

## Meat Science and Muscle Biology: Meat Science Poster Session 1

**M161 Regulation of CYP17A1 activity and its potential implications on the development of boar taint.** M. J. Billen and E. J. Squires\*, *University of Guelph, Guelph, Ontario, Canada.*

Male pigs are routinely castrated to prevent boar taint from the accumulation of 16-androstene steroids, in particular 5 $\alpha$ -androstene. Our objectives were to investigate how the two forms of porcine CYB5, CYB5A and CYB5B, and the phosphorylation status of porcine CYP17A1 modulate 17 $\alpha$ -hydroxylase, C17,20 lyase and andien- $\beta$  synthase activity of CYP17A1. We were especially interested in systems that would maintain the normal production of sex steroids (through the 17 $\alpha$ -hydroxylase and C17,20 lyase reactions) while decreasing the production of the 16-androstene steroids (through the andien- $\beta$  synthase reaction), since this might lead to methods for controlling boar taint. HEK-293 cells that were over expressing CYP17A1, cytochrome P450 reductase (POR), cytochrome b5 reductase (CYB5R3) and cytochrome b5A (CYB5A) or cytochrome b5B (CYB5B) were used. Increasing the ratio of CYB5A to CYP17A1 caused a decrease in 17 $\alpha$ -hydroxylase, a transient increase in C17,20 lyase, and an increase in andien- $\beta$  synthase activity ( $p < 0.0001$ ). Increasing the ratio of CYB5B to CYP17A1 also decreased 17 $\alpha$ -hydroxylase ( $P < .004$ ), but did not affect the andien- $\beta$  synthase activity; however, the C17,20 lyase was significantly increased ( $P < .004$ ). In cells over expressing CYB5A, treatment with the phosphatase inhibitor, okadaic acid (OA) increased C17,20 lyase activity ( $P < .004$ ) and decreased 17 $\alpha$ -hydroxylase and andien- $\beta$  synthase activities ( $P < .003$ ), while co-transfection with an expression vector for protein phosphatase 2A (PP2A) increased 17 $\alpha$ -hydroxylase and decreased C17,20 lyase and andien- $\beta$  synthase activities ( $P < .020$ ). Using site directed mutagenesis to change wild type CYP17A1-Ser106 to CYP17A1-Ala106 resulted in an increase in 17 $\alpha$ -hydroxylase and decrease in C17,20 lyase activities ( $P < .05$ ) in the presence of CYB5A. These results point to the different isoforms of CYB5 and phosphorylation status of CYP17A1 as selective targets for producing entire male pigs with a normal production of sex steroids and decreased production of the 16-androstene steroids that contribute to boar taint

**Key Words:** boar taint, cytochrome b5, phosphorylation

**M162 Effects of dietary energy level and slaughter weight on carcass quality traits and grades in finishing pigs.** M. J. Park<sup>1</sup>, J. Y. Jeong<sup>1</sup>, D. M. Ha<sup>2</sup>, J. C. Han<sup>2</sup>, B. C. Park<sup>3</sup>, S. T. Joo<sup>1</sup>, and C. Y. Lee<sup>\*2</sup>, <sup>1</sup>Gyeongsang National University, Jinju, Korea, <sup>2</sup>Jinju National University, Jinju, Korea, <sup>3</sup>CJ Corps., Seoul, Korea.

In Korea, pig carcass is valued according to its quality and yield grades mainly determined by the fat:muscle balance and backfat thickness, respectively. The present study was undertaken to investigate the effects of dietary energy level and slaughter weight (SW) on carcass grades, physicochemical characteristics and sensory quality traits of belly, ham and loin in lean-type, cross-bred finishing gilts and barrows beginning from 80-kg BW under a 2 (sex)  $\times$  2 [diet; 3.2 Mcal (medium energy; ME) vs 3.0 Mcal (low energy; LE) DE/kg]  $\times$  3 (SW; 110, 125 & 138 kg) factorial arrangement of treatments. Backfat thickness, which increased with increasing SW ( $P < 0.01$ ), was not affected by sex or diet. Carcass marbling score was greater ( $P < 0.01$ ) in gilts and LE than in barrows and ME, respectively. Carcass quality grade, which was greater in barrows and LE vs gilts and ME, respectively ( $P < 0.01$ ), had no relation to SW, whereas the yield grade decreased remarkably ( $P < 0.01$ ) between 125- and 138-kg SW primarily due to the upper limits of carcass wt imposed

on the A & B grades. Physicochemical characteristics including pH, drip loss, and variables pertaining to color of belly, ham and loin were not affected significantly by the treatments, albeit statistically significant in some cases, in terms of quality criteria. In sensory evaluation for the primal cuts, the fat:muscle balance of fresh belly improved between 110- and 125-kg SW, but it did not change further between 125- and 138-kg SW. Marbling score of fresh ham was greater in LE vs ME ( $P < 0.01$ ) and tended to increase between 110- and 125-kg SW ( $P = 0.10$ ), whereas in loin, the increase of this variable between the two SW was significant ( $P < 0.01$ ). In the acceptability, LE was superior to ME in cooked belly and ham, but the effect of SW was insignificant in these and cooked loin. In conclusion, SW can be increased up to 138 kg without compromising carcass quality, whereas carcass yield grade decreases between 125- and 138-kg SW. Moreover, LE has some beneficial effects on quality of the whole carcass and the major primal cuts.

**Key Words:** finishing pig, slaughter weight, carcass

**M163 Feedlot performance and carcass traits of Nellore, Simmental, Simbrasil and F<sub>1</sub> Simmental  $\times$  Nellore bullocks.** S. R. Baldin<sup>1,2</sup>, C. L. Martins<sup>1</sup>, R. D. L. Pacheco<sup>\*1</sup>, D. D. Millen<sup>1</sup>, R. S. Barducci<sup>1</sup>, L. M. N. Sarti<sup>1</sup>, T. M. Mariani<sup>1</sup>, J. P. S. T. Bastos<sup>1</sup>, M. D. B. Arrigoni<sup>1</sup>, and J. C. Hadlich<sup>1</sup>, <sup>1</sup>FMVZ/Unesp, Botucatu, São Paulo, Brazil, <sup>2</sup>Apio FAPESP, São Paulo, Brazil.

The objective of this study was to evaluate feedlot performance and carcass traits of *Bos indicus* and *Bos taurus* breeds: Nellore (NE), Simmental (SM) and its crosses. The experiment was conducted at São Paulo State University feedlot, Botucatu campus, Brazil. It was used 54 8-month-old bullocks (250.4  $\pm$  32.7 kg) randomly assigned to one of 27 pens (two animals per pen) according to genotype: 18 NE, 12 SM, 12 Simbrasil (SB; 5/8 SM, 3/8 NE) and 12 F<sub>1</sub> Simmental  $\times$  Nellore (SN). Pens were considered the experimental unit. Bullocks were fed 80% concentrate after 21-d of adaptation, and were weighed every 28-d to calculate the ADG. After slaughter, rib eye area (REA) and back fat thickness (BFT) were measured to evaluate muscle growth and fat deposition. Meat samples were harvested between twelfth and thirteenth ribs to evaluate tenderness measured by Warner-Bratzler shear force (WBSF) of the steaks at 0, 7 and 14-d of ageing. SM had greater ( $P < 0.05$ ) ADG when compared to the others genotypes (NE = 1.06, SM = 1.67, SB = 1.32, SN = 1.22 kg), while SN and SB had ( $P < 0.05$ ) greater ADG than NE. No differences were observed ( $P > 0.10$ ) for dressing percentage (NE = 54.5, SM = 53.6, SB = 54.4, SN = 53.9%). NE presented smaller ( $P < 0.05$ ) REA, measured in square centimeters, than others genotypes (NE = 54.43, SM = 67.03, SN = 64.59, SB = 71.89). On the other hand, NE, SB and SN presented in millimeters ( $P < 0.05$ ) greater BFT when compared to SM (NE = 3.46, SB = 3.42, SN = 3.25, SM = 2.55). At day 0, steaks from NE and SM presented ( $P < 0.05$ ) higher shear than SB and SN (NE = 4.98, SM = 4.45, SB = 3.13, SN = 3.33 kg), however these differences were not detected ( $P > 0.10$ ) when steaks were aged for 7 and 14-d. Means WBSF among genotypes were 3.97, 2.72 and 2.53 kg for steaks aged for 0, 7 and 14-d, respectively. Steaks aged for 7 and 14-d had lower shear ( $P < 0.05$ ) than those steaks without ageing. The thinnest group evaluated was SM, which performed better than NE and its crosses (SB and SN). Seven days of ageing seem to be sufficient time to improve meat tenderness of beef cattle regardless of genotype.

**Key Words:** Nellore, Simmental, WBSF

**M164 Effects of vitamin D supplementation on carcass traits of Nellore and Canchim bullocks fed high concentrate diets.** F. S. Parra<sup>1,2</sup>, S. R. Baldin<sup>1</sup>, M. D. B. Arrigoni<sup>1</sup>, C. L. Martins<sup>1</sup>, J. R. Ronchesel<sup>1</sup>, N. R. B. Consolo<sup>3</sup>, A. L. Campanini<sup>1</sup>, R. S. Barducci<sup>1</sup>, L. M. N. Sarti<sup>1</sup>, D. D. Millen<sup>1</sup>, R. D. L. Pacheco<sup>\*1</sup>, D. Tomazella<sup>1</sup>, H. D. Rosa<sup>1</sup>, T. Leiva<sup>1</sup>, E. N. Andrade<sup>1</sup>, <sup>1</sup>FMVZ/Unesp, Botucatu, São Paulo, Brazil, <sup>2</sup>Apoio FAPESP, São Paulo, Brazil, <sup>3</sup>UD/Unesp, Dracena, São Paulo, Brazil.

This study, conducted at the São Paulo State University feedlot, Botucatu Campus, Brazil, was designed to test the effects of vitamin D supplementation (VDS) on final BW, HCW, dressing percentage and carcass pH of Nellore (NE) and Canchim (CC; 5/8 Charolais, 3/8 NE) bullocks fed high concentrate diets. The experiment was designed as a 2 × 2 factorial arrangement, replicated 9 times, in which 18 8-mo-old bullocks (209.4 ± 23.3 kg) of each of two breeds evaluated were fed diets with or without vitamin D at 7.5 × 10<sup>6</sup> IU·animal<sup>-1</sup>·d<sup>-1</sup> for 10-d prior to slaughter. Animals were adapted for 21-d to the high concentrate diets fed. Diets contained 47.5% high moisture corn, 20% citrus pulp, 12.8% soybean meal, 13.7% sugarcane bagasse, 4.6% *Cynodon* hay and 1.5% supplement. Bullocks were withheld from feed for 16-h before every weight assessment. Carcass pH was measured on *Longissimus dorsi* muscle at 0 and 24-h after slaughter with a meat pH meter (Hanna Instruments model 99163). No significant (P > 0.10) breeds and VDS main effects or interactions between breeds and VDS were observed for any of the carcass traits parameters evaluated (Table 1). In conclusion, vitamin D supplementation did not affect the carcass traits of NE and CC bullocks in this study.

**Table 1. Effects of vitamin D supplementation on carcass traits of NE and CC bullocks**

Item					P value	P value	SEM
	NE	CC	VIT D <sup>3</sup>	NONE <sup>4</sup>	Breeds	VIT <sup>5</sup>	
Final BW, kg	365.3	384.1	375.6	373.1	0.20	0.90	44.6
HCW, kg	194.1	201.3	197.1	198.3	0.39	0.88	25.2
Dressing, %	53.1	52.4	52.4	53.0	0.15	0.21	1.4
pH <sup>0</sup>	6.84	6.88	6.85	6.87	0.46	0.61	0.16
pH <sup>24</sup>	5.57	5.59	5.58	5.58	0.73	0.95	0.17

<sup>1</sup> Carcass pH at time 0; <sup>2</sup> Carcass pH after 24-h of chilling; <sup>3</sup> VDS; <sup>4</sup> No VDS; <sup>5</sup> P value for VDS.

**Key Words:** bullocks, carcass, vitamin D

**M165 Interaction of dietary vitamin D<sub>3</sub> and sunlight exposure on meat tenderness and color of *Bos indicus* cattle.** A. R. Lobo Jr.<sup>1</sup>, E. F. Delgado<sup>\*1</sup>, G. B. Mourão<sup>1</sup>, A. Berndt<sup>2</sup>, and J. J. A. Demarchi<sup>2</sup>, <sup>1</sup>Escola Superior de Agricultura, Piracicaba, SP, Brazil, <sup>2</sup>Agência Paulista de Tecnologia do Agronegócio, Andradina, SP, Brazil.

Beef tenderness improvement through dietary vitamin D<sub>3</sub> supplementation has been challenged by null results and negative impacts on animal performance. The animal is able to synthesize vitamin D by action of ultraviolet (UV) radiation from the sunlight. Therefore, sunlight exposure may modulate the effectiveness of vitamin D<sub>3</sub> supplementation to increase active metabolites of that vitamin in the body fluids. Hence, this work aimed to verify whether dietary vitamin D<sub>3</sub> modifies meat tenderness and color in *Bos indicus* cattle under natural sunlight exposure or protected conditions. Forty-one castrated bulls (411±38 kg) were confined and fed high concentrate diet, after assignment to 6 treatments: 1) neither vitamin D<sub>3</sub> supplementation (NV) nor shade (NS); 2) NV with shade (WS – 50% UV filtration); 3) 2×10<sup>6</sup> IU of vitamin D<sub>3</sub> for 2 days

pre-slaughter (WV2) + NS; 4) WV2 + WS; 5) 2×10<sup>6</sup> IU of vitamin D<sub>3</sub> for 8 days pre-slaughter (WV8) + NS; and 6) WV8 + WS. The myofibrillar fragmentation index and shear force were measured at 1, 7 and 21 days (d) *postmortem* (pm). The meat color was measured at 24 hours pm using the CIELab parameters L\*, a\* and b\*. Plasma and muscle calcium were also measured. The WV8 increased fragmentation index (P = 0.09) in NS (22.3±1.5) compared to WS (18.3±1.5), even though cattle under NS had lower (P < 0.05) muscle calcium concentration. There was no effect of either vitamin or sunlight exposure (P > 0.05) on shear force, which decreased (P < 0.01) during pm storage (1 dpm: 10.4±0.4 kg; 7 dpm: 8.8±0.5 kg; 21 dpm: 6.8±0.5 kg). The WV8 (32.3±0.5) increased (P = 0.065) L\* values compared to WV2 (30.5±0.5), while both were similar (P > 0.05) to NV (31.6±0.5). Higher a\* (P = 0.02) and b\* (P < 0.001) values were observed for WV8 (17.1±0.4 and 4.5±0.2, respectively) than for both WV2 and NV (15.8±0.4 and 3.6±0.2; and 15.5±0.4 and 3.4±0.2, respectively). NS (34.5±0.5) animals presented (P < 0.05) higher L\* values than WS (32.6±0.5) at 24 hours pm. Vitamin D<sub>3</sub> or sunlight exposure can alter beef color. Both factors interacted to change the myofibrillar fragmentation, but were not sufficient to impact shear force in *Bos indicus* cattle.

**Key Words:** aging, calcium, shade

**M166 Expression of calpastatin isoforms and meat tenderness of pure-bred Large White and Duroc animals fed different doses of ractopamine.** E. F. Leonardo, E. F. Delgado\*, I. L. Stella, L. L. Coutinho, and G. B. Mourão, Escola Superior de Agricultura, Piracicaba, SP, Brazil.

Calpastatin is a specific endogenous inhibitor of calpains and it is coded by a single gene. Studies had demonstrated that exons 1xa, 1xb and 1u of the calpastatin XL domain are functional and generate three differentiated isoforms which might be related with muscular growth and meat tenderness. The objective was to verify the impact of calpastatin isoforms on pork tenderness and whether they are responsive to beta adrenergic agonist. Sixty animals (30 barrows and 30 gilts) being 30 Large White (LW) and 30 Duroc (DU) were randomly assigned to different doses of ractopamine (RAC): 0 (control), 10 ppm (RAC 10) and 20 ppm (RAC 20) in the diet. The RAC was given to the animals from 85 kg to 110 kg of live weight in a period of 4 weeks. Samples of muscle *L. dorsi* had been collected immediately after slaughter and frozen in liquid nitrogen for quantification of relative mRNA abundance of three calpastatin isoforms (CAST1: 1xa; CAST2: 1xb; CAST3: 1u). The myofibrillar fragmentation index (MFI) was measured at 1, 3 and 5 days *postmortem* (dpm), while shear force (SF) was measured at 1 and 5 dpm. Rib eye area (REA) was obtained in those animals. Only CAST1 had differential expression between breeds and RAC doses, with higher (P < 0.05) expression in the LW animals and RAC fed pigs. CAST2 presented low relative expression. CAST3 had similar expression with no effect (P > 0.05) of gender, breed or RAC. MFI was lower (P < 0.01) for LW on d 1 and 5 pm [(LW 1 dpm: 32±1.1; 5 dpm: 52±1.2) and (DU 1 dpm: 37±0.7; 5 dpm 58±0.9)] and for 20 ppm of RAC at all times pm [(Control/1 dpm: 40±1.1 ; 3 dpm: 49±1.4 ; 5 dpm: 60±0.4); (RAC 10 / 1 dpm: 36±1.3; 3 dpm: 48±1.2; 5 dpm: 57±0.7) and (RAC 20 / 1 dpm: 31±1.1; 3 dpm: 39±0.5; 5 dpm: 47±0.9)]. There was a positive correlation (r = 0.81; P < 0.01) between CAST1 mRNA abundance and shear force 1 dpm. There was also a positive correlation (r = 0.58; P < 0.01) between REA and CAST1 expression for the LW pigs. RAC or LW pigs produced muscled loin and tougher meat that could be related to higher CAST1 expression

**Key Words:** myofibrillar fragmentation, growth, shear force

**M167 Heat shock protein  $\beta$ -6 emerges as a potential biomarker to predict meat tenderness.** I. Zapata\*, H. N. Zerby, and M. Wick, *The Ohio State University, Columbus.*

The mechanisms controlling meat tenderness involve a multitude of cellular functions, which have proven difficult to develop into a coherent model. A novel approach is the use of functional proteomics, a combination of electrophoretic, image, statistical and protein sequencing technologies that identifies the protein(s)/peptide(s) bands associated with tenderness measured by Warner Bratzler Shear (WBS). The aim of this study was to statistically associate the staining intensity of electrophoretically separated bands from a myofibrillar fraction with WBS and determine the sequence of the protein(s)/peptide(s) within those bands. Twenty two Angus crossbred steers were harvested. Muscle samples were taken from the *Longissimus dorsi*. Samples for functional proteomics and for WBS were taken at 36h and 72h postmortem, respectively. The myofibrillar fraction was resolved on a 10% to 20% acrylamide gradient gel. Gel images were analyzed by a stepwise multiple linear regression model fitted using the dependent variable of 72h WBS. Significant bands were analyzed by capillary liquid chromatography nanospray tandem mass spectrometry (nano-LC/MS/MS). The regression model significantly identified two bands ( $R^2 = 0.508$ ). In the first band, myosin heavy chain along with myosin light chain 2 were identified. The second band contained multiple isoforms of myosin light chain 2 and the heat shock protein  $\beta$ -6 (hspb6). This heat shock protein has never been associated to tenderness variability. Hspb6 has been related, *in vivo*, to muscle relaxation during high calcium concentration events during situations of acute stress. Hspb6 is known to be intimately related to the stability of the actin thin filament. The band that contained this protein was found to be negatively associated with 72 h WBS which suggests that higher levels of hspb6 lead to tougher meat while lower levels lead to more tender meat. By identifying the mechanisms through which tenderness is mediated, it will be possible to implement breeding strategies to produce cattle with greater and more consistent tenderness.

**Key Words:** functional proteomics, heat shock protein, tenderness

**M168 Evaluating the application of dual x-ray energy absorptiometry (DEXA) to assess dissectible fat and muscle from the 9–11th rib section of beef cattle.** F. R. B. Ribeiro\*<sup>1</sup>, R. D. Rhoades<sup>2</sup>, L. O. Tedeschi<sup>3</sup>, S. E. Martin<sup>3</sup>, and S. F. Crouse<sup>3</sup>, <sup>1</sup>Texas A&M University, Commerce, <sup>2</sup>The King Ranch Institute, Kingsville, TX, <sup>3</sup>Texas A&M University, College Station.

The objective of this study was to evaluate the adequacy of measuring dissectible fat and muscle from the 9–11th rib section of beef cattle using a dual x-ray energy absorptiometry (DEXA) scanner (GE Lunar Prodigy Advance, General Electric, Madison, Wisconsin). Data were obtained from 52 animals (20 steers, 16 bulls and 16 heifers) from two trials. Trial 1 was composed of Angus steers ( $n = 24$ ) and Trial 2 had Angus bulls ( $n = 16$ ) and heifers ( $n = 16$ ). The 9–11th rib section samples were removed from the carcasses and digital images were obtained using the DEXA scanner. The outputs of the DEXA scanner were total fat percentage and lean muscle amount. The lean muscle percentage was calculated in order to compare with the rib dissection composition. Then, the 9–11th rib samples were physically dissected and chemical analyses were performed following the Hankins and Howe procedure. Regression analysis was performed with PROC REG. The DEXA fat prediction explained 84 and 86% of the variation in the physical and chemical rib fats, respectively. For both predictions, the regression analysis indicated that the intercept and the slope were not different from zero and one

( $P < 0.001$ ), respectively. However, the mean biases were significantly different from zero and underpredicted (3.4 and 2.3% for physical and chemical rib fats, respectively). The DEXA lean prediction explained 82% of the variation in the physically separable lean with a mean bias of -16% (overpredicted). These results indicated that DEXA scanners can precisely predict the 9–11th rib section fat and lean tissue of beef cattle, but accuracy is lacking. More calibration might be needed to improve accuracy of DEXA scanners.

**Key Words:** DEXA, carcass composition, cattle

**M169 Age entering the feedlot and implant potency: I. Post-weaning-weaning and feedlot performance.** P. Beck\*<sup>1</sup>, B. Barham<sup>2</sup>, S. Gadberry<sup>2</sup>, J. Apple<sup>3</sup>, M. Miller<sup>4</sup>, and L. Hughes<sup>4</sup>, <sup>1</sup>University of Arkansas, Hope, <sup>2</sup>University of Arkansas Coop. Ext. Ser., Little Rock, <sup>3</sup>University of Arkansas, Fayetteville, <sup>4</sup>Texas Tech University, Lubbock.

According to the National Beef Quality Audit, beef exporters and beef producers have cited carcass quality as a primary challenge facing the industry. This research focused on animal age and implant status and their effects on animal performance. Spring-born calves ( $n = 80$ , BW,  $= 220 \pm 5.7$  kg) were weaned at 7 months and backgrounded for 63-d. Backgrounding diets were fed at a rate to promote ADG of 1 kg/d. Fifty percent of the calves were then sent directly to the Texas Tech University research feedyard for finishing (CALF), the remainder were placed on small grain pasture for 133-d prior to finishing (YRLNG). One-half of each feeding group received an aggressive implant regimen (AGG), where cattle were implanted at the beginning of backgrounding (Synovex S or H), at the start of grazing (Synovex S or H), at the initiation of feeding (Synovex S or H), and 50-d prior to the end of the finishing (Synovex Plus). The remainder received a low potency implant regimen (LOW) where the initial implant was delayed until 50-d prior to the end of finishing (Synovex S or H). Feedyard cattle received steam-flaked corn based finishing diets until the average backfat thickness for each group reached 1.5 cm. Data were analyzed as a  $2 \times 2$  factorial arrangement of treatments by the mixed procedure of SAS. During backgrounding, AGG calves gained  $0.13 \pm 0.06$  kg/d more ( $P = 0.03$ ) than LOW. Forage allowance restricted grazing performance and there was no effect ( $P = 0.88$ ) of implant on ADG, but AGG YRLNG were still  $17 \pm 7.6$  kg heavier ( $P = 0.03$ ) than LOW YRLNG at the end of grazing. During finishing, ADG of LOW was  $0.30 \pm 0.04$  less ( $P \leq 0.01$ ) than AGG and CALF gained  $0.26 \pm 0.06$  less ( $P \leq 0.01$ ) daily than YRLNG (ADG 1.65, 1.92, 1.89,  $2.21 \pm 0.05$  kg, for LOW CALF, AGG CALF, LOW YRLNG, and AGG YRLNG, respectively). Implanting in early stages of production do not reduce performance enhancement in subsequent stages. Implantation increases beef production when nutrient dense diets are fed to growing and finishing cattle, this increased productivity becomes essential when feed costs increase cost of production.

**Key Words:** beef cattle, finishing, implants

**M170 Age entering the feedlot and implant potency: II. Carcass quality, shear force and sensory panel characteristics.** B. Barham\*<sup>1</sup>, P. Beck<sup>2</sup>, S. Gadberry<sup>1</sup>, J. Apple<sup>3</sup>, W. Whitworth<sup>4</sup>, and M. Miller<sup>5</sup>, <sup>1</sup>University of Arkansas, Little Rock, <sup>2</sup>University of Arkansas, Hope, <sup>3</sup>University of Arkansas, Fayetteville, <sup>4</sup>University of Arkansas, Monticello, <sup>5</sup>Texas Tech University, Lubbock.

The objective of the study was to evaluate the effects of age of calf entering the feedlot and implant treatment on carcass characteristics.

Spring-born calves (n = 80, BW = 228 ± 5.7 kg) were weaned at 7 mo. of age and backgrounded for 63-d. Backgrounding diets were fed at a rate to promote ADG of 1 kg/d. Fifty percent of the calves were sent directly to the Texas Tech University research feedyard for finishing (CALF) and the remainder stayed at the SWREC for a 133-d small grain grazing program prior to finishing (YRLNG). One-half of each feeding group received an aggressive implant regimen (AGG), where cattle were implanted at the beginning of backgrounding (Synovex S/H), at the start of grazing (Synovex S/H), at the initiation of feeding (Synovex S/H), and 50-d prior to the end of the finishing (Synovex Plus). The remainder received a low potency implant regimen (LOW) where the initial implant was delayed until 50-d prior to the end of finishing (Synovex S/H). Cattle were fed corn based finishing diets until the average backfat thickness for each group reached 1.5 cm. Ribeye area was increased (P < 0.01) by AGG implant program of both CALF and YRLNG. Marbling scores were decreased in AGG compared to LOW (P = 0.03) and in YRLNG compared to CALF (P < 0.01). The percent choice was not different (P = 0.58) between LOW and AGG CALF (86 ± 8.8 and 78 ± 9.3%, respectively). The percentage choice was decreased (P < 0.01) from 94 ± 8.7% for LOW YRLNG to 46 ± 8.4% in AGG YRLNG. Sensory panel scores for initial and juiciness, flavor intensity, and beef flavor were lower for AGG when compared to LOW (P < 0.01). Initial and sustained tenderness were lower in AGG YRLNG compared to LOW YRLNG (P < 0.01), AGG CALF compared to LOW CALF (P < 0.01), LOW CALF compared to AGG YRLNG (P < 0.01) and AGG CALF compared to LOW YRLNG (P < 0.01). Shear force values were lower in AGG compared to LOW (P < 0.01). This research indicates that implantation should be delayed if cattle are placed on a grazing program when a nutrient restriction may occur and cattle are to be marketed on a grid that places economic emphasis on carcass quality.

**Key Words:** beef cattle, implants, carcass characteristics

**M171 Enhancing pork loin quality attributes through genotype, chilling method and ageing time.** M. Juárez\*, W. R. Caine, J. L. Aalhus, W. M. Robertson, and M. E. R. Dugan, *Agriculture and Agri-Food Canada, Lacombe Research Centre, Lacombe, Alberta, Canada.*

Opportunities to niche market pork with enhanced quality attributes are expanding. One method used in other species to enhance quality attributes, such as tenderness and flavour, is guaranteed ageing. Pork can suffer from excessive purge losses and oxidative rancidity during extended ageing, which might be controlled through management of genotype and chilling regimes. To examine the opportunity to enhance pork quality through ageing, alternate sides from carcasses from Large White (LW, n = 24) and Duroc × Large White (Duroc, n = 24) barrows were either conventionally or blast chilled. The longissimus thoracis et lumborum muscle was dissected from the carcass sides (24 h post-mortem) and trimmed of cover fat. Three sections (15 cm length) were vacuum packaged and assigned to 2, 7 or 14 days of ageing (2°C) controlling for muscle location. Blast chilled meat had lower purge (P < 0.01) and drip (P < 0.001) losses and higher hue (P < 0.05) than conventionally chilled meat. However chilling by conventional or blast-chilling methods had no effect on sensory characteristics (P > 0.2). When breeds were compared, meat from Duroc barrows had lower moisture (P < 0.001) and higher intramuscular fat content (P < 0.001), L\* (P < 0.001) and hue (P < 0.01) values than LW. Overall tenderness (P < 0.01) and palatability (P < 0.001), as well as flavour intensity (P < 0.001) and desirability (P < 0.001) and juiciness (P < 0.001) values were higher and undesirable flavours were lower (P < 0.001) for meat from Duroc pigs, when compared with LW. Days of ageing dependent increases were observed for

purge loss (P < 0.001), L\* (P < 0.001), hue (P < 0.001), chroma (P < 0.001) and content of protein (P < 0.01), with corresponding decreases (P < 0.001) in drip loss and moisture content. Instrumental (P < 0.001) and sensory (P < 0.01) tenderness increased from day 2 to 14. Therefore independent of chilling method, ageing seemed to improve pork quality of loins. Moreover ageing had greater effect on tenderness, while breed, due to differences in intramuscular fat content, had greater effect on flavour.

**Key Words:** blast chilling, ageing, breed

**M172 Effects of dry-ageing on pork quality of vitamin E enhanced loins.** M. Juárez\*, W. R. Caine<sup>1</sup>, J. L. Aalhus<sup>1</sup>, M. E. R. Dugan<sup>1</sup>, N. Hidiroglou<sup>2</sup>, and B. E. Uttaro<sup>1</sup>, <sup>1</sup>*Agriculture and Agri-Food Canada, Lacombe Research Centre, Lacombe, AB, Canada,* <sup>2</sup>*Health Products and Food Branch, Health Canada, Sir Frederick G. Banting Research Centre, Ottawa, ON, Canada.*

Presumably, dry-ageing enhances flavour attributes of meat by surface desiccation to increase fatty acid content and other organoleptic molecules. However information regarding dry-ageing of fresh pork is limited. Supplementation of vitamin E to pigs prior to slaughter has been shown to enhance DL- $\alpha$ -tocopherol level in muscle and reduce lipid oxidation. To examine the effects of vitamin E dietary supplementation and dry-ageing on pork quality, Large White (LW, n=24) and Large White x Duroc (Duroc, n=24) barrows were assigned to control or high vitamin E (addition of 600 mg vitamin E kg<sup>-1</sup>) dietary treatments, slaughtered and three longissimus thoracis et lumborum sections from each side of the carcass were wet or dry-aged for 2, 7 or 14 days. Dry-aged meat had lower (P < 0.001) moisture and higher (P < 0.001) protein content due to higher drip and purge losses when compared with wet aged meat. Dry-ageing also increased (P < 0.001) TBARS content in pork, but no effect (P > 0.05) was observed on sensory characteristics. Vitamin E dietary supplementation resulted in lower (P < 0.05) purge loss and L\* values and higher (P < 0.05) tenderness and flavour desirability and intensity, however TBARS content was not affected (P > 0.05). The increase in duration of ageing decreased moisture content and drip loss and increased (P < 0.001) protein and TBARS content, purge loss and L\*, chroma and hue values. These changes were more accentuated in dry-aged meat (P < 0.01). Moreover days of ageing dependent increases (P < 0.001) were observed for instrumental and sensory tenderness, juiciness and overall palatability. The increase (P < 0.01) in flavour desirability and intensity and the decrease in off-flavour for meat from LW barrows were higher (P < 0.05) in day 7 than in day 14. Meat from Duroc barrows had lower (P < 0.001) moisture and protein content, and higher (P < 0.01) fat and TBARS content and L\* and hue values. Instrumental and sensory tenderness, juiciness, flavour and palatability were higher (P < 0.01) in meat from Duroc than LW barrows. Therefore while duration of ageing affected most quality and sensory characteristics, there were only variable changes to quality attributes of dry versus wet-aged pork.

**Key Words:** tocopherol, blast-chilling

**M173 Age at the beginning of the free-range fattening period affects meat quality of Iberian pigs.** M. A. Latorre\*, J. A. Rodríguez-Sánchez, and G. Ripoll, *Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain.*

The traditional productive cycle for Iberian pigs includes a final free-range fattening phase (from November to February) in which animal intake natural feed resources, mainly acorns and grass. This period has

important consequences on the meat quality, which is determinant for elaboration of dry-cured products. The high amount of intramuscular fat (IMF) is one of the most relevant quality aspects in meat from Iberian pigs. The reproductive planning of the traditional system is based on two births per year (spring and autumn), beginning the free-range period with different age (18 or 12 months) but similar weight (110 kg BW) and being slaughtered with 160 kg BW (21 or 15 months of age, respectively). In this context, a total of 40 Iberian pigs were used to study the effect of age at the beginning of the outdoor fattening period on loin characteristics; 18 months old (OP) and 12 months old (YP). The YP fed higher quantity of concentrates than P22 (4.5 vs. 2.5 kg/day) during the growing phase to achieve the finishing period at similar weight. Each treatment was replicated twenty times (barrows and gilts in the same proportion in each treatment). The carcass weight was not affected by age (130.4 vs. 130.7 kg for OP and YP, respectively;  $P > 0.10$ ). However, carcasses from YP had thicker backfat between the last 3rd and 4th last ribs than carcasses from OP (64.8 vs. 60.6 mm;  $P < 0.01$ ). Meat from OP had less protein content (2.12 vs. 2.18%;  $P < 0.05$ ) but tended to show higher IMF content (5.9 vs. 5.1%;  $P < 0.10$ ) than meat from YP. Loin from OP was more red ( $a^*$ ) (8.5 vs. 6.8;  $P < 0.05$ ) but showed lower  $H^{\circ}$  value (63.3 vs. 68.8;  $P < 0.01$ ) than loin from YP. Meat from OP had higher water holding capacity than meat from YP because of lower thawing (1.34 vs. 2.17%;  $P < 0.001$ ) and cooking losses (16.5 vs. 17.3%;  $P < 0.10$ ). It is concluded that meat quality of pigs that began the outdoor fattening period with 12 months of age was better than that of pigs that did it with 18 months of age.

**Key Words:** age, meat quality, free-range Iberian pigs

**M174 Effects of electrical stimulation and aging on beef tenderness of dairy cows.** A. A. Souza<sup>\*1</sup>, T. I. Ferreira<sup>2</sup>, and J. C. Hadlich<sup>3</sup>, <sup>1</sup>UNIDERP/ANHANGUERA, Campo Grande, Mato Grosso do Sul, Brazil, <sup>2</sup>IAGRO, Campo Grande, Mato Grosso do Sul, Brazil, <sup>3</sup>UNESP, Botucatu, Sao Paulo, Brazil.

Tenderness is considered by consumers the most important characteristic related to meat quality. The use of electrical stimulation (ES) is thought to be useful in increasing meat tenderness. Besides ES effects, aging may also have the same effects on meat tenderness, and potentially additive effects when associated with ES. Therefore, the aim of this study was to evaluate ES and aging influence on meat tenderness. Slaughter and meat processing were performed at Sao Paulo State Institute of Food Technology (ITAL). A total of 400 samples were collected from 80 crossbred dairy cows, 12-15 years old and finished on intensive grazing. At slaughter, each carcass was subjected to electrical stimulation on the right side of the carcass. Left side was used as control. After chilling, samples were obtained between 12<sup>a</sup> and 13<sup>a</sup> ribs of *Longissimus dorsi* muscle. Reading of pH values were made on hours 1, 3, 5 and 24 during chilling time. Meat tenderness and pH decline were evaluated for different treatments: Control=no ES/no aging; ES = electrical stimulation; AG = Aging; ESAG = electrical stimulation + aging. Electrical stimulation consisted of 100 v and 60 Hz during 90 seconds, with pulses of 3 s followed by 3 s resting interval. The aging time used was 14 days at 0-2°C. The ES increased meat tenderness whereas aging alone or combined with ES showed no beneficial effects on tenderness. Early decline in pH using ES or aging was not observed. High initial pH values at this trial suggests animals were well rested at time of slaughter. These results suggest ES must be used to improve carcass quality from old cows, and meat can be made available to consumers without further aging processing.

**Table 1. Carcass tenderness and pH decline**

	Control	Electrical stimulation	Aging	Electrical stimulation + aging
Shear Force (kgf/cm <sup>2</sup> )	11.24±1.88 <sup>a</sup>	7.82±1.68 <sup>b</sup>	8.56±1.72 <sup>ab</sup>	8.66±1.03 <sup>ab</sup>
pH (24h)	5.56±0.72 <sup>a</sup>	5.68±0.084 <sup>a</sup>	5.58±0.11 <sup>a</sup>	5.75±0.14 <sup>a</sup>

\*means with different superscripts are statistically different ( $P < 0,05$ )

**Key Words:** electrical stimulation, meat quality, aging

**M175 Relationship between raw breast meat color lightness values and functionalities of broiler fillets deboned six to eight hours post-mortem.** H. Zhuang<sup>\*</sup> and E. Savage, ARS-USDA, Athens, GA.

The relationships between International Commission on Illumination (CIE) color lightness ( $L^*$ ) measurements and pH, drip loss, cook yield and Warner-Bratzler (WB) shear force of broiler breast fillets deboned 6-8h postmortem were investigated. In each of three replicate trials, broiler fillets were collected from a commercial processing plant and separated based on CIE  $L^*$  values (measured using a Minolta spectrophotometer on the medial side) into three color groups: light,  $L^* > 60.5$ ; median,  $56.0 < L^* < 58.8$ ; and dark,  $L^* < 54.5$ . For each fillet within each color group, pH and drip loss of the raw meat and cook yield and WB shear force of the cooked meat were determined. Our results showed that there were significant differences in pH, drip loss and shear values between the light, median and dark fillet groups. There were significant differences in cook yield between the light group and both the middle and the dark groups which were not different from each other. There were significant negative Pearson's correlations between  $L^*$  and pH and cook yield, and positive correlations between  $L^*$  and drip loss and WB shear force values. These results demonstrate that functionality parameters of fillets removed from broiler carcasses at 6-8h postmortem are related to their CIE  $L^*$  values.

**Key Words:** broiler breast, functionality, color

**M176 In vitro analysis of effect of time-temperature combinations on viability of *Taenia hydatigena* eggs.** B. S. Buttar<sup>\*</sup>, M. L. Nelson, J. R. Busboom, D. P. Jasmer, D. D. Hancock, and D. Walsh, Washington State University, Pullman.

In the Pacific Northwest USA, potato co-product has been incriminated as a source of infection of *Taenia saginata* for beef cattle. The parasite leads to serious carcass defects and condemnation. Potato co-product have been heat treated at processing plants and feedlots which resulted in gelatinization of the starch and an increased incidence of acidosis. *Taenia hydatigena*, a canine tapeworm, was used as a surrogate organism to study the minimum amount of heat required to inactivate *Taenia spp.* eggs. A supply of eggs was obtained by maintaining the sheep-dog life cycle of the tapeworm under laboratory conditions. The parasite eggs were heat treated in a Completely Randomized Design with a 4×4 factorial arrangement of time-temperature combinations (5, 10, 15, 20 min. at 40, 50, 60, 70°C) in a heating block and further processed for ex-shelling (with 1% NaClO) and activation (with 50% sheep bile) to release activated oncospheres. Viabilities were measured by counting the percent activated oncospheres and internal staining with 1% trypan blue. A semi-log plot showed the percent active oncospheres decreased at the rate of 3.7%/min ( $R^2 = 0.84$ ) with increasing time of heat application at 40°C. No activity was found for any treatment beyond 50°C

for 5 minutes. A linear plateau model of percent internal staining vs. temperature indicated increased internal staining until 70°C with a slope of 1.12. Measures of percent activity indicated complete inactivation

of oncospheres at temperature below the gelatinization temperature of potato starch. Additionally, trypan blue staining was not a good measure of viability of *Taenia* eggs.

**Key Words:** *Taenia hydatigena*, thermal inactivation, viability

## Nonruminant Nutrition: Feed Ingredients

**M177 Characterization of protein structure of the new co-products from bioethanol production in western Canada using DRIFT Spectroscopy: Comparison among blend DDGS, wheat DDGS and corn DDGS, between wheat and wheat DDGS, and corn and corn DDGS.** P. Yu\*, D. Damiran, and W. Nuez Ortin, *Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, SK, Canada.*

The objective of this study was to use DRIFT spectroscopy as a novel approach to identify differences in protein molecular structure in terms of amide profile between wheat and wheat DDGS, between corn and corn DDGS, between bioethanol plants, and among wheat DDGS, corn DDGS and blend DDGS. The items assessed included protein amide I, amide II and amide I-to-II ratio. The protein IR spectrum has two primary features, the protein amide I (ca. 1600-1700 cm<sup>-1</sup>) and amide II (ca. 1500-1560 cm<sup>-1</sup>) bands. The amide I and II profile depends on the protein molecular structural chemical make-up and they are usually affected by processing methods and condition. The hypothesis was that protein molecular structure (chemical make-up) was changed after bioethanol processing and these changes affected DDGS nutritive value. Results showed that using DRIFT spectroscopy, the protein molecular structural makeup was revealed and identified. Amide I peak area significantly differed between wheat and wheat DDGS (162.5 vs. 291.8 KM unit,  $P < 0.05$ ), corn and corn DDGS (64.4 vs. 261.8 KM unit,  $P < 0.05$ ), wheat and corn ( $P < 0.05$ ). No difference ( $P > 0.05$ ) among wheat DDGS, corn DDGS and blend DDGS was detected. The amide II peak area significantly differed between wheat and wheat DDGS (35.1 vs. 95.0 KM unit,  $P < 0.05$ ), and corn and corn DDGS (14.1 vs. 118.5 KM unit,  $P < 0.05$ ). No differences ( $P > 0.05$ ) between wheat and corn and among wheat DDGS, corn DDGS and blend DDGS were found. Amide I-to-II ratios significantly differed between wheat and wheat DDGS (4.61 vs. 3.08,  $P < 0.05$ ), corn and corn DDGS (4.56 vs. 2.21,  $P < 0.05$ ). No differences ( $P > 0.05$ ) between wheat and corn, between bioethanol plants but significant differences among wheat DDGS, blend DDGS and corn DDGS were detected. These results indicated that bioethanol processing changes the original protein molecular structure (chemical make-up), which may play a major role to determine nutritive value.

**Key Words:** protein structure and amide I to II ratio, DDGS, molecular spectra

**M178 Effects of various cereals on nursery pigs: Gastrointestinal bacterial populations.** Y. Liu\*, M. Rossoni, J. Barnes, and J. E. Pettigrew, *University of Illinois, Urbana.*

A study was conducted to evaluate the influence of different cereal grains on the bacterial populations in the gastrointestinal tract of young weaned pigs. A total of 24 pigs (7.71 kg BW) were weaned at 21 days of age and randomly allotted to one of four treatments. Corn, barley, rolled oats, and rice were the only cereals contained in each treatment. Pigs were allowed *ad libitum* access to feed and water throughout the 14-day experimental period. At the end of the experiment, all pigs were euthanized and slaughtered to collect mucosal and digesta samples from

ileum and distal colon. Denaturing gradient gel electrophoresis (DGGE) was used to estimate the species diversity of the bacterial population (the number of bands) and quantitatively measure the similarity of population structures (banding pattern) expressed by Sorenson's pairwise similarity coefficients (Cs) among pigs within (intratreatment) and between (intertreatment) treatments. Intratreatment Cs values varied according to the digestive tract site and sampling type. In ileal mucosa, the higher ( $P < 0.05$ ) intratreatment Cs value in corn group (79, 68, 67% for corn, barley and rolled oats) indicated that feeding corn made pigs more similar to each other. However, in ileal digesta, barley had higher ( $P < 0.05$ ) intratreatment Cs value compared with rolled oats and corn (71, 58, 49% for barley, rolled oats and corn). The intertreatment Cs values were lower ( $P < 0.05$ ) than the intratreatment Cs values in the mucosa of distal colon, indicating that there were significant effects of different cereal grains on microbial populations in the distal colon mucosa of nursery pigs. Pigs fed rolled oats diet had more (22.25 vs. 12.25;  $P < 0.05$ ) bands in ileal digesta than pigs fed corn diets. There was no difference in the number of bands in other sample sites. In a few cases, specific bands were present in most pigs fed one treatment, but absent from most pigs fed other treatments. In conclusion, feeding of different cereals as sources of energy altered microbial populations in the GI tract.

**Key Words:** cereals, microbial ecology, nursery pigs

**M179 Effects of altering the syrup inclusion rate and the dryer recycling rate on DDGS composition and digestibility in pigs.** K. A. Houin\*, B. E. Aldridge, B. T. Richert, A. L. Sutton, and J. S. Radcliffe, *Purdue University, West Lafayette, IN.*

Ten crossbred barrows with an average initial BW of 27 kg were used in a replicated 5 x 5 Latin Square designed experiment to investigate the effects of syrup inclusion rate and dryer recycling rate on nutrient digestibility of DDGS. For this experiment the syrup inclusion level and the dryer recycling rate were altered in a commercial plant to produce the following DDGS batches: 1) normal syrup, normal recycle rate, 2) 0.5x syrup, normal recycle rate, 3) no syrup, normal recycle rate, and 4) 0.5x syrup, no recycling. Diets 1-4 consisted of 50% of each DDGS batch and 50% of a corn basal diet. Diet 5 was the corn basal diet. Each 2-week period consisted of a 7 d adjustment period, then a 7 d collection period comprised of a 3 d total collection, 12 h ileal collection, 3-day adjustment, and a second 12 h ileal collection. Feed was provided at 9% metabolic BW (BW<sup>0.75</sup>) in 2 daily feedings and water was provided *ad libitum*. Ileal samples were pooled by pig and freeze dried. During total collections, feces and urine were collected twice daily. Urine was collected in buckets containing HCl to prevent N loss. Feed, ileal digesta, and feces were analyzed for N, Cr, Ca, P, and DM. Amino acid concentrations of feed and ileal samples were determined by HPLC. As syrup inclusion in DDGS decreased, protein and amino acid concentration increased, while mineral content decreased. For example, CP protein concentration increased from 26.7% to 32.3% when syrup was reduced to 0%, while ash content decreased from 4.0