846 Predicting growth efficiency in live animals using infrared thermography (IRT). S.L. Scott*[1], A.L. Schaefer[2], A.D. Kennedy[3], R.J. Christopherson[4], A.K.W. Tong[2], and H. Harrison[5], [1]*Agriculture and Agri-Food Canada, Brandon, Manitoba, Canada,* [2]*Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada,* [3]*University of Manitoba, Winnipeg, Manitoba, Canada,* [4]*University of Alberta, Edmonton, Alberta, Canada,* [5]*VitaHealth Inc., Winnipeg, Manitoba, Canada.*

Within populations of beef cattle raised for slaughter, there is a great deal of variability in growth efficiency. This leads to variability in profit per head, because some animals are marketed underfinished while penmates may be marketed overfinished. The objective of this study was to devolop a non-invasive, inexpensive method to predict growth efficiency in live cattle in order to sort them into uniform groups. Since more efficient animals lose less heat to the environment, we used infrared thermography (IRT) to measure heat lost from the animal's body by radiation; this avenue of heat loss accounts for around 60% of total heat loss. The heat loss was then related to growth efficiency to develop a predictive index. Eighteen yearling crossbred heifers averaging 370 kg body weight were randomly allocated to one of two treatments: 1) Cold ad libitum (CAL) in which animals were adapted to -18°C for three weeks in environmental chambers and given a pelleted feed (alfalfa-based; 88.7% dry matter, 0.68 Mcal NE kg^{-1}, 12% crude protein, 0.02% Rumensin® and 0.025% MGA) ad libitum, and 2) Warm ad libitum (WAL) in which the animals were adapted to +18°C for three weeks in environmental chambers and given the same pelleted feed ad libitum. Heat loss was measured by two methods on day 22 of the study in a thermoneutral environment: 1) Measurement of oxygen consumption by indirect calorimetry, and 2) Determination of total radiant heat loss from the body surface using infrared thermography. Body weights and feed intake of the animals were also measured throughout the study. Heat production calculated from oxygen consumption was 0.133 Mcal $kg^{-0.75}$ day^{-1} in the WAL group and 0.155 Mcal $kg^{-0.75}$ day^{-1} in the CAL group ($P<0.05$). A Spearman ranking test showed that feed efficiency significantly ranked with heat loss measured by IRT ($P<0.05$). This means that animals with the highest growth efficiencies displayed the lowest heat loss values based on IRT. Therefore, heat loss as measured by IRT can be used as an index of feed efficiency in cattle.

Key Words: Infrared thermography, Growth efficiency, Beef cattle

847 Application of the Richard's function to characterize growth potential for different biological types of cattle. C. B. Williams*, *U.S. Meat Animal Research Center, Clay Center, NE.*

Different patterns of growth in cattle result mostly from different patterns of nutrient intake and most of the observed variation in nutrient intake is due to diet quality, and physical capacity and nutrient requirements of the animal. Nutrient intake of animals given ad libitum access to a nutrient dense diet is largely controlled by nutrient requirements. To predict growth response for different nutrient intakes, the nutrient requirements for growth should be based on the full growth potential of the animal. On high quality diets, nutrient intake would support potential growth, and on low quality diets, physical capacity would limit nutrient intake, resulting in a lower than potential growth response. The Richard's function was used to characterize the growth potential of 21 biological types of cattle that were evaluated at MARC. Parameters for this function are 1) asymptotic value for empty body weight (**EBW**) at maturity (**A**), 2) scaling parameter (**b**), 3) maturing index (**k**), and 4) inflection parameter (**M**). Standard reference EBW (**SREBW**) was defined as EBW of mature cattle that contained 25% fat, and stage of maturity was defined as EBW/SREBW. The value of M was set to 5.8 for all breeds, so that the mean stage of maturity for steers and females was .5 at the point of inflection. Breed values for A were set at 1.6 and 1.4 times published values of SREBW for steers and cows, respectively. These values were based on data that showed steers and cows on high quality diets attained mature EBW that were 1.6 and 1.4 times SREBW, respectively. Time at birth was set to zero, and breed values for b were calculated from birth weight, A, and M. Breed values for k were estimated by using the first derivative of the Richard's function to predict observed growth with values of k that varied from .002 to .004 in increments of .0001. The k value that minimized the sum of squared deviations between observed and predicted values was selected. Evaluation using independent data sets showed a close agreement between predicted and observed growth curves.

Key Words: Cattle, Growth Curves, Model

Meat Science and Muscle Biology
Meat Quality

848 Effect of days fed on live weight gains and carcass traits in feedlot heifers. G. L. Bishop*, T. E. Lawrence, J. R. Brethour, T. T. Marston, and B. J. Johnson, *Kansas State University, Manhattan.*

A serial harvest trial was conducted to quantify the effects of days on feed (DOF) on feedlot performance and carcass characteristics of feedlot heifers. Moderate framed, crossbred heifers (n=160, BW=362 ± 5.3 kg) were processed, implanted with Synovex® Plus™, and allotted to different feeding groups (92, 113, 134, and 155 d). Heifers were harvested at a commercial packing facility and carcass measurements were collected approximately 24 h postmortem. Feedlot ADG was similar ($P>0.58$) between feeding groups from d0 to d92. Overall ADG was similar ($P>0.07$) for heifers fed 92 (1.21 kg/d), 113 (1.30 kg/d), and 134 d (1.21 kg/d) but decreased ($P<0.01$) for heifers fed 155 d (1.09 kg/d). Final weight increased from d92 to d134 ($P<0.01$). Heifers harvested on d155 had similar ($P>0.39$) final weight as their d134 contemporaries. Incremental increases ($P<0.05$) in hot carcass weight were observed with increasing DOF (92=284.5 kg; 113=300.0 kg; 134=323.2 kg; 154=333.6 kg). Dressing percentage (DP) was lowest ($P<0.07$) at d92 and d113 (59.6% vs. 58.8%, respectively), intermediate ($P<0.01$) at d134 (60.1%) and greatest ($P<0.01$) at d155 (62.1%). Marbling scores were similar ($P>0.54$) between d92 and d113, and increased from d113 to d134 ($P<0.01$). No differences ($P>0.50$) were measured in ribeye area (REA) between d92, d113, and d134 heifers, but REA was greatest ($P<0.01$) in heifers fed 155 d. Backfat increased ($P<0.05$) from d92 to d113, but d113, d134, and d155 were not different. Yield grade increased ($P<0.05$) from d92 to d113, but was similar ($P>0.05$) for groups fed longer than 113 d. Overall carcass maturity did not differ, but tended to increase at d155 ($P<0.06$). Increasing DOF caused heifer carcasses to become fatter and heavier with greater marbling scores, while live weight gain decreased.

Key Words: Heifers, Serial harvest, Carcass

849 The effect of pregnancy status on feedlot performance and carcass quality. G. L. Bishop*, T. E. Lawrence, J. R. Brethour, and T. T. Marston, *Kansas State University, Manhattan.*

Sixty-eight, spring-born yearling heifers were used to determine the effects of pregnancy status on carcass traits and feedlot performance. All heifers were estrus synchronized and artificially inseminated 60 d prior to the finishing phase. Ultrasound and rectal palpation was used to determine if the heifers would be considered open (OPEN) or pregnant (PREG). Heifers were placed in the feeding facility (BW=418 ± 5.3 kg), and after a two wk step-up period, were fed a sorghum grain-based diet (CP=12.9%, NEg=1.50 Mcal/kg) until harvest. Heifers did not receive a growth implant during their lifetime. Ultrasound was used to predict a backfat endpoint of 13 mm at either 105 or 147 days on feed. Cattle were individually weighed within 24 h of slaughter. Fetal age averaged 174 d at harvest. Pregnancy status was visually confirmed at the abattoir and agreed with treatment assignments. After a 24 h chilling period, carcass measurements were collected. Because backfat was similar between harvest dates ($P>0.99$), carcass data were pooled for analysis. Final weight, ADG, and backfat were not different ($P>0.50$) for OPEN vs. PREG heifers (579 ± 6.3 kg, 1.30 kg/d, 13.5 mm; 584 ± 8.2 kg, 1.33 kg/d, 14.2 mm, respectively). The OPEN and PREG heifers had similar ($P<0.35$) hot carcass weights (362 ± 4.5 kg vs. 355 ± 6.0 kg, respectively). Even with these similarities, dressing percentage was greater ($P<0.01$) for OPEN (62.6%) than for PREG (60.4%) heifers. There was a trend ($P=0.16$) for OPEN heifers to have about 3.2

sq cm larger ribeye areas than PREG contemporaries. Numerical USDA yield grades tended (P<0.20) to be greater for PREG (2.36) than OPEN (2.16) heifers, as was USDA marbling score (Modest18 vs. Small94). Although little difference was noted (P=0.14) in overall maturity estimates between PREG and OPEN heifers, PREG heifers tended to have lower maturity scores (A69 vs. A75). Our data indicate that short-term pregnancy has minimal effects on most feedlot performance and carcass traits with the exception of hot carcass yield.

Key Words: Heifers, Pregnancy, Carcass

850 Metabolism of 3-methylindole (skatole) by porcine hepatocytes. F. Lanthier, Y. Lou, and E.J. Squires, *University of Guelph, Guelph, ON, Canada*.

The objective of this study was to determine the metabolite profile of 3-methylindole (skatole) in porcine hepatocytes. Hepatocytes where prepared from six gilts and incubated with skatole. Media was extracted after 0, 15, 30, and 60 minutes of incubation, and metabolites where quantified using HPLC-UV and HPLC-Fluorescence. The rate of production of each metabolite was determined and metabolites were expressed as a percent of the total metabolites produced. There were four major metabolites produced in porcine hepatocytes: 3-Hydroxy-3-methyloxindole (HMOI), 3-Methyloxindole (3MOI), Indole 3-carbinol (I3C), and 6-Hydroxyskatoles (6-OH-sktls), which include: 6-hydroxy-3-methylindole, 6-sulfatoxyskatole, and 6-hydroxyskatole glucuronide. Two metabolite profiles were observed. HMOI and 6-OH-sktls were significantly different in the two profiles while 3MOI and I3C were not (p=0.05). Profile 1: 18.3% ± 4.5 HMOI, 17.9% ± 2.0 3MOI, 2.0% ± 0.4 I3C, and 61.9% ± 6.0 6-OH-sktls. Profile 2: 52.7% ± 3.1 HMOI, 18.8% ± 3.1 3MOI, 2.1% ± 0.5 I3C, and 26.5% ± 4.5 6-OH-sktls. Regression analysis revealed that HMOI and 6-OH-sktls are negatively correlated (R^2= 0.9379). Increased production of 6-hydroxyskatole has been associated with efficient skatole clearance. The skatole metabolite profiles reported here using hepatocyte incubations agree more closely to in vivo profiles of skatole metabolism than to in vitro profiles. This suggests that hepatocyte incubations are a useful model for the study of skatole metabolism. Future research will focus on determining the key enzymes involved in skatole metabolism in pigs.

Key Words: Skatole, Boar taint

851 Influence of sex class and slaughter weight on meat quality of pig. M.A. Latorre*[1], M. Nieto[2], M.D. Garcia-Cachan[3], M.I. Gracia[1], and G.G. Mateos, [1]*Universidad Plitecnica de Madrid, Spain,* [2]*Copese S.A., Segovia, Spain,* [3]*Estación Tecnologica de la Carne, Salamanca, Spain*.

A trial was conducted to study the influence of sex and slaughter weight on meat quality of Pietrain*Large White x Landrace*Large White pigs. There were six treatments arranged factorially with two sexes (castrates and females) and three slaughter weights (115, 124, and 133 kg). Each treatment was replicated four times and the experimental unit was formed by four loin samples (175 ± 10 g) obtained from the last rib of four pigs of each replicate chosen at random. All the animals received *ad libitum* access to a common diet based on barley, wheat, and soybean meal that contained 2,415 kcal NE/kg, 17% CP, and 0.70% total lysine. Meat color as measured by the CIELAB method was affected by slaughter weight; L* and b* values decreased, and a* and chroma values increased with increasing slaughter weight (P<0.01). Meat color, however, was not affected by sex. Cooking losses were greater for females than for castrates (19.6 vs 17.9%; P<0.05). Also, the loin from females tended to have greater Warner-Bratzler shear force values than meat from castrates (8.5 vs 7.7%; P=0.07). Defrosting losses decreased with increasing slaughter weight (8.2, 6.6, and 5.7%, for 115, 124, and 133 kg, respectively; P<0.01). Loin from castrates had less protein (23.7 vs 24.0%; P<0.05) and more intramuscular fat (2.81 vs 2.33%; P<0.05) than loin from females, but moisture content was not modified by sex (73.6 vs 73.8% for castrates and females, respectively; P>0.05). Neither fat nor protein content of the loin was affected by slaughter weight. It was concluded that increasing slaughter weight tended to improve the color and the quality of the meat of pigs destined to the industry for cured products.

Key Words: Meat quality, Slaughter weight, Pigs

852 Effect of exercise on the activity of proteolytic enzymes in skeletal muscle and carcass quality of Iberian pigs. R. Lazaro*[1], F. Toldra[2], J.M. Ferrer[2], L. Silio[3], M.C. Rodriguez[3], and C.J. Lopez-Bote[4], [1]*Universidad Politecnica de Madrid,* [2]*Instituto de Agroquimica y Tecnologia de los Alimentos (CSIC),* [3]*Instituto Nacional de Investigaciones Agroalimentarias,* [4]*Universidad Complutense de Madrid*.

A total of sixteen castrated males (two full sibs per litter) was used to study the influence of physical exercise on the activity of the proteolytic enzymes present in the skeletal muscles of Iberian pigs. There were two experimental treatments and eight animals of 111 kg of initial body weight per treatment. Pigs from one group were maintained under individual confinement conditions (3 m^2 per pig) and pigs from the other group were kept outdoor in individual facilities provided with a corridor of 5 m wide and 1,000 m long. Both groups received a barley-soybean meal diet provided at 9:00 a.m. and 5:00 p.m., daily. For pigs kept outdoor, the morning feed was supplied at one extreme of the corridor while the afternoon feed was supplied at the other end, forcing pigs to walk at least 2 km daily. Visual observation indicated that outdoor pigs walked and moved frequently, while indoor pigs remained resting most of the time. At the end of the trial (106 d of age and a final body weight of around 166 kg) no differences between treatments were observed for daily gain, carcass fatness measured at P_2 level, or pH of the *longissimus* (P>0.05). Immediately after slaughter, a sample of the *psoas major* muscle was obtained and the activity of the proteolytic enzymes was analyzed. No significant differences between experimental groups were detected for cathepsin B, arginyl aminopeptidase and methionyl aminopeptidase (P>0.05). However, the activities of cathepsin B + L (29,100 vs. 23,900 U/g muscle), alanyl aminopeptidase (12.9 vs. 11.2 U/g muscle), and dipeptidyl peptidase III (2.8 vs. 1.9 U/g muscle) were higher for confined than for outdoor kept pigs (P<0.05), suggesting that the breakdown of the muscle protein was lower in exercised pigs. Therefore, exercise might improve protein accumulation by reducing protein breakdown rather than by increasing protein synthesis.

Key Words: Iberian pigs, Exercise, Proteolytic enzymes

853 Study of residual feed intake and frame type on carcass composition using Principal Component Analysis (PCA). Z. Wang*[1], J.A. Basarab[1], L.A. Goonewardene[1], M.A. Price[2], J.L. Aalhus[3], E. K. Okine[2], and W.M. Snelling[4], [1]*Alberta Agriculture, Food and Rural Development,* [2]*University of Alberta,* [3]*Agriculture and Agri-Food Canada,* [4]*Beefbooster, Canada, AB, Ltd.*.

Individual feed intakes were obtained and residual feed intakes (RFI) calculated on seventy-five spring born steer calves of three frame types, 30 from large (foundation breeds, Limousin, Gelbvieh and Charolais), 30 from medium (foundation breeds, Angus and Hereford) and 15 from small (foundation breeds, various small breeds) frame types. The animals were grouped into three (high, medium and low) RFI groups based on standard deviations from the mean. Carcass composition that included muscle, fat and bone distribution and the composition of nine wholesale cuts were analyzed by principal component analysis (PCA). For carcass composition, the first (lean) and second (fat) principal components accounted for 71.1% and 27.3% of the total variation in carcass composition respectively. There was no association between RFI groups and carcass composition. A clear association between carcass compositions and frame type was found. The results show that the large frame type cattle had more lean muscle deposition than the medium frame animals and the medium frame animals deposited more lean muscle than small frame. The association between total fat deposition and frame type showed an opposite trend. RFI is an efficiency measure related to feed intake and the differences in RFI do not translate into either difference in body tissue composition or wholesale cuts.

Key Words: Rsidual feed intake, Carcass composition, frame type, Principal Component Analysis

854 Oxidation and color of stored pork from pigs given supplemental magnesium through drinking water. B. R. Frederick*, E. van Heugten, and M. T. See, *North Carolina State University, Raleigh, NC*.

Sixteen barrows and sixteen gilts (119 ± 4 kg BW) were individually penned, provided 2.7 kg of feed (0.12% Mg) daily, and allowed free access to water via a nipple waterer for the duration of the study. Pigs were

randomly allotted by weight and sex to receive 900 ppm Mg in drinking water for 0, 2, 4, or 6 d prior to slaughter. Pigs were then transported 110 km to a commercial abattoir and slaughtered approximately 45 min after arrival. At 24 h postmortem, *longissimus* and *semimembranosus* chops were placed on styrofoam trays with absorbent pads and wrapped in oxygen permeable film for 0, 4, or 8 d of display storage at 4°C. The remaining posterior portion of the loin was split into two equal sections, vacuum packed, and stored at 4°C for 25 or 50 d. After storage, Minolta color measurements were obtained after 45 min of bloom from an interior chop of the vacuum packed loins. Magnesium addition for 2 d reduced the extent of lipid oxidation (TBARS) in the loin following 4 d of display storage compared to 0 d of Mg (145 vs. 192 ± 11 μg of malonaldehyde (MDA)/kg of tissue, $P < 0.05$). Although not different than 0 d of Mg supplementation (219 μg of MDA/kg), lipid oxidation of the ham during 8 d of display storage decreased linearly ($P < 0.02$) as duration of supplementation decreased (250, 235, and 194 ± 17 μg of MDA/kg). Magnesium addition for 2 and 4 d decreased loin lightness (L*) and yellowness (b*) following 25 d of storage compared to 0 d of supplementation, 51.6 and 51.9 vs. 56.4 1.1 ($P < 0.05$) and 7.9 and 8.0 vs. 9.0 ± 0.4 ($P < 0.10$), respectively. However, Mg supplementation did not affect loin color after 50 d of storage. Although not different than 0 d of Mg supplementation (183 μg of MDA/kg), lipid oxidation of the loin during 50 d of storage decreased linearly ($P < 0.03$) as duration of supplementation decreased (210, 178, and 166 ± 12 μg of MDA/kg). Magnesium supplementation through drinking water for as brief as 2 d prior to slaughter improved color of vacuum packed loins and reduced the extent of lipid oxidation of loins during retail display.

Key Words: Pork quality, magnesium sulfate, lipid oxidation

855 Effect of dietary levels of vitamin E on fiber characteristics of lamb longissimus. F. Nicastro*, L. Zezza, F. Pinto, and R. Gallo, *Department of Animal Production, University of Bari, Bari, Italy.*

Twenty-eight, 8 d old Val di Belice male lambs were injected with one of four doses of acetate DL-alpha tocopheryl acetate (group I : 0 IU; group II : 800 IU; group III : 1200 IU; group IV : 1700 IU) until they reached 40 d of age. The animals were slaughtered on d 47, and samples of longissimus (LD) were collected from all animals 48 h after slaughter. The muscle samples were rolled in talcum powder prior to freezing in liquid nitrogen and left inside the cryostat for about an hour to equilibrate to -20°C. Cross sections 10 μm in thickness were cut and mounted on glass microscopic slides and were reacted with myofibrillar ATPase at alkaline pH in order to differentiate muscle fiber types according to their glycolytic capability. Reciprocal slides also were reacted with NADH-Tr to differentiate muscle fibers based on their oxidative capability. Fibers were classified into Beta-Red (Red), alpha-Red (Intermediate) and alpha-White (White) types. Sections also were stained with Oil-Red-O and hematoxylin to stain fat cells in the intercellular space. Fiber size and fat cell size were determined using a Zeiss particle size analyzer. Data were analyzed by the statistical analysis system, through the general linear model and least squares means procedures. The LD from group III had larger fiber diameter (37.5 vs 28.3 and 27.5 μm; $P < 0.05$) than that of groups I and II. The LD from group II lambs had larger red fibers (23.5 μm; $P < 0.05$), while no significant difference ($P > 0.05$) was noted for intermediate and white fibers. Percentages for all three fiber types were influenced by dietary level of vitamin E with a higher proportion of intermediate fibers (43.7%; $P < 0.05$) in group III lambs. No significant differences in fat cell parameters were observed among treatments. The effects of dietary vitamin E levels on muscle fiber characteristics may have implications for meat quality traits.

Key Words: lamb, diet, fiber

856 Control of dietary energy level and vitamin E intramuscular supplementation to optimize lamb meat production and quality II. Intramuscular collagen properties. A. Manchisi, F. Filetti, C. Cavone, M. Gambacorta, and G. Maiorano*, *University of Molise, Campobasso, Italy.*

A low energy level in the diet improves meat nutritional quality but can decrease meat tenderness. Our recent studies on lambs have indicated that vitamin E supplementation affects intramuscular collagen (IMC) amount and crosslinking, which are factors contributing to meat tenderness. Therefore, the aim of this study was to test a combined pattern of dietary energy level and vitamin E supplementation in lamb in order to improve IMC properties. Twenty-four 15-d-old Ile de France male lambs were allotted within weight in a 2x2 factorial arrangement of DL-α-tocopheryl acetate supplementation (C, control = 0 and V = 150 IU/wk, i.m. injected for 8 wk) and dietary energy level (N, normal = 7.6 and L, low = 6.5 MJ/kg DM). Lambs, weaned at 22 d of age, were allowed *ad libitum* access to a weaning diet for a week and, and then to experimental diets until slaughter (71 d of age). *Longissimus* samples were taken from held (24 h at 2 to 4C) carcasses, lyophilized and then hydrolyzed in 6N HCl for analysis of hydroxyproline (Hyp) and hydroxylysylpyridinoline (HLP) crosslink. IMC amount was calculated assuming that collagen weighed 7.25 times the measured Hyp weight. HLP was quantified by RP-HPLC. Collagen amount (22.9, 23.5, 24.0 and 23.2 μg/mg of muscle for CN, VN, CL and VL, respectively) was not affected ($P>0.05$) by studied factors. The i.m. vitamin E, associated to the N energy diet, lead to a decrease ($P<0.05$) in HLP concentration (2.1 vs 2.7 μg/mg of muscle for VN and CN, respectively) and produced a slowing down in IMC maturation, as indicated by the HLP/IMC ratio lower ($P<0.01$) in VN (0.06 mol/mol) than in CN (0.08 mol/mol). No differences ($P>0.05$) due to vitamin E were found between CL and VL in HLP (2.4 and 2.3 μg/mg, respectively) and in HLP/IMC (0.07 and 0.07 mol/mol, respectively). Results show that an i.m. supplementation with 1,200 IU of DL-α-tocopheryl acetate in lambs, associated with a normal energy level in the diet, decreased collagen crosslinking in lamb *longissimus* which might improve meat tenderness.

Key Words: Intramuscular Collagen, Vitamin E, Dietary Energy

857 Control of dietary energy level and vitamin E intramuscular supplementation to optimize lamb meat production and quality I. Feedlot performance and carcass quantitative and qualitative characteristics. F. Filetti, G. Maiorano*, C. Cavone, A. Prisciantelli, M. Gambacorta, and A. Manchisi, *University of Molise, Campobasso, Italy.*

Dietary energy level and vitamin E supplementation are important factors affecting meat quality. Therefore, this study was conducted to test a combined pattern of these two factors in lamb in order to optimize lamb meat production and quality. Twenty-four 15-d-old Ile de France male lambs were allotted within weight in a 2 x 2 factorial arrangement of DL-α-tocopheryl acetate supplementation (C, control = 0 and V = 150 IU/wk, i.m. injected for 8 wk) and dietary energy level (N, normal = 7.6 and L, low = 6.5 MJ/kg DM). Lambs, weaned at 22 d of age, were allowed *ad libitum* access to a weaning diet for a week and then to the experimental diets. Live weight and feed intake were weekly evaluated. At 71 d of age lambs were slaughtered and carcass weight was recorded after dressing and after chilling at 2 to 4C for 24 h. In addition, pelvic limb weight, metacarpal growth plate width, *longissimus* (LD) area and pH (45 min and 24 h postmortem = pH_1 and pH_u, respectively) were measured. Feedlot performance, carcass weights, dressing percentages, metacarpal growth plate ossification, and LD area were not affected ($P > 0.05$) by studied factors. Regardless of dietary energy level, vitamin E supplementation reduced carcass shrink losses (over 10 %; $P < 0.05$) and pelvic limb percentage (10.3 and 10.3 vs 12.4 and 12.0 % for VN, VL, CN and CL, respectively; $P < 0.01$). Both pH values were higher ($P < 0.05$) in vitamin E treated lambs (pH_1 = 6.49 and 6.64, pH_u = 5.70 and 5.73 for VN and VL, respectively) than in controls (pH_1 = 5.86 and 6.13, pH_u = 5.60 and 5.64 for CN and CL, respectively). Results suggest that care must be taken in supplementing young lambs with i.m. 1,200 IU of DL-α-tocopheryl acetate, especially for the occurrence of negative effects on pelvic limb growth.

Key Words: Lamb, Vitamin E, Dietary Energy

858 Application of a sensitive and robust ELISA for haptoglobin measurement in meat juice and its relation to blood haptoglobin concentrations. S. Hiss[1,2], S. Knura-Deszczka[1], G. Regula[3], B. Petersen[1], and H. Sauerwein*[1], [1]*Bonn University,* [2]*Biofocus GmbH, Recklinghausen, Germany,* [3]*Swiss Federal Veterinary Office, Bern, Switzerland.*

Quantification of haptoglobin (Hp), an acute phase protein, in blood is presently discussed as being useful to monitor animal health and welfare. We developed an ELISA which is specific for porcine Hp, is not impaired by hemolytic samples and is sufficiently sensitive to be applied in meat juice. Hp was purified from porcine serum after Na_2SO_4 precipitation by affinity chromatography on hemoglobin-sepharose followed by gel filtration. Purity and identity were confirmed by SDS-PAGE.

Specific rabbit antisera were obtained. Biotinylated porcine Hp was used as tracer and incubated with Hp standard or sample in microtiter plates coated with anti rabbit sheep IgG Fc fragments. After adding the specific rabbit antiserum, plates were incubated for 1 h, washed and evaluated using the streptavidin peroxidase system. The limit of detection was 0.02 mg/L, parallelism of serum and meat juice dilutions was proven, and the recovery of Hp added to serum samples was 99.6%. The coefficients of intra- and inter-assay variation were 3.3 (n=5) and 10.2 (n=16), respectively. At slaughter, after CO_2 stunning, blood and muscle samples (diaphragmatic pillar [DP] and m. brachiocephalicus [MB]) were collected from 106 hybrid slaughter pigs (100-110 kg). Meat juice was obtained after freezing and thawing the muscle samples. Concentrations [mean (SD)] were 0.39 (0.5) mg/mL in blood, 0.04 (0.06) mg/mL in DP juice, and 0.06 (0.06) mg/mL in MB juice. Hp concentrations in blood were correlated with those in DP juice ($P<0.001$; $r=0.750$) and MB juice ($P<0.001$; $r=0.776$). In view of the many reports on Hp measurements being predictive for animal health even in the subclinical range, we conclude that Hp quantification in meat juice might be a useful parameter to assess the potential impact of animal health on meat quality at slaughter and further along the processing chain.

Key Words: Haptoglobin, Acute phase protein, Pig production

859 Estimation of Canadian and European lean yields and composition of pig carcasses by dual-energy X-ray absorptiometry. M. Marcoux*[1,2], J.F. Bernier[2], and C. Pomar[1], [1]*Agriculture and Agri-Food Canada, Lennoxville, Québec, Canada,* [2]*Université Laval, Sainte-Foy, Québec, Canada.*

Dissection is the preferred reference method for the determination of carcass lean yield. However, this method is time-consuming, expensive and subject to biases. Dual-energy X-ray absorptiometry (DEXA) capabilities to estimate dissected tissue masses in primal cuts and overall carcasses was studied on 136 pig carcasses selected in a commercial slaughterhouse in a 2x3x3 factorial arrangement. Sex (barrows and gilts), fat depth at the last rib, 7 cm off the mid-line ($<$ 15.8, 15.8 to 19.8 and $>$ 19.8 mm) and carcass weight (75.5 to 81.8, 81.9 to 86.2 and 86.3 to 92.7 kg) were the main factors. Using the same number of observations for each subclass, including the less frequent ones, increased prediction model robustness. Alternately, right and left half carcasses were separated into primal cuts (shoulder, ham, belly and loin), scanned by DEXA, dissected and lean yield calculated according to the Canadian method. The other side was dissected and lean yield calculated according to the European method. DEXA readings were used to predict weight of lean, fat (including skin), bone and total weight of primal cuts and carcasses, and to predict the Canadian and the European lean yields. The best relationships were obtained when predicting ham (R^2 = 0.99, RSD = 0.06), loin (R^2 = 0.99, RSD = 0.07), shoulder (R^2 = 0.96, RSD = 0.14), belly (R^2 = 0.93, RSD = 0.14), half carcass (R^2 = 0.98, RSD = 0.27), ham lean (R^2 = 0.89, RSD = 0.19), loin lean (R^2 = 0.89, RSD = 0.18) and shoulder lean (R^2 = 0.87, RSD = 0.20) weights, and the meat weight used in the estimation of the Canadian (R^2 = 0.92, RSD = 0.44) and the European lean (R^2 = 0.82, RSD = 0.60) yields. While fat weight in carcass and primal cuts was accurately estimated by DEXA ($R^2 \geq 0.72$, RSD $\leq$ 0.58), DEXA was less accurate when predicting dissected bone weights ($R^2 \leq 0.54$, RSD $\geq$ 0.10). DEXA measurements can be used to predict lean yields, dissected lean from pig carcasses and primal cuts, but not dissected bone weights.

Key Words: Pigs, Carcass grading, X-radiation

860 Comparing the Canadian lean yield predicted from Destron and Hennessy probe measurements in pork. C. Pomar*, J. Rivest, and M. Marcoux, *Agriculture and Agri-Food Canada, Lennoxville, Québec, Canada.*

In Canada, grading methods based on Destron (PG-100) (DPG) and Hennessy (HGP2) (HGP) probe measurements were last time approved in 1994. However, today hog carcasses are heavier and leaner. The objective of this study was to verify if both grading methods predict similar lean yields and grading indexes in modern pork carcasses. For each carcass, selected databases included information on hot carcass weight and backfat and muscle depths measured with both probes. Probes had to be inserted alternatively at the Canadian grading site by a certified operator under experimental conditions. Databases included (1) 1458 carcasses probed in the 1992 Canadian National Cutout, (2) 500 carcasses probed in 1997, (3) 82 carcasses probed in 1998 by the Fdration des Producteurs de Porc du Qubec and (4) 270 carcasses probed during the revision of the grading system in 1999. Lean yield prediction equations were those used in Canada since 1994. Grading indexes were attributed according to the 1999 official grid. The null hypothesis for the difference between the HGP and DPG predicted lean yields and HGP AND DPG attributed indexes was tested with the non-parametric Wilcoxon signed-rank test. The relationships between HGP and DPG predicted lean yields and between HGP and DPG indexes were studied by regression analysis. For the four databases used, HGP-DPG lean yields were different from zero ($P < 0.001$) with values of 0.32, 0.35, 0.38, and 0.18, in chronological order. HGP-DPG grading indexes also were different from zero with values of 0.51 ($P < 0.0001$), 0.36 ($P < 0.0001$) and 0.50 ($P < 0.0001$), 0.21 ($P < 0.09$), respectively. Regression analyses between HGP and DPG predicted lean yields and between HGP and DPG indexes indicated that the underestimation of lean yields and indexes by the DPG method increased with increasing carcass leanness.

Key Words: Swine, Carcass grading, Invasive probes

861 Estimating the Canadian lean yield and European lean content of pork carcasses based on different methodologies for measuring fat and muscle depth. C. Pomar*[1], A. Fortin[2], and M. Marcoux[1], [1]*Agriculture and Agri-Food Canada, Lennoxville, Quebec, Canada,* [2]*Agriculture and Agri-Food Canada, Lacombe, Alberta, Canada.*

Research was undertaken to evaluate the precision of different classification probes for measuring backfat thickness and muscle depth, to compare classification techniques used in Canada and France and to develop current equations for predicting Canadian lean yield (CLY) and European lean content (TVM). Two hundred seventy pig carcasses were selected in a commercial slaughterhouse in a 2 x 3 x 3 factorial arrangement. Sex (barrows and gilts), fat depth at the last rib, 7 cm off the mid-line ($<$ 15.75, 15.75 to 19.75, and $>$ 19.75 mm) and carcass weight (75.5 to 81.8, 81.9 to 86.2, and 86.3 to 92.7 kg) were the main factors. Forcing each sex, weight and fat depth classes to have the same observation number increased prediction model robustness. Hennessy (HGP2), Destron (PG-100) and CGM optic probes were used according to the Canadian and French CGM methods. The CVT ultrasound probe was used with two transducers (PCA-5049, 172 mm and PCB-5011, 125 mm). Both sides of each carcass were dissected alternatively according to the Canadian and European cutout methods. All probes precisely measured backfat thickness ($R^2 \geq .79$, RSD $\leq$ 1.87 mm), but they were less precise in estimating muscle depth ($R^2 \leq .41$, RSD $\geq$ 3.55 mm). They were not effective measuring the intercostal muscle depth ($R^2 \leq .09$, RSD $\geq$ 2.72 mm). When predicting CLY or TVM, adding fat or muscle depths as quadratic terms or their interactions to a model, which already included fat and muscle depths, did not improve ($P \leq 0.05$) the R^2 or decrease ($P \leq 0.05$) the RSD. Sex identification, perforation angle or inclusion of an additional measurement site or carcass weight did not greatly reduce the model RSD. According to the Canadian method, observed RSD for predicting CLY were 1.52, 1.53, 1.62, 1.67 and 1.82, respectively, and 2.14, 2.15, 2.24, 2.24, 2.52 when predicting TVM. Overall, the CVT-PCB-5011 probe produced the smallest RSD when predicting the CLY or TVM. The Hennessy, CVT-PCA-5049, CGM and Destron probes followed in that order.

Key Words: Swine, Carcass grading, Grading probes

862 Use of 25-hydroxyvitamin D_3 to improve beef tenderness. A. E. Wertz*[1], A. Trenkle[1], R. L. Horst[2], F. C. Parrish[1], E. J. Huff-Lonergan[1], T. J. Knight[1], R. N. Sonon[1], and D. C. Beitz[1], [1]*Iowa State University, Ames, IA,* [2]*National Animal Disease Center, USDA-ARS, Ames, IA.*

Previous research in our laboratory has indicated that plasma calcium concentration remained elevated after the oral administration of 25-hydroxyvitamin D_3 (25-OHD) had been terminated. We hypothesized that a one-time oral bolus of 25-OHD would be sufficient to elevate plasma and tissue calcium concentrations so that the calcium-dependent protease system could more rapidly degrade myofibrillar proteins postmortem and result in more tender beef. The objective of this trial was to evaluate the effects of a one-time oral bolus of 25-OHD on plasma calcium concentration and tenderness of loin steaks from beef cattle. Continental crossbred steers (n=108) were allotted to 18 pens (six head per pen). Treatments were 25-OHD dosage (62.5 or 125 mg) and time before harvest (35, 21, 7, or 4 d). Each dosage by time combination

was assigned randomly to two pens, and two pens served as the control, receiving no 25-OHD. A blood sample was collected at harvest for control and all treatment groups. A 2.54-cm loin steak was removed at 48 h postmortem, vacuum packaged, and aged at 2°C to d 6 postmortem. Steaks from one-half of the cattle in each pen were used for measurement of Warner-Bratzler shear force and troponin-T degradation as indicators of muscle tenderness. Average DM intake, ADG, and feed efficiency did not differ ($P > 0.05$) as a result of 25-OHD treatment. The one-time oral bolus of 25-OHD, regardless of time of administration, did not elevate ($P > 0.05$) the calcium concentration of plasma collected at harvest. Warner-Bratzler shear force averaged 4.0 kg among treatments and did not differ ($P > 0.05$) as a result of 25-OHD treatment. The intensity of the 30 kDa protein component of troponin-T degradation was not different ($P > 0.05$) as a result of 25-OHD treatment. Additionally, hot carcass weight, fat thickness, quality grade, yield grade, and longissimus area were not different ($P > 0.05$) as a result of 25-OHD treatment. Administration of a one-time oral bolus of 25-OHD 35, 21, 7, or 4 d before harvest was not sufficient to result in elevated plasma calcium concentration at harvest or in the improved tenderness of the loin steak at 6 d postmortem.

Key Words: 25-Hydroxyvitamin D_3, Beef, Tenderness

863 The effect of antemortem harvest conditions on stress and meat quality in Muskox. A.L. Schaefer*[1], W.M. Robertson[1], J.L. Aalhus[1], J.A. Nagy[2], and B. Elkin[3], [1]*Agriculture and Agri-Food Canada, Lacombe, AB,* [2]*Dept. Resources, Wildlife and Economic Development, Inuvik, NWT,* [3]*Dept. of Resources, Wildlife and Economic Development, Yellowknife, NWT.*

Banks Inland, Northwest Territories supports a large population of muskoxen (Ovibos moschatus). Muskoxen are harvested for subsistence use and for export of meat, quiviut and hides. The purpose of the present study was to examine the impact of harvest conditions (gathered or field shot) on indicies of stress and meat quality. Data are reported from 36 animals from 2 to 4 years of age and represented both males and females. For gathered animals (n=20) the muskoxen were herded from approximately 22 km distance in one day prior to holding overnight in a capture pen. The animals were provided with hay treated with glucose, amino acids and electrolytes in the preslaughter capture pen. The animals were allowed to rest for 12 hours prior to slaughter. For field shot animals (n=16), the muskoxen were located on their natural range and shot within minutes of discovery. Immediately postmortem blood samples were collected into EDTA tubes from which blood smears were prepared and differential white blood cell counts measured. For gathered animals, one carcass side was frozen and one side held at approximately 4 to 5°C for 24 h postmortem. Muscle pH in the longissimus lumborum (LL) was measured at the 12th rib approximately 24 h postmortem. Muscle colour on thawed samples was measured on the longissimus thoracis (LT) at 7 days postmortem. Neutrophile/lymphocite ratios (N/L) in gathered animals averaged 2.17 (0.95 SD) which were higher ($P < 0.01$) than the N/L ratios seen in the field shot animals 0.59 (0.29). Muscle pH also was relatively high in gathered animals averaging 6.59 (0.19). Objective colour in the LT was slightly dark, displaying L*, a* and b* values of 29.52 (2.0), 16.66 (2.56), and 6.26 (1.73), respectively. The data suggest that gathering and lairage can be stressful events for wild muskox with detrimental effects on meat quality attributes.

Key Words: Muskox, Stress, Meat Quality

864 Effect of cooking methods on camel meat quality. I.B. Hashim*, *United Arab Emirates University, Al-Ain, UAE.*

In the Gulf region, during the pre-oil period the camel (Camelus dromedaries) was the main source of food (meat and milk). Due to the socio-economic changes in the United Arab Emirates camel meat is consumed mainly during social ceremonies. Meat of young camels, below 3 years, is comparable in taste and texture to beef. But usually camels are slaughtered at an older age, which results in greater meat toughness. The objectives of the study were to investigate the effect of cooking methods (roasting, braising, grilling and microwaving) on: cooking loss, moisture and fat content, sensory quality (appearance, color, odor, taste, tenderness, and juiciness) and overall acceptance of cooked camel meat. Sixty-four female students were selected to evaluate the cooked meat using 9-point hedonic scale (1=extremely dislike and 9=extremely like). Fat content was not affected ($P > 0.05$) by cooking method. Cooking loss (62.1 and 60.9%) was significantly higher ($P < 0.05$) while moisture content (36.4 and 38.2%) was significantly lower ($P < 0.05$) for grilled and roasted meat, respectively, compared to braising or microwaving. Roasted camel meat was significantly more ($P < 0.05$) juicy (7.8) and tender (7.5) compared to the meat cooked using other cooking methods (5.9 to 6.9 for juiciness) and (6.2 to 6.6 for tenderness). Roasted camel meat had the highest ratings for all sensory attributes, including overall acceptance (7.8), compared to meat cooked using the other methods, and thus, roasting is the best method for cooking camel meat.

Key Words: Camel meat, Cooking methods, Sensory quality

865 Pharmacological modulation of nitric oxide in beef longissimus lumborum causes chemical, not physiological changes to meat quality. J.J. Cottrell*[1,2], F.R. Dunshea[2], and R.D. Warner[1,2], [1]*Victoria University, Werribee, Victoria, Australia.,* [2]*Natural Resources and Environment, Werribee, Victoria, Australia.*

The *longissimus lumborum* (LL) was hot-boned at 25 min postmortem from 42 Hereford or Hereford cross beef carcasses (191 to 244 kg hot carcass weight) and injected with the nitric oxide (NO) donor sodium nitroprusside (SNP) and substrate inhibitors of nitric oxide synthase (NOS) to determine the effect of nitric oxide (NO) on meat quality. Solutions consisting of saline (0 mM), SNP (1, 10 and 100 mM) or the NOS inhibitors (90% L N^g-N-nitro-L-arginine methyl ester hydrochloride and 10% N-nitro-L-arginine, NOS-) (1, 10 and 100 mM) were randomly allocated to each LL and injected 10% w/w in a 2 x 1 cm matrix. Data were analysed using ANOVA within SNP and NOS- treatment concentrations (0, 1, 10, 100 mM). SNP and NOS- did not affect Warner-Bratzler shear force (5.2, 5.1, 6.5, and 5.9, P=0.46 and 5.2, 5.6 and 7.1 kg/cm^2, P=0.227 for 0 and 1, 10 and 100 mM NOS- and SNP) or myofibrillar fragmentation index (76, 83, 72, and 73, P=0.87 and 84, 88, 70 units P=0.65 0 and 1, 10 and 100 mM NOS- and SNP) after 14 d of aging. Meat oxidation, measured by thiobarbituric acid reactive substances (TBARS), was inversely proportional ($P < 0.001$) to SNP concentration (0.071, 0.686, 0.441, and 0.011 g malonaldehyde/kg meat, for 0 and 1, 10 and 100 mM SNP, respectively), while oxidation was unaffected by NOS- in LL aged for 14 days (0.062, 0.082, and 0.179, for 1, 10 and 100 mM NOS-; P=0.11). Since NO is an oxidant it should increase oxidation as seen by the 1mM SNP dose. However doses above 1mM may have resulted in reactions with cyanide, a breakdown product of SNP, thus, reducing the oxidation initiated by NO, and therefore, SNP caused chemical, not NO mediated, effects on meat quality. NOS activity is O_2 dependent and most likely maximally inhibited postmortem. If so, then substrate inhibitors will be unable to further reduce NOS activity. In conclusion, it appears that SNP is not suitable to use as a NO donor in meat because of its degradation to cyanide over time and its reduction of NOS activity in hot-boned beef LL. *Supported in part by Meat and Livestock Australia.*

Key Words: Nitric oxide, Meat quality, Bovine

Nonruminant Nutrition
Nutrient Metabolism and Feed Evaluation or Processing

866 Predicting amino acids in triticale by NIRS and simple regression equations. S. Jaikaran*, E. Prommer, D. Salmon, H. Hsu, and G. Recinos-Diaz, *Alberta Agriculture Food and Rural Development.*

The routine determination of amino acid composition of triticale is of major interest to animal nutritionists who use this data for the precise and accurate formulation of diets for monogastric animals. Chemical analysis for amino acids is labour intensive, costly and produces chemical effluents which are environmentally destructive. In addition, this method destroys the original sample. A new technology for nutrient analysis is available in the form of Near Infrared Spectroscopy (NIRS) which is rapid, cost effective, more accurate, environmentally friendly