MEAT SCIENCE AND MUSCLE BIOLOGY

146   Effect of the halothane mutation on the calpain - calpastatin system in porcine longissimus muscle. P. L. Sensky*, T. Parr, A. K. Lockley, R. G. Bardsley, and P. J. Buttery, *University of Nottingham, U. K.*

The halothane mutation associated with porcine stress syndrome is characterized by an abnormality in the ryanodine receptor in muscle sarcoplasmic reticulum which permits calcium ions to leak out of the intracellular stores into the cytosol. The calpain proteolytic enzymes, μ-calpain and m-calpain, as well as their endogenous inhibitor, calpastatin, are highly sensitive to changes in calcium fluxes. The balance of the components of this system is known to be important in myofibrillar turnover and in postmortem tenderization in pigs, sheep and cattle. In this study the activity and protein levels of μ-calpain, m-calpain and calpastatin in longissimus muscle 2 h after slaughter were measured in 11 halothane heterozygote pigs (Nn) and 19 halothane negative pigs (NN) of matched slaughter weight. Activities were measured using a fluorescent substrate after separating the three components by hydrophobic chromatography and subsequent ion exchange chromatography. Levels of μ-calpain, m-calpain and calpastatin protein were measured by densitometry of Western blots on crude muscle samples probed with specific antibodies raised against expressed fusion proteins. No differences were seen in μ-calpain and calpastatin activities between NN and Nn animals. The activity of m-calpain in NN animals ($3.23 \pm .21 \times 10^7$ fluorescence units/kg) was greater than in Nn animals ($2.42 \pm .25 \times 10^7$ fluorescence units/kg, $P < .05$). Quantitative levels of m-calpain and calpastatin immunostaining did not differ between NN and Nn animals, whilst μ-calpain in Nn animals (60.2 ± 5.4) was greater than it was in NN pigs (46.4 ± 3.8, $P < .05$). The data indicate that presence of the halothane mutation alters the calpain system postmortem in a manner that could partly explain the reduced meat quality seen in Nn pigs. The apparent discrepancy in the halothane effect on μ-calpain expression and activity warrants further investigation.

Key Words: Pig, Calpain, Halothane Gene

147   Role of proteolysis activity on lamb skeletal muscles. F. Nicastro* and T. Montano, *Università di Bari, Dipartimento di Produzione Animale, Bari, Italy.*

The myofibrillar protein biosynthesis and degradation determine the protein content and mass of skeletal muscle. Proteolytic enzyme activity participates in myofibrillar breakdown during normal turnover and continue to be active in muscle post-mortem influencing tenderization of meat. Muscle type is one of the biological factors which are involved in the proteinases activity. To determine the activity account of cathepsin D the longissimus thoracis (LT) and the semitendinosus (ST) muscles from 48 lambs were analysed. Samples from each muscle (15 g) were minced and homogenized in 3 vol of the lysing buffer (50 mM sodium citrate buffer, 1mM EDTA and .2% Triton X-100 (vol/vol), pH adjusted to 5.0 with acetic acid). Haemoglobin was used as substrate at the following final concentrations (in % w/v): 0.6 and 2.0. All samples and blank assayed in quadruplicate were incubated at 45 °C for 1h and the enzyme activity was defined as the increase in absorbance at 280 nm and 700 nm per hour at 45°C and pH 3.7.The extraction of cathepsin D was also determined with Lowry method and expressed in terms of tyrosine equivalents from a tyrosine standard curve. Cathepsin D activity increased with substrate concentrations, reaching the maximum value in the LT muscle with 2% of haemoglobin (P< 0.001) and same results were obtained with Lowry method. Values of the specific activity (27,51 vs 20,055 μg of tyrosine/g protein/h at 45 °C) and total activity (μg of tyrosine/g muscle/h at 45 °C) of cathepsin D showed the same trend observed above and suggest that a greater presence of cathepsin activity may determine meat less tough. The results confirmed the differences between the muscles and the proteolysis of myofibrillar proteins probably contributes to make the LD the more tender muscle.

Key Words: Lamb, Muscle type, Cathepsin D

148   Sex related differences in the calpain system in skeletal muscle of Korean native cattle. S. S. Sun*, J. H. Kim, K. H. Myung, S. J. Moon, K. H. Kim, K. Kook, and B. H. Choi, *Chonnam National University, Kwangju, Korea.*

The objective was to determine calpain and calpastatin activity in bovine skeletal muscle. Ten Korean native cattle (*Bos taurus coreanae*) (five male, m; five female, f) were slaughtered at 550-600kg and 5 g sample was taken from the longissimus muscle (LM) and semitendinosus muscle (STM) to determine levels of the calcium dependent proteases (calpains) and their inhibitor (calpastatin). The calpain assay was a modified procedure of Koohmaraie 1990. Elution of calpain and calpastatin was achieved by using a step-wise salt gradient. Calpain and calpastatin levels were lower (P < 0.05) in female than in the male, but no differences were found for u-calpain (P > 0.05) in both muscle types. Calpain and calpastatin levels were higher for the LM than for the STM in both sex. These results suggest that the calpain proteolytic system is influenced by sex and muscle type in bovine skeletal muscle.

Muscle Type / Sex	LM/m	STM/m	LM/f	STM/f	SE
Calpastatin (U/g)	2.96	3.01	2.66	2.85	0.22
u-calpain (U/g)	1.02	1.32	0.92	1.20	0.08
m-calpain (U/g)	1.74	1.76	1.59	1.64	0.12

Key Words: Calpain, Calpastatin, Skeletal Muscle

149   Nutritionally mediated protein synthesis and creatine kinase activity in the L-8 myogenic cell line. R. J. Maddock* and C. S. Park, *North Dakota State University, Fargo.*

The objective of this study was to determine the effects of glucose restriction and subsequent refeeding on protein synthesis and the activity of creatine kinase in the L-8 myogenic cell line. L-8 cells were plated at a density of 2.4×10^4 cells/well in 16 mm culture plates. Cells were pre-incubated for 24 hr in Dulbecco's Modified Eagles Medium (DMEM) and 2% horse serum (HS). Plates were then randomly assigned to either a control or treatment (glucose restriction-refeeding) regimen. Treatment media was glucose-free DMEM and 2% HS with the desired level of glucose added. Control cells were maintained in DMEM containing 16 mM glucose. Restricted cells were maintained in DMEM containing 1 mM glucose for 12 hr. Restricted cells were subsequently refed in control media for 12 hr or harvested to determine protein synthesis. Both control and treatment media were changed at the 12 hr point to minimize effects of fresh media and HS. [3H] leucine was added to the media 6 hr before harvesting cells. For the creatine kinase assay, cells were harvested by scraping at the end of the trial (24 hr point). Cells harvested after 12 hours of glucose restriction had a 35% reduction (p, .05) in [3H] leucine incorporation, while restricted and refed cells had no change in [3H] leucine incorporation when compared with the control. Creatine kinase, a marker of muscle cell differentiation was measured by the release of creatine from phosphocreatine via a colormetric assay. There was no difference in the enzyme activity of creatine kinase between treatment and control cells. Results of this study revealed that glucose restriction decreased protein synthesis while glucose restriction and refeeding had no effect. Creatine kinase activity was not affected by glucose restriction.

Key Words: L-8 cell line, Protein synthesis, Creatine kinase

150   Some results on the application of adipocyte morphometry in young Holstein bulls in Hungary. J. Tõzsér[1], A. Hidas[2], M. Mézes[1], J. Agabriel[3], A. Kovács[1], E. Szűcs[1], I. Holló[4], and Z. Szakács[1]*, [1]University of Gödöllő, [2]Research Center for Small Animal Breeding and Nutrition, Gödöllő, [3]Research Center of Clermont-Ferrand-Theix, France, and [4]Pannon Agricultural University, Kaposvár.

In Hungary the so-called adipocyte morphometry concerning the size of the fat cells in vivo condition has not been used, yet. Young fattening bulls of Holstein were studied at a feed-lot farm of Zirc in Hungary. The feeding of the young bulls tested was based on maize silage, meadow hay (ad libitum) and concentrate (limited) during of the fattening period of 253 days. Three subcutaneous adipose tissue samples (I.,II.,III.) were taken during the fattening period on the level of rump. Adipose cells were fixed by osmium tetroxide and isolated in urea solution as proposed by Robelin-Agabriel, (1986). The fixed cells were trapped on a cellulose nitrate filter (Sartorius).The adipocyte diameter was measured by image analysis (Cytosoft). The bulls were sent to slaughter at the age of 609 days on average. The gut and its water content were also determined at slaughter. Having been cooled for 24 hours, the left carcass were dissected. A significant growth (+18.6microns ,P<0.001) in adipocyte diameter was observed. The adipose cell diameter joined to liveweight resulted in a reasonably good estimation of total body fat content (R^2=0.61, P<0.001). Coefficients of determination (R^2) by the liveweight, empty body weight and adipocyte diameter on the estimation of the lean-to-fat ratio was less than 0.50 (R^2=0.46; 0.39). The use of the adipocyte morphometry to the Hungarian breeders was proposed by the authors.

Key Words: Adipocyte morphometry, Fat cells, Image analysis

151   Feedlot performance and wool growth of feeder lambs supplemented daily with selenium enriched yeast and varying levels of vitamin E. K. D. Kirby, J. D. Thomas*, T. T. Ross, F. A. Schneider, L. A. Appeddu, S. Hogge, M. Salisbury, C. Schultz, and A. S. Thomas, *New Mexico State University, Las Cruces.*

The objective of this study was to evaluate the effect of daily supplementation of selenium enriched yeast and (or) varying levels of vitamin E (D-α-tocopherol) to western white face feeder lambs, on feedlot performance and wool growth. Sixty-four ewe lambs were obtained from a single New Mexico range flock. Lambs were group fed for 24 d acclimation period prior to initiation of trial. Wool was dye-banded at beginning of trial and 3 growth measurements were obtained on last day of trial. There were 2 animals/pen and 4 pens/treatment. Treatments consisted of: 1) no supplementation; 2) 250 IU D-α-tocopherol·animal^{-1}·d^{-1}; 3) 500 IU D-α-tocopherol·animal^{-1}·d^{-1}; 4) 1000 IU D-α-tocopherol·animal^{-1}·d^{-1}; 5) Selenium enriched yeast (SE); 6) SE and 250 IU D-α-tocopherol·animal^{-1}·d^{-1}; 7) SE and 500 IU D-α-tocopherol·animal^{-1} ·d^{-1}; 8) SE and 1000 IU D-α-tocopherol·-animal^{-1}·d^{-1}. Selenium enriched yeast was added to feed at 30 g/kg of feed (DM), approximating a supplementation rate of 10 ppm SE/kg of feed (DM). Vitamin E (VE) was added daily to feed as a top dressing. Lambs were fed for 82 d (period 1 was 19 d and the remaining 3 periods were 21 d each). There was no VE × SE interaction for all variables measured. There were no main effects for SE (*P*=.10). However, intake (*P*=.07), gain (*P*=.01), efficiency (*P*=.03), and ADG (*P*=.01) were all effected by VE supplementation. Vitamin E had a linear effect on intake (*P*=.04), as VE levels increased intake decreased. Significant quadratic effects were seen for gain (*P*<.01), efficiency (*P*=.01), and ADG (*P*<.01) with VE supplementation, primarily due to high VE level depressing performance. Wool growth was not effected by either VE and (or) SE supplementation (*P*>.10). These data indicate that SE supplementation had no influence on feedlot performance and wool growth, while a high VE supplementation rate depressed feedlot performance.

Key Words: Lamb, Selenium, Vitamin E

152   Effects of feeding systems on lambs non-carcass and carcass characteristics and retail cuts yields. O. E. Moron-Fuenmayor*, T. Clavero, and N. Huerta-Leidenz, *Universidad del Zulia, Facultad de Agronomia, Venezuela.*

Thirty crossbred lambs were assigned randomly to three different feeding systems:T1 grazing+2h Leucaena *leucocephala*; T2 grazing+300 g/anim/d (concentrate CP 18%) and T3 grazing Cenchrus *ciliaris* for determine the effect of supplement on carcass and non-carcass characteristics and retail cuts yield. Data were analyzed by analysis of varianza and Duncan's multiple> range. Live weight (LW) and empty weight (EW) were 22 and 30 % more (P<0.05) heavier for T1 and T2 compared with T3 respectively. T2 was different (P<0.05) of T1 and T3 for hot carcass weight (2.1 and 3.6 kg more) and cold carcass weight (1.5 and 2.2 kg more) respectively. T2 had significant (P<0.05) higher dressing percentage compared with T1 and T3 (40.77 vs 37.88; 35.07 %) respectively. Compared to T1 and T2 with T3, lambs had larger (P<0.05) ribeye area (7.81 and 8.32 vs 5.94 sq cm), carcass conformation was not very favourable. The leg conformation score for T1 and T2 was slightly and tapering legs and lean maturity were (P<0.05) slightly dark red and for T3 was thin and slightly concave legs and lean maturity cherry red. Liver weight and connective tissue for T1 and T2 were (P<0.05) more heavier (115 and 40 g) compared with T3. There were no differences (P>0.05) between treatments to kidneys, head, skin, blood, lungs, heart, gallbladder, full digestive tract, empty digestive tract and penis. However, T1 and T2 had higher percentages to feet and testicles compared with T3. No significant (P>0.05) were observed in the rack, leg and neck cuts but to loin percentages was different (P<0.05) T1 and T2 compared with T3 (4.69 and 4.57 vs 3.93 %) respectively. T2 had significantly higher fat depot percentages in kidney, internal fat and thickness of external fat that T1 and T3 respectively. In conclusion the Leucaena *leucochephala* and concentrate supplement or combination, represent an alternative to produce lambs carcass good conformation and higher retail cuts yields and better meat quality.

Key Words: Feeding systems, Lambs, Carcass

153   Evaluation of live animal and carcass yield traits in Holstein crossbred calves castrated at birth or weaning. R. Browning, Jr., S. C. Landry*, and T. Wakefield, *Tennessee State University, Nashville.*

Twenty-two crossbred calves, in four slaughter groups according to birth date, were used to determine how time of castration may effect calf development and subsequent carcass traits. Calves were castrated at birth (n = 10; B) or weaning (n = 12; W) and were evenly distributed in each slaughter group. All groups were on identical nutritional programs which included creep feed available for ad libitum consumption while on their Holstein dams. After weaning at 223 d of age (SD = 14), steers consumed a grower-finisher ration in the feedlot for 146 d (SD = 11). Body weights were recorded at birth, weaning, and monthly thereafter until slaughter at 372 d of age (SD = 21). Longissimus muscle area and backfat thickness were recorded by ultrasound monthly from weaning until slaughter. Body weight and longissimus muscle area did not differ (*P* > .10) among treatments at any date before or after adjustment for age. The ratio of longissimus muscle area to body weight was higher (*P* < .03) for W calves than for B calves through at least 30 d after weaning. At approximately 90 d after weaning, backfat between the 12th and 13th rib was thicker (*P* < .03) for B calves than for W calves. After slaughter, hot carcass weights tended to be heavier (*P* = .07) for W calves than for B calves and USDA Yield Grades were lower (*P* < .04) for W calves than for B calves. Results suggest that developmental differences may exist between calves castrated at birth or weaning that can influence carcass cutability.

Key Words: Calves, Castration, Development, Carcass Yield

154   Modeling of estimated carcass values in cattle by X-ray computer tomography. I. Holló[1], E. Szücs[2]*, J. Tözsér[2], G. Holló[2], P. Rózsahegyi[1], and I. Repa[1], [1]Pannon Agricultural University, Faculty of Animal Science, Kaposvár and [2]Gödöllõ University of Agricultural Science, Gödöllõ.

In recent years, experiments using X-ray CT have been conducted in Hungary to obtain in vivo measurements on various species. In living cattle the application of the procedure is possible only to a limited extent, up to 200 kg LW due to the large dimension. A number of investigations, however, demonstrated that carcass composition can be estimated using samples taken from M. longissimus dorsi (LD) between the 11th and 13th ribs post mortem. Based on this principle the objective was to establish a relationship of loin section tissue composition with carcass traits and/or, a composition where density values of tissues were determined in 10 mm sections of LD samples using Siemens Somatom Plus CT equipment in a spiral mode. Samples were taken from 31 Holstein-Friesian growing-finishing bulls weighing 527±50 kg on the average at slaughter, having 59.00±2.91 dressing percentage. Having been chilled for 24 hrs both half carcasses were dissected and separated into muscle, bone, and fat tissues. Multi- and bivariate correlations between measurements were calculated. Highly significant (P<0.01 and P<0.001) relationships were found between carcass meat, bone, and fat and the amount of meat, bone and fat in LD samples, using estimated density values of CT measurements, where the coefficients of correlation were r = 0.73, 0.54 and 0.86, respectively.

Key Words: Cattle, Carcass value, CT

155   Analysis of pig carcass composition by dual-energy x-ray absorptiometry (DXA). A. D. Mitchell[1]*, A. M. Scholz[2], V. G. Pursel[1], and C. M. Evock-Clover[1], [1]USDA, Agricultural Research Service, Beltsville, MD and [2]Humboldt University, Berlin, Germany.

Dual-energy x-ray absorptiometry (DXA) was used as a non-invasive method to measure the composition of pig carcasses. A total of 181 half-carcasses (10 to 51 kg, from pigs slaughtered at approximately 30, 60, 90, and 120 kg) were scanned using a Lunar (Madison, WI) DPX-L densitometer. DXA results were compared with chemical analysis. Although highly correlated (R^2 = .81), the DXA measurement of percentage fat in the half-carcass was significantly (P < .001) less than the chemical measurement (16.2% vs. 23.2%). The DXA measurement of lean tissue mass was highly correlated with carcass protein (R^2 = .97) and water (R^2 = .99) content. The high correlations suggest that DXA values could be used to accurately predict carcass fat, protein, and water content. Using the DXA R value (ratio of observed attenuation coefficients) to predict percentage fat in the carcass (% fat = 465 - 325 × Rval) resulted in a mean value of 23.8% and was not significantly different from the chemical value (P > .05). Similarly, carcass protein and water content were predicted from DXA lean using the following equations: protein (g) = 33.9 + (.217 × DXA lean) and water (g) = 981 + (.678 × DXA lean). These prediction equations were used to evaluate DXA measurements of the half-carcasses of 28 gilts and 37 boars slaughtered at approximately 120 kg. Based on these estimates the half-carcasses of gilts contained more fat (33.9% vs. 27.8%, P < .001), less protein (14.1% vs. 16.1%, P < .001) and less water (45.9% vs. 52.1%, P < .001) as compared to boars. When DXA results were evaluated separately for the ham, shoulder, loin and belly regions, it was observed that the fat content of the carcasses of gilts was greater in all four regions (P < .001). These results indicate that DXA could be a valuable research tool for measuring the composition of pig carcasses.

Key Words: Pigs, Carcass composition, Dual-Energy x-ray absorptiometry

156   Use of the Hennessy optical grading probe to predict yield of bone-in and boneless pork carcass four lean cuts fabricated to different external fat trim levels. D. W. Grams[1], E. P. Berg[1]*, R. K. Miller[1], J. W. Wise[2], and J. C. Forrest[3], [1]Texas A&M University, College Station, [2]USDA AMS, Washington DC, and [3]Purdue University, W. Lafayette, IN.

Two hundred pork carcasses were selected (25% US #1, 36% US #2, 25% US #3 and 14% US #4 USDA carcass grades) from six U.S. plants representing five companies. A Hennessy Optical Grading Probe (HGP; Auckland, New Zealand) measured fat and muscle depths adjacent the last and between the 3rd and 4th from last costae on warm (prerigor) and chilled carcasses. Right or left sides were randomly selected for fabrication to seven different cutting styles; bone-in and boneless four lean cuts (FLC) trimmed to .64, .32, and 0 cm of s.c. fat (64TFLC, 32TFLC, 0TFLC and B64TFLC, B32TFLC, B0TFLC, respectively) and B0TFLC with seam fat removed (B0TSFLC). All were expressed as a percentage of carcass weight and used as dependent variables while HGP fat and loin muscle depths served as independent variables. Warm carcass fat and loin depths collected at the ¾ from last costae were more accurate predictors of carcass yield than probes adjacent the last costa. Last costa fat and loin depths from chilled carcasses were more accurate predictors of chilled carcass yield. Equations had the lowest coefficient of determinations (CD) and highest root mean square error (RMSE) for 64TFLC (warm CD – 46.70 RMSE – 3.30% and chilled CD = 36.58; RMSE = 3.60%). The CD increased as s.c. and bone were removed from the FLC. Prediction of B0TFLC had the lowest RMSE(2.70% and 2.94%; warm vs chilled, respectively) while percentage of total dissected carcass lean equations had the highest (3.47% and 3.99%; warm vs chilled, respectively).

Key Words: Pork, Optical probe, Carcass yield

157   Studies on visible fat during growth in cattle based on video image analysis. E. Albrecht*, J. Wegner, and K. Ender, Research Institute for Biology of Farm Animals, Dummerstorf, Germany.

The objective of this work was to assess the quantity, structure and distribution of intramuscular fat objectively to study the development of fat storages in the longissimus muscle of different cattle breeds during growth. Stained muscle slices from cattle of the breeds German Angus (GA), Galloway (GW), Black Pied (BP) and White-Blue Belgian (WBB) where taken at different stages of age (2, 4, 6, 12, and 24 months). For basic studies on intramuscular fat deposition staining of muscle slices is more favorable because even very small fat deposits with only few fat cells become visible and thereby measurable. As a result of video image analysis, a complex of new characteristics of intramuscular fat originates. The quantity of the stored fat is grasped as proportion of fat areas and as number of fat areas. The size of fat areas, the proportion of the 3 biggest fat areas, the proportion of long fat areas, the maximum skeleton line length and the number of its branching points are characteristics that describe the structure of fat storages quantitatively. The distribution of the fat areas in the muscle cross section is determined as number and area distribution. During growth, the quantity of the stored fat increases through the increase of the number and the enlargement of the fat areas. Between the breeds, differences appear in the quantity, structure and distribution of the fat areas. The fat storage in the WBB remains up to 24 months of age essentially more inferior than in the other breeds. The GA is particularly marked by bigger fat areas. With the GW, the regular distribution of the fat areas is accentuated, and the fine structure is accentuated in the BP. Between image analytic proportion of fat areas and the chemical fat content, narrow relationships are verifiably natural. A positive influence on the tenderness and the sensory score of the meat can be determined with higher proportion of fat areas, finer structure and more regular distribution of fat.

Key Words: Marbling, Beef, Image Analysis

158 Tenderness classification of beef. S. D. Shackelford*, T. L. Wheeler, and M. Koohmaraie, *USDA-ARS U.S. Meat Animal Research Center, Clay Center, NE.*

The objective was to develop a system for automated tenderness classification of beef and determine the efficacy of that system. At the time carcasses are normally ribbed for determination of quality and yield grade, a 2.54-cm thick rib steak is removed from the 12th rib region of the right side of each carcass. The steak is trimmed of fat and bone and the longissimus is rapidly (7.33 min) cooked to an internal temperature of 70°C. A 5-cm long, 1-cm thick slice is removed from the cooked steak parallel to the muscle fibers. The slice is sheared by a flat, blunt-end blade attached to an electronic testing machine and the slice shear force (SSF) value is determined. The process is completed during the 10 min that the ribeye blooms for quality grading. Thus, tenderness classification does not interfere with production rates. The repeatability of tenderness classification was .89 (n = 204). Tenderness classification conducted at 3 d postmortem on A-maturity carcasses (n = 131) predicted with 95% accuracy whether or not a given sample would be "Tender" (standard Warner-Bratzler shear force < 5 kg) at 14 d postmortem. Carcasses were classified into three groups based on SSF (< 23, 23 to 40, and > 40 kg) at 3 d postmortem which differed greatly (P < .001) in mean Warner-Bratzler shear force (3.4, 4.1, and 6.8 kg) and the percentage (100, 88, and 0%) of "Tender" samples at 14 d postmortem. Thus, tenderness classification could be used to accurately segregate beef carcasses into expected palatability groups.

Key Words: Beef, Classification, Tenderness

159 *In vivo* muscle glycogen metabolism in pigs of different stress susceptibility studied by means of ^{13}C nuclear magnetic resonance spectroscopy. A. M. Scholz[1]*, A. D. Mitchell[2], H. Song[3], and P. C. Wang[3], [1]*Humboldt University Berlin, Institute of Animal Science, Germany,* [2]*USDA, ARS, Growth Biology Lab, Beltsville, MD, and* [3]*Howard University, Department of Radiology, Washington, DC.*

^{13}C Nuclear magnetic resonance spectroscopy (NMRS) was performed in 6 to 8 week old crossbred pigs with different stress susceptibility to compare *in vivo* changes in glycogen, glucose, creatine and body temperature during halothane (HAL) exposure. Homozygous "stress stable" pigs (NN), heterozygous (Nn) and homozygous stress susceptible pigs (nn) of the Iowa State University Experimental Station were identified by the ryanodine receptor gene test. Spectra were collected every 5 minutes by placing a combined proton and carbon surface coil on the skin above the M. biceps femoris. In addition, from each pig 4 spectra were collected before and at least 5 spectra after HAL administration. A generalized linear model procedure was used for the statistical analysis. The nn genotype showed a significant decrease in the glycogen level accompanied by a slight increase in creatine and a significant increase in the body temperature (Temp) after about 8 min of HAL exposure. Metabolic changes in creatine and glucose varied considerably in all three genotypes—partly due to inaccuracies in detecting the low level NMR signals for these two components. The glycogen level of NN pigs decreased very slowly. Overall, Nn showed an intermediate response to halothane confirming the detrimental additive effect of the "defective" allele (n) on muscle energy metabolism and meat quality found in a previous ^{31}P NMRS study.

	Glycogen (%)	Creatine %	Glucose (%)	Halothane (min)	Temp (°C)
NN (n = 6)	−21.26 ± 6.36[a#]	−20.19 ± 19.02	−26.31 ± 50.66	33.87 ± 8.08[a]	−0.36 ± 0.80[a]
Nn (n = 8)	−35.75 ± 5.49[b]	−17.01 ± 16.43	−27.72 ± 46.03	19.47 ± 6.98[b]	+0.59 ± 0.70[ab]
nn N (n = 7)	−40.31 ± 4.60[b]	10.02 ± 13.77	−25.27 ± 31.74	8.13 ± 5.85[b]	+1.40 ± 0.58[b]

#) Least squares means with different characters differ at least with P < .07.

Key Words: Muscle Metabolism, Glycogen, Nuclear Magnetic Resonance

160 Pork quality decline in response to selection for lean growth efficiency in the absence of the halothane gene. E. Huff-Lonergan*, D. L. Kuhlers, S. M. Lonergan, W. B. Mikel, S. B. Jungst, S. Dale, and V. D. Reed, *Auburn University, Alabama.*

A model for indirect selection for improved lean growth efficiency was developed in a line of Duroc pigs. Four generations of selection were made for decreased 10th-rib backfat as measured by real-time ultrasound and improved feed conversion. A contemporary, randomly selected line was maintained as a control. Carcass data were collected on representative barrow carcasses from each litter (n=165). By generation 4, 10th-rib backfat was significantly lower (P<.001) and loineye area and lean gain/day were significantly greater (P<.001) in the selected group (S) than in the control group (C). Pigs from generations 3 and 4 were tested for the presence of the halothane genotype and were found to be negative. Meat quality traits in the longissimus dorsi (LD) and in the semitendinosis (ST) were evaluated from barrow carcasses from generations 3 and 4. The S line LD muscles had lower water-holding capacity (WHC) (P<.05), greater percentage drip loss (P<.001), lower subjective firmness scores (P<.01), lower 24-h pH (P<.05), and higher calpastatin activity (CA) (P<.05) than did the C line. Subjective color scores and Hunter A and B values were not significantly different between the two lines. However, Hunter L values for the LD were lower (P<.05) in the S line than in the C line. The S line ST muscles had lower WHC (P<.05), lower 15 minute pH (P<.01), lower 30 minute pH (P<.05) lower 24-h pH (P<.05), lower protein solubility (P<.05) and higher calpastatin activity (P<.05) than was measured in the C line carcasses. No significant differences in Hunter L, A or B values were detected in the ST. The results from this study suggest that while significant improvements in lean growth efficiency and carcass composition have been made, ultimate product quality has declined. The fact that the decrease in product quality has occurred in the absence of the halothane gene indicates a causative mechanism other than PSS.

Key Words: Pork, Meat quality, Lean growth efficiency

161 Postmortem protein degradation and calpastatin activity in top loin steaks from Brangus cattle. E. Huff-Lonergan, S. M. Lonergan*, L. A.Kriese, and B. R. Wiegand, *Auburn University, Alabama.*

Prediction of beef tenderness can play an important role in improving the consistency and palatability of fresh, whole muscle beef products. In order to accurately predict tenderness it is imperative that an understanding of the biology behind postmortem (PM) aging and tenderization of beef be achieved. Calpastatin activity and myofibrillar protein degradation have been implicated as influencing PM tenderization. The objective of this study was to determine the relationships between PM protein degradation, calpastatin specific activity (CSpA) and Warner-Bratzler shear force measurements (WBS). Brangus bulls and steers were slaughtered between 13 and 16 months of age. Top loin steaks were removed from the carcasses and aged for 2, 7, and 14 d PM. WBS values and CSpA (units/mg of heat stable protein) were determined on samples from all animals at each aging period. Samples from steaks from each aging period were utilized to prepare whole muscle samples for SDS-PAGE and immunoblotting. In this population, there was no significant effect of sex condition on WBS at any time PM. Day 2 PM CSpA was significantly (P<.05) correlated with d 7 WBS (r=.589), but not with d 2 or d 14 WBS. SDS-PAGE and immunoblotting results demonstrated that the rate of protein degradation of specific myofibrillar proteins over the PM aging period was related to CSpA and WBS at 2, 7, and 14 d PM. These data suggest that degradation of key myofibrillar proteins and the production of specific degradation products in conjunction with CSpA measures may provide important information on the rate and extent of postmortem tenderization that can occur in beef samples.

Key Words: Beef tenderness, Calpastatin, Postmortem aging

162   Muscle protein synthesis and protein degradation play a role in callipyge-induced muscle hypertrophy. C. L. Lorenzen[1], M. L. Fiorotto[2], H. C. Freetly[3], S. D. Shackelford[3], T. L. Wheeler[3], J. W. Savell[1], and M. Koohmaraie[3], [1]*Texas A&M University, College Station,* [2]*Baylor College of Medicine, Houston, TX, and* [3]*U. S. Meat Animal Research Center, Clay Center, NE.*

To determine the mechanism of muscle hypertrophy in callipyge lambs, callipyge (Cc) Dorset rams were mated to Romanov ewes (cc). Lambs (n = 38) were slaughtered serially at 5, 8, and 11 wk of age and callipyge phenotype was determined. Mean BW at 5, 8, and 11 wk was 9.3, 15.4, and 22.9 kg, respectively, and was not affected by callipyge phenotype (P > .05). At slaughter, longissimus (LD) and biceps femoris (BF), which have been shown to be affected by the callipyge phenotype, and infraspinatus (IS) and supraspinatus (SS), which have been shown to not be affected by the callipyge phenotype were sampled. Mixed model analyses were used to partition the effects of phenotype, BW, and their interaction. As BW increased, LD (18.8 vs 15.5 g/kg BW) and BF (11.5 vs 8.3 g/kg BW) weights increased at a faster (P < .05) rate in callipyge lambs. In contrast, IS weight increased (P < .05) at a slower rate in callipyge lambs (3.5 vs 4.6 g/kg BW). Callipyge phenotype reduced SS weight (P < .05). Regardless of slaughter weight, the callipyge phenotype elevated (P < .05) protein:DNA in LD and BF but not IS and SS. Regardless of slaughter weight, LD and BF calpastatin activity were elevated (P < .05) and LD RNA: protein tended to be decreased (P < .1) for callipyge. Phenotype did not affect (P > .05) IS and SS calpastatin activity or RNA: protein. These results suggest that protein degradation, as indicated by elevated calpastatin levels, and synthesis, as indicated by RNA:protein, are involved in callipyge-induced muscle hypertrophy.

Key Words: Callipyge, Protein Synthesis, Protein Degradation

163   Effect of long term postmortem aging on tenderness of callipyge and normal lamb. J. R. Busboom[1]*, R. K. Leckie[1], A. O. Silvestri[1], N. M. Rathje[2], P. S. Kuber[2], H. H. Meyer[3], S. K. Duckett[4], and G. D. Snowder[5], [1]*Washington State University, Pullman,* [2]*Superior Packing Company, Dixon, CA,* [3]*Oregon State University, Corvallis,* [4]*University of Idaho, Moscow, and* [5]*U. S. Sheep Experiment Station, Dubois.*

The objective of this study was to determine the effect of long term postmortem aging (80 d) on tenderness of callipyge and normal lamb chops. Twenty callipyge and 20 normal phenotype lambs out of Polypay ewes and sired by heterozygous callipyge Dorset rams were fed to an average weight of 55 kg and slaughtered at a commercial lamb plant. Carcasses were chilled overnight (−1 to −2°C), standard carcass measurements were obtained and muscling phenotype was confirmed based on leg conformation. Carcasses were fabricated into closely trimmed subprimal cuts, and loins were sawed into 2.54 cm thick chops. Four loin chops from the left side of each carcass were vacuum packaged and aged at −1 to −2°C for 14 d. Four chops from the right side of each lamb were placed in foam trays, packaged in a modified atmosphere containing CO_2 and aged for 80 d at −1 to −2°C. After aging, all chops were frozen at −30°C for up to 4 mo. One chop from each aging treatment from each lamb was thawed at 2°C for 24 h, broiled to 70°C internal temperature and Warner Bratzler shear force was determined. Shear force values for callipyge chops (6.1 kg) were higher (P < .01) than for normal lamb chops (3.5 kg). The phenotype × aging interaction was significant for shear force. Aging for 80 d in a modified atmosphere package decreased (P < .01) shear force of callipyge lamb chops from 7.15 kg to 5.01 kg. The effect of long term aging on normal lamb chops was significant (P < .01), but less pronounced, decreasing shear force from 3.75 kg to 3.25 kg. In conclusion, long term aging significantly improved the tenderness of normal and callipyge loin chops. The improvement was most pronounced for callipyge chops, but callipyge chops aged for 80 d were still not as tender as normal chops aged for 14 d.

Key Words: Callipyge lamb, Tenderness, Aging

164   Carcass and meat characteristics of extremely different cattle breeds. K. Ender*, E. Albrecht, J. Wegner, and H.-J. Papstein, *Research Institute for the Biology of Farm Animals, Dummerstorf.*

The objective was to characterize meat of White-Blue-Belgian (WBB), German Angus (DA), Galloway (GA), and Black pied (SR) cattle by new techniques. Bulls (14 animals per group) were slaughtered at different ages (6, 12, 24 month of age). Carcass composition and meat quality traits have been estimated. Moreover the newly developed methods by means of automatic image analysis permit quantitative description of the visual appearance of the intramuscular fat and the muscle structure. An objective comparison of breed and age groups is now possible. The WBB is a heavily muscled breed with double muscling and has a low content of carcass and intramuscular fat. There are only a few deposits of intramuscular fat. The large muscles are caused by a double number of muscle fibres. The values indicate that DA, GA and SR shows similar proportions of fat, but there were differences in the fineness and distribution of fat (values lowered symetrically). The GA showed the smallest and best values for the fat distribution, associated with the largest number of fat deposits.

24 month of age	WBB	DA	GA	SR
Carcass weight, kg	476	449	358	402
Meat, %	77.7	58.3	63.5	56.1
Carcass fat, %	4.4	15.1	20.7	18.2
M.long.:Intram.fat, %	0.63	3.76	5.45	4.79
Fat particles, no.	170	427	615	538
Fat area distr., %	9.9	5.7	4.4	5.6
M. semitend.:				
Muscl. area, cm^2	142.5	99.6	81.4	81.0
Muscl. fibres, no. $\times$ 106	3.36	1.71	1.70	1.83

Key Words: Cattle, Visible Fat, Muscle Structure, Video Image Analysis

165   Economical Advantage of Hot Fat Trimming Beef Carcasses. E. W. Hawkins[1], L. E. Orme[1], and R. Lacey[2], [1]*Brigham Young University, Provo, UT and* [2]*Drummund, MT.*

External fat has little economical value to the packer or consumer. A pilot study was conducted to determine if hot fat trimming was economically beneficial to the producer and packer. Forty-seven yearling steers (12.2 mo) from the BYU Skaggs Ranch in Declo, ID were shipped to the Monfort plant in Greely, CO to be slaughtered and hot fat trimmed. The cattle were shipped a month earlier than expected due to declining economic forecasts. Cattle were lighter thus lowering live and carcass weights. Steers weighed an average of 468.6 kg. Carcasses dressed 64% having an average adjusted carcass weight of 273.1 kg. Average ribeye was 72.52 sq. cm. Quality grades were 42% choice and 57% select. Average percentage fat trimmed from each carcass was 7.22%, comparing the trim base price $121.32± the grid adjustment (Monfort's formula) for an average $123.51. Live animal base price was $70 with average live weight 468.6kg for total live cost of $723.10 per steer. Carcass base price was $1.09 or an average carcass value of $656.18. Individual carcasses were evaluated for positive and negative traits; data was sent to the ranch. Hot fat trimmed cattle had a positive dollar gain over the live price of $20.42 and over total carcass value $87.34. Based upon study results, removal of external fat can be an economical advantage to producers and packers.

Key Words: Beef cattle, Hot fat, Trimmings

166   Sensory attributes, retail display and storage characteristics of pasture- and/or grain-fed beef. P. H. Sapp*, S. E. Williams, and M. A. McCann, *University of Georgia, Athens.*

Ribeye and loin steaks were removed from carcasses of Angus sired, crossbred steers that were assigned to one of three postweaning feeding programs: 1) wheat-ryegrass pasture only, 2) wheat-ryegrass pasture followed by grain feeding, and 3) grain feeding only. Steaks were analyzed for sensory panel, shear force, proximate analysis, storage and display life. Steaks from pasture-fed steers were similar (P>.05) to steaks from grain-fed steers in sensory tenderness and sensory connective tissue amount. Off-flavor percentage was greater (P<.05) in steaks from steers on pasture only than grain and pasture/grain. Steaks from steers on pasture/grain had higher (P<.05) shear force values than from grain, while steaks from pasture-fed steers were similar (P>.05) to steaks from grain-fed steers. No differences (P>.05) due to treatment were found in visual color and discolor scores over 10 d display period. In addition, C.I.E. (1978) a* values showed steaks from steers fed pasture only and pasture/grain retained higher (P<.05) redness values than steaks from steers grain-fed during the 10 d display period. Provided technologies can be developed to enhance flavor characteristics, pasture finishing systems could be as effective in maintaining beef shelf-life characteristics as grain finishing systems.

Key Words: Forage, Steers, Sensory

167   Effects of genotype, sex, slaughter weight and dietary fat on porcine carcass fat distribution. J. M. Eggert, A. P. Schinckel*, E. B. Sheiss, and A. L. Grant, *Purdue University, West Lafayette, IN.*

A study of fat distribution in porcine carcasses of two genotypes which have different rates of lean growth and fat deposition was conducted. Pigs were randomly assigned to a 2×2×2×3 factorial arrangement of genotype, sex, diet and slaughter weight. At 60 kg BW, 48 pigs of each genotype were fed diets without (NF) or with 5% added beef tallow (BT). Diets were formulated to have equivalent lysine:calorie ratios and offered on an ad-libitum basis. Four pigs of each sex × diet × genotype combination were slaughtered at 105, 120 and 135 kg BW. Carcasses were evaluated and the four primal cuts on the right side (loin, ham, picnic and boston) were dissected into lean, subcutaneous fat (SUBQ) and intermuscular fat which were analyzed for % lipid. Pigs of the high lean genotype had lower 10th rib fat depth (21.84 ± 0.76 vs. 29.46 ± 0.76 mm, P<0.001) than those of the average lean genotype. Carcasses from high lean pigs contained less fat in each primal cut and fat depot, less total (4 primals) fat (9.99 ± 0.22 vs. 12.04 ± 0.21 kg, P<0.001) and more total fat-free lean (15.26 ± 0.27 vs. 13.61 ± 0.25 kg, P<0.001) than carcasses from average lean pigs. BT did not affect total fat, total fat-free lean or kidney fat. BT fed pigs had larger hams (10.23 ± 0.08 vs. 10.01 ± 0.08 kg, P<0.05), more total ham fat (3.30 ± 0.08 vs. 3.02 ± 0.08 kg, P<0.05) and greater ham SUBQ % lipid (76.55 ± 0.61 vs. 74.60 ± 0.60%, P<0.05). No difference in total fat (kg) was observed between high lean barrows and gilts (4.14 ± 0.17 vs. 4.18 ± 0.17), but barrows contained more total fat than gilts of the average lean genotype (5.52 ± 0.16 vs. 4.82 ± 0.15, P<0.05). In conclusion, primal cuts from average lean genotype pigs contain more fat than those from high lean genotype pigs, but carcass fat distribution is not affected; however, dietary fat supplementation does influence fat distribution.

Key Words: Pigs, Genotype, Fat Distribution

168   Effects of genotype, sex, slaughter weight and dietary fat on pork quality. J. M. Eggert*, A. L. Grant, E. B. Sheiss, and A. P. Schinckel, *Purdue University, West Lafayette, IN.*

A study of pork quality of two genotypes that have different rates of lean growth and fat deposition was conducted. Pigs were randomly assigned to a 2×2×2×3 factorial arrangement of genotype, sex, diet and slaughter weight. From 15 to 60 kg BW, the pigs were fed a conventional corn-soybean meal diet containing 0.85% lysine with no added fat (NF). At 60 kg BW, 48 pigs of each genotype were fed diets containing 0.90% lysine with or without 5% added beef tallow (BT). Diets were formulated to have equivalent lysine:calorie ratios and offered on an ad-libitum basis. Four pigs of each sex × diet × genotype combination were slaughtered at 105, 120 and 135 kg BW. Pigs fed NF had greater feed intake (3.13 ± 0.04 vs. 2.89 ± 0.04 kg/d, P<0.001) and greater feed:gain ratio (3.34 ± 0.04 vs. 3.03 ± 0.04, P<0.001). Beef tallow did not affect 24-h postmortem pH (*longissimus dorsi* and *semimembranosus*), Hunter color scores, backfat depths, loin eye area, drip loss, dressing percentage, carcass length or color, firmness, and marbling evaluations. Percent intramuscular fat of loins was not affected by BT in the lean line (BT: 1.89 ± 0.26 vs. NF: 1.85 ± 0.25%), but was increased in the average line (BT: 4.14 ± 0.25 vs. NF: 2.87 ± 0.25%, P<0.05). Marbling scores (1 = devoid to practically devoid; 5 = moderately abundant or greater) of the loin muscle at the 10th rib were greater in the average line than the high lean line (1.77 ± 0.10 vs. 2.35 ± 0.10, P<0.001). Percent intramuscular fat increased (2.16 ± 0.21, 2.93 ± 0.23 and 2.98 ± 0.22%, P<0.05) as slaughter weight increased (105, 120 and 135 kg, respectively). In conclusion, differences in quality of pork from high lean and average lean pig genotypes appear to be a result of changes in intramuscular fat deposition.

Key Words: Pigs, Genotype, Pork Quality

169   Ultrasonic prediction of quality grade and percent retail cuts in beef cattle. T. L. Perkins*[1], J. C. Paschal[2], N. C. Tipton[3], and M. J. DeLaZerda[4], [1]*Southwest Missouri State University, Springfield,* [2]*Texas Agricultural Extension Service, Corpus Christi,* [3]*Texas A&M University, College Station, and* [4]*Texas A&M University, Kingsville.*

The objectives of this research were to determine if ultrasonic measurements of 12-13th rib fat thickness (FTU) and longissimus muscle area (LMAU) can be used to predict carcass yield and if ultrasonic measurements of percent fat (PFU) in the LMA can be used to predict carcass quality. Two groups of cattle were used in this study. Group one (G1) consisted of Santa Cruz steers and heifers (n=25) while group two (G2) were Brangus bulls (n=31). Measurements were taken via an Aloka 500V real-time, ultrasound unit with a 3.5 MHz transducer at the 12-13th rib interface to measure FTU and LMAU. Intramuscular fat software developed by Iowa State University was used to determine PFU. Carcass data including hot carcass weight (HCW), carcass LMA (LMAC), fat thickness (FTC), %KPH fat, marbling score (MARB) and quality grade (QG) were collected 24h post mortem. Yield grade (YG) and percent retail cuts (RTLC) were calculated. Percent LMA fat (PFAT) was determined. Statistical analysis used general linear models with HCW as a covariate. Simple correlations for FTC and FTU, LMAC and LMAU, YG and FTU, YG and LMAU, RTLC and FTU, RTLC and LMAU, PFU and MARB, and PFU and QG, in G1 and G2 were .92, .93; .95, .80; .76, .79; −.41, .31; −.06, −.81; .61, −.33; .63, .58; and .69, .51; resp. In G2, simple correlations of PFAT with PFU, MARB and QG were .45, .54 and .45. This research indicated that ultrasound measurements can be very accurate predications of carcass yield, but less for carcass quality.

Key Words: Beef cattle, Ultrasound, Carcass grading

170   Development of a model to predict intramuscular fat in live swine using real-time ultrasound. K. D. Ragland*, L. L. Christian, T. J. Baas, and V. R. Amin, *Iowa State University, Ames.*

Live animal ultrasound scans were taken on 350 pigs (196 barrows; 154 gilts) ranging between 91 kg and 124 kg in weight. Scans were taken 24 h prior to slaughter using a Corometrics ALOKA 500V real-time ultrasonic machine fitted with a 12.5 cm, 3.5 MHz ultrasonic probe. A single longitudinal ultrasonic image was collected on each animal while the transducer was aligned parallel to the *longissimus* muscle while transecting the ninth, tenth, eleventh and twelfth ribs at a position approximately 8 cm from the midline. Following a 2 h rapid chill, carcasses were ribbed between the tenth and eleventh ribs, a marbling score recorded and a loin muscle sample excised from each animal. Lipids of the sample were measured following extraction in a methanol and chloroform solution. Ultrasonic images were preprocessed to subjectively score image quality and to select a square region of interest (ROI). Twelve gray scale statistics and Fourier transformation parameters were determined for the selected ROI of each ultrasonic image. The Pearson correlation coefficient between marbling score and chemically extracted intramuscular fat (IMF) was .20 (p<.01). The R^2 and MSE for the IMF model which included only ultrasonic gray-scale statistics and Fourier transformation parameters were .33 and 1.12, respectively. Including sex and real-time ultrasound tenth rib subcutaneous fat measurements in the model improved the R^2 to .38 and reduced the MSE to 1.04. These results indicate gray-scale and Fourier transformation statistics to be useful in predicting IMF. Live animal measurements and information, however, add prediction accuracy to gray scale and Fourier transformation information.

Key Words: Intramuscular fat, Swine, Real-time ultrasound

171   Validation of a model to predict intramuscular fat in the *longissimus* muscle of live swine. K. D. Ragland, T. J. Baas*, L. L. Christian, and V. R. Amin, *Iowa State University, Ames.*

A single longitudinal ultrasonic image was collected on 350 market weight pigs (154 gilts; 196 barrows) 24 h prior to slaughter using a Corometrics ALOKA 500V real-time ultrasonic machine fitted with a 12.5 cm, 3.5 MHz linear array transducer. The transducer was aligned parallel to the *longissimus* muscle across the ninth, tenth, eleventh and twelfth ribs at a position approximately 8 cm from the midline. A marbling score was recorded and a loin muscle sample was excised from each carcass following a 2 h rapid chill. Lipids from the sample were determined by extraction in a methanol and chloroform solution. Gray scale statistics and Fourier transformation parameters were measured on each ultrasonic image. The images were randomly divided into two groups. The first group (n=200) was used to develop percentage intramuscular fat (IMF) and marbling score prediction models. The second group (n=150) was used to validate the prediction models. The independent variables used to predict IMF were sex, ultrasound-measured backfat thickness at the tenth and eleventh ribs and image gray-scale and Fourier transformation statistics. Mean values for actual and predicted percentage intramuscular fat were 2.78 and 2.83, respectively. Pearson product moment and Spearman rank correlation coefficients between actual and predicted values of IMF were .40 (p<.01) and .49 (p<.01), respectively. The standard error of prediction between actual and predicted IMF was 1.45 and between actual and predicted marbling score was .96. This research indicates that real-time ultrasound can be an effective estimator of IMF in the *longissimus* muscle of live swine. Improvements in data collection and analysis systems will further enhance prediction accuracy.

Key Words: Intramuscular fat, Swine, Real-time ultrasound

172   The feasibility of meat quality assessment using elastography. F. Kallel[1]*, J. Ophir[1], R. K. Miller[2], and E. P. Berg[2], [1]*University of Texas Medical School, Houston* and [2]*Texas A&M University, College Station.*

Subjective USDA marbling scores have an intermediate correlation to chemically determined intramuscular fat. Elastography is an ultrasonic method for assessment of meat quality relative to muscle tissue stiffness by imaging tissue elasticity. The technique uses ultrasonic pulses to quantitatively measure tissue displacement, or strain, in response to an externally applied stress. A computer simulation study was conducted to enhance the clarity of elastographic images. Such simulation was based on finite element (FE) analysis combined with the use of an echographic image formation model. A specified region of interest from the modest (MT) and moderately abundant (MDA) USDA marbling photographs was digitized and converted to a binary image. Apparent (optical) marbling was detected as numerous closed contours and identified as fat tissue (marbling element) and used to build the geometry necessary for FE analysis. The 2-dimensional linear elasticity equation was solved numerically using commercial FE software (Algor) for a given Young's modulous of fat and muscle tissues under pre-established boundary conditions whereby muscle/fat contrast ranged from –16 to –6 dB. Based on the computer simulation study it was shown that elastography could be used to estimate percent marbling fat (MT = –4.0%; MDA = 7.0%). Algorithms generated from computer simulation established strain thresholds discerning fat and lean tissue. Evaluation of marbling features in beef longissimus muscle have shown elastic contrast and can be displayed as an elastographic image. As a result of FE computer simulation study, elastogram image quality and spatial resolution were further improved. With current elastography, using simulated data, it is possible to distinguish between MDA and MT marbling.

Key Words: Elastography, Ultrasound, Beef

173   Carcass maturity and characteristics of open and bred Santa Gertrudis cross heifers differing in age. D. B. Griffin, N. C. Tipton*, D. S. Hale, and J. C. Paschal, *Texas A&M University, College Station.*

Recent changes in USDA quality grades have caused scrutiny of older heifer carcasses implicating them as possible tenderness problems. Therefore, two Groups (GRP) of Santa Gertrudis cross females were evaluated for presence of fetuses (PREG), USDA carcass characteristics, and 12th rib longissimus steak Warner-Bratzler shear force (WBS) to determine possible age differences. GRP one (n=31) was 32-34 mo. old at slaughter, bred during their first breeding season, but palpated open after their second breeding season. GRP two (n=15) was 25-27 mo. old at slaughter and palpated open after their initial breeding season. Both GRP, however, had bred animals due to missed palpations. Both GRP were combined, fed for approximately 93 days on a high energy ration and then commercially slaughtered. There were no significant differences due to PREG. GRP was significant (P<.03) for longissimus muscle area (LMA), skeletal maturity (SMT), overall maturity (OMT), as well as new (NQL) and old (OQL) quality grade, but GRP did not differ in marbling score (P>.18) or any other carcass trait. Least squares means for SMAT were $B^{23}\pm10$ and $B^{96}\pm12$, for GRP two and one, respectively. This resulted in OQL least squares means of Select$^{43}\pm21$ and Standard$^{28}\pm24$ with resulting NQL least squares means of Select$^{01}\pm19$ and Utility$^{97}\pm22$ for GRP two and one, respectively. Also, carcass maturity groups (MAT) of A, B or C were not significant for any unrelated carcass characteristic. MAT was, however, numerically higher for B maturity than either A or C maturity WBS (3.13kg, 3.64kg and 3.10kg for A, B and C MAT, respectively). This study suggests that a small increase (6 mo.) in chronological age of fed Santa Gertrudis cross heifers, regardless of pregnancy, leads to increased skeletal maturity, decreased USDA quality grade, and, due to the recent USDA quality grade change, the potential to be severely discounted.

Key Words: Heifers, Maturity, Quality

174   Comparison of growth and carcass traits between freemartin and co-twin males. S. E. Echternkamp*, K. E. Gregory, and M. Koohmaraie, *USDA, ARS, RLH US Meat Animal Research Center, Clay Center, NE.*

Bovine freemartin females were evaluated for meat production by comparing growth and carcass traits between co-twin female and male calves or single-born females. Calves were weaned at 173.6±1.4 d of age; males were castrated at a BW of 306.7±6.5 kg. Postweaning diets contained 2.63 Mcal ME/kg DM, 14.4% CP to 272 kg BW and 3.12 Mcal ME/kg DM, 11.5% CP from 272 kg to slaughter. Birth weight was similar (P>.1) for male (39.4±1.3 kg) and female (36.6±1.1 kg) twin calves but heavier (P<.05) for single heifers (42.6±2.0 kg). Freemartins were lighter at weaning (203.4±4.4 vs 219.0±5.2 kg; P<.1), gained slower (1.1±.02 vs 1.2±.03 kg/d; P<.01), and were lighter (522.4±5.5 vs 570.8±6.5 kg; P<.01) and older (480.6±3.3 vs 464.2±3.9 d; P<.01) at slaughter than steers. Intact heifers were similar to twin steers in weaning weight (217.2±7.9 kg), ADG (1.1±.04 kg) and slaughter age (464.6±5.9 d) but lighter at slaughter (534.4±9.8 kg; P<.01). Except for six with ovotestes, freemartins had smaller gonads (.5 g) and their reproductive tracts were undifferentiated. Estimated retail product (ERP) was less for freemartin vs steer carcasses due to increased marbling (r = −.82) and fat thickness (adj. fat) (r = −.57). Increased subcutaneous and perirenal fat (KPH) in intact and freemartin females vs steers suggest that fat deposition is mediated by sex genotype. Whereas, increased (P<.01) ribeye area (REA), meat color and carcass maturity for intact heifers suggest an ovarian influence on muscle development.

Sex	n	HCWT kg	Marb.	Adj. fat cm	Est. KPH %	REA cm^2	ERP %	Shear force kg	Serum T4 ng/ml
Free-martin	34	317.2[a]	MT80[*]	.83[c]	4.1[a]	74.6[a]	59.4[a]	3.81	.21
Steer	24	343.4[b]	MT20	.68[d]	3.6[b]	76.1[a]	62.3[b]	3.93	.14[*]
Heifer	12	328.3[ab]	MT20	.89[c]	4.3[c]	85.8[b]	61.3[ab]	4.15	.21

[ab]P<.01; [cd]P<.05; [*]P<.1.

Key Words: Freemartin, Twins, Carcass

175   The effects of Vitamin E on retail meat caselife; a commercial setting. E. A. Westcott[1], R. L. Stubbs[1], J. B. Morgan[1], D. M. Schaefer[2], K. E. Belk[3], H. G. Dolezal[1], G. C. Smith[3], [1]*Oklahoma State University, Stillwater,* [2]*University of Wisconsin, Madison,* [3]*Colorado State University, Fort Collins.*

Approximately 235,000 steers were utilized in three commercial feedyards to evaluate the effects of supplementing 500 IU /animal/day of α-tocopheryl (VITE) for the last 100 days of the finishing period on retail beef caselife. To determine the α-tocopheryl concentration of diets, feed samples were collected from five pens every other week during the feeding period. Microassay analysis of feed samples revealed a higher (P < .01) concentration of α-tocopheryl in VITE than control (CON) diets (24.0 vs. 6.1 mg E/lb DM). Post-harvest, samples were taken from the Rectus capiti dorsalis major muscle for determination of α-tocopherol concentration using a new rapid assay analysis. VITE carcasses had higher (P < .01) concentrations of α-tocopherol than CON (3.5 vs. 1.5 μg/g). After chilling, carcasses were graded, conventionally fabricated and cuts were vacuum packaged for transport to four geographically selected retail stores. Sample collection of muscle tissues from specified retail cuts at participating grocers were analyzed and revealed VITE cuts contained higher (P < .01) levels of α-tocopherol than CON cuts. Supplementing cattle with VITE resulted in retail cuts with a slightly more desirable lean color. The percentage of discounted items were not statistically different (P > .05); however, chuck, round, and ground beef products from cattle supplemented with α-tocopherol had lower percentages of discounted items than controls (7.4, 7.7 and 7.5 %, respectively). Caselife for VITE chuck cuts was prolonged (P < .01; 3.6 vs. 3.2 days for VITE vs. CON). Additionally, the caselife of round cuts from VITE steers (3.5 days) was extended (P < .05) over CON steers (2.9 days). Although not statistically significant (P > .05), the percentage of ribeye, strip loin, T-bone and tenderloin steaks discounted as a result of discoloration was lower for VITE compared to CON (1.9, 3.5, 1.4, 1.6 % lower for VITE vs. CON, respectively). Interestingly, VITE supplementation was not beneficial for top sirloin steaks (VITE discount was 23.9% vs. 23.7% for CON). This survey indicates supplementing cattle with VITE at 500 IU/animal/day for 100 days prior to harvest will result in improved caselife and, consequently, a decrease in discount percentages for most products.

Key Words: Beef, Vitamin E, Retail

176   Utilization of calcium chloride and spice marination to improve the sensory and textural characteristics of precooked *semitendinosus* roasts. K. G. DeYonge*, T. D. Pringle, S. E. Williams, and A. E. Reynolds, *University of Georgia, Athens.*

Seventy-two denuded *semitendinosus* roasts from mature cows were used to evaluate the tenderizing effects of calcium chloride (CaCl$_2$), along with the efficacy of spice marination to overcome potential off-flavors associated with CaCl$_2$ treatment. The experiment was conducted as a 4×2 factorial, with 0, 200, 300 and 400 mM solutions of CaCl$_2$ and inclusion (ISP) or exclusion (NSP) of a commercially prepared spice mixture (SP). Additionally, an uninjected control (CON) was included in the experiment. An ANOVA fixed effects model and Tukey s test were used to analyze the data. Roasts were randomly allocated to treatment solutions and injected at 10% (wt/wt) approximately 48 hours post-mortem. The roasts were vacuum tumbled, vacuum packaged and held at 4°C for 12 hours before cooking. Roasts were cooked in the bag to a final internal temperature of 70°C. Cooked weight, cooking loss and total loss ((green weight – cooked weight)/green weight) were measured. Roasts were also evaluated by Warner-Bratzler shear (WBS) and a trained sensory panel. Roasts in the ISP treatments had less (P<.05) cooking (17.2 vs 31.3 and 27.6%) and total (6.9 vs 24.0 and 26.2%) loss than NSP and CON treatments. Neither CaCl$_2$ or SP affected WBS values. Sensory evaluation showed that the ISP roasts were more (P<.05) tender (5.3 vs 3.9 and 2.9) and juicy (4.6 vs 3.6 and 3.5) than NSP or CON. Possibly, the increased water-holding capacity is the means by which ISP improved tenderness and juiciness. Both SP and CaCl$_2$ enhanced (P<.02) spice flavor. Furthermore, ISP had fewer (P<.05) off-flavors than NSP. Based on these data, it is apparent that the injection of SP can overcome off-flavors. However, it does not appear that CaCl$_2$ injection is efficacious as a tenderizing agent in the *semitendinosus* muscle of mature cows.

Key Words: Calcium chloride, Spice, Roast

177   Objective and subjective determination of texture in Caprine (Goat) sausages. J. M. Dzakuma*, E. Risch, and P. M. Johnson, *Prairie View A&M University, Prairie View, TX.*

The objective of this study was to compare the textural characteristics of caprine sausages determined objectively with an Instron Universal Testing Machine, and subjectively by a trained descriptive attribute panel. Three replications of two sausage meat blends (caprine/turkey [C/T] and caprine/pork [C/P]) were formulated in 75:25, 50:50, and 25:75 ratio increments. A control blend of 70:30 beef/pork was also formulated. An air oven was preheated to 350°F for 15 minutes; the sausages were then cooked for 30 minutes in the oven. The sausages were cooled to between 100 and 120°F, and cylindrical samples (1 inch diameter by 1 inch length) were prepared. The sausage samples were subjected to instrumental textural tests including compressive moduli of elasticity, fracturability, hardness, cohesiveness and shear stress. Sensory evaluation of the sausage blends was done by a trained descriptive attribute panel. Statistical analyzes were performed using SAS with replications and sausage formulations as main effects. There were no statistically significant differences in the sensory parameters. Instron tests yielded significant differences for fracturability, and shear at P<.05. For fracturability, 50:50 and 25:75 C/T sausages had the lowest values (123N and 126N, respectively), and did not differ from the control (133N). However, these C/T products differed significantly (P<.05) from the C/P blends (145N). Toughness and cohesiveness values for the sausages were statistically non significant. Shear force values followed the same trends as fracturability and indicated 25:75 C/T as requiring the least shear force. Correlations between objective Instron measurements and subjective sensory scores for cohesiveness, toughness and fracturability were, -0.46, -0.25 and 0.60, respectively.

Key Words: Caprine sausage, Texture, Shear force

178   Breed group differences in shear force tenderness in the Texas A&M University Ranch to Rail-South Program.

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A total of 270 IMPS 107 ribs were collected from steers in the 1995 and 1996 Texas A&M Ranch to Rail-South Program. The steers were consigned by 81 ranches and represented diverse breeds and crosses. All carcasses were electrically stimulated. Each rib was aged 14 d then three 2.54 cm steaks were cut from the posterior end of the longissimus muscle (LD). Steaks were assigned to breed groups on the basis of breeding (>50%): Bos indicus (A), British (B), or Continental (C). Each steak was weighed, cooked to an internal temperature of 35°C then turned and cooked to an internal temperature of 70°C on a Faberware Open Hearth Oven, removed and reweighed. After cooling 3 h, six 1.27 cm diameter cores were collected parallel to LD muscle fibers. These cores were subjected to shear force determination. Data were analyzed using GLM procedure of SAS. Group, year, days on feed(year), uncooked ribeye weight (RWT) and cooking loss were effects of interest. All effects except group and RWT were significant. Least square means for groups A, B, and C for average shear were 3.1±.1, 2.9±.1 and 2.9±.1 kg. When steers were reclassified into six groups on the basis of percent Brahman (1=0%, 2=.01–.24%, 3=.25–.49%, 4=.50–.74%, 5=.75–99%, and 6=100%), group was not significant. These results indicate that differences in tenderness in IMPS 107 ribeye steaks due to either breed group or percent Brahman influence may not be as great in carcasses that are electrically stimulated.

Key Words: Beef cattle, Tenderness, Breed effects