547   Condition and cleanliness of live animals in relation to microbiological counts on cow carcasses. M. L. Kain[1]*, S. L. Kochevar[1], J. N. Sofos[1], K. E. Belk[1], C. Rossiter[2], J. O. Reagan[3], and G. C. Smith[1], [1]*Colorado State University, Ft. Collins, CO* [2]*Cornell University, Ithaca, NY* [3]*National Cattlemen's Beef Association, Denver, CO.*

Understanding the relationship of condition and cleanliness of cows to microbiological counts on their carcasses should be useful in designing animal and carcass handling/processing protocols to identify potential sources of *Salmonella* and *Escherichia coli* O157:H7 and to reduce microbial contamination. Eighty cull cows from twelve lots were weighed and categorized for breed; then, four live animal characteristics were evaluated including body condition, filth on the animal, ambulatory (lameness) condition and feces condition. The cows were harvested during a 4-day period and the carcasses were weighed, graded and sampled for microbiological analyses. Aerobic plate counts (APC), total coliform counts (TCC) and *E. coli* counts (ECC) were determined on samples taken at three plant locations (pre-evisceration, post final wash, and post 24 hr chill) from two carcass sites (brisket and round). In addition, samples of fresh feces, hide-surface sponged samples and carcass tissue samples were analyzed for *Salmonella* and *E. coli* O157:H7. Live weight, carcass weight, and carcass grade had a significant (P<0.05) effect on APC; lot number and slaughtering date had a significant effect on APC, TCC, and ECC; and ambulatory (lameness) score had a significant effect on APC and TCC. In 77 fresh fecal samples and 80 hide-surface sponged samples, incidence of *E. coli* O157:H7 was 0% and 0%, respectively, while incidence of *Salmonella* was 0% and 13.8%, respectively. Of the 427 carcass samples, 0% tested positive for *E. coli* O157:H7 and 1.2% tested positive for *Salmonella*. These results suggest that most live animal and carcass characteristics were not related to the microbial contamination of carcasses, and that activities associated with slaughtering/dressing were the source of most of the differences in microbiological contamination on carcasses.

Key Words: *E. coli* O157:H7, *Salmonella*, Live/Carcass Contamination

548   Influence of sampling procedure and stage of sampling on the microbiological status of fresh beef. L. M. Ware, M. K. Kain, J. N. Sofos, K. E. Belk, and G. C. Smith, *Colorado State University, Fort Collins.*

This study evaluated sponging and excising as sampling procedures for microbiological analysis of beef carcass tissue (n=96−192 carcasses) in a commercial plant. In addition, subprimals (clod and top butt, n=46−96) were sampled by sponging in the plant and when they reached their destination at the retail level. The carcass sampling protocol was the same as that in the Federal Register for the Pathogen Reduction: Hazard Analysis and Critical Control Point (HACCP) systems regulation. The samples were analyzed for aerobic plate counts (APC), total coliform counts (TCC), *Escherichia coli* counts (ECC), lactic acid bacteria counts (LAB; only carcass), psychrotrophic plate counts (PPC), *Salmonella* spp. and *Listeria* spp. No *Salmonella* spp. positive samples were detected, while *Listeria* spp. was detected in 8.33% of excised and 2.08% of sponged samples (P>.05). Recovery of TCC, ECC, LAB was higher overall (P<.05) when sampled using excision compared to the sponging procedure. However, the sponging method was more effective in recovering APC (3.92 log cfu/300 cm^2-excising and 4.39 log cfu/300 cm^2-sponging). Excision yielded 3.82 log cfu/300 cm^2 (LAB), 2.46 log cfu/300 cm^2 (TCC) and 2.49 log cfu/300 cm^2 (ECC). Sponging yielded LAB at 3.07 log cfu/300 cm^2, TCC at 1.69 log cfu/300 cm^2 and ECC at 1.61 log cfu/300 cm^2. However, excising and sponging were not significantly (P>.05) different in recovering PPC, yielding counts of 4.25 and 4.31 log cfu/300 cm^2 for excising and sponging, respectively. Subprimals were sampled on the lean and fat side. There were no significant (P>0.05) differences in APC (3.36−6.12 log cfu/300 cm^2), TCC (1.65−3.31 log cfu/300 cm^2) or ECC (1.46−2.65 log cfu/300 cm^2) recovered from the different subprimals in the plant or at the retail level. In addition, the steaks cut from the subprimals were analyzed and the results indicated no significant (P>0.05) differences among types of steaks.

Key Words: Sponging, Excising, Bacteria

549   Diets that improve amino acid balance enhance carcass protein accretion rates and muscle mass in beef cattle. T. F. Robinson*, D. H. Beermann, T. C. Perry, and D.G. Fox, *Cornell University, Ithaca, NY.*

Fifty crossbred steers weighing an average of 305 kg were blocked by weight into five groups. Ten served as an initial slaughter group and forty were implanted with Revalor^{TM} and housed in individual pens. Treatments consisted of dietary levels (0, 3, 6 or 9% of DM) of a mixture of undegraded intake proteins (UIP) in a corn-soy total mixed ration offered *ad libitum* for 112 days. The UIP mixture was formulated using the Cornell Net Carbohydrate and Protein System Model to optimize amino acid balance at the site of absorption using meat and bone meal, blood meal, fishmeal and feathermeal. Objectives were to determine effects and optimum level of feeding this protein mixture on growth performance, carcass traits and composition of carcass gain, and composition and tenderness of longissimus muscle in finishing steers. Carcass composition was estimated from proximate composition of the 9th through 11th rib section (Hankins and Howe, 1946). The trial was terminated when at least 75% of the cattle were expected to achieve the "low choice" USDA Quality Grade. Daily gain was 30%, 23% and 10% higher (P<.05) in the 6% UIP group after 56, 84 and 112 days (significant interaction with time). Although slaughter weight, carcass traits and carcass composition were not significantly affected by treatment, carcass protein accretion rates were 14%, 43% and 12% greater (P<.05) when UIP was fed at 3, 6 and 9% levels, respectively. Weight of the longissimus in the 6th through 12th rib section was increased (P<.05) 8%, 18% and 9.5% when the UIP supplement was fed at the 3, 6 and 9% levels, respectively. Feeding the UIP supplement did not alter longissimus composition or shear force values. Results demonstrate that corn-based finishing diets for medium-frame to large-frame steers can be formulated to improve efficiency of protein use for growth and to improve rates of protein gain without hindering longissimus muscle quality. Maximum anabolic response was observed with feeding the 6% level of UIP in the diet.

Key Words: Cattle, Amino Acids, Muscle Growth

550   Expression of cardiac fatty acid-binding protein (H-FABP) mRNA in three different muscles of growing bulls and steers. A. M. Brandstetter*[1], J. F. Hocquette[1], H. Sauerwein[2], and Y. Geay[1], [1]*INRA, Clermont/Theix (France),* [2]*FML Weihenstephan, TU München (Germany).*

H-FABP plays a key role in energy metabolism of skeletal muscle. It is involved in oxidation of fatty acids, an important energy source for muscle growth, and in fatty acid esterification, and hence, fat storage within muscle fibers.
We aimed to compare H-FABP mRNA expression in three muscles of different metabolic types, i.e. in *m. semitendinosus* (ST; glycolytic), *m. triceps brachii* (TB; mixed) and *m. splenius* (SP; oxidative). Seventeen Montbéliard bulls and 18 steers were assigned to be slaughtered in groups at 4, 8, 12 or 16 months of age. Equal amounts of total extracted RNA (20 μg) were assayed for H-FABP mRNA levels by Northern hybridization, using a radiolabelled bovine H-FABP probe. Intensity of resulting bands was quantified with the ImageQuant software (Molecular Dynamics). Hybridization results were normalized for 18S ribosomal RNA, and were expressed per total RNA loaded as well as per g of tissue, taking total extractable RNA into account.
H-FABP mRNA levels in SP and TB at 4 months were 1.97 (±0.431) and 0.88 (±0.345) units per RNA loaded (least-squares means ± SE), and increased 1.8- and 2.8-fold respectively up to 16 months of age. The levels measured in ST remained constant at 1.20 (±0.193) units per RNA loaded (least-squares mean ± SE) over all ages investigated. Therefore, H-FABP mRNA levels in SP were 1.8- and 2.6-fold higher than those measured in ST at 4 and 16 months, respectively. The same age-related changes were observed when results were expressed per g of tissue. But, due to higher total RNA yields in TB than in the other muscles, H-FABP mRNA levels per g of tissue were similar in TB and SP and the lowest in ST. Both sex groups showed the same development without any significant differences of H-FABP mRNA expression rates.
In conclusion, H-FABP mRNA levels are higher in the oxidative than glycolytic muscles. In addition, regulation of H-FABP expression with age is muscle-specific.

Key Words: Fatty Acid-binding Protein, Skeletal Muscle, Cattle

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551   A survey on lipid content and fatty acid gravimetric composition of beef *longissimus* in Venezuela. S. Uzcategui, N. Huerta-Leidenz, L. Arenas de Moreno*, G. Colina, and N. Jerez-Timaure, *Universidad del Zulia, Maracaibo (Venezuela).*

To study lipid and fatty acid (**FA**) gravimetric composition of *longmssimus* muscle, a group of 145 slaughter cattle, of Dairy (n=14) or Zebu (n=131) phenotypic predominance (**PHENOTYPE**), representing the two main beef production systems of Venezuela, were segregated by sex class (61 bulls, 64 steers and 20 females), age by dentition (2.5, 3.0, 3.5 and 4.0 yr), and fatness condition, as described by different criteria, including marbling level. After lipid extraction, FA content (g/100g fresh tissue) was determined by gas chromatography. Data were submitted to analysis of variance and adjusted means were compared by the least square method. Total lipid content (g/100g fresh tissue) of *longissimus* was only affected (P < .05) by sex condition, bulls being leaner (2.6 ± .25) than steers (3.2 ± .21) and females (3.4 ± .30). Sex class, age, PHENOTYPE, marbling level, loin external depth and external fat distribution on the carcass affected FA gravimetric profile. In most cases, it was observed that an increase in total intramuscular lipids resulted in higher contents of individual FA. Mean comparison of age groups showed leaner beef from the oldest cattle had the highest (2.04 ± 0.14) unsaturated/saturates FA index (P < .05). Leanest beef from bulls exhibited the highest polyunsaturated/saturates FA index (.15 ± .01) as compared to steers (.12 ± .01) and females (.13 ± .01) (P < .05). *Longissimus* muscle of Dairy types presented higher (P < .05) contents of myristic (.10 vs .07), and linolenic (.01 vs .007) than that of Zebu counterparts. Carcasses with irregular, "patch-like" fat distribution showed the highest polyunsaturated/saturates index (.16 ± .017). Results suggest that Venezuelan beef is a very lean product with a low content of saturates as compared to that produced in other countries.

Key Words: Fatty Acid, Beef, Breed Types

552   Estimation of carcass lean meat yield and percentage based on adipocyte morphometry and using CT from rib samples. G. Holló[1], I. Repa[2], J. Tözsér[1], I. Holló[2], and E. Szücs*[1], [1]*Gödöllö University of Agricultural Science, Gödöllö,* [2]*Pannon Agricultural University, Kaposvár (Hungary).*

Subcutaneous adipose tissue samples were taken from Holstein growing finishing bulls' rump (n=31) in the last phase of finishing. Adipose cells were fixed by osmium tetroxide and isolated in urea solution (Robelin and Agabriel, 1986). The fixed cells were then trapped on a cellulose nitrate filter and the diameter was measured by image analysis. The animals were slaughtered at 609 days of age weighing 527 kg. on average. After killing and bleeding the weight of the head and four feet was recorded. After being chilled for 24 hr.'s right half carcasses were dissected and tissues of muscle, bone and fat were separated. Rib samples were taken from LD between the 11th and 13th ribs, and volume as well as area of tissues were determined in 10 mm sections by Siemens Somaton Plus CT equipment in spiral mode. In two separate studies, variables recorded were as follows: (I) lean meat yield (y_1), adipocyte diameter (x_1), weight of the head (x_2), four feet weight (x_3), volume of muscles (x_4), bone (x_5), fat (x_6), connective tissue (x_7) and water (x_8); (II) lean meat percentage (y_{11}), adipocyte diameter (x_{11}), percentage of head (x_{22}), percentage of four feet (x_{33}), total area of muscles (x_{44}), bone (x_{55}), fat (x_{66}), connective tissue (x_{77}) and water (x_{88}). Basic statistics were calculated for each trait and bivariate correlation coefficients were estimated in both studies. Mean values (and standard deviations in parentheses) were 202.4 (29.1) kg, 103.4 (9.7) μ, 17.5 (1.1) kg, 10.0 (0.9) kg, 1870 (220) cm^3, 469 (47) cm^3, 100 (45) cm^3, 219 (45) cm^3, 98 (20) cm^3, 65.7 (3.7) %, 103.4 (9.7) μ, 5.8 (0.4) %, 3.3 (0.2) %, 477 (24) cm^2, 120 (14) cm^2, 25 (10) cm^2, 56 (8) cm^2 and 25 (4) cm^2, respectively. For the estimation of dependent variables stepwise multivariate regression analysis was made. Independent variables remaining in the models were: (I) adipocyte diameter (x_1), weight of head (x_2), volume of muscles (x_4), and bone (x_5) in rib samples, and (II) adipocyte diameter (x_{11}) and four feet percentage (x_{33}). Coefficients of determination were R^2=0.81, and R^2=0.50 (P≤0.001), respectively.

Key Words: Carcass, Lean Yield, Lean Percentage

553   Prediction of the crude fat percentage of a beef rib-eye area from the fat area ratio calculated by computer image analysis. K. Kuchida*[1], K. Konishi[2], M. Suzuki[1], and S. Miyoshi[1], [1]*Obihiro University of AVM,* [2]*Ouu station, National Livestock Breeding Center (Japan).*

Marbling is one of the most important characteristics of "Wagyu" production in Japan. The chemical crude fat percentage is often measured in order to evaluate marbling more objectively. We developed a computer image analysis (CIA) technique that accurately calculate the marbling area ratio of a rib-eye area using multiple threshold values. The purpose of this study was to examine the possibility of estimation of chemically measured crude fat percentage from the fat area ratio calculated by CIA. The materials used were 64 cross-sections of the 6–7th rib from 35 Japanese Black, 6 Angus and 23 F_1 breeds of Japanese Black sires and foreign breed dams. A CCD camera (SONY:DXC930) was used to photograph the cross-sections of the 6–7th rib after they had been kept in a refrigerator for a least half a day. The image resolution from this equipment was 512×480. The fat area ratio was calculated using software developed by the authors for the objective evaluation of beef marbling. After separating from the surrounding muscle, the rib-eye section was trimmed from the intermusclar fat, sliced to about 1cm in thickness from the cross-section, and minced. Chemical measurement of the crude fat percentage was performed by the official regulation method, which uses ether extraction for minced meat. The following equation for the prediction of crude fat percentage from the fat area ratio was obtained: Y=0.741X−2.22, (R^2=0.91:p<0.01) where Y is the chemically measured crude fat percentage and X is the fat area ratio calculated by CIA. The difference (prediction error) between the predicted crude fat percentage using the above regression equation and measured crude fat percentage was −2.54 to +2.80%. Five samples were overestimated by more than +2%, and one sample was underestimated by more than −2%. For the remaining 58 samples, the prediction error was within ±2%. No significant effect of breed on the regression coefficient was found (p>0.10).

Key Words: Image Analysis, Fat Area Ratio, Crude Fat

554   Coupling of image analysis and tenderness classification to simultaneously evaluate carcass cutability, longissimus area, subprimal cut weights, and tenderness of beef. S. D. Shackelford, T. L. Wheeler, and M. Koohmaraie, *USDA-ARS Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE.*

The present experiment was conducted to determine if image analysis of the 12th rib cross section used for tenderness classification could accurately predict carcass cutability, longissimus area, and subprimal cut weights. The right side of crossbred steer and heifer carcasses (n = 66) was fabricated and the yield of totally-trimmed retail product was determined. Following procedures we have described for tenderness classification, a 2.54-cm thick steak was removed from the 12th rib region of the left side of each carcass and image analysis was conducted using off-the-shelf technology. Image analysis accounted for more of the variation in retail product yield (RPYD; 89% vs 77%) and retail product weight (95% vs 90%) than did calculated yield grade. Also, image analysis accurately predicted longissimus area (R^2 = .88). For most subprimals, the combination of image analysis-predicted RPYD and hot carcass weight (HCW) accounted for more of the variation in subprimal weight than did the combination of calculated yield grade and HCW. Whereas HCW, by itself, only accounted for 30 to 34% of the variation in weights of round cuts, the combination of image analysis-predicted RPYD and HCW accounted for 78 to 82% of the variation in weights of round cuts. Hot carcass weight, the combination of calculated yield grade and HCW, and the combination of image analysis-predicted RPYD and HCW accounted for 54, 83, and 91% of the variation in the weight of 80% lean trimmings. Thus, it appears that image analysis could be used by the beef industry to more accurately predict individual subprimal weights. In turn, that information and appropriate price extensions could be used to more accurately estimate carcass value. Thus, image analysis could be used by the beef industry in combination with tenderness classification to accurately characterize beef carcasses for cutability and tenderness. These tools should help facilitate the development of value-based marketing systems.

Key Words: Beef, Cutability, Instrumentation

555   Shear force mapping: Is that the best way for tenderness demonstration?. H. Zuckerman*, B. W. Berry, J. S. Eastridge, and M. B. Solomon, *USDA, Agricultural Research Service, Meat Science Lab, Beltsville, MD.*

Consumers are concerned about meat tenderness including the variations that can exist within cuts of meat. Strip loin steaks were cooked using Farberware® convection/broiler ovens to an internal temperature of 71C. Steaks were cut to a 1 cm x 1 cm square cross sample section, parallel to fiber orientation. Each sample was assigned a grid name that identified (mapped) its location within the steak. It is easier to obtain square shaped samples parallel to the orientation of muscle fibers than coring parallel to muscle fibers since there is less loss due to trimming meat of insufficient size. A trained 10-member sensory panel evaluated steaks and found medial steak portions to be more tender (P<.01) than lateral portions. However, with the shear force mapping we identified within the lateral and the medial portion of the steaks, both tough and tender regions. A tougher area was found close to the ventral side (bone side) of the steak in the medial portion of the steak. In the lateral portion of the steak the tougher area was found adjacent to the subcutaneous fat. Shear force mapping was applied to steaks subjected to the Hydrodyne process. This process uses explosives to generate a hydrodynamic shock wave in a tank of water containing meat. According to the shear force mapping procedure, it was found that the Hydrodyne process eliminated tenderness variations which existed within steaks, by lowering shear force values for all locations. By the shear force mapping procedure it was seen that not all locations were lowered in shear force by the same degree, the tougher the region was the more it was tenderized, which means shear force variation across the area of a steak decreased. This information could not be obtained by the standard coring procedure. The coring method showed an average reduction in shear force value after the Hydrodyne process was applied but it did not illustrate the locations where these tenderization effects occurred. The suggested mapping method has the potential to test the efficiency of other meat tenderization processes, to minimize tenderness variability within steaks.

Key Words: Shear force, Mapping, Tenderness

556   Interrelationships among Warner-Brazler shear force, descriptive texture profile sensory panel and descriptive attribute sensory panel evaluations of beef Longissimus and Semitendinosus muscle tenderness . M. M. Otremba*, M. E. Dikeman, G. Milliken, J. A. Unruh, and E. Chambers, *Kansas State University, Manhattan, KS.*

The objectives of our study were to examine the interrelationships among Warner-Bratzler shear force (WBSF), sensory evaluation by a highly trained descriptive texture profile (DTP) sensory panel and sensory evaluation by a trained descriptive attribute (DA) sensory panel as affected by muscle fiber orientation of samples and shear-blade type. Eighteen *Longissimus lumborum* and 18 *Semitendinosus* muscles were cut into 2.54 cm steaks for WBSF evaluations using two blade types (flat and v-shaped), two coring methods (parallel to the muscle fiber orientation and perpendicular to the cut steak surface), and two sensory panels (DTP and DA panels). The v-shaped blade resulted in lower (P < .05) mean WBSF values than the flat blade for both muscles. Samples taken parallel to the muscle fiber orientation had higher (P < .05) mean WBSF values than samples taken perpendicular to the cut steak surface. Both panels detected differences among replications;however, there was a panelist x replication effect for the DA panel. Both panels detected differences (P < .05) in muscle fiber orientation for attributes related to tenderness. Correlations between sensory panel attributes and WBSF were dependent on blade type and coring method, especially for the DTP panel. The magnitude of correlations between DTP panel attributes and WBSF were more dependent on blade type and coring method than between the DA panel attributes and WBSF. Correlations of sensory panel attributes with WBSF were comparable for the two types of panels. The DTP panelists were more consistent in their evaluations of texture attributes; however, they were more sensitive to muscle fiber orientation. Both panels were effective in detecting differences among replications.

Key Words: Shear Force, Sensory Panels, Coring Method

557   Carcass characteristics and tenderness of 29-30 month old Santa Gertrudis and Santa Cruz heifers treated with two different implant strategies. R. J. Maddock*, D. S. Hale, D. B. Griffin, N. C. Tipton, J. C. Pascal, R. Bretz, and J. W. Savell, *Texas A&M University, College Station, TX.*

Changes in USDA quality grading standards have placed cattle with an overall B-maturity and Slight or Small marbling into the Standard grade. This change was based on concerns about the consistency of beef from "B" maturity carcasses, including tenderness. The objective of this study was to characterize the carcass characteristics and tenderness of 24-30 month old heifers. One hundred seventy-one heifers representing an established breed (Santa Gertrudis) and a composite breed (Santa Cruz), and treated using either Synovex-H^{TM} or Revalor-H^{TM} were slaughtered and hot carcass weight (HCW); 12th rib fat thickness (FAT); ribeye area (REA); kidney, pelvic and heart fat (KPH); skeletal maturity (SMAT); lean maturity (LMAT); and marbling scores (MARB) were measured. Also, 2.54 cm thick steaks were removed from the loin at the 13th rib on fifty-one sides representing each breed, maturity level, and implant strategy for tenderness determination. Steaks were transported to Texas A&M, aged for 7 days and frozen until Warner-Bratzler shear (WBS) force values could be determined. Steaks were thawed overnight to 5-10°C, and cooked on indoor grills to an internal temperature of 70°C, with each steak being turned at 40°C internal temperature. Six cores were removed from each steak for WBS force determination. The mean for the carcass characteristics of the group were HCW, 343 kg; FAT, 1.49 cm; REA, 95.4 cm^2; and KPH, 2.08%. The group had an average overall maturity (OMAT) of A^{86}, with 79.4% A, 18.9% B, and 1.7% C maturities. Santa Cruz cattle had less FAT, larger REA, lower (more desirable) yield grade (YG), and higher SMAT and OMAT ($P < .05$) than Santa Gertrudis. Heifers implanted with Revalor-H^{TM} had lower KPH ($P < .05$). Shear force values were only affected by MARB ($P < .05$), with no significant breed, implant, or maturity differences ($P > .05$). These results indicate that maturity did not impact WBS values, as there were no differences in WBS force among maturity levels.

558   Profiles of steroid hormones in beef from implanted (Synovex-S®) and control steers. S. Fritsche*[1], T. S. Rumsey[2], and H. Steinhart[1], [1]*University of Hamburg, Germany,* [2]*USDA-ARS, Beltsville, MD.*

European consumers are fearful of ingesting hormonal residues from meat of animals treated with anabolic steroids. Studies have revealed that natural hormones are not elevated in meat from treated cattle. This study determined if the natural profile of steroid hormones, their precursors and metabolites was distorted in beef steers (Angus x Hereford) treated with the approved anabolic implant Synovex-S® (200 mg progesterone + 20 mg estradiol benzoate; implanted on d 0 and 80 of a 160-d feeding period). Longissimus samples from nine implanted and nine control steers were analyzed by gas chromatography-mass spectrometry. Concentrations of progesterone, its precursor pregnenolone, and its metabolites (also androgen and estrogen precursors and metabolites) were similar (P>0.05) between treatments (table). Concentrations of the catabolic corticosteroids (formed from progesterone) also were similar (P>0.05) between treatments. Concentrations of the androgens testosterone and 5α-dihydrotestosterone, of the estrogens 17β-estradiol and estrone, and their metabolites 17α-estradiol and estriol were <0.02 μg/kg (determination limit) in both implanted and control steers. It is concluded that natural hormone profiles are not affected by using the approved anabolic implant Synovex-S®.

Steroid, μg/kg	Control steers	Implanted steers
Pregnenolone	2.32 ± 0.27	2.27 ± 0.26
Progesterone	1.21 ± 0.25	0.81 ± 0.13
17α-Hydroxyprogesterone	0.06 ± 0.02	0.05 ± 0.02
Dehydroepiandrosterone	0.25 ± 0.04	0.23 ± 0.03
Androstenedione	0.45 ± 0.13	0.30 ± 0.06
Epitestosterone	0.14 ± 0.03	0.09 ± 0.01
α-Androsterone	0.22 ± 0.06	0.15 ± 0.02
Cortisone	0.40 ± 0.08	0.70 ± 0.14
Cortisol	11.49 ± 2.92	8.62 ± 1.27

Key Words: Steroid Hormones, Beef, Anabolic Implant

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559   Effect of repeated freezing and thawing on the eating quality of beef striploins. E. M. Stephens[1], W. S. Pitchford[1], and P. A. Speck*[2], [1]*Department of Animal Science, University of Adelaide, Australia, and* [2]*Agriculture Victoria, Rutherglen, Australia.*

The practice of thawing and refreezing Australian frozen quarter beef, destined for some export markets, is of concern. The objective of this study was to replicate this process, in order to determine the effect of repeated freezing and thawing on beef palatability traits. Storage treatments, (F)frozen at -18°C and (A)thirty days aging at 4°C, were applied to each pair of striploins from eleven grass-fed steers (CWT 240–280kg). Striploins were divided into 3 treatments (1)thawed once, (2)thawed and refrozen twice and (3)thawed and refrozen three times. Grilled steaks were evaluated by a 20 member panel, using a 9 point category scale for tenderness, juiciness, flavour and acceptability (where 1=extremely tough, dry, bland and dislike extremely). Analysis of sensory data showed significant effects of aging, thawing, and aging by thawing interaction on tenderness. No significant effects were seen for juiciness. Beef flavour was significantly affected by aging, but no effect of thawing was found. Acceptability was significantly affected by aging, thawing, and aging by thawing interaction. Acceptability was positively correlated with both tenderness and beef flavour (0.62 and 0.61 respectively), however the correlation between tenderness and flavour was only 0.34.

TREATMENT	TENDERNESS	BEEF FLAVOUR	ACCEPTABILITY
A1	6.4^a	5.9^a	6.2^a
A2	6.6^a	5.8^a	6.2^a
A3	6.8^a	6.0^{ac}	6.2^a
F1	3.7^b	5.4^b	4.8^b
F2	4.0^b	5.6^{ab}	4.9^b
F3	5.3^c	5.7^{abc}	5.8^{ac}
S.E.	0.15	0.14	0.16

Least square means with different superscripts in the same column differ, P<.05

Aging produced significant improvements in tenderness and beef flavour and hence increased acceptability. Thawing treatments had little effect on palatability traits of aged beef. The effect of thawing on frozen unaged beef significantly improved tenderness, flavour and acceptability, indicating that the thawing effect is an aging effect.

Key Words: Beef Eating Quality, Aging, Tenderness

560   Consumer assessment of Select, Choice and Certified Angus beef loin steaks. S. W. Claborn, C. B. Ramsey*, and M. F. Miller, *Texas Tech University, Lubbock.*

Strip loin steaks (n = 1,200) from Select (Se), Choice (Ch) and Certified Angus Beef (CAB) carcasses were sold in four supermarkets to test consumer acceptance. One-hundred-three demographic and palatability data questionnaires were returned (8.5%) representing 197 consumers who bought 95 Select, 40 Choice, and 56 CAB steaks. Steaks were evaluated by a trained panel, sheared with a Warner-Bratzler shear (WBS) device, and ether extract was determined. About one-half of the consumers had at least some college education, earned over $50,000 per year, and was over 50 y of age. Consumers buying Select steaks most often listed "Value in relation to price" as the principal reason for purchase. Those buying CAB steaks listed "More marbling" as the main reason for buying. Two-thirds of the consumers chose outdoor grilling as the cooking method while 15% fried the steaks. Consumers rated all steaks acceptable in tenderness if they were scored 6, 7 or 8 on an 8-point tenderness scale. All CAB steaks were rated acceptably tender. If scored 5 in tenderness, all CAB, 65% of Select and 33% of Choice steaks were acceptable in tenderness. The trained panel scored CAB steaks higher (P < .05) than Select or Choice steaks in initial and sustained tenderness and juiciness, flavor intensity and beef flavor. Select and Choice differed only in flavor intensity and beef flavor (P < .05) with Choice superior. WBS value was lowest for CAB steaks (P < .05). Cooked Select steaks contained a mean ether extract percentage of 6.3; Choice, 8.7%; and CAB, 10.8%. Steaks that consumers scored a 3 on tenderness had a mean ether extract of 6.5%, those scored 4 to 7 had 7.4 to 8.0%, and those scored an 8 had 13.1%. If steaks were scored at least a 5 (slightly tender), the WBS value was <3.5 kg. Donenesses chosen by consumers for the steaks were rare, 2%; medium-rare, 32%; medium, 34%; medium-well, 24%; and well-done, 8%. Steaks cooked well-done and medium-rare were scored higher in tenderness, juiciness and flavor than those cooked to medium or medium-well (P < .05). These data show that consumers who bought CAB steaks rated them higher in palatability and that Choice and Select differed little in palatability.

Key Words: Beef, Palatabilty, Grade

561   Carcass characteristics of Zebu-influenced, slaughter cattle produced in Venezuela and their relationships to eating quality of beef. N. Huerta-Leidenz, O. Atencio-Valladares*, A. Rodas-Gonzalez, N. Jerez-Timaure, and B. Bracho, *Universidad del Zulia, Maracaibo, Venezuela.*

Sensorial and shear force data of rib *(longissimus)* steaks from 680 Zebu-influenced slaughter cattle were segregated by sex class (steers and heifers; bulls) to study relationships of carcass traits to eating-quality attributes within each class group. In the group composed by steers and heifers (n = 261) significant, positive relationships were found between external fat estimators (EXFAT) and tenderness (r = .18 to .20) and flavor (r = .14 to .19) ratings, whereas marbling amount, at the levels found herein (slight to practically devoid) was inversely related to tenderness (r = −.13), flavor (r = −.18) and juiciness (r = −.13) ratings (P < .05). In bulls (n = 419) EXFAT were significantly related to most of the sensorial attributes (r = .18 to .36), whereas marbling scores were not related (P > .05) to any of them. An adipose maturity score (5-point scale for fat color), used to adjust for the final maturity score was significantly (r = .45) related to shear force of the steers and heifers group (SH) and served to improve most of the poor, insignificant associations of individual (skeletal, lean and fat) maturity indicators to important quality attributes of bull beef. Since carcass quality indicators did not account individually for more than 15% (in bulls) or 20% (in SH) of the total variation observed in beef quality attributes, external fat measures and final maturity estimators should be used in conjunction to design carcass grading systems for zebu-type cattle as those produced under Venezuelan conditions.

Key Words: Beef, Sensory Evaluation, Shear Force

562   Slaughter, cutability, cooking and palatability traits of savannah-fed entire males of Water buffalo (*Bubalus bubalis*) vs Zebu type cattle in Venezuela. D. Mansutti[1], S. Merle[1], J. Gonzalez[1], A. Rodas-Gonzalez[2]*, and N. Huerta-Leidenz[2], [1]*Universidad de Oriente, Monagas,* [2]*Universidad del Zulia, Zulia (Venezuela).*

Thirty-three entire male water buffaloes of Murrah breeding (**BUFFALOES**) and 18 Zebu type bulls (**CATTLE**) were savannah-fed on the same ranch and slaughtered at a conventional finish point (desirable conformation) to be compared in slaughter, cutability, cooking traits and palatability traits. Slaughter weight ranged 435 to 512 kg for BUFFALOES and 375 to 494 kg for CATTLE. Least square means differences between species in percent head, cooler shrink, feet, blood and genitals were not significant. BUFFALOES had significantly heavier hides, larger gastrointestinal tract and higher (P < .05) percentages of pluck and organ fat than CATTLE. CATTLE yielded a higher (P < .05) proportion (+.77%) of the composite group of high-valued boneless cuts (due to a higher yield of rib, loin, rump, eye of round and top round) although buffaloes exceeded (P < .05) cattle in proportion of tenderloin, knuckle, and bottom round. BUFFALOES yielded more (P > .05) of the low-valued cuts (flank and bone-in shanks and rib plate). Non-significant differences were found between species for total trimmed fat, bone and the composite group of medium-valued boneless cuts from the chuck. *Longissimus* steaks from CATTLE cooked 10 min faster (P = .02), exhibited higher (P < .01) cooking losses (28.9% vs 31.9%), higher (P < .001) shear force values (5.05 kg vs 3.52 kg) and lower (P < .05) overall tenderness ratings (4.3 vs 4.8 based on a 8-point descriptive scale). It was concluded that the commercial advantage in dressing percent (+6.5%) of cattle over buffaloes is mainly due to lighter hides and the lower percentages of live weight removed as gastrointestinal tract and content. Commercial significance in the Venezuelan market remains to be elucidated for the compositional and palatability differences observed between these species.

Key Words: Water Buffalo, Cattle, Palatability

J. Anim. Sci. Vol. 76, Suppl. 1/J. Dairy Sci. Vol. 81, Suppl. 1/1998

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563 The effect of castration on carcass grade and calpain and calpastatin activities in skeletal muscle of Korean native cattle. S. S. Sun*, K. H. Myung, J. H. Kim, K. H. Kim, S. J. Moon, and B. H. Choi, *Chonnam National University, Kwangju, Korea*.

The objective was to determine the carcass grade and calpain and calpastatin activity in bovine skeletal muscle. Ten Korean native cattle (*Bos taurus coreanae*) (five bulls, five steers) were fed on long-term feeding program. Animals were slaughtered at 24 months of age (BW 550–650kg) and carcass was evaluated. Five gram samples were taken from the loin (L) and tenderloin (TL) in order to determine the levels of the calcium dependent proteases (calpains) and their inhibitor (calpastatin). The calpain assay used was a modified procedure of Koohmaraie (1990). The elution of calpain and calpastatin was achieved by a stepwise salt gradient. The growth rate was decreased about 10 percent in steers. Castration enhanced the marbling score although bull and steer has same dressing percentage. It may be related with higher fat content in steer (8.4%) than in bull (4.9%). Calpain and calpastatin activities were decreased (P<0.01) by castration. However, there was no difference in these activities between L and TL. These results indicate that castration enhance marbling score but reduce calpain and calpastatin activities in bovine skeletal muscle of Korean native cattle.

Key Words: Calpain, Calpastatin, Skeletal Muscle

564 Specificity of Bovine Metalloproteases. A. L. Phillips, N. Kalchayanand, R. J. McCormick, and W. J. Means, *University of Wyoming, Laramie*.

Enzymes currently used to tenderize meat hydrolyze both connective tissue and myofibrillar protein, often resulting in over-tenderization and an undesirable mushy texture. Therefore, our objective was to extract and crudely purify bovine metalloproteases from Holstein placentas for possible use as tenderizers in meat systems. Enzymes were extracted from homogenized tissue and purified by ammonium sulfate precipitation. Samples were collected before (crude enzyme, CE) and after gel filtration on a Sephadex G-100 column. Spectrophotometric analysis identified one major peak (filtered enzyme, FE). SDS-PAGE of CE and FE was conducted before and after activation with p-aminophenylmercuric acetate (APMA). Electrophoretic separation of CE and FE using substrate-incorporated gels (gelatin, casein, and type I acid soluble collagen) followed by enzyme renaturation was conducted to determine substrate specificity. Beef myofibrillar proteins (actin and myosin) were incubated with CE and FE, quenched and visualized using SDS-PAGE. A rearrangement of protein bands occurred after APMA activation giving a high molecular weight (171 kDa) protein and suggesting a conformational change in quaternary structure. Active gelatinases and collagenases were detected on substrate-incorporated gels exhibiting molecular weights of 58-70 kDa. Banding patterns from CE indicated two enzymes with both gelatinase and collagenase activity and a third enzyme with gelatinase activity only. Banding patterns from FE indicated two enzymes with both gelatinase and collagenase activity. Collagenases were detected in PAGE gels with .0150% but not .0225% collagen incorporation, suggesting substrate inhibition. Proteolytic activity was not detected with casein, actin or myosin. Due to specificity for collagen and gelatin, this newly purified enzyme may be capable of improving the tenderness of certain cuts, especially those relatively high in connective tissue, while avoiding myofibrillar protein hydrolysis.

Key Words: Bovine, Collagen, Collagenase

565 Flavor of Ground Lamb Formulated with Hydrocolloids. R. A. Gebault, K. A. Staab, R. A. Field, and W. J. Means, *Department of Animal Science, University of Wyoming*.

Objectionable flavor may be the primary reason lamb consumption is less than .8kg per capita in the U.S. Therefore, our objective was to determine if hydrocolloids affect flavor of ground lamb. Iota carrageenan, carboxymethyl cellulose, sodium alginate, guar gum, and pectin, each at the .5% level, were mixed with ground lamb, stuffed into 8.2cm diameter fibrous cellulose casings and blast frozen. Frozen chubs were then cut into 1.9cm thick slices and vacuum packaged. After thawing slices in $10° \pm 2°$ water, purge and raw pH were determined. Slices were then roasted to $71°C$ internal temperature in a convection oven set at $163°C$. Cooked slices were removed, blotted with paper towels, and weighed for cook yield. Slices were cut into eight pie-shaped segments, placed in moisture-impermeable bags, and submerged in $57°C$ water until presented to seven to ten trained panelists. Each treatment occurred in three triangle tests. Lamb containing carrageenan, guar gum, pectin, or sodium alginate treatments differed from the control (P<.05). Panelists suggested these hydrocolloids masked lamb flavor. Flavor differences were not detected (P>.05) between the control and lamb containing carboxymethyl cellulose. Purge, raw pH, and cook yield did not differ (P>.05). Sodium alginate and carrageenan increased (P<.05) cooked pH more than guar gum or pectin; carboxymethyl cellulose was intermediate. Hydrocolloids may be used in ground lamb products to mask lamb flavor.

Key Words: Lamb, Flavor, Hydrocolloids

566 Structure and proteins of the exosarcomeric muscle cell cytoskeleton. R. M. Robson*, S. W. Sernett, R. M. Bellin, S. A. Seiler, and H.-S. Lee, *Iowa State University, Ames*.

The major part of the cytoskeleton of a skeletal muscle fiber, which is a terminally differentiated cell designed specifically for movement, consists of the myofibrils. The objectives of this presentation are to describe and review properties of key proteins and structures responsible for integration of the myofibrils into the overall muscle cell cytoskeleton. Important parts of the exosarcomeric cytoskeleton include the intermediate filaments (IFs) and the cell membrane skeleton. We and others have shown that the $\sim$10-nm diameter, several μm long IFs appear to encircle myofibrils at their Z-lines, link all myofibrils together, and help link the peripheral layer of myofibrils to the sarcolemma. The major IF protein in mature striated muscle cells is desmin, a 53-kDa protein that contains an $\sim$310 amino acid α-helical rod domain. Purified desmin self-assembles, under physiological-like conditions, into IFs. We recently have found in cloning and sequencing studies that synemin and paranemin, previously known as IF-associated proteins, also contain the $\sim$310 amino acid rod domain that defines IF proteins. Both are novel members of the IF protein superfamily, having huge C-terminal tail domains. The expressed rod domains of synemin and paranemin bind to desmin. We hypothesize that synemin and paranemin function as components of heteropolymeric desmin-containing IFs, with their tail domains linking the IFs to the myofibrillar Z-lines and to the cell membrane skeleton. In addition to IF attachments at costameric sites along the sarcolemma, key costameric proteins, such as the integrins, talin, vinculin, and α-actinin, may provide costameric protein-actin interactions that help link the peripheral layer of cellular myofibrils to the sarcolemma. We have shown that talin, which binds to the transmembrane protein integrin, also directly interacts with actin. Thus, our results indicate there may be two mechanisms for attachment of myofibrils to the sarcolemma. (Studies described from our lab are supported in part by USDA-NRICGP 96-35206-3744).

Key Words: Muscle Structure, Cytoskeleton, Intermediate Filaments

567 Functional analysis of the myosin rod: Studies on dimerization of the coiled-coil and assembly of higher order aggregates. E. Bandman, M. Wick, M. Arrizubieta, and Q. Zhang, *University of California, Davis.*

All vertebrate sarcomeric myosins contain a long alpha-helical coiled-coil domain referred to as the myosin rod. The myosin rod is involved in the assembly of myosin monomers into higher order aggregates, typically filaments, that are found within the myofibril. Portions of the rod are believed to encode sequences and/or domains that determine the interactions of the alpha helices in the coiled-coil, myosin's solubility characteristics, as well as the architecture of the myosin thick filament. We have characterized the unique biochemical properties associated with chicken fast myosin that specify their preferential association into the homodimeric coiled-coil. Experiments employing site-directed mutagenesis to generate unique chimeric rods demonstrate that specific amino acid differences near the amino end of the alpha-helix determine dimerization specificity. Site-directed mutagenesis has also been used to investigate the role of the 100 carboxy-terminal amino acids in myosin aggregation. At physiological ionic strength, myosin rod fragments are insoluble and form paracrystalline aggregates which share structural similarities with the myosin thick filament. Removal of 16 C-terminal amino acids alters the ionic strength at which myosin aggregates form, but does not significantly alter their physical structure. Removal of an additional 56 amino acid residues had no further effect on solubility characteristics, but did alter the appearance of the paracrystal. These results suggest there are multiple domains at the C-terminus regulating aggregation and precipitation of myosin rod peptides in low salt. Sequence analysis of conserved charged residues found on the outside of the rod, suggest that in addition to the 16 amino acids at the C-terminus, a unique charge cluster between 72 and 100 aa from the C-terminus may be necessary for stabilizing intermolecular interactions that govern myosin assembly. Further experiments deleting specific residues within this region which reveal how myosin molecules aggregate during the initiation of assembly will be discussed.

568 Influence of high ambient temperature on Δ9-desaturase activity and fatty acid composition of tissues of the growing pig. M. Kouba*[1,2], J. Le Dividich[2], and J. Mourot[2], [1]*ENSAR, Rennes,* [2]*INRA, Saint Gilles (France).*

Mechanisms of the decrease in the unsaturation rate of fat deposits due to exposure of pigs to high ambient temperature are unknown. A study involving 18 Large White X Landrace barrows weighing initially 19.7 ± 2 kg was conducted to examine the effect of high ambient temperature on Δ9-desaturase activity and fatty acid composition in homogenates of backfat (BF), leaf fat (LF) and longissimus muscle (LM). Pigs were subjected to one of 3 following treatments: 31 °C, ad libitum fed (31AL), 17 °C, ad libitum fed (17AL) and 17 °C, pair-fed with 31AL (17R). Pigs were killed when the weight of 33 ± 1 kg was reached. Feed intake in the 31AL and 17R groups averaged 1134 and 1193 g/d, respectively, and were lower (P < .01) than the 1356 g/d recorded in the 17AL group. At 17 °C, level of feed intake had no effect on the Δ9-desaturase activity in BF, whereas in LF and LM, the lower feeding level resulted in an increased enzyme activity (P < .01). At similar level of feeding, (31AL and 17R groups), activity of the enzyme was lower (P < .001) at 31 °C than at 17 °C regardless of the tissue, suggesting that high ambient temperature depressed the enzyme activity. This was consistent with the fact that percentage of monounsaturated fatty acids was lower (P < .01) in 31AL than in 17R group, averaging 40.5 and 45.4 %, respectively in BF, 34.5 and 41.2 %, respectively in LF and 38.8 and 43.1 %, respectively in LM. These results suggest that the effect of high ambient temperature on the change in fatty acid composition may be mediated, at least in part, by an alteration of Δ9-desaturase activity.

	Treatment				
	31AL	17AL	17R	RSD	Treatment effect
	Δ9-desaturase activity[z]				
Backfat	76.9[a]	120.3[b]	107.3[b]	24.4	.001
Leaf fat	92.9[a]	110.2[b]	137.9[b]	24.9	.001
Longissimus muscle	36.2[a]	41.1[a]	59.6[b]	11.9	.001

[ab]P < .05

[z]: expressed as nmol oleic acid formed/h/g tissue

Key Words: Pig, High Ambient Temperature, Δ9-desaturase

569 Muscle fat infiltration disorder in growing pigs. M. F. Palin*[1], C. Pomar[1], and C. Gariepy[2], [1]*Agriculture and Agri-Food Canada, Lennoxville, Canada* [2]*Agriculture and Agri-Food Canada, St. Hyacinthe, Canada.*

In swine, specific ham muscles such as semi-tendineous, biceps femoris and semi-membraneous are sometimes abnormally infiltrated with fat, leading to a severe muscle degeneration. Different genetic and nutritional factors assumed to be implicated in the development of this muscular fat infiltration disorder were studied. After slaughter, 80 commercial pigs (105 ± 3.91 BW) were alloted to treatments according to a 2 × 2 factorial design with muscular fat infiltration (0 or severe) and sex (barrows and gilts) as main factors. Carnitine levels in muscle and plasma, creatine kinase activity in plasma and selenium levels in blood and plasma were not different between treatments (P >.05). Muscle analysis revealed a decreased superoxide dismutase activity in the severely affected pigs (P < .002). Affected pigs also had higher levels of alpha-tocopherol in the liver (P < .001) but not in plasma (P > .05). Blood and tissular analysis allowed us to assert that a genetic origin is more likely. Pentadecenoic acid (C15:1), Linoleic acid (C18:2) and Arachidonic acid(C20:4) were found in higher levels (P < .001) in the semi-tendineous ham muscle of affected pigs. Since both, normal and severely affected pigs were fed and raised in the same conditions, it was concluded that different fatty acid metabolisms must be implicated in the development of this disorder. No sex differences were associated with any of the parameters studied (P > .05).

Key Words: Fat, Muscle, Infiltration

570 Carcass characteristics for swine fed potato chip scraps. R. J. Borton* and S. Rahnema, *Ohio State University Agricultural Technical Institute, Wooster.*

Seventy pigs were used in an experiment to determine the effect of the level of potato chip scraps (PCS) consumption on the carcass characteristics of swine. When the hogs reached an average weight of 107 kg, 18 pigs (107 to 116kg) were slaughtered and evaluated for backfat thickness (BF), loin eye area (LEA), off-odor (OO), pork flavor (PF), off-flavor (OF), juiciness (JC), tenderness (TN) and overall evaluation (OE). The hogs were fed rations in which PCS replaced 0, 12.5, and 25% of the corn. The BF was measured 7.6 cm from the midline at the 9th- 10th rib. The LEA was measured by tracing the ribeye muscle at the 9th-10th rib and using a planimeter to measure the tracing. The organoleptic properties were determined using chops that were 1.9 cm thick, wrapped in aluminum foil and baked for 1 hr at 177°C. A panel of 8 people evaluated the cooked chops on scale of 0-9 for OO, PF, OF, TN, JC and OE. For JC, 0 represents very dry and 9 very juicy. For TN, 0 represents very tough and 9 very tender. For OE 0 represents very poor and 9 excellent.

		BF, cm $\bar{x}$ (S.E.)	LEA, cm^2 $\bar{x}$ (S.E.)	OO $\bar{x}$ (S.E.)	PF $\bar{x}$ (S.E.)	OF $\bar{x}$ (S.E.)	JC $\bar{x}$ (S.E.)	TN $\bar{x}$ (S.E.)	OE $\bar{x}$ (S.E.)
PCS	No.								
0	6	23.65[a] (1.10)	40.26[a] (1.24)	1.47[a] (.15)	5.37 (.14)	0.88 (.15)	5.25[ab] (.15)	5.90[ab] (.13)	5.53 (.12)
12.5	5	18.22[b] (1.18)	42.26[a] (1.33)	1.16[ab] (.15)	5.45 (.15)	0.76 (.16)	4.91[a] (.16)	5.65[a] (.14)	5.37 (.12)
25	7	22.77[a] (1.02)	36.53[b] (1.15)	0.90[b] (.15)	5.65 (.13)	0.56 (.14)	5.50[b] (.14)	6.13[b] (.12)	5.75 (.11)

Values in the same column with different superscripts indicate significant differences (p≤.05)

Chops from pigs that consumed 25% PCS were ranked as being more juicy, more tender with less OO and OF than those that consumed 12.5%. LEA was smaller for chops from 25% PCS than those of 0% and 12.5%. None of these differences would cause concerns about the quality of the carcasses and therefore feeding potato chip scraps is acceptable on the basis of carcass quality.

Key Words: Pork, Carcass, Quality

J. Anim. Sci. Vol. 76, Suppl. 1/J. Dairy Sci. Vol. 81, Suppl. 1/1998

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571 The effects of poultry fat and choice white grease on pork longissimus muscle quality. J. J. Engel*, J. W. Smith II, J. A. Unruh, R. D. Goodband, M. D. Tokach, and J. L. Nelssen, *Kansas State University, Manhattan.*

Eighty-four crossbred gilts (initially 60.3 kg) were used to evaluate the effects of added fat in finishing pig diets on longissimus muscle quality (LM). Poultry fat (PF) or choice white grease (CWG) were added at 2, 4, and 6% to a corn-soybean meal based control diet. Pigs were slaughtered at 109 kg to evaluate longissimus quality traits. Pigs fed PF had greater cooking loss than those fed CWG (P<0.05). Increasing PF resulted in increased then decreasing cooking loss (quadratic P<0.05). Neither fat source or level influenced (P>0.05) other LM quality or sensory traits. These data indicate PF and CWG can be added to finishing pig diet with minimal affects on LM quality.

		Poultry Fat, %			Choice White Grease, %			
Item	Control	2	4	6	2	4	6	CV
Visual color	2.50	2.46	2.46	2.45	2.57	2.67	2.34	16.1
Visual firmness	2.86	2.66	2.81	2.66	2.83	3.02	2.80	16.2
Visual marbling	2.61	2.40	2.53	2.20	2.44	2.56	2.33	26.4
WHC(FPP), %[c]	37.04	35.83	38.68	37.32	36.77	38.96	6.69	13.4
Drip loss, 24 h %	3.91	4.58	3.67	4.81	4.98	3.94	4.57	54.6
Cooking loss, %[a][b]	26.60	34.16	32.34	24.08	26.81	28.12	6.61	6.80
Shear force, kg	4.13	3.99	4.99	4.14	4.14	4.06	4.21	32.60

| | | Poultry | Choice White | |
	Control	Fat, 6%	Grease, 6%	CV
Flavor intensity	5.75	5.67	5.68	2.70
Juiciness	5.47	5.35	5.43	6.60
Overall tenderness	6.15	6.34	6.23	12.50
Connective tissue amount	6.96	7.04	6.87	6.80
Myofibrilar tenderness	6.02	6.12	6.04	13.70

[a] PF vs CWG, P<0.05
[b] PF quadratic, P<0.05
[c] Filter paper press (FPP)

Key Words: Pork, Longissimus Quality, Poultry Fat

572 The effects of poultry fat and choice white grease on pork belly quality and bacon sensory evaluation. J. J. Engel*, J. W. Smith II, J. A. Unruh, R. D. Goodband, and M. D. Tokach, *Kansas State University, Manhattan.*

Eighty-four crossbred gilts (initially 60.3 kg) were used to evaluate the effects of added fat in finishing pig diets on belly and bacon quality. Poultry fat (PF) or choice white grease (CWG) was added at 2, 4, and 6% to a corn-soybean meal based control diet. Pigs were slaughtered at 109 kg to evaluate belly and bacon quality. Increasing PF decreased, then increased belly lean Minolta a* and b* values (P<0.05). Increasing CWG increased and then decreased Minolta b* values (P<0.05). As PF increased, bacon slicing score decreased. Bacon from pigs fed PF had higher sensory panel "off flavor" scores (P<0.05) than those fed CWG. Slicing scores and off flavor scores for pigs fed PF were still within acceptable quality ranges. These data indicate that increasing levels of PF or CWG can be added to finishing pig diets with minimal influence on belly and bacon quality.

		Poultry Fat, %			Choice White Grease, %			
Item	Control	2	4	6	2	4	6	CV
Minolta L*	48.17	46.84	46.91	47.00	47.70	47.65	47.05	5.80
Minolta a[a]	22.35	19.94	19.91	21.23	19.81	20.69	20.12	11.50
Minolta b[a][b]	9.59	8.63	7.82	8.69	8.35	8.13	8.67	17.40
Slicing score[c]	3.94	3.66	3.50	3.06	3.26	3.24	3.32	27.2
Cooking loss, %	37.3	34.94	37.09	35.59	36.12	36.19	35.5	11.6
Shear force, kg	5.95	5.83	5.99	5.90	5.38	5.48	5.84	27.40
Aftertaste	3.94	3.77	4.19	3.88	3.81	3.86	3.75	12.7
Off flavor[d]	1.26	1.39	1.31	1.38	1.27	1.24	1.27	15.1
Saltiness	5.11	4.82	4.96	4.83	5.01	4.85	4.88	6.6
Flavor intensity	5.60	5.32	5.44	5.39	5.39	5.33	5.30	5.2
Brittleness	5.27	5.38	5.40	5.21	5.47	5.28	5.34	10.3

[a] PF quadratic, P<0.05
[b] CWG quadratic, P<0.05
[c] PF linear, P<0.05
[d] PF vs CWG, P<0.05

Key Words: Pork, Quality, Poultry Fat

573 Effects of longissimus glycolytic potential on growth performance, carcass and meat quality characteristics. K. D. Miller*[2], M. Ellis[2], F. K. McKeith[2], and E. R. Wilson[1], [1] *Pig Improvement Company, Franklin, KY,* [2] *University of Illinois, Urbana.*

Animals (n=72) with glycolytic potential (GP) values ranging from 113.8 to 301.1 μmol/g of tissue, determined from live animal biopsy samples from the longissimus, were classified as having low (n = 24), moderate (n = 24), and high (n = 24) GP levels (154.3, 196.8, 253.4 ± 5.13 μmol/g, respectively; P < .001). The three GP classifications were compared for differences in growth performance, carcass, and meat quality characteristics. Growth and carcass traits were not different between GP classifications. However, meat quality measurements such as longissimus ultimate pH, subjective color score, longissimus Minolta L* values, and longissimus drip loss percent were significantly poorer for animals classified as having either high or moderate GP levels compared to those with low GPs. Compared to low and moderate GP animals, those with higher GP had significantly lower (P < .05) longissimus protein percent (24.1 vs. 23.8 vs. 23.3 for low, moderate; and high, respectively). Cooking loss was increased for high compared to low GP animals with samples from those with moderate being intermediate but not different (22.78 vs 21.13 vs 19.71; high, moderate, low, respectively; P < .05). Taste panel tenderness (9.64 vs 8.72 vs 8.59; high, moderate, low, respectively; P < .001) and juiciness (8.58 vs 7.80 vs 7.92; high, moderate, low, respectively; P < .05) indicated better eating quality for high compared to low and moderate GP animals, These data indicate higher levels of GP, within the longissimus, has negative effects on water holding capacity, but positive effects on eating quality.

Key Words: Glycolytic potential, Meat quality, Longissimus

574 Regression relationships between longissimus glycolytic potential and growth performance, carcass and meat quality characteristics. K. D. Miller*[2], M. Ellis[2], F. K. McKeith[2], and E. R. Wilson[1], [1] *Pig Improvement Company, Franklin, KY,* [2] *University of Illinois, Urbana.*

Glycolytic potential was determined on live−animal biopsy samples and post mortem samples taken from the longissimus of 72 pigs. The relationships between glycolytic potential and growth, carcass, and meat quality traits was investigated using regression analysis. Glycolytic potential values ranged from 113.8 to 301.1 mol/g and 91.0 to 270.5 mol/g for biopsy and post mortem samples, respectively. Growth and carcass traits showed minimal relationships with glycolytic potential with only regression between glycolytic potential and last lumbar backfat thickness (P < .05) and loin eye area (P < .05) being significant. However, meat quality measurements on the longissimus such as Minolta L* values, drip loss, ultimate pH, and cooking loss showed significant relationships with glycolytic potential determined on post mortem samples. (R^2 values = .10, .19, .24, and .11; correlation coefficients =.32, .43, -.49, and .34; P < .01, P < .001, P < .001, and P < .01, respectively). However, relationships between these traits and glycolytic potential values determined from biopsy samples were weaker with R^2 values .06, .12, .10, and .06 and correlation coefficients .24, .34, -.31, and .25, respectively. Significant regressions were also detected between longissimus protein percent and glycolytic potential determined on both post mortem (P < .001) and live animal (P < .001) samples with a R_2 values of 0.20 and 0.17 and correlation coefficients of -.45 and -.41, respectively. These data indicate that reducing longissimus glycolytic potential levels may enhance pig meat quality.

Key Words: Glycolytic Potential, Meat Quality, Longissimus

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575 The effects of feeding high levels of vitamin D_3 on pork quality. K. L. Enright*, B. K. Anderson, M. Ellis, F. K. McKeith, L. L. Berger, and D. H. Baker, *University of Illinois, Urbana*.

The objective of this study was to determine the effect of feeding high levels of dietary vitamin D_3 during the last 10 days of the finishing phase on growth and meat quality in pigs. A total of thirty-five pigs (avg initial BW 105± 1.44 kg) consisting of Yorkshire × Duroc and Duroc barrows and gilts were allotted on the basis of weight, sex, and genotype to three treatments: 1) Low (L) vitamin D_3 (331 IU/kg); 2) Moderate (M) vitamin D_3 (55031 IU/kg); 3) High (H) vitamin D_3 (176000 IU/kg). Diets were formulated to exceed Ca requirements for finishing pigs by 15% and to meet requirements for other nutrients NRC (1988). Pigs were housed in pens of six in a conventional finishing facility and given ad libitum access to feed. Blood samples were taken on d 0 and d 10 to measure serum calcium level. Pig weights were recorded at the start and end of the study and group feed intake levels were monitored over the feeding period. Pigs were slaughtered and carcass and meat quality characteristics were evaluated. Treatment had a significant(P<.05) effect on daily gain (.77 ±.16 , .67 ±.17, and .07 ±.16 kg for L, M, and H, respectively; P<.05), and daily feed intake (3.82 ±.01, 3.63 ±.01, and 2.90 ±.01 kg, respectively; P<.001). Pigs on treatments M and H had elevated serum calcium concentrations at the end of the test period (9.43 ±.26, 10.27 ±.27, and 13.78 ±.26 mg/dl, respectively; P<.001). Carcass length, fat depths, loin eye area, subjective marbling score, and 24-h longissimus pH were not different among treatments. Subjective longissimus color (2.08, 2.72, and 3.08 for L, M, and H, respectively; P<.01) and firmness scores (2.25, 2.62, and 2.92, respectively; P<.05) increased with increasing vitamin D_3, whereas Hunter L* values (54.6, 52.5, and 51.2, respectively; P-07)and drip loss (4.39, 3.21, and 2.04, respectively; P<.05) decreased. Supplementation of diets with high levels of vitamin D_3 during the 10 day period prior to slaughter improved color and water-holding capacity of pork loin but depressed feed intake and growth rate.

Key Words: Swine, Vitamin D3, Meat Quality

576 Changes in muscle accretion, calpastatin activity, and tenderness of three muscles from normal and callipyge lambs across the growth curve. S. K. Duckett[1], G. D. Snowder[2], T. A. Klein*[1], J. G. Andrae[1], and N. E. Cockett[3], [1]*University of Idaho, Moscow*, [2]*U.S. Sheep Experiment Station, Dubois, and* [3]*Utah State University, Logan*.

The objective was to assess changes in muscle accretion, calpastatin activity, and tenderness of three muscles (longissimus dorsi, LD; semimembranosus, SM; supraspinatus; SS) from callipyge (CLPG) and normal (N) lambs across the growth curve. Forty (20 = CLPG; 20 = N) lambs were slaughtered at live weights (LW) of 7, 20, 36, 52, and 69 kg. At 24 h postmortem, muscles (LD, SM, SS) were removed from each carcass, weighed, and sample removed for calpastatin activity (CA). One chop (2.54 cm thick) was removed, aged for 6 d, and broiled for Warner-Bratzler shear force (WBS) analysis. Data were analyzed using GLM procedure of SAS with weight group, muscle and phenotype as the main effects with all possible two-way and three-way interactions tested. Weight group*muscle*phenotype interactions (P < .05) were observed for muscle accretion rates (g/kg LW) and CA (act/g muscle). All two-way interactions were significant for WBS (kg). Muscle accretion rates were similar (P > .05) between phenotypes for all three muscles at 7 kg LW and for SS across the growth curve. From 20 to 69 kg LW, accretion rates were higher (P < .05) for CLPG LD and SM than N. Calpastatin activities were higher (P < .05) at 7 kg than 69 kg for all three muscles. In the CLPG-LD, CA was similar (P > .05) at 20, 36, and 52 kg LW and did not differ (P > .05) from 7 kg or 69 kg values. Calpastatin activity declined (P < .05) across the growth curve for the SM and SS but values were higher (P < .05) in SM of CLPG. Shear force values of the LD were lower (P < .05) for N at 36, 52 and 69 kg LW than CLPG. In the SM and SS, WBS values decreased (P < .05) across the growth curve and were similar (P > .05) between phenotypes. In summary, muscle accretion rates were similar between phenotypes at 7 kg LW but were higher for CLPG LD and SM from 20 to 69 kg LW. Calpastatin activity was higher in LD and SM of CLPG; however, WBS differed between phenotypes in LD only.

Key Words: Lamb, Callipyge, Calpastatin

577 Use of dual-energy x-ray absorptiometry in estimating the carcass composition of wether lambs. K. J. Rozeboom, M. G. Thomas*, L. Hillman, F. Chanetsa, R. J. Lipsey, and D. H. Keisler, *University of Missouri, Columbia*.

Sixty-three crossbred wethers were scanned with dual-energy x-ray absorptiometry (DXA; Hologic model 1000^{TM}/W) to determine its accuracy in predicting chemical carcass composition. Lambs were slaughtered over the weight range of 6.1 to 48.6 kg and DXA analysis was performed 48 h prior to slaughter. Carcass weight and linear measurements were recorded 48 h postmortem. Chemical composition was determined for ground samples of carcass right halves by AOAC methods for percentage of water (PWAT), protein (PPRO), and fat (PFAT). Percentage of fat-free mass (PFFM) and percentage of boneless, closely-trimmed retail cuts (PBCTRC) was determined. Prediction equations were developed to estimate PFAT, PPRO, PWAT, PFFM, and PBC-TRC. Independent variables included the DXA measurements of total tissue mass (DXAWT), lean mass (DXALEAN), percentage of lean mass (PDXALEAN), fat mass (DXAFAT), and percentage of fat mass (PDX-AFAT). Carcass weight (CW) was highly correlated to DXAWT (r = .96, P <.01). A strong relationship existed between PDXALEAN and PFFM (r = .77, P <.01) while a moderate association occurred between PDXAFAT and PFAT (r = .58, P <.01). Maximum predictive accuracy occurred when DXALEAN was included as an independent variable. Prediction equations using DXA measurements to estimate PWAT, PFAT, and PFFM accounted for 84, 74, and 85% of the variation, respectively. Percentage of carcass protein (PPRO, R^2 = .62, CV = 4.12) and PBCTRC (R^2 = .52, CV = 8.35) were predicted with lower accuracy. This research indicates that DXA has significant value as a research tool and potential value as a commercial tool for accurately estimating carcass composition of live lambs over a wide range in weight. Furthermore, with the DXA scanner specific regions of the body can be individually analyzed for composition. Therefore the potential exists for differential selection pressure to be applied to more valuable wholesale cuts. Work supported in part by USDA Postdoc Grant 95-37206-2119.

Key Words: Dual-Energy X-Ray Absorptiometry, Carcasss Composition, Lamb

578 Consumer evaluation of retail cuts from normal and callipyge lambs. S. W. Moore*, R. A. Field, M. L. Riley, and W. C. Russell, *University of Wyoming, Laramie*.

Forty-eight consumers purchased normal lamb carcasses weighing 29 kg and 48 different consumers purchased callipyge carcasses weighing 30 kg from the University abattoir. All carcasses were aged approximately 20 d at 2 to 4°C before they were made into retail cuts trimmed to 5 mm of subcutaneous fat and frozen at −29°C. A questionnaire for consumer evaluation of leanness, flavor, tenderness and intent to repurchase was attached to a package of loin chops, arm chops and a leg roast from each carcass. Differences in fat depths of .38 and .70 cm and longissimus muscle areas of 25 and 17 cm^2 (P < .01) were typical of those for callipyge and normal lambs, respectively. Forty to 46 replies for each cut within lamb phenotype were received and analyzed employing the CATMOD procedures of SAS. Phenotype by cut interactions existed with 85% of the consumers rating loin chops from normal lambs tender and 46% rating loin chops from callipyge lambs tender. Differences in tenderness of leg roasts and arm chops from normal and callipyge lambs were not significant (P > .05). Flavor ratings for chops from normal lambs tended (P < .12) to be higher than those from callipyge lambs but no trends in flavor of leg roasts or arm chops were detected. Differences in leanness ratings by phenotype and cut existed (P < .01) with 18% of the loin chops and 13% of the leg roasts from callipyge lambs being rated too lean. No loin or leg cuts from callipyge lambs were rated too fat and only one leg roast from a normal lamb was rated too lean. However, 23% of the arm chops from normal lambs compared to 5% from callipyge lambs were rated too fat. Positive repurchase intentions from consumers eating callipyge loin chops, leg roasts and arm chops accounted for 77, 91 and 90% of the replies while comparable values for normal lambs were 91, 93 and 82%, respectively. Overall, a problem with tenderness of loin chops from callipyge lambs exists but consumers also object to the amount of seam fat remaining in arm chops of normal lambs.

Key Words: Lamb, Tenderness, Acceptability

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579   Effects of selenium enriched yeast and vitamin E, supplemented daily to feeder lambs, on feedlot performance, carcass characteristics and meat quality. 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*.

A feeding trial was conducted to evaluate the effect of selenium enriched yeast (Se) and (or) vitamin E (D-α-tocopherol; vit E), supplemented daily to 64 western white face feeder lambs. Lambs were randomly assigned to treatments and treatments randomly assigned to pens. Treatments consisted of: 1) no supplementation; 2) 250 IU D-α-tocopherol·animal^{-1}·d^{-1} (low); 3) 500 IU D-α-tocopherol·animal^{-1}·d^{-1} (med); 4) 1000 IU D-α-tocopherol·animal^{-1}·d^{-1} (high); 5) selenium enriched yeast; 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}. No main effect differences for feedlot performance with Se (P>.05) were found. However, gain, efficiency, and ADG were affected (P<.03) by vit E supplementation. Quadratic effects (P<.01) were seen for gain, efficiency, and ADG with vit E supplementation, due to high vit E level depressing performance. Carcass data analysis found a vit E x Se interaction (P≤.05) for untrimmed and trimmed wholesale cuts. Selenium, Low vit E and Med vit E treatments had heaviest untrimmed and trimmed wholesale cuts. High vit E, Control and Se plus High vit E treated lambs had lightest untrimmed and trimmed wholesale cuts. High vit E supplemented lambs (average over Se level) had lowest cold carcass weights (P=.03). No main effect differences (P≥.29) were found for Se supplementation. No differences (P≥.12) were detected for Se or vit E (any level) for retail drip loss, thaw drip loss, cooking moisture loss or tenderness. These data indicate that Se supplementation had no influence on feedlot performance, while a high vit E supplementation rate depressed feedlot performance. However, supplementing with Se and (or) vitamin E to feeder lambs may be a value relative to retail display life.

Key Words: Vitamin E, Selenium, Lamb Feeding

580   Effect of poultry byproduct meal on growth, carcass traits and muscle accretion of finishing lambs. S. J. Lewis*, B. T. Larson, D. G. Ely, W. P. Deweese, and E. Fink, *University of Kentucky, Lexington*.

Fifteen crossbred wethers (initial BW 27 $\pm$ 1 kg) were allotted in a completely randomized design to evaluate the effect of poultry byproduct meal (PBM) and soybean meal (SBM) supplementation fed on a limited intake, restricted CP basis. Parameters measured included growth rate, carcass traits and muscle accretion of finishing lambs. Lambs were randomly assigned to isonitrogenous, isocaloric diets (85% concentrate, 15% roughage) containing PBM or SBM as the protein source. Lambs were individually fed a diet formulated to meet NRC recommendations to provide energy for 136 g/d gain at 30 kg BW (moderate growth potential) and reformulated at 40 kg. CP requirement was limited to 160 g/d the entire trial. Intakes were adjusted weekly to 2.75% BW. All lambs were fed to a similar final weight (49 $\pm$ 2 kg). Carcass traits included rib eye area, backfat thickness, quality grade, and the weights of major and minor cuts. In addition, the semimembranosus (SM), semitendinosus (ST), and adductor (AD) muscles were dissected and weighed. The right side of the carcass was analyzed for composition of lean and adipose tissue. Average daily gain for PBM and SBM was .12 and .14 kg (P > .10), respectively. Weights of SM, ST and AD were not different (P > .10) between treatments at 348.8 vs. 347.8, 124.9 vs. 122.7, and 143 vs. 146.8 g, respectively. Lean tissue composition of feeding PBM and SBM was not different (P > .10) at 33.42 and 34.21% (DM basis). There were no significant differences in ribeye area, backfat thickness, quality grade, and weights of major and minor cuts (P > .10). Feeding PBM does not affect carcass traits or tissue composition of finishing lambs when DM intake is equalized and CP restricted.

Key Words: Poultry Byproduct Meal, Sheep, Carcass

581   Prediction of swine body composition by total body electrical conductivity (TOBEC). A. D. Higbie*, T. D. Bidner, J. O. Matthews, L. L. Southern, T. G. Page, M. A. Persica, M. B. Sanders, and C. J. Monlezun, *Louisiana State University Agricultural Center, Baton Rouge*.

An experiment was conducted to determine prediction equations that used readings for total body electrical conductivity (TOBEC) in the model for estimation of total fat-free lean and total fat weight in the pork carcass. Ultrasound measurements of live hogs were used to select 32 gilts that represented a wide range in weight, muscling, and fatness. The TOBEC readings were recorded on warm carcass sides, chilled carcass sides, and the untrimmed ham from the left carcass side. Fat-free lean weight of the carcass was determined by physical dissection and chemical analysis. All of the ham tissues were analyzed separately from the remainder of the carcass tissues to incorporate ham measurements for prediction of total fat-free lean and total fat weight in the entire carcass. Prediction equations were developed using stepwise regression procedures. A single-variable equation that used a warm carcass TOBEC reading in the model was the best equation ($R^2 = .91$) for warm carcasses. A three-variable equation that used chilled carcass TOBEC reading, chilled carcass temperature, and carcass length in the model was the best equation ($R^2 = .93$) for chilled carcasses. A four-variable equation that included chilled carcass side weight, untrimmed ham TOBEC reading, ham temperature, and fat thickness beneath the butt face of the ham in the model was determined to be the best equation overall ($R^2 = .95$). The TOBEC and the fat-free lean weight of the ham are excellent predictors of total carcass fat-free lean weight.

Key Words: Pork, Body Composition, Electromagnetic Scanning

582   Use of ultrasonic strain-image analysis to estimate fresh pork quality parameters of the ham semimembranosus muscle. E. P. Berg*[1], F. Kallel[2], F. Hussein[3], R. K. Miller[1], J. Ophir[2], and N. Kehtarnavaz[3], *Texas A&M University* [1]*Dept. of Animal Science and Dept. of* [3]*Electrical Engineering and the University of Texas (Houston) Medical School* [2]*Dept. of Radiology*.

Forty-five *semimembranosus* (inside ham; IH) muscles were selected representing a range of ultimate pH to obtain a range of fresh pork quality. One 2.54 cm steak was removed from the IH to determine Warner-Bratzler (WB) shear force. Ultrasonic (US) strain-images were obtained perpendicular to the muscle fibers of an 8 cm square cube cut from the IH. Each sample was pre-compressed using a rectangular aluminum plate with a 5 MHz linear array transducer inserted in a central opening window. Samples were incrementally compressed in a step of approximately 0.5% applied strain. Radio-frequency (rf) images of each sample were obtained from a field-of-view (FOV) of $40 \times 50 mm^2$ and digitized for each step. Tissue displacements in the FOV were computed by a cross-correlation technique on successive rf image pairs. Tissue strains were computed from displacement data using a least-square-strain-estimator (LSQSE). Each strain distribution was converted to gray scale images of 256 levels. From each strain-image, 21 fractal dimension (FR) parameters were obtained as a measure of tissue irregularity. Two neighborhood distances (N) were evaluated (4 and 8 neighborhood resolution pairs). Statistical correlation coefficients were generated between FR parameters (at specified N) and 30h percentage drip loss (PDRIP), percentage of intramuscular fat (IMF), inside ham ultimate pH (IHPH), WB shear force (WBS), and Hunter L* (lightness) values. The variable FR3N4 had a $-.281$ correlation with IHPH (P<.1); FR6N8 correlated to WBS at .326 (P<.05); and FR21N8 had a correlation coefficient of .364 with IMF (P<.01). Linear regression equations generated from FRN parameters for IMF (R^2=.462; RMSE 1.53%), WBS (R^2=.119; RMSE 1.13kg), and PDRIP (R^2=.133; RMSE 0.48%).

Key Words: Pork Quality, Ultrasound, Strain Image

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583   The effect of dietary quercetin on meat quality of pork. B. T. Kremer*, T. S. Stahly, and J. G. Sebranek, *Iowa State University, Ames.*

Nine sets of three littermate barrows weighing 110.6 ± 6.8 kg were used to determine the effects of dietary quercetin, an inhibitor of lactate dehydrogenase, on the postmortem biochemistry of pig muscle and its effect on pork quality. Pigs were offered a basal diet (5 g/kg BW) containing 0, 2.5, and 12.4 ppm quercetin for 4 h prior to stunning. Pigs were transported 5 km to the ISU Meat Lab and killed within 60 min of arrival. Pigs were stunned with 270 V for 5 s, exsanguinated, and scalded for 5 min at $60°$C. Muscle temperature and pH were determined on the longissimus dorsi and semimembranosus of each carcass side at 20, 45, 90, and 180 min postmortem. At 45 min postmortem, the right carcass half was chilled at $0°$C while the left side was kept at $15.6°$C for 180 min and then chilled. At 24 h postmortem, chops (2.5 cm) were taken from each muscle and side for measurement of water loss (WL) and Hunter color on d 0, 3, 6, 9, and 12 of retail storage ($7.2°$C). Pigs consumed 342, 431, and 377 g of feed, respectively, resulting in intakes of 0, 1, and 5 mg of quercetin. Pooled across muscle type and chilling temperature, dietary quercetin increased (P < .10) muscle pH at 20 min (6.30 vs 6.45, 6.41), 45 min (6.23 vs 6.29, 6.24), 90 min (5.79 vs 5.84, 5.98), and 180 min (5.59 vs 5.68, 5.72) independent of time. Dietary quercetin also lowered (P < .11) percentage WL (11.32 vs 9.10, 10.97%) independent of storage days, but the response was greater (P < .05) for the 1 vs 5 mg dose. Dietary quercetin did not alter Hunter L values (52.87 vs 52.78, 53.43), but lowered Hunter a color values (5.61 vs 5.04, 4.99; P < .01). Feeding the dietary glycolytic inhibitor quercetin decreased percentage WL from pork and slowed the decline in postmortem muscle pH.

Key Words: Pigs, Pork Quality, Quercetin

584   Characterization of pork quality in response to five generations of selection for lean growth efficiency. E. Huff-Lonergan, D. L. Kuhlers, S. M. Lonergan, and S. B. Jungst, *Auburn University, AL.*

A strategy for indirect selection for improved lean growth efficiency has been applied over five generations of selection in a line of Duroc pigs at Auburn University. The approach has been selection for decreased 10th-rib fat thickness as measured by real-time ultrasound and improved feed conversion in the selected line (S). A contemporary, randomly selected line has been maintained as a control line (C). Carcass and quality data from generation 5 represent barrow carcasses from each litter (n=39). All pigs in the study tested negative for the presence of the halothane gene. The S line loin eye area and percent lean cuts were significantly greater than C line. 10th rib fat thickness was less in the S line than the control line. Meat quality traits in the longissimus dorsi (LD), semitendinosus (ST), biceps femoris (BF) and semimembranosus (SM) were documented. There were no selection line effects on LD subjective color and marbling scores, Hunter L, a, b values or protein solubility. pH at 15, 30 and 45 min postmortem were lower in S line than C line LD and ST muscles. S line ST pH at 24 h was lower and had lower protein solubility than C line ST chops. Selection had no effect on calpastatin activity in the LD or ST. Warner-Bratzler shear values were higher in S line LD (P<.05) and ST (P< .10) chops than C line chops. Drip loss was greater in S line LD, ST and SM chops than C line after 24, 48, 72 and 96 h storage. The data imply the selection strategy has been successful in improving carcass composition. This suggests that consideration must be given to pork quality when developing selection approaches to improve lean growth efficiency even with the absence of the halothane gene.

Key Words: Pork, Meat Quality, Lean Growth Efficiency

585   Effect of halothane gene status on myosin heavy chain content and meat quality attributes. F. F. S. Depreux*, A. L. Grant, J. C. Forrest, and D. E. Gerrard, *Purdue University, West Lafayette, IN.*

Porcine genotypes possessing the halothane gene offer the pork industry great potential for increasing meat production. Unfortunately, these pigs often generate pale, soft and exudative meat which results from denaturation of an unknown muscle protein during the transformation of muscle to meat. Although the exact mechanisms are unknown, protein denaturation is thought to occur as a result from a rapid pH decline caused by a rapid muscle metabolism. To understand better the mechanisms leading to an aggressive postmortem pH decline, the relative amount of each adult skeletal myosin heavy chain (MHC) isoform (type I, IIA, IIB and IIX) was evaluated in the longissimus muscle (LM) of halothane-positive (HH), heterozygous (HN) and halothane-negative (NN) pigs weighing 100–140 kg. Myofibrillar proteins were extracted from muscle samples and subjected to indirect enzyme-linked immunosorbent assays. Increased levels of type IIB MHC were observed in muscle containing lower amounts of type IIX MHC (r = −.84) suggesting an antagonism may exist between the synthesis of the two isoforms. Genotype altered type I and IIB MHC content in LM (P<.04 and P<.006, respectively). Muscle of HN and HH pigs had greater amounts (P<.01) type IIB MHC, whereas muscle of NN pigs had greater (P<.02) amounts of type I MHC. Abundance of type I and IIB MHC was correlated with pH values taken at 45 minutes post-exanguination (r = .32 and −.39, respectively). In addition, color scores were correlated with amount of type I, type IIA and IIB/I (r = .32, .31 and −.31, respectively). Several meat quality characteristics, such drip loss and firmness values, were also correlated with MHC content (r >.50) across all genotypes. These data show that MHC content is related to meat quality attributes of various genotypes and suggest that alteration in muscle fiber type may prove useful for modifying pork quality.

Key Words: Halothane, MHC, Meat Quality

586   *In vivo* muscle fiber characteristics, muscle metabolism and body composition of pigs with different ryanodine receptor genotypes. A. M. Scholz*[1], A. D. Mitchell[2], M. B. Solomon[2], and P. C. Wang[3], [1]*Humboldt University Berlin, Germany,* [2]*USDA, Agricultural Research Service, Beltsville, MD,* [3]*Howard University, Washington, DC.*

Muscle samples were taken between the 13th and 14th ribs *in vivo* by shot biopsy (Schoeberlein, 1976) on 18 pigs of different stress susceptibility with an average age of 150 days and an average live weight of 84 kg. Muscle samples were immediately frozen in liquid nitrogen and then prepared for fiber type and fiber area analysis according to the simultaneous combination staining procedure described by Solomon and Dunn (1988). At the same age, the volume of both longissimus dorsi muscles was measured in a 10 cm section using ^{1}H magnetic resonance imaging. At an age of between 4 and 9 weeks (7–14 kg), muscle metabolism was studied by ^{31}P nuclear magnetic resonance spectroscopy (Scholz et al., 1995) to compare *in vivo* metabolic changes of phosphocreatine (PCr) and pH minimum after halothane exposure. Homozygous normal pigs (NN), heterozygous (Nn) and homozygous defective allele carriers (nn) were identified by the ryanodine receptor 1 gene test. The nn genotype has significantly greater mean fiber areas and consequently a larger muscle volume than NN, but unexpectedly, did not differ from Nn in the mean fiber area. No differences among genotypes could be found in the proportion of type I fiber area to total fiber area (%). The most severe stress response (PCr decay and pH) was observed in the homozygous defective genotype followed by the heterozygous and homozygous normal genotypes. Muscle fiber area depending on the genotype is a better indicator for the stress response than fiber type proportions.

	Fiber area (μm^2)	Fiber type I (%)	Muscle volume (cm^3)	PCr decay (%)	pH minim.
NN (n=7)	2775±472[a]	6.54±2.11	689.3±21.2[a]	7.65±6.85[a]	6.97±0.04
Nn (n=6)	6897±453[b]	7.02±2.20	680.4±20.4[a]	18.68±6.92[ab]	6.94±0.04
nn (n=5)	6275±533[b]	7.27±2.90	926.1±24.0[b]	30.59±9.29[b]	6.91±0.05

Least Squares Means with different superscripts are significantly different (p<0.05).

Key Words: Muscle Fiber, Muscle Metabolism, Ryanodine Receptor

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587 The effect of heavy slaughter weight on growth and carcass traits in barrows and gilts. P. Horn*, G. Kovách, Z. Meszáros, Z. Házas, and L. Babinszky, *Pannon University of Agriculture Faculty of Animal Science, Kaposvár, Hungary.*

A trial involving a total of 480 pigs was undertaken in order to determine the performance of commercial crossbred barrows and gilts fattened, slaughtered and dissected at 105 and 130 kg live weight. The pigs were reared with the sexes kept separately, in groups of ten. *Ad libitum* feeding from 30 to 65 kg live weight was with commercial mash diets (air dry basis: 13.6 MJ digestible energy per kg diet, 129 g digestible protein per kg), and from 65 kg live weight to slaughter with a finishing diet (air dry basis 13.7 MJ digestible energy per kg diet, 104 g digestible protein per kg).

Daily live weight gains during the whole experimental period (live weight 30-103 kg and 103–130 kg) increased in the barrows from 695 to 769 g (P<0.01) and decreased in the gilts from 656 to 630 g (P<0.05).

In the barrows killing-out proportion increased from 77.9 % to 80.6 %, and in the gilts even more strongly, from 78.0 % to 81.7 % (P<0.05). The weight of valuable meat cuts increased significantly in both sexes: in the barrows from 34.10 to 42.52 kg, and in the gilts from 36.13 to 44.24 kg. The results obtained demonstrate that the type of pigs used maintains high values for growth and carcass quality characteristics if fattened to higher slaughter weight. Gilts produce leaner carcasses and a significantly higher proportion of valuable meat cuts than barrows.

Weight at slaughter (kg)	105		130	
Sex	barrows	gilts	barrows	gilts
Daily gain (g)	695 ^{a}	656^b	769^a	630^b
Killing-out proportion (%)	77.9^a	78.0^a	80.6^a	81.7^b
Fat in carcass (kg)	25.94^a	22.85^b	35.17^a	31.69^b
Valuable meat cuts (kg)	34.10^a	36.13^b	42.52^a	44.24^b
Hams (kg)	13.42^a	14.31^b	16.70^a	17.55^b
Fat in ham (%)	8.41^a	6.83^b	10.48^a	7.16^b

Different superscripts indicate significant difference between the barrows and gilts within each respective slaughter weight category for any one trait (P<0.05).

Key Words: Heavyweight, Fattening Pigs, Performance

588 Processing characteristics of cured products from Duroc pigs selected for lean growth efficiency. E. Huff-Lonergan, S. E. Harris*, D. L. Kuhlers, S. M. Lonergan, and S. B. Jungst, *Auburn University, AL.*

Improved lean growth efficiency in pigs has been achieved through indirect selection for decreased 10th rib fat thickness and improved lean conversion over 5 generations in a line of Duroc pigs (S). A contemporary, randomly selected line has been maintained as a control line (C). Previous experiments from earlier generations have shown that selection has negatively influenced drip loss and postmortem pH The objective of the present experiment was to evaluate the effect of selection on performance of LD and ST muscles in a cured and cooked product. LD and ST muscles were removed from 39 select and control barrows in the fifth generation of the selection study. LD muscles were injected up to 110 % (TRT1) or 150 % (TRT2) of initial weight with an appropriate curing brine, allowed to equilibrate and cooked to an internal temperature of 70°C. ST muscles were injected up to 110 % (TRT1) of initial weight with a curing brine, tumbled to improve brine uptake, and cooked to an internal temperature of 70°C. Purge was measured 28 d after processing. Hunter color values were evaluated at 1, 14 and 28 d post processing. S line LD samples in TRT1 had higher percent purge lost (P<.1), lower Hunter L values at d 1, 14, and 28 and a and b values at d 1 (P<.05) than C line LD samples. S line LD samples in TRT2 had lower Hunter L values at d 1 (P<.05). S line ST samples in TRT1 had lower Hunter b values at d 28 (P<.1). No selection line differences in percent purge lost were observed in LD TRT2 or ST TRT1. These data indicate that, though selection for lean growth had a large impact on fresh pork quality, fewer effects on cured products characteristics were observed.

Key Words: Pork, Cured Meat Quality, Lean Growth Efficiency

589 Palatability and carcass characteristics of lamb from two rearing systems finished in drylot or on pasture and processed at different ages. P. G. Hatfield*[1], R. A. Field[2], R. W. Kott[1], and J. H. Hopkins[3], [1]*Montana State University, Bozeman,* [2]*University of Wyoming, Laramie,* [3]*USDA-ARS, Dubois, ID.*

Alternatives to fall marketing of lamb may reduce concentrate intake, increase forage use, and improve seasonal lamb supply. However, these alternatives will not be practical unless carcass traits and palatability are acceptable. A 2-yr study was conducted using 68 wethers to investigate the effects of lamb rearing systems (range lambing, RL; shed lambing , SHED), and age at slaughter/finishing system (7 to 8 mo, confinement finished, E; 10 to 11 mo, confinement finished, M; 14 to 15 mo, confinement finished, L; and 14 to 15 mo pasture finished, P) on factors influencing carcass characteristics and consumer acceptability. Wethers not used in the E trial grazed crop residue until included in the M, L, or P trial. The model included effects of year, rearing system, age at slaughter/finishing system, and their interactions. Hot carcass weight was a covariate. Longissimus muscle area (LM) was greater (P = .03) and fat depth lower (P = .03) for SHED than RL lambs in yr 1 and 2, respectively. Year x age at slaughter/finishing system means are presented. Range lambing, wintering on crop aftermath, and finishing older lambs on spring range produced acceptable carcasses with desirable palatability traits in lambs fed to 56 to 61 kg live BW. However, yearly variation can influence carcass and flavor characteristics.

Key Words: Lamb, Low Input, Palatability

590 Carcass characteristics of yearling castrated males of five goat breed-types raised for meat production. T. A. Gipson[1]*, P. P. Graham[2], and M. J. Estienne[3], [1]*Virginia State University, Petersburg* [2]*Virginia Polytechnic Institute & State University, Blacksburg* [3]*University of Maryland Eastern Shore, Princess Anne.*

Five Brush, seven Myotonic, seven Nubian, five Pygmy and seven Spanish yearling castrates were slaughtered to evaluate breed differences for carcass quality. Prior to slaughter, loin eye area and depth were estimated by real-time ultrasonography. Live weights were taken immediately before slaughter and carcass weights were taken immediately and 24-hr after slaughter. At 24 hr post-slaughter, one entire side of each animal was broken into leg, loin, rack, shoulder and thin cuts. Each section was dissected into edible product, bone and trimmable fat (> 2.5 mm). The correlation coefficient of ultrasound loin eye area with actual loin eye area was 0.72 (p<.01) and ultrasound depth with actual depth was 0.66 (p<.01). Ultrasound and actual loin eye area and depth, when adjusted for carcass weight differences, were not affected by breed. Brush and Nubian were significantly (p<.05) heavier at slaughter than Spanish, which was heavier than Myotonic, which was heavier than Pygmy. Breed affected dressing percentage, which ranged from 53% for Myotonic to 43% for Pygmy. Actual and adjusted fat cover over the loin eye were unaffected by breed and averaged .066 and .100 cm, respectively. Myotonic tended to have the least fat cover and Brush and Nubian the most. Myotonic had a significantly (p<.05) lower amount of kidney fat (1%) than did the other breeds, which averaged 2.4%. Primal cuts, when expressed as a percentage of the half carcass, were unaffected by breed and were: leg at 32.6%, loin 8.2%, rack 7.4%, shoulder 24.2% and thin cuts 27.6%. Myotonic had a significantly (p<.05) higher edible product to bone ratio at 3.8 than the other breeds which averaged 3.0. Warner-Bratzler shear scores of the various muscles and the percentage fat and moisture, which averaged 7.7% and 70%, respectively, were unaffected by breed. This study indicates that several carcass traits are affected by genotype; however, additional work is needed.

Key Words: Goat, Breeds, Carcass traits

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591 Live linear body measurements in Spanish-type meat goats of differing sex, age, weight, and conformation. K. W. McMillin[1], S. Gebrelul*[2], J. M. Fernandez[1], O. Phelps[2], K. E. Mellad[2], G. Simon[2], N. Dawkins[2], and F. Pinkerton[3], [1]*Louisiana State Univ. Agric. Center, Baton Rouge, LA,* [2]*Southern Univ., Baton Rouge, LA,* [3]*The Goat Man, Grapeland, TX.*

The demand for goat meat in the U.S. is increasing with increased ethnic populations and demands for leaner meat. Classifying of live market goats, carcasses, and cuts would provide increased marketing opportunities in the goat and meat industries. This study had the objective to compare live characteristics of Spanish-type meat goats from male and female kid and yearling goats of two weights (<20kg and >20 kg) and three body conformation types (low, medium, high). Goats (n=137) were selected from ranches in Texas to fit into the appropriate treatment combination cell, transported ~14 h to the University Meat Laboratory, held over night, and weighed and measured prior to sacrifice by humane procedures. Tape measures and calipers were used to determine linear body measurements. Analyses of variance indicated that live conformation scores of independent observers matched the desired cell grouping, although yearling goats and males weighed more than kids and females within conformation groups. Rump was longer (P<0.05) in lighter goats and loin and chine were longer (P<0.05) and chest was wider in light males, yearling males, and heavy females compared with goats in other classifications. Chest was deeper (P<0.05) in heavy females compared with lighter females. Heavier or yearling goats had larger (P<0.05) barrel circumference and heart girth and were taller at withers (P<0.05) than lighter or kid goats. The linear body measurements were representative of differences in maturation patterns with age and sex, but were not influenced by body conformation grouping. Live Spanish-type goats could be classified into marketing groups based upon objective linear body measurements and subjective conformation scores.

Key Words: Goats, Conformation, Marketing

592 Carcass traits and primal cut yields in Spanish-type meat goats of differing sex, age, weight, and conformation. O. Phelps*[1], K. W. McMillin[2], S. Gebrelul[1], J. M. Fernandez[2], K. E. Mellad[1], G. Simon[1], N. L. Dawkins[1], and F. Pinkerton[3], [1]*Southern Univ., Baton Rouge, LA,* [2]*Louisiana State Univ. Agric. Center, Baton Rouge,* [3]*The Goat Man, Grapeland, TX.*

The increased consumer demand for goat meat in the U.S. requires knowledge of carcass traits and primal cut yields to facilitate the marketing of goat meat. The objective of the study was to characterize carcass traits and determine yields of primal cuts from goats of kid and yearling male and female Spanish-style goats (n=137) selected from Texas ranches for weight (<20kg or >20 kg) and body conformation type (low, medium, or high). Goats were transported ~14 h to the University Meat Laboratory and rested overnight before humane sacrifice. Carcass traits were measured and primal cuts were fabricated at 24 h postmortem after 1°C chilling. Hot and cold carcass weights corresponded to live weight classifications with a 49.5% average dressing % (s.e.m.=1.46) across all classes of goats. Carcass conformation did not match the live conformation classification. Estimated and actual kidney and pelvic fat % was increased (P<0.05) in heavier and in female carcasses. Rib eye area was greater (P<0.05) in heavier compared with lighter goats and in yearling compared with male kids. Flank color was darker (P<0.05) in carcasses from heavier or older goats compared with lighter or younger goats. Flank streaking was less (P<0.05) in low conformation carcasses of light males and heavy females while rib feathering was less in light male and light female carcasses compared with those in other classifications. Higher (P<0.05) shoulder and loin primal cut % in light male carcasses were attributed to the cutting procedures for this group. Light or female kid carcasses resulted in higher % leg than male and heavy or yearling female carcasses. Raw shoulder cuts from carcasses had only minor variation in moisture, crude fat, protein, or ash. Live conformation classes for Spanish-type goats were not predictive of subsequent carcass characteristics or primal cut yields.

Key Words: Goats, Carcasses, Primal Cuts

593 Mode of inheritance of triacylglycerol fatty acids in beef adipose tissue. A. E. O. Malau-Aduli*, B. D. Siebert, C. D. K. Bottema, and W. S. Pitchford, *University of Adelaide, Australia.*

Subcutaneous adipose tissues were biopsied in 67 Jersey, Limousin and Jersey x Limousin calves at the age of 9-10 months. All calves were grass-fed in a single management group and biopsied from the same anatomical site. Triacylglycerol fatty acids were extracted and analysed by gas-liquid chromatography. Genetic effects of heterosis, additive and maternal variances were estimated to investigate the mode of inheritance of fatty acids. Sex and genotype differences were also examined. Heifer calves had significantly higher proportions of palmitoleate, total monounsaturated fatty acids, desaturase enzyme activity index and lower stearate than bull calves. Genotype differences were observed: Limousin calves had the highest proportions of palmitate and total saturated fatty acids, while Jersey calves had the most palmitoleate and desaturase enzyme activity index. The mode of inheritance of palmitate, stearate, desaturase and elongase enzyme indices was by dominance. Myristate, palmitate and total saturated fatty acids showed significant additive genetic effect. The study showed that triacylglycerol fatty acids are heritable. Heterosis can also be exploited in reducing the percentage of saturated fatty acids in beef by crossbreeding Limousin and Jersey cattle.

Key Words: Fatty acids, Triacylglycerols, Inheritance

594 Modification of fatty acid profile in muscle lipids of ruminants. K. Nuernberg, K. Ender*, S. Grumbach, H.-J. Papstein, and G. Nuernberg, *Research Institute for Biology of Farm Animals, Dummerstorf (Germany).*

The relative proportion of nutrients and the fatty acid composition depends on various factors like fatness, species, diet, age/weight, sex, breed, keeping, hormones, and depot site. The effects of dietary fat on the fatty acid composition of ruminant fatty tissues are relatively small because of the partial or complete hydrogenation in the rumen. The objective of the studies was to determine the effects of different feeding systems (Group 1: extensive without supplement, Group 2: keeping on pasture and finishing indoor, Group 3: intensive feeding with concentrate and roughage) and the effect of breed on fatty acid composition of muscle fat in lambs, steers, and bulls. The composition of intramuscular fat in longissimus muscle of lambs (at 39 kg live weight) and steers (300–340 kg live weight) was significantly affected by diet. The relative content of n-3 fatty acids of intramuscular fat was increased in lambs up to 4 % and in cattle up to 3.5 %. Grass fat contains about 50 % linolenic acid. When young ruminants (lambs, steers) are fed relative high concentrations of linolenic acid the level of the n-3 fatty acids increases in fatty tissues. The intramuscular fat quality of longissimus muscle in lambs and steers kept on pasture was more valuable for human nutrition because of the high percentage of n-3 fatty acids and the low cholesterol concentration.

The effect of breed was investigated in an experiment with White−blue Belgian (WBB) and Black Pied (BP) bulls. There were genetically based differences in intramuscular fatty acid composition of longissimus muscle. WBB bulls produced a very high content of lean meat with very small total carcass and intramuscular fat compared to Black Pied bulls. The relative content of linoleic acid in WBB muscle was very high. The percentages of phospholipids in genetically different longissimus muscles did not differ.

Key Words: Fatty Acid, Muscle, Ruminant

J. Anim. Sci. Vol. 76, Suppl. 1/J. Dairy Sci. Vol. 81, Suppl. 1/1998

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595   Bacterial counts and incidence of *Salmonella* spp., *Listeria monocytogenes* and *Escherichia coli* O157:H7 detected on U.S. beef variety meats. R. J. Delmore*, J. N. Sofos, G. R. Schmidt, K. E. Belk, and G. C. Smith, *Colorado State University, Fort Collins.*

This research was conducted to determine levels of bacterial contamination, along with the incidence of three pathogens (*Salmonella* spp., *Listeria monocytogenes* and *Escherichia coli* O157:H7), on each of 17 beef variety meats. Samples were taken at each of two locations (the point at which each variety meat was boxed or racked prior to chilling or freezing—Site A, and the point at which each variety meat was chilled or frozen and would be ready for shipment—Site B) in each of six beef packing facilities. Aerobic plate counts (APC), total coliform counts (TCC) and Escherichia coli counts (ECC) were determined for samples taken at sites A and B. Presence or absence of pathogens was determined for products sampled at Site B. Beef cheek meat, flexor tendons, honeycomb tripe, lips, liver, mountain chain tripe, omasum, oxtail, rumen tripe, tongue, tongue trim and weasand had higher (P<.05) APC at sampling Site B than at sampling Site A. Bacterial counts for beef variety meats from Site B were highly variable. Rumen tripe and tongue trim had the most variable counts with APC ranging from 1.0 to 7.4, and 2.0 to 7.3 log CFU/g, respectively. The lowest APC were detected on hearts (4.2 log CFU/g) and the highest on flexor tendons (6.2 log CFU/g). Beef tongue had the lowest TCC (2.0 log CFU/g); the highest TCC were found on flexor tendons (3.9 log CFU/g) and cheek meat (3.5 log CFU/g). The lowest ECC were found on sweetbread (1.3 log CFU/g) and tongue (1.4 log CFU/g); the highest ECC were on flexor tendons (3.4 log CFU/g) and large intestine (3.2 log CFU/g). Pathogen incidence was relatively low, with 0.8% of the samples positive for *Salmonella* spp. and 4.5% positive for *L. monocytogenes*. In examination of 830 samples of beef variety meats, no positive samples of *E. coli* O157:H7 were detected. These data may serve as a baseline for present contamination levels on beef variety meats.

Key Words: Beef, Variety meat, Bacteria

596   Developing hydrodyne technology parameters for tenderizing meat from Brahman cattle. J. S. Eastridge[1]*, M. B. Solomon[1], R. L. West[2], A. C. Hammond[3], and C. C. Chase, Jr.[3], [1]*USDA-ARS, Beltsville, MD,* [2]*Univ. of Florida, Gainesville, FL,* [3]*USDA-ARS, Brooksville, FL.*

After an 18 to 24 hr chill, longissimus [8th to 12th rib (LM)], semitendinosus (ST), semimembranosus (SM), and biceps femoris (BF) muscles were removed from carcasses representing Brahman cattle, vacuum packaged and shipped to the USDA Meats Science Laboratory in Beltsville, MD. Samples were held at 4C until 7d postmortem, then frozen at −20 C. Frozen samples were thawed under refrigeration and treated with the Hydrodyne process (HYD). This novel technology uses an ultra high-pressure shock wave generated by a small amount of explosive detonated in a tank of water. Two different explosives a binary-ammonium nitrate with nitromethane (ANN) and a molecular-Pentolite®(PL) were tested for their effectiveness in the HYD process. Variations in shock wave pressure fronts were achieved by modifying amount and (or) distance of the explosive to the bottom of the HYD vessel. From calculated curves, pressures for treatments were: 0 MPa for controls (C); 82 MPa for 350 g ANN at 41 cm (ANN); 138 MPa for PL, 250 g at 25 cm (PL25); and 90 MPa for 250 g PL at 36 cm (PL36). Peak shear-force of cores from steaks cooked to 71 C were used for evaluating the efficacy of the HYD process. Shear-force was reduced 13% in the SM using ANN in the HYD process (5.7 vs 5.0 kg). For BF samples, ANN reduced shear-force by 22% compared to C (6.6 vs 5.2 kg), whereas PL25 and PL36 had little or no effect (6.0 and 6.1 kg, respectively). A similar trend was also observed for the ST. In the LM, the effect of different pressures was observed. Reductions in shear force for PL25 (4.4 kg), PL36 (4.7 kg) and ANN (4.2 kg) compared to C (6.8 kg). These results suggest that HYD treatments, were effective at improving the tenderness of meat from Brahman cattle.

Key Words: Tenderness, Brahman, Technology

597   Characterization of factors associated with the postmortem tenderization in top loin steaks from Brangus cattle. S. M. Lonergan, E. Huff-Lonergan, and L. A. Kriese-Anderson*, *Auburn University, Auburn, AL.*

Definition of factors that influence beef tenderization during the aging process will allow development of classification and processing strategies intended to decrease the current industry-wide inconsistency in beef tenderness. Variations in calpastatin activity (CA) and postmortem (PM) degradation of myofibrillar protein have been hypothesized to be related to variations in PM tenderization of beef. The objective of this study was to define the relationships between calpastatin activity, PM degradation of myofibrillar protein and Warner-Bratzler shear force values (WBS) in steaks aged 2, 7 and 14 d PM. Brangus bulls (n=41) and steers (n=49) were utilized to define these relationships. Slaughter age for both bulls and steers ranged from 13–16 mo. CA and WBS were determined in top loin steaks aged 2, 7 and 14 d PM. Samples from steaks at each aging period were utilized to prepare whole muscle extracts for SDS-PAGE and immunoblotting. Steaks from bulls had higher WBS and CA in samples aged 2 and 7 d PM, but not after aging 14 d PM. WBS 2 d PM was correlated with WBS after 7 d PM aging (r=0.574) and WBS after 14 d PM aging (r=0.448). CA 2 d PM was correlated with WBS after 7 d PM aging (r=0.423), but not with WBS after 14 d PM aging. SDS-PAGE and immunoblotting results indicate that degradation of specific myofibrillar proteins after aging 2 d PM is a consistent indicator of the aging time necessary to complete tenderization. Beef from Brangus bulls and steers did vary in the rate of tenderization during the first 7 days PM, but not in the shear force achieved after aging 14 d. WBS, CA, and PM degradation of myofibrillar protein after aging 2 d PM may be reliable predictors of rate of tenderization during the aging process.

Key Words: Beef Tenderness, Calpastatin, Postmortem Aging

598   Determining optimal postmortem aging times for beef subprimals. B. H. Weatherly*, C. L. Lorenzen, and J. W. Savell, *Texas A&M University, College Station.*

The objective of this study was to determine guidelines for optimal aging times for beef subprimals from different USDA quality grades. USDA Select (n = 10) and USDA Choice (n = 10) carcasses were selected, and from these carcasses, the following subprimals were collected: shoulder clod, chuck roll, ribeye, shortloin, top sirloin butt, top round, and bottom round. All subprimals then were cut into steaks (2.54 cm), vacuum-packaged and aged for an assigned aging time. When the steaks reached the assigned aging time they were frozen at −40°C. The aging times assigned to steaks from the shoulder clod, chuck roll, top round, and bottom round were 4, 8, 12, 16, 20, and 24 d. Aging times for steaks from the ribeye and top sirloin butt were 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, and 34 d. Aging times for steaks from the shortloin were 4, 7, 10, 13, 16, 19, 22, 25, 28, and 31 d. All steaks within a USDA quality grade and subprimal then were cooked on the same day and then used for Warner-Bratzler shear force determination. Means and standard deviations within cut, USDA quality grade, and aging day were generated and regression equations were developed with aging time used as the independent variable. Slopes were similar ($P > .05$) between USDA Choice and Select within a cut and, therefore, aging responses due to grade were pooled. Three of the cuts used in this study, ribeye ($R^2 = .83$), shortloin ($R^2 = .69$), and chuck roll ($R^2 = .57$), had curvilinear responses to aging. Top round ($R^2 = .82$) and bottom round ($R^2 = .65$) showed linear responses to aging. Shoulder clod ($R^2 = .02$) and top sirloin butt ($R^2 = .11$) also showed a linear response to aging, but the response was negligible. Therefore, no requirement for optimal aging of these two subprimals was assigned. The following optimal aging times were made: ribeyes and shortloins should be aged at least 13 days; chuck rolls and bottom rounds should be aged for at least 12 days; and top rounds should be aged at least 16 days.

Key Words: Beef, Postmortem Changes, Shear Value

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599 Examination of sire breed differences for post-mortem protein degradation, calpastatin activity, and Warner-Bratzler Shear force in top loin steaks from cattle finished in the Southeastern United States. S. M. Lonergan*, E. Huff-Lonergan, L. A. Kriese-Anderson, and R. L. Kelley, *Auburn University, Auburn, AL*.

Variation in beef tenderness continues to be a concern for the beef industry. The objective of this project was to characterize sire breed effects on changes in beef top loin tenderization, calpastatin activity and postmortem (PM) proteolysis of myofibrillar proteins during a 14 d PM aging period. Top loin steaks (n=65) from steers sired by Gelbvieh (GV), Hereford (HE), or Limousin (LM) bulls and from Angus-Simmental dams were utilized for this evaluation. Warner-Bratzler shear force (WBS) and PM myofibrillar protein degradation were determined on steaks aged 2, 7, and 14 d postmortem. Calpastatin activity was measured after PM aging for 2 and 7 d. Steaks in the GV sired group had higher calpastatin activities after aging 2 d than those in the LM group. WBS in GV and LM groups were not different after aging 2 d. However, steaks from GV sired steers had higher WBS values than the LM group after aging 7 d. WBS in HE sire group was less than the GV group after aging 2 and 7 d. No sire breed differences in WBS were observed in steaks aged 14 d PM. Across breeds, calpastatin activity (r=0.32) and WBS (r=0.28) after aging 2 d were significantly correlated with WBS after aging 7 d. Furthermore, PM proteolysis of myofibrillar proteins at 2 d PM was a consistent indicator of the rate of tenderization that occurred between 2 d and 7 d PM. These data demonstrate evidence of a sire-breed difference in the rate of tenderization and proteolysis. However, there were no sire breed effects on the extent of tenderization after aging 14 d. The results suggest that calpastatin activity and the extent of postmortem proteolysis are consistent predictors of the aging response observed between 2 d and 7 d PM.

Key Words: Beef Tenderness, Calpastatin, Postmortem Aging

600 Variability of Shear Values from Beef Rib Steaks Aged Different Times. R. A. Field, R. A. Gebault, S. V. Huzurbazar, D. E. Legg, and W. J. Means, *University of Wyoming, Laramie*.

Although it is well documented that Warner-Bratzler Shear values (WBS) decrease with increased aging time, variability has not been clearly defined. Therefore, our objectives were to determine if 1) WBS variability changed during aging, and 2) technician affected variability. Primal ribs from 28 steers were collected and sequential steaks were allotted to one of four treatments in each of two trials. Trial 1 treatments included aging 14 and 28 d; aging 14 d with WBS conducted by different technicians; and aging 14 d/frozen 1 d/continued aging 14 d. In Trial 2, treatments included aging 6 and 28 d; aging 14 d with WBS conducted by different technicians; and aging 6 d/frozen 60 d/continued aging 22 d. Steaks were thawed at $4°C$ and roasted to $71°C$ internal temperature in a convection oven set at $163°C$. WBS values were analyzed by standard ANOVA procedures. In addition, variances of WBS values were calculated for each steak within treatments. Standard ANOVA procedures were used to analyze the variances after they were normalized using a natural logarithm transformation. Mean WBS scores and variances were similar ($P<.05$) between technicians, indicating variability can be minimized with training and standardized protocols. Generally, WBS decreased ($P<.05$) with increasing aging times (3.2 and 2.6 kg for 14 and 28 d aging, respectively in Trial 1). This was expected based on literature values. However, in both Trial 1 and 2, the variance increased ($P<.05$) as aging time increased. Therefore, even though average WBS values decrease during prolonged aging, the actual variability in tenderness may increase. Decreased shear values after aging are primarily due to enzymic degradation of myofibrillar proteins with connective tissues (CT) being minimally affected. Our data support the theory that CT is the primary source of tenderness variability once variation resulting from myofibrillar proteins is reduced by post-mortem aging.

Key Words: Beef, Shear, Variability

601 Sire comparisons for improving carcass and tenderness traits in beef cattle. H. D. Alderson, S. R. Pohlman*, A. D. Herring, M. F. Miller, and C. B. Ramsey, *Texas Tech University, Lubbock*.

Purebred steers and heifers (n = 153), the progeny of 16 registered sires, were used to evaluate feedlot growth, carcass and palatability traits. These cattle were assigned to one of four kill groups (160, 175, 188, and 195 dof) based on estimated fat thickness and live weight, and all steers were fed to a similar slaughter weight and fat thickness (1.0 cm) at a commercial feedlot. Strip loin steaks were randomly assigned to four aging treatments (3, 7, 14, or 21 days) at $3°C$. Least squares means for initial weight were 277.89 kg, final weight 514.71 kg, and ADG 1.33 kg. Hot carcass weight averaged 318.66 kg, fat thickness 1.09 cm, ribeye area 78.69 cm^2, kidney, pelvic and heart fat percentage 1.78, yield grade 2.77, and quality grade of Select$^-$. Combined Warner-Bratzler shear force mean for all aging time treatments was 3.71 kg. Sire effect was significant (P < .05) for initial weight, final weight, ADG, temperament, frame and muscle scores, hot carcass weight, carcass muscle score, lean texture, CIE L* value and 48 h muscle pH. Sire effect was not significant for phenotype, skeletal, lean or overall maturity, marbling score, quality grade, fat thickness, ribeye area, kidney pelvic and heart fat, yield grade, lean color, heat ring and hump score. A slaughter age effect was found for initial weight, frame and muscle scores, lean and overall maturity, adjusted fat thickness, yield grade, lean color and hump score (P < .05). Days of aging improved Warner-Bratzler shear force, initial and sustained tenderness, flavor intensity and overall mouthfeel (P < .05). Sire affected (P < .05) shear, and all sensory characteristics. Using these traits as selection criteria for sires, producers could ultimately improve the consistency, palatability, and consumer demand for beef by selecting superior sires for use in their breeding programs.

602 Effects of demographics of retail consumers on the acceptability of beef. M. A. Carr, M. F. Miller, K. L. Crockett, L. C. Hoover, J. L. Montgomery*, L. M. Huffman, and C. B. Ramsey, *Texas Tech University, Lubbock*.

A nationwide retail consumer study was conducted to determine the acceptability of beef top loin steaks with a known Warner-Bratzler shear force. Consumers (n = 239) from Chicago, IL, Dallas, TX, Baltimore, MD, Los Angeles, CA, and Lubbock, TX, evaluated steaks cooked to $71°C$. Steaks were categorized by shear force into tender (1.6 to 2.3 kg), intermediate (3.9 to 4.5 kg), and tough (5.4 to 7.4 kg) categories. White consumers found 88% of tender, 86% of intermediate, and 58% of tough steaks acceptable in tenderness (P < .05). Hispanic and African American consumers found 91, 69, and 62%, and 97, 79, and 69% of the tender, intermediate, and tough steaks, respectively, acceptable in tenderness (P < .05). For overall acceptability of the steaks, white consumers indicated 85, 84, and 61% of the tender, intermediate, and tough steaks, respectively, were acceptable. Hispanic and African Americans found 97, 75, and 72% and 92, 81, and 79% of the tender, intermediate, and tough steaks were acceptable (P < .05). Thus, white consumers found steaks categorized as tough to be less acceptable than Hispanic and African American consumers. Preferences for the degree of doneness by white consumers were 11% rare, 26% medium rare, 41% medium, 14% medium well, and 8% well (P < .05). Hispanic consumer preferences for degree of doneness were 25% medium rare, 16% medium, 34% medium well, and 25% well (P < .05). African American consumers preferences for the degree of doneness were 8% medium rare, 23% medium, 28% medium well, and 41% well (P < .05). Consumers eating less than 3 meals including beef in a 2-week period indicated 94% of the tender steaks, 77% of the intermediate steaks, and 55% of the tough steaks were acceptable in tenderness (P < .05). As the number of meals containing beef increased, the tenderness and overall acceptabilities of the intermediate and tough steaks tended to increase although the distributions were not significant. Thus, consumers eating beef more often are more likely to categorize tough steaks as acceptable in tenderness, than consumers eating beef less than 5 times in a 2-week period. Consumers with annual incomes between $15,000 and 34,999 found the tender and intermediate more acceptable in tenderness than tough steaks (P < .05). These results suggest that ethnic background and income level have a significant impact on consumers' perception and acceptability of beef.

Key Words: Beef Palatability, Consumers Preference

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603   Consumer tenderness evaluation of beef loin steaks cooked to a medium degree of doneness. M. A. Carr, C. R. Kerth*, K. L. Crockett, M. F. Miller, and C. B. Ramsey, *Texas Tech University, Lubbock*.

The threshold for tenderness and overall acceptability of steaks by consumers in relation to Warner-Bratzler shear (WBS) values was determined. Beef strip loin steaks (n = 56) were cooked to 70°C on open-hearth broilers in supermarkets in Lubbock, TX, Dallas, TX, Chicago, IL, Los Angeles, CA, and Baltimore, MD. The steaks were cut into 1 x 1 x 2.5 cm cubes and served warm to 743 consumers in the stores. Consumers rated the steaks on an 8-point scale for tenderness and overall palatability and as acceptable or unacceptable for tenderness and overall acceptability. Responses by consumers were compared to WBS values to determine the shear threshold for tenderness acceptability by consumers. Shear values of steaks in the study ranged from 1.6 to 11.8 kg. The mean WBS threshold for 100% acceptability was affected by city (P < .05). The mean WBS thresholds for 100% tenderness acceptability for Baltimore, Chicago, Dallas, Lubbock, and Los Angeles were 3.9, 3.1, 2.7, 3.6, and 4.0 kg, respectively. When the data was pooled from all cities, consumers rated steaks acceptable in tenderness 100% of the time when the mean WBS value was 3.1 kg or less; 99% of the time when the mean WBS value was 3.5 kg or less; 94% of the time when the mean WBS value was 4.0 kg or less; and 86% of the time when the mean WBS value was 4.3 kg or less. Overall acceptability of the steak was not affected (P > .05) by the WBS value, indicating that, while tenderness is important, juiciness and flavor also contribute to the overall acceptability of beef loin strip steaks. For a nation-wide marketing effort, beef loin strip steaks should have WBS values of 3.1 kg or less to insure consumer acceptability of tenderness.

Key Words: Tenderness, Consumer, Shear Value

604   Consumer evaluation of beef loin steaks cooked to three degrees of doneness. M. A. Carr[1], C. R. Kerth[1], K. L. Crockett[2], C. B. Ramsey[1], and M. F. Miller[1], [1] *Texas Tech University,* [2] *Lubbock Christian University, Lubbock, TX*.

Degree of doneness (DOD) and tenderness category effects on consumer evaluations of steaks were determined. Beef strip loin steaks (n=56) with known Warner-Bratzler shear (WBS) values at a medium doneness (70C) were randomly assigned a cooking treatment of either 65C (medium rare), 70C (medium), or 75C (medium well), cooked on open hearth broilers and evaluated by consumers in Lubbock,TX, Dallas, TX, Chicago, IL, Los Angeles, CA, and Baltimore, MD, supermarkets. The steaks were cut into 1 X 1 X2.5 cm cube and served warm to 743 consumers. Consumers rated the steak on a scale from 1 to 8 for tenderness, juiciness, beef flavor and overall acceptability scores. Consumers scored tender steaks (<5.2 kg WBS) significantly higher in overall acceptability when cooked to medium (6.13) compared to both medium rare and medium well(5.28). No differences in scores (P>.05) were found within the intermediate steaks (8.5 to 10.0 kg WBS) cooked to three endpoints. Tough steaks (>11.8 kg) were significantly more acceptable at medium rare or medium well than at medium (6.18, 5.98, and 4.96, respectively). Tenderness category and DOD also affected juiciness scores. Within the tender category, juiciness scores were highest (P<.05) for medium and lowest for medium well doneness steaks. Intermediately tender steaks were most juicy (P<.05) at medium rare, followed by medium and medium well (5.41, 5.04 and 4.73). Tough steaks were more juicy at medium rare (5.67) followed by medium well (5.00), and medium (4.64). Tender steaks were rated higher (P<.05) in beef flavor (6.05) at medium than at medium rare (5.40) or at medium well (5.47). No differences (P>.05) in beef flavor were found for intermediately tender steaks, but though steaks were least flavorful at medium (5.19, P<.05) than at medium well (5.91) or medium rare (6.13). Steaks in the tender category were scored more tender (P>.05)at medium (6.43) than at medium rare (4.87) or medium well (4.91).

Key Words: Consumer, Tenderness, Degree of Doneness

605   Consumer tenderness evaluation of beef loin steaks injected with calcium chloride and cooked to a medium degree of doneness. M. A. Carr, K. L. Crockett, C. B. Ramsey, M. F. Miller, and G. G. Hilton*, *Texas Tech University, Lubbock*.

Calcium chloride effects on trained sensory and consumer evaluations were determined. Boneless strip loin subprimals (n = 8) were obtained from eight Standard grade beef carcasses. At 72 h postmortem, the strip loins were cut in half and alternating halves were injected with either 200 mM CaCl2 at 5% (wt/wt) or not injected to serve as controls. After 7 d aging in vacuum packages at 2oC, 2.5-cm-thick steaks were cut and used for Warner-Bratzler shear (WBS) force determinations, trained sensory panel evaluation and national consumer evaluation. Consumers varying widely in ethnic background, education, income level and age evaluated the steaks in three supermarkets in Los Angeles, CA, Baltimore, MD, Chicago, IL, and Dallas, TX. The steaks were cooked to 70oC on open-hearth broilers, cut into $1 \times 1 \times 2.5$ cm cubes and served warm to 393 consumers who rated the steaks on an 8-point scale for tenderness, beef flavor, juiciness and overall acceptability. Consumers and the trained sensory panel scored steaks with CaCl2 (6.03, 6.37) significantly higher than control steaks (5.79, 5.57) in beef flavor. Consumers also rated steaks with CaCl2 higher (P < .05) than control steaks in tenderness (5.88 vs. 5.66) and overall acceptability (6.02 vs. 5.77). The average improvement in WBS for steaks with CaCl2 compared to their control counterparts was 1.39 kg (4.1 kg without injection and 2.8 kg after injection). CaCl2 can be used to improve beef tenderness and improve consumer perceptions of both flavor and tenderness.

606   Pre-harvest tenderization through oral calcium gel administration. S. K. Duckett*, T. A. Klein, J. G. Andrae, and W. K. Sanchez, *University of Idaho, Moscow*.

Twenty-nine steers (539 kg) were used to test the efficacy of administering an oral drench of calcium propionate at 3 to 6 hour prior to slaughter on longissimus muscle pH, calcium content, calpain activity and Warner-Bratzler shear force (WBS). The steers were randomly assigned to one of the following treatments: controls (N; n = 14) and calcium gel administered (CA; n = 15). At three to six h prior to slaughter, the CA steers were dosed with 1.5 L of Dr. Larson's Up and Over 1000[TM] which contained 150 g of calcium, 630 g propionate, and 600 g propylene glycol. Immediately after slaughter, longissimus muscle pH was recorded and a 5 g sample removed for calpain and calpastatin activity. At 48 h postmortem, carcass data and muscle pH were collected and six steaks (2.54 cm thick) removed for muscle calcium determination and WBS at various postmortem ages (2, 4, 7, 14 and 28 d). Hot carcass weights, fat thickness, ribeye area, percent kidney, pelvic and heart fat, yield grade, marbling score and quality grade were similar (P > .05) between treatments. Muscle pH at 0 h was lower (P < .05) for CA than N; however, pH values were similar (P > .05) between treatments at 48 h. Administration of the oral calcium propionate gel prior to slaughter increased (P < .05) μ-calpain and m-calpain activity (act/g muscle) with no change (P > .05) in calpastatin activity. Total mineral (g/100g) and calcium (mg/100g) content of the longissimus muscle were higher (P < .05) for CA than N. Steaks from steers that received calcium gel had WBS values lower (P < .05) than N after 4 d and 7 d of aging. No differences (P > .05) were noted in WBS values at d 2, 14, or 28 of postmortem aging between the treatments. Regression equations showed that the rate of decline in WBS across postmortem aging was faster (P < .05) for CA than N. Thus, pre-harvest calcium gel administration elevated longissimus muscle calcium content, increased calpain activity, and accelerated postmortem aging to improve tenderness.

Key Words: Beef, Calcium, Tenderness

607 Tenderness classification of beef: Effect of the interaction of end point temperature and tenderness on Warner-Bratzler shear force of beef longissimus. T. L. Wheeler*, S. D. Shackelford, and M. Koohmaraie, *USDA-ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The objective of this experiment was to determine the effect of an interaction between end point temperature and Warner-Bratzler shear force on tenderness classification. Warner-Bratzler shear force was determined on longissimus thoracis cooked to either 60, 70, or 80°C after 3 and 14 d of aging from carcasses of 100 steers and heifers. Warner-Bratzler shear force values (3 and 14 d aged steaks pooled) for steaks cooked to 70°C were used to create five tenderness classes. The interaction of tenderness class and end point temperature was significant ($P < .05$). The increase in Warner-Bratzler shear force as end point temperature increased was greater ($P < .05$) for less tender longissimus than more tender longissimus (Tenderness class 5 = 5.1, 7.2, and 8.5 kg and Tenderness class 1 = 2.4, 3.1, and 3.7 kg, respectively for 60, 70, and 80°C). The slopes of the regressions of Warner-Bratzler shear force of longissimus cooked to 60 or 80°C against Warner-Bratzler shear force of longissimus cooked to 70°C were different ($P < .05$) providing additional evidence for this interaction. One effect of the interaction of tenderness with end point temperature on tenderness classification was to increase ($P < .01$) the advantage in shear force of a "Tender" class of beef over "Commodity" beef as end point temperature increased (.24 vs .42 vs .60 kg at 14 d for 60, 70, and 80°C, respectively). When aged 14 d and cooked to 80°C, "Commodity" steaks were six times more likely ($P < .01$) than "Tender" steaks to have shear force values ≥ 5 kg (24 vs 4%). Another effect of the interaction was that a few (4%) of the Tender steaks had shear force values ≥ 5 kg if cooked to 80°C. However, this latter effect could be adjusted for during classification. The detrimental effects on palatability from consumers cooking beef to elevated degrees of doneness could be alleviated by identifying and marketing "Tender" longissimus.

Key Words: Beef, Cooking, Tenderness