ) as follows. Analyses of these equations showed that the effects of HL and LL on LM area and LP differentiated from 70 kg on, and those on IMF and WL from 40 kg. It was concluded that nutritional levels did not influence development models of meat traits and meat quality until pigs reach a certain bodyweight.

**Key Words:** Meat Quality, Development Model, Nutritional Level

## 80 Effects of dietary supplementation of copper and Vitamin E on pigmeat quality. Daiwen Chen\*, Keying Zhang, Yongyi Li, Fangqun Li, Zhuyu Hu, and Xuwei Li, Institute of Animal Nutrition, Sichuan Agricultural University, Yaan, Sichuan 625014, PR.China.

Copper (Cu) is widely used as growth promoter for growing-finishing pigs in China. Whether Cu application has impacts on meat quality and vitamin E (VE) needs to be supplemented in Cu-containing diets are not

known. Two experiments were conducted in this study to investigate the effects of Cu or/and VE supplementation in diets on pigmeat quality. In Exp.1, 250 ppm Cu in form of copper sulfate or 200ppm VE or Cu and VE together were added into corn-soybean-meal basal diet(control) which contained DE 13.8MJ/kg, CP 16.5-14%, Cu 16-20 ppm, and VE 27-40 ppm. In Exp.2, 200 ppm VE was supplemented into 250-ppm-Cu basal diets(control) when pigs reached 20, 60 or 80 kg liveweight (LW). For each Exp., 36 Large White x Landrace barrows with initial LW of 20 kg were randomly allotted into 4 treatments with 3 replicates each. Pigs were slaughtered at 100kg LW. Cu supplementation tended to increase ( $p < 0.1$ ) average daily gain (ADG), feed conversion rate (FCR), area of longissimus muscle, and decrease backfat thickness. No significant differences were observed for color scoring, marbling, pH, drip loss and the contents of protein, lipid, collagen, Cu, Fe and VE for both fresh meat and meat chops stored at  $-4^\circ\text{C}$  up to 9 days. VE supplementation in diets either with or without Cu supplementation tended to improve ( $p < 0.1$ ) ADG, FCR, color scoring, and decrease drip loss of fresh meat. Fe, Cu and VE contents in fresh meat were enhanced ( $P < 0.05$ ). After meat chops were stored at  $-4^\circ\text{C}$  for 9 days, VE content and color scoring were higher, and drip loss and lipid oxidation, reflected by thiobarbituric acid reaction value, were lower for VE supplementation ( $p < 0.01$ ) compared to the control. The extent of effects was greater when VE was included at 20 kg LW than at 60 kg or 80 kg. There were no interactions between Cu and VE. It is concluded that Cu supplementation in growing-finishing diets has no adverse effects on pork quality and VE supplementation was able to improve pork quality and extend pork shelf life.

**Key Words:** Meat Quality, Copper/Vitamin E, Pigs

## 81 Effects of dietary levels of ideal protein on pig meat quality. Keying Zhang\*, Daiwen Chen, Xianmei Luo, Xuwei Li, Fangqun Li, and Zhuyu Hu, Institute of Animal Nutrition, Sichuan Agricultural University, Yaan, Sichuan, PR. China.

There are no investigations on the relationship between dietary ideal protein (IP) levels and pork quality up to now. In this study, sixty Large White x Landrace barrows with initial live weight (LW) of 20 kg were used to examine the effects of dietary IP levels on meat quality. Five dietary IP levels were designed as 8, 11, 14, 17 and 20% on as-fed basis (DM 89%). Corn-soybean-meal diets were formulated to contain DE 14.2MJ/kg, digestible lysine 4.75 g per 100 g of N x 6.25, and a ratio of lysine: sulfur-containing amino acids: threonine and tryptophan on digestible basis of 100:61:64:20. Pigs were randomly assigned into each treatment with 4 replicates each and given ad libitum access until 100 kg LW, when 1 pig of each replicate was slaughtered to check carcass quality. The results were showed in the table. There were no significant differences among treatments in terms of meat pH, color scoring. However, as IP increased, area and drip loss of longissimus muscle significantly improved, while marbling and intramuscular fat decreased. Because marbling, intramuscular fat and drip loss are related to meat tenderness, juiciness and overall acceptability, this study indicates that appropriately low level of dietary ideal protein may be favorable to eating quality of pig meat.

**Key Words:** Meat Quality, Ideal Protein, Pigs

## 82 Validation of three cookery methods to eliminate Listeria monocytogenes on short versus long term aged country ham slices. J.S. Kotrola\*, W.B. Mikel, and M. C. Newman, University of Kentucky, Lexington, KY.

Newly implemented USDA regulations dictate that all ready-to-eat products, of which Country-cured hams are classified, have validated cooking instruction on the label to be considered not ready to eat. Recent research indicates that if the USDA process for curing country hams is not strictly adhered to, then Listeria may possibly be present in sufficient numbers to cause illness in immuno-compromised individuals. Therefore, three cookery methods were evaluated on short versus long term aged country ham slices to determine mean temperature at which Listeria monocytogenes was no longer viable. Country-cured hams slices were inoculated with a cocktail of 5 strains of Listeria monocytogenes at  $3.70 \times 10^5$  CFU/ml,  $1.33 \times 10^5$  CFU/ml and  $7.10 \times 10^5$  CFU/ml in preparation for cookery by microwave, oven and griddle respectively. Heating times were as follows: microwave (1000 watts) for 1, 2, 4, 6, 8 min.; oven ( $350^\circ\text{F}$ ) for 2, 4, 8, 12, 16, 20 min.; and Griddle ( $350^\circ\text{F}$ ) for 30, 45, 60, 90, 120, 150 sec. There were nine observations per cook

method and time combination. After the heat treatment, 25 gm of meat was rapidly mixed with 225 ml chilled UVM broth to terminate heating effect. Microwave heating effectively eliminated the *Listeria monocytogenes* cultures after 2 minutes for the long term ham and 1 minute for short term ham slices. Oven heating resulted in no viable cultures remaining after 8 minutes for the long term and short term cured products. Griddle heating eliminated populations after 45 sec for short term aged slices and after 60 sec for long term aged sliced. The efficacy of eliminating *Listeria monocytogenes* from country cured ham slices is dependent upon time, temperature, and cookery method used.

**Key Words:** *Listeria monocytogenes*, Country-cured ham, cookery

### 83 Analysis of postmortem tenderization in porcine *longissimus dorsi* muscle. C.P. Allison\*, R.J. Tempelman, and M.E. Doumit, Michigan State University, East Lansing, MI.

Our objective was to quantify the rate and extent of postmortem tenderization in porcine *longissimus dorsi* (LD) muscle and determine if proteolysis of desmin corresponds to mechanical measures of tenderness. Berkshire (n=32) and Yorkshire (n=16) sired pigs were harvested on two days at a commercial abattoir. Four 5.72-cm sections of the LD were removed at d 1 from the 11th rib to the 3rd lumbar vertebrae. Loin sections were randomly assigned to aging treatments of 1, 3, 7 and 14 d, vacuum packaged and stored at 4°C. After storage, two 2.5-cm thick chops were cooked to an internal temperature of 71°C on Farberware Open Hearth™ broilers. Chops were cooled overnight at 4°C and three 1.27-cm diameter cores per chop were sheared with a Warner-Bratzler Shear (WBS) machine. No differences in WBS values were observed between breed or loin location (P>.05). Shear values decreased (P<.0001) from 4.1 kg at d 1 to 3.6 kg and 3.2 kg at d 3 and d 7, respectively. Chops aged for 7 and 14 d had similar WBS values (P>.05). Western blot analysis of desmin from 4 tender (<4 kg) and 4 less tender (>4.7 kg) samples at d 1 revealed that desmin degradation paralleled decreases in WBS. Intact desmin was typically undetectable in tender samples by d 7 and in less tender samples by d 14. Tenderization of most pork loin chops is complete by d 7, however some chops exhibit additional tenderization and desmin degradation between 7 and 14 d postmortem.

**Key Words:** Pork, Tenderness, Desmin

### 84 Desmin degradation influences water-holding capacity and tenderness of fresh pork. L.J. Rowe\*<sup>1</sup>, E. Huff-Loneragan<sup>1</sup>, and S.M. Lonergan<sup>1</sup>, Iowa State University Ames, Iowa.

Proteolysis of desmin and troponin-T has been related to increased tenderness of meat. Degradation of desmin may also influence water-holding capacity (WHC) by disrupting linkages among adjacent myofibrils as well as myofibrils and the sarcolemma which would allow more space for fluid to reside in the tissue. We hypothesized decreased proteolysis of the myofibril-associated protein desmin would result in reduced WHC and tenderness. The objective was to determine if degradation of desmin was related to WHC and/or tenderness of pork. Halothane negative Duroc pigs (n=82) were harvested and pH measurements of the *longissimus dorsi* (LD) were taken at 45 min and 24 h postmortem (PM). Drip loss was measured on LD chops taken at 24 h and held at 4°C for an additional 24 h. Warner-Bratzler shear (WBS) force measurements were made on chops held 5 d PM at 4°C. LD samples taken at 1 d PM and 5 d PM were analyzed by immunoblotting using antibodies for desmin and troponin-T. Immunoreactive bands were quantified using densitometry. Desmin degradation was indicated by a decrease in intensity of an approximately 55 kDa immunoreactive band while troponin-T degradation was indicated by an increase in a 30 kDa band. 24 h drip loss was significantly correlated with 45-min pH (-.372) and 24 h pH (-.329). Drip loss at 24 h was not correlated with 5 d troponin-T degradation (-.119, P=.28) but was correlated with desmin degradation (.437, P < .01) indicating that products with less desmin degradation may have greater drip loss. 45 min pH and 24 h pH measurements were also significantly correlated with 5 d desmin degradation (-.254, -.377 respectively) indicating higher pH products tended to have greater desmin degradation. WBS at 5 d was significantly correlated with 5 d desmin degradation (.295) and 5 d troponin-T degradation (-.295). These results indicated increased drip loss and decreased tenderness of pork may be related to reduced proteolysis of proteins like desmin. (This work was supported by the National Pork Producers Council.)

**Key Words:** Water-holding capacity, Tenderness, Desmin

### 85 Dietary Conjugated Linoleic Acid and IGF-I Transgene Effects on Pork Quality. J. S. Eastridge\*<sup>1</sup>, M. B. Solomon<sup>1</sup>, V. G. Pursel<sup>1</sup>, A. D. Mitchell<sup>1</sup>, and A. Arguello<sup>2</sup>, <sup>1</sup>USDA-ARS, BARC, <sup>2</sup>Univ. de las Palmas de Gran Canaria, Spain.

Transgenic (T) pigs produced with a fusion gene composed of avian skeletal  $\alpha$ -actin regulatory sequences and cDNA encoding human IGF-I have exhibited increased lean tissue and less fat than normal (N) controls. While the use of T-pigs for meat production has not yet been approved, it is worthwhile to explore the quality of the meat from these pigs. Thirty pigs (14 T and 16 N siblings) were finished on a control (CO) growing-finishing diet or with added conjugated linoleic acid (CLA) to 120 kg. Carcass weight for N pigs was heavier (P<.01) than for T (92.5 vs 87.4 kg, respectively); however T loin eye area (38.1 cm<sup>2</sup>) was 16% larger than in N (32.5 cm<sup>2</sup>). Backfat thickness was lower (P<.05) for T-CLA-fed pigs (21.4 mm) than for N-CO, N-CLA and T-CO pigs (29.8, 27.5 and 27.0 mm, respectively). Although pH at 45 min was higher (P<.01) in N (6.10) compared to T (6.01), there were no differences detected in ultimate pH (N=5.65 vs T=5.59). CLA affected pH at 45 min (5.99 vs 6.13 for CO and CLA, respectively) but not ultimate pH (CO=5.58; CLA=5.66). Gene and diet effects on pork quality traits of ultimate pH, amount of purge after 21 d, cook yield and shear force values were not different. Shear force for N vs T (6.3 vs 5.8 kg) and for CO vs CLA (6.1 vs 5.9 kg) was not different. Malonaldehyde (TBARS) formation after 5 d fresh, 21 d fresh and 6 mo frozen storage was not influenced by gene or diet. CLA added to growing-finishing diet may help reduce carcass fatness. Based on the present study, the muscle hypertrophy induced by the IGF-I transgene has no detrimental effects on quality of meat as compared to control.

**Key Words:** Pork quality, IGF-I transgenic pig, Conjugated linoleic acid

### 86 Enhanced rates of postmortem muscle glycolysis differ across porcine genotypes. M. D. Spires\*, B. C. Bowker, J. E. Hammelman, A. P. Schinckel, A. L. Grant, and D. E. Gerrard, Purdue University, West Lafayette, IN.

Pork quality development varies with genotype. Mechanisms responsible for this variation likely involve postmortem muscle metabolism. Curiously, many genotypes do not develop adverse pork quality unless they are subjected to pre-slaughter stress or postmortem mishandling. The objective of this study was to challenge pork carcasses of different genotypes using electrical stimulation (ES) to determine if some genotypes are more susceptible than others to exaggerated postmortem muscle metabolism. Three different genotypes, fifty pigs each, were slaughtered, then subjected to ES (100V or 200V, 13 pulses, 2 sec on / 2 sec off) at 15 or 25 min post-exsanguination, or no stimulation (NS). *Longissimus* muscle (LM) pH and temperature were recorded at 1, 10, 20, 30, 40, 50, and 60 min, and 24 h postmortem. Samples were collected from LM at 1, 30, and 60 min, and 24 h and analyzed for glycogen, glucose, glucose-6-phosphate (G6P), and lactate concentration. Muscle pH, but not temperature, differed (P < .05) across genotype. Genotype altered (P < .05) muscle glucose, glycogen, G6P, and lactate concentrations postmortem. In particular, G6P decreased (P < .05) from 1 to 60 min postmortem for all genotypes; however, G6P at 24 h accumulated to concentrations equivalent to 1 min levels for one genotype, but only accumulated to concentrations equivalent to 30 min levels for the other genotypes. Genotype effects were not observed for color, firmness, drip loss, 24 h pH, or CIE L\*, a\*, b\* values. These data show that genotypes respond differently to postmortem perturbation by altering muscle glycolysis.

**Key Words:** Genotype, Pigs, Muscle Metabolism

### 87 Effect of processing plant on pork quality. E. Hambrecht\*<sup>1</sup> and M.W.A. Verstegen<sup>2</sup>, <sup>1</sup>Nutreco, <sup>2</sup>Wageningen University.

The objective of the present study was to compare meat quality of pigs processed at three different plants. Plant A and B worked with head-to-heart electrical stunning (Midas<sup>®</sup>, Stork) while plant C had a CO<sub>2</sub>-dip-lift system (87% CO<sub>2</sub>, Butina). Line speed varied from 420 (plant B) to 500 pigs/hour (plant A and C). In plant A carcasses passed through a 3-phase rapid chilling tunnel (-15/-10/-1°C, air velocity (AV) 2-3m/s, 90 min), in plant B through a pre-cooling tunnel (4-5°C, AV 3-3.5m/s, 30

min), and in plant C carcasses were directly transported to the cold storage (1-3°C, AV 2m/s). All carcasses were chilled until 20 h postmortem when meat quality was measured in the loin (3<sup>rd</sup>/4<sup>th</sup> lumbar vertebra). From October to March, 9 batches of ~150 pigs each (halothane-negative, average carcass weight 87kg) were purchased at commercial farms, divided in three and sent to the plants on three consecutive days. Feed withdrawal, transport and lairage time were identical for the three plants within batch. At 30 min postmortem pH was measured: plant A and C showed a lower pH<sub>30</sub> than plant B (A: 6.50 and C: 6.53 vs. B: 6.70, P<.001). After 4 h, pH was highest at plant B and lowest at plant C (A: 6.06 vs. B: 6.12 vs. C: 5.99, P<.001). Ultimate pH (pH<sub>u</sub>) was lowest for plant C (5.62), intermediate for plant B (5.68) and highest for plant A (5.71, P<.001). In agreement with other measurements, drip losses (DL) differed between plants (P=.057) with highest DL found at

plant C (C: 5.2% vs. A: 4.8%, P<.05, B: 5.0%, P>.10). The plants ranked the same with regards to conductivity as with DL (A: 5.5 vs. B: 6.5 vs. C: 7.4 mS, P<.001). Although instrumental color measurement (Minolta) did not show significant differences, visual scoring (Japanese color scale, 1-6, 6 being darkest) revealed a paler color for plant C (A and B: 2.9 vs. C: 2.7, P<.001). Correlations (corrected for plant, batch and day of slaughter) were low to moderate: DL showed highest correlation with conductivity (r=.63) but lower correlations with pH<sub>30</sub>, pH<sub>4h</sub> and pH<sub>u</sub> (pH<sub>30</sub>: r=-.38, pH<sub>4h</sub>: r=-.38, pH<sub>u</sub>: r=-.45). It is concluded that processing plant can affect meat quality with differences being most likely related to pre-slaughter stress, stunning and/or cooling systems.

**Key Words:** Pork quality, Stunning, Cooling

## ASAS Nonruminant Nutrition: Health, Nutrition Interactions

**88 Use of menhaden oil to alter n-6:n-3 fatty acid ratios in nursery pig diets.** T. A. Meyer\*, M. D. Lindemann, G. L. Cromwell, and H. J. Monegue, *University of Kentucky, Lexington, KY.*

Weanling pigs (n=125, 21.4 d of age, and 6.8 kg BW) were used in two 28-d experiments to evaluate five dietary n-6:n-3 fatty acid (FA) ratios on performance, cell-mediated immunity, and intestinal morphology. Pigs were blocked by weight and randomly allotted to five pigs/pen. Complex diets with 5% oil (menhaden, corn, or a mixture) and calculated n-6:n-3 FA ratios of 0.7, 1.9, 6.9, 35.5, and 70.0 were then randomly allotted to pens within a replicate. Diets were formulated to contain 1.28% lysine; all other nutrients met or exceeded requirement estimates (NRC, 1998). Pig weights and feed consumption were recorded weekly. Cell-mediated immunity was assessed on d 14 and 28 by measuring the inflammatory response to an intradermal injection of phytohemagglutinin solution in the ear. One pig/pen was euthanized on d 28 and sections of duodenum and jejunum were taken to measure villi height and crypt depth. No overall differences (P = 0.10) in ADG (402, 448, 433, 456, and 428 g/d), ADFI (608, 677, 694, 709, and 656 g/d), or F/G (1.52, 1.51, 1.61, 1.56, and 1.53) occurred with increasing n-6:n-3 ratios. The inflammatory response (1.02, 1.00, 0.99, 0.93, and 0.96; 0.90, 0.86, 0.83, 0.95, and 0.85 mm) did not differ (P = 0.10) with increasing n-6:n-3 ratios on d 14 or 28, respectively. Duodenum crypt depth did not differ with increasing n-6:n-3 ratios (220, 215, 231, 213, and 225 mm; P = 0.10), but a quadratic effect occurred in jejunum crypt depth (239, 244, 252, 259, and 233 mm; P < 0.05). The duodenum and jejunum villi height (394, 394, 411, 407, and 364; 408, 432, 431, 415, and 424 mm), and villi height:crypt depth ratios (1.92, 1.93, 1.89, 2.07, and 1.70; 1.78, 1.86, 1.77, 1.68, and 1.91) did not differ (P = 0.10) among dietary treatments. Alteration of dietary n-6:n-3 FA ratios did not influence performance or skin inflammatory response to PHA, but did have a small effect on intestinal morphology.

**Key Words:** Pigs, Fatty acids, Performance

**89 Response of early-weaned pigs to pea protein isolate-based diets supplemented with chicken egg-yolk anti-E. coli (K88) antibody.** A. Owusu-Asiedu\*<sup>1</sup>, R. R. Marquardt<sup>1</sup>, C. M. Nyachoti<sup>1</sup>, and S. K. Baidoo<sup>2</sup>, <sup>1</sup>University of Manitoba, Winnipeg, Manitoba/Canada, <sup>2</sup>University of Minnesota, Minneapolis, Minnesota/USA.

In practical swine production, enterotoxigenic *E. coli* (ETEC) infection and resulting scours is a major problem for young pigs especially where purified plant proteins compared to spray-dried porcine plasma (SDPP) are fed. The effect of supplementing a pea protein isolate (PPI)-based diet with egg-yolk antibodies (EYA) obtained from laying hens immunized with ETEC K88 on piglet performance and incidence of scours was studied in a 14-d experiment. Ninety 10-d old weaned pigs were assigned to 5 dietary treatments in a completely randomized design to 6 replicate pens per treatment. The treatments were PPI, PPI + EYA, SDPP, SDPP + EYA and PPI + SDPP. All diets were formulated to similar nutrient levels and provided for ad libitum consumption. On d 7, piglets were orally challenged with 6 ml of ETEC K88 dose of 10<sup>12</sup> CFU ml<sup>-1</sup>. Piglets were weighed on d 7 and every other d after ETEC challenge. Weekly feed intake, BW change and number of piglets with scours and scour score were recorded. Fecal swabs from 10 pigs per treatment were taken for polymerase chain reaction (PCR) test to detect *E. coli* K88.

Feed efficiency ranged from 1.3 to 1.4 and was not affected (P>0.05) by dietary treatment. Mean daily feed intake was lower (P<0.05) in piglets fed diet PPI (64.3 g/d) compared to PPI + EYA (94.8 g/d) during WK 1. Piglets fed PPI without EYA had lower (P<0.05) ADG (84.0 g/d) compared to those fed PPI + EYA (123.0 g/d) or SDPP-based diets. Scour appeared in all groups of pigs 4-6h after ETEC K88 oral challenge. However, piglets fed PPI + EYA or SDPP-based diets recovered after 10h post-challenge, whereas those fed PPI continued to have severe diarrhea resulting in 46.5% mortality. PCR results showed that all PPI fed piglets continued to shed ETEC K88 at the end of the 14-d experimental period. It was concluded that specific EYA and SDPP can provide passive control of ETEC (K88) infection and potentially improve feed intake and weight gain in early-weaned pigs fed PPI

**Key Words:** Porcine plasma, *E. coli*, Scours

**90 High levels of dietary ascorbic acid on liver gulonolactone oxidase activity, serum and liver ascorbic acid concentration, and growth performance of postweaning pigs.** S. Ching\*<sup>1</sup> and D.C. Mahan, <sup>1</sup>The Ohio State University.

Pig liver ascorbic acid synthesis activity was found to be suppressed while nursing the sow, but increased during the initial 2 wk postweaning. Blood and tissue ascorbic acid concentration declined postweaning and continued at a low concentration for several weeks. This experiment therefore evaluated the effects of feeding high dietary vitamin C levels on liver gulonolactone oxidase (GLO) activity, tissue ascorbic acid contents, and growth performance during a 38 d postweaning period. A randomized complete block design was conducted with four levels of dietary ascorbic acid (0, 500, 1000, 3000 ppm) in 12 replicates. Diets were comprised using typical Phase 1, 2, and 3 starter pig diets, except that a stabilized form of vitamin C (Stay C ? 35%) was used. A total of 260 crossbred pigs was weaned at 17 d of age and averaged 6.2 kg BW. At the end of each phase (10, 24, and 38-d postweaning) pigs were weighed and feed consumption measured. Pigs were bled at each period with the serum analyzed for ascorbic acid. Two pigs per treatment group were killed at the end of each period and liver GLO activity and ascorbic acid concentration determined. Daily gains (P < 0.05) and G/F ratio (P < 0.10) increased linearly as dietary ascorbic acid increased during the 0 to 10-d period, but not thereafter. Liver GLO enzyme activity decreased linearly (P < 0.01) at 10, 24, and 38 d as dietary vitamin C increased. As dietary vitamin C levels increased, serum ascorbic acid (P < 0.01), liver ascorbic acid (P < 0.01), and urinary ascorbic acid (P < 0.01) increased at 10, 24, and 38-d postweaning. These results indicate that high levels of dietary vitamin C suppressed vitamin C synthesis in the pig, but stimulated pig growth and feed efficiency during the initial 10-d postweaning with higher serum, tissue, and urinary ascorbic acid concentrations.

**Key Words:** Ascorbic acid, Gulonolactone oxidase, Weanling pigs

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