258 On-farm factors influencing the tenderness of pasture-fed beef raised commercially in New Zealand. B.C. Thomson*, K.V. Gilbert, and N.J. Simmons, *AgResearch Limited, Hamilton, New Zealand.*

This survey aimed to identify the amount and factors contributing to the variation in tenderness of strip loins from New Zealand beef animals. Strip loins (longissimus dorsi) were collected 24 hours post-slaughter from 10 beef animals from four abattoirs every fortnight over the killing season for a year (n=740). Producers were asked about the history of their animals. Shear force was determined 2 and 7 days post-slaughter in samples cooked to an internal temperature of 75°C in a boiling water bath, using a MIRINZ tenderometer. The influences of the different variables were analysed and the least square means presented.
Although, there was a wide range of tenderness values (1.5 to 16.6 kgF 7 days post-slaughter), 91 % of the samples were below 8 kgF 7 days post-slaughter. Possible reasons for the variation were examined. There was a strong seasonal effect on tenderness 2 days post-slaughter; samples in the spring were tougher than those in summer, winter and fall (8.7, 8.2, 8.0 and 7.2 kgF respectively, $P< 0.009$), this effect was reduced by day 7 of storage. This effect appeared to be at least partially due to the producer's perception of weather conditions immediately prior to slaughter; animals that were slaughtered when the weather was classified as colder than normal for the period were tougher than when it was warmer, hotter or normal (9.5, 8.6, 7.1 and 6.0 respectively, $P<0.03$). Heifers were tougher than steers at both time points (9.1 vs 6.5 and 6.4 vs 5.0 kgF for 2 and 7 days post-slaughter respectively, $P< 0.005$), an effect unrelated to ultimate pH (5.56 vs 5.61 for heifers and steers respectively, $P <0.30$). Poor growth rates as classified by the producer, buying from the saleyard vs buying direct from another producer, and low levels of contact with humans also reduced tenderness, but the effects were smaller. The identification of key factors like the above, will allow the development of appropiate measures for handling animals and carcasses of different backgrounds on-farm and during processing to reduce the variation in the tenderness of the final product. Work is currently underway to examine the effects of factors immediately prior to slaughter.

Key Words: Tenderness, Sex, Season

259 National Beef Quality Audit-2000: Survey of producers, packers, and end-users. D. L. Roeber*[1], D. R. McKenna[2], P. K. Bates[3], T. B. Schmidt[4], K. E. Belk[1], J. W. Savell[2], J. B. Morgan[3], T. H. Montgomery[4], and G. C. Smith[1], [1]*Colorado State University, Fort Collins, CO,* [2]*Texas A & M University, College Station, TX,* [3]*Oklahoma State University, Stillwater, OK,* [4]*West Texas A & M University, Canyon, TX.*

National Beef Quality Audits (NBQA) in 1991 & 1995 provided benchmark data on quality challenges for the beef industry. Face-to-face interviews in 1991 & 1995 identified hide defects and lack of uniformity in live cattle as leading quality challenges for packers, and external fat and low overall uniformity and consistency as leading quality challenges for purveyors, retailers, and restaurateurs. For NBQA-2000, face-to-face interviews were replaced with questionnaires to solicit opinions of seedstock generators, cow-calf producers, stockers/backgrounders, and feedlot operators and to increase data collected from packers, purveyors, retailers, and restaurateurs. The most frequently cited ($P < 0.05$) management changes made since 1991 in the seedstock and cow-calf sectors (n = 2,308) were improved genetics using EPDs, changed injection-site location, and improved genetics using physical characterization. The most frequently cited ($P < 0.05$) management changes in the stocker/backgrounder and feeder sectors (n = 740) were changed injection-site location, improved handling, and changed genetic types of cattle. Identified changes coincided with those quality challenges for which packers (n = 29) and end-users (n = 113) have seen the greatest improvement. Seedstock and cow-calf producers said results of the previous audits had a "strong" (18.7%) or "moderate" (57.6%) impact on changes in beef quality since 1991; comparable responses were, for stocker/backgrounders plus feedlot operators (15.3% or 62.7%), for packers (6.9% or 55.2%), and for end-users (9.5% or 71.8%). Aggregated responses of the production sectors revealed the greatest quality challenges facing the beef industry were lack of uniformity in live cattle, inadequate tenderness, and insufficient marbling in carcasses and cuts. Aggregated responses of end-users revealed that the greatest quality challenges for the beef industry were insufficient marbling, lack of uniformity in cuts, and inadequate tenderness. These findings should be useful to the beef industry and those who provide educational and research services in seeing where progress has been made and challenges still exist.

Key Words: Beef quality, Market survey

260 National Beef Quality Audit-2000: Results of slaughter floor assessments. P.K. Bates*[1], D.R. McKenna[2], D.L. Roeber[3], T.B. Schmidt[4], J.B. Morgan[1], J.W. Savell[2], T.H. Montgomery[4], D.B. Griffin[2], D.S. Hale[2], and G.C. Smith[3], [1]*Oklahoma State Univeristy,* [2]*Texas A&M University,* [3]*Colorado State Univeristy,* [4]*West Texas A&M Univeristy.*

In order for the beef industry to improve quality and consistency of beef, the current state of the industry must be assessed. The National Beef Quality Audit-2000 was conducted as a sequel to previous audits in 1991 and 1995. Plants (n = 30) were audited from May to November 2000. Each university team (n = 4) surveyed seven or eight plants for the equivalent of one day's production. Fifty percent of each lot was audited in each plant resulting in a total sample size of 43,415 carcasses for hide-on and 43,595 carcasses for bruise evaluations. For condemnation data, approximately 10% of each lot was sampled, resulting in a total sample size of 8,588. Slaughter floor data was segmented into three categories: hide-on, bruise, and condemnation. Hide-on data consisted of evaluations of hide color, mud/manure characteristics, horns, and brands. Bruise data consisted of the frequency, location, and severity of bruises. Offal and carcasses were evaluated for the incidence of condemnation. Data indicated that 45.1% of cattle were predominately black hided, 31.0% were red and 8.0% were yellow. Of the cattle surveyed, 18.0% had no mud/manure, while 55.8% had a small amount. The frequency of cattle without horns was 77.3%. Data revealed 49.3% of the cattle were not branded, 46.2% had one brand, and 4.4% had multiple brands. Of the cattle surveyed, 36.3%, 13.7% 3.6% had brands located on the butt, side and shoulder, respectively. Data indicated that 53.3% of cattle had no bruising, while 30.9% had one bruise and 15.8% had multiple bruises. Of the cattle with bruises, 14.9%, 25.9%, 19.4%, 28.2%, and 11.6% were located on the round, loin, rib, chuck and brisket, flank and plate, respectively. Offal and carcasses were evaluated for the incidence of condemnation and corresponding reasoning for condemnation. Head, tongue, liver, lung, tripe, and carcass condemnations were 30.3%, 13.8%, 11.6%, 6.2%, 7.0% and 0.1%, respectively. Results from the slaughter floor assessment indicate quality and consistency improvements have been made in the fed-beef cattle industry since previous the audits.

Key Words: Beef Quality, Slaughter, Market Surveys

261 National Beef Quality Audit-2000: Results of carcass assessments. D.R. McKenna*[1], P.K. Bates[2], D.L. Roeber[3], T.B. Schmidt[4], D.S. Hale[1], D.B. Griffin[1], J.W. Savell[1], J.B. Morgan[2], T.H. Montgomery[4], and G.C. Smith[3], [1]*Texas A&M University, College Station, TX,* [2]*Oklahoma State University, Stillwater, OK,* [3]*Colorado State University, Ft. Collins, CO,* [4]*West Texas A&M University, Canyon, TX.*

The National Beef Quality Audit-2000 was conducted to assess the current status of the quality and consistency of the U.S. fed steer and heifer population. Previous audits, conducted in 1991 and 1995, have been used as a baseline to pinpoint inadequacies and problems that the industry needs to improve upon. Plants (n = 30) were audited during a seven-month period (May to November, 2000). Each university team (n = 4) surveyed seven or eight plants for the equivalent of one day's production. Ten percent of each lot for each shift was audited in each plant, resulting in a total sample size of 9,396 carcasses. USDA grade factors and other data were collected in the cooler. Mean (SD) USDA yield grade traits were as follows: USDA yield grade, 3.0 (0.87); carcass weight, 356.9 (42.7) kg; adjusted fat thickness, 1.24 (0.53) cm; longissimus muscle area, 84.5 (10.8) cm^2; and kidney, pelvic, and heart fat, 2.35 (0.76) %. The distribution of USDA yield grades were as follows: yield grade 1, 12.2%; yield grade 2, 37.4%; yield grade 3, 38.6%; yield grade 4, 10.4%; and yield grade 5, 1.3%. Carcasses weighing over 431 kg were 3.9% and carcasses having ribeyes greater than or equal to 96.8 cm^2 were 13.2% of the carcasses surveyed, respectively. Mean (SD) USDA quality grade traits were as follows: USDA quality grade, $Select^{85}$ (60.6);

marbling score, Small[23] (101.0); overall maturity, A[66] (23.8); lean maturity, A[64] (19.9); and skeletal maturity, A[67] (30.5). The distribution of USDA quality grades were as follows: Prime, 2.0%; Choice, 49.1%; Select, 42.3%; Standard, 5.6%; and Commercial, Utility, Cutter, and Canner, 0.9%. The incidence rates of dark cutters, blood splash, and yellow fat were 2.3%, 0.5%, and 0.4%, respectively. B-maturity carcasses were 2.5%, and C-maturity and older carcasses were 0.9% of the population surveyed. Steers were 67.9%, heifers 31.4%, and bullocks 0.3% of the fed-beef population evaluated. Results indicate a trend toward heavier carcass weights and larger ribeyes, however, other yield grade factors, and quality grade factors were similar to previous audits.

Key Words: Beef quality, Meat grades, Market surveys

262 National Beef Quality Audit-2000: Consensus of the beef industry. T. B. Schmidt*[1], D. L. Roeber[2], P. K. Bates[3], D. R. McKenna[4], T. G. Field[2], T. H. Montgomery[1], J. B. Morgan[3], J. W. Savell[4], and G. C. Smith[2], [1]*West Texas A & M University, Canyon, TX,* [2]*Colorado State University, Fort Collins, CO,* [3]*Oklahoma State University, Stillwater, OK,* [4]*Texas A & M University, College State, TX.*

Representatives of the beef industry, as participants in the Strategy Workshop of the National Beef Quality Audit-2000 (NBQA-2000), reached consensus regarding the leading quality challenges for the industry. Participants (n = 40) included seedstock generators, cow-calf producers, stockers/backgrounders, feedlot operators, packers, purveyors, restaurateurs, retailers, and academicians. Participants ranked the top ten quality challenges, by severity of the problem for the industry, based upon results of questionnaires and in-plant audits. Severity of quality challenges was determined on an 11-point scale (-5 = severe problem, +5 = above expectations). Leading quality challenges were (1) low overall uniformity and consistency of cattle, carcasses, and cuts (-3.0 ± 0.5); (2) inappropriate carcass size and weight (-2.9 ± 0.2); (3) inadequate tenderness of beef (-2.2 ± 0.3); (4) insufficient marbling (-2.0 ± 0.4); and (5) reduced Quality Grade and tenderness due to growth-promoting implants (-2.0 ± 0.3); all different from zero ($P < 0.05$). Participants developed strategies, tactics, and goals to overcome quality shortfalls by 2005. Goals included (1) eliminate USDA Standard carcasses, (2) eliminate USDA Yield Grade 4 and 5 carcasses, (3) eliminate injection-site lesions from whole muscle cuts, including the chuck, (4) eliminate side brands, (5) reduce horns to less than 5% of fed cattle supply, (6) develop and implement a standardized electronic identification system, (7) develop information systems that allow producers to conduct a quality audit of their own herd, (8) eliminate major and critical bruises that result in subprimal devaluation, (9) improve transportation, (10) market seedstock animals with meaningful genetic data for production and end-product traits, (11) train all producers in Beef Quality Assurance, and (12) continually improve the eating quality of beef. Beef producers can begin to recapture a portion of the $100.10 (Waste = $50.96, Taste = $24.45, Management = $18.23, Weight = $6.46) in quality losses per fed steer/heifer harvested if they develop, implement, and manage cattle using a total quality management approach.

Key Words: Beef quality, Market survey

263 Incidence of injection-site lesions in top sirloin butts of fed steers and heifers. D. L. Roeber*[1], R. C. Cannell[2], K. E. Belk[1], J. N. Sofos[1], J. A. Scanga[1], G. L. Cowman[3], and G. C. Smith[1], [1]*Colorado State University, Fort Collins, CO,* [2]*ConAgra Beef Company, Omaha, NE,* [3]*National Cattlemen's Beef Association, Englewood, CO.*

Damaged beef muscle tissue resulting from intramuscular injections of animal-health products represents a "quality control" problem and an economic loss to the beef industry. Injection-site lesion audits commenced in 1990 when the incidence was documented to be 21.6%. Such lesions are unsightly and the wound-healing process causes toughening of muscle in a radius of 7.6 cm around the injection-site. Fifteen individual and sequential national audits of injection-site lesions in beef top sirloin butts were conducted at the steak provisioner/cutting level between November 1995 and July 2000. The national incidence of injection-site lesions in the top sirloin butts audited (n = 240,080) decreased ($P < 0.05$) between November 1995 (11.4%) and July 2000 (2.1%). From November 1995 to July 1997, mean injection-site lesion weight, across all lesion classes, increased ($P < 0.05$) from 192.5 g to 435.8 g, respectively; mean lesion weight subsequently decreased ($P < 0.05$) to 249.8 g in July 2000, but was still heavier ($P < 0.05$) than in November 1995. The increase from 1995 to 1997 coincided with a response by steak cutters to the release of data confirming the "toughening response" in tissues surrounding injection-site lesions. Results of these audits indicate that producers have changed injection practices; probably due to the efforts of the National Cattlemen's Beef Association and state beef quality assurance programs to heighten awareness of the injection-site lesion issue. Analyses of results for lesion classes, partitioning lesions according to chronological stages of the healing process, suggested that the majority of lesions were induced at times which coincide with cow-calf, stocker, or early finishing-period stages of cattle production.

Key Words: Injection-site lesion, Top sirloin butt, Incidence

264 Incidence of injection-site lesions in beef and dairy cow rounds. D. L. Roeber*[1], R. C. Cannell[2], K. E. Belk[1], J. A. Scanga[1], J. N. Sofos[1], G. L. Cowman[3], and G. C. Smith[1], [1]*Colorado State University, Fort Collins, Co,* [2]*ConAgra Beef Company, Omaha, NE,* [3]*National Cattlemen's Beef Association, Englewood, CO.*

While incidence of injection-site lesions in top sirloin butts and rounds in fed cattle has been well documented, incidence and severity of lesions in rounds of beef and dairy cows has not been reported. This study determined incidence and type of injection-site lesions in beef and dairy cow rounds. Audits were conducted in 1998, 1999, and 2000 on 3,190 gooseneck rounds (beef: n = 1,695; dairy: n = 1,495) in seven states. Rounds were cut into 1.25-cm slices to determine the number of lesions present and the type of lesion. In 1998, 31.1% of beef rounds and 60.1% of dairy rounds had an injection-site lesion. The frequency of lesions in beef rounds declined ($P < 0.05$) nearly 6 percentage points between 1998 and 1999 and an additional 6 percentage points between 1999 and 2000 ($P < 0.05$). The frequency of lesions in dairy rounds did not change ($P > 0.05$) from 1998 (60.1%) to 1999 (51.0%). However, the incidence in dairy rounds declined ($P < 0.05$) over 16 percentage points between 1999 and 2000. In 1998, 1999, and 2000 the incidence in beef rounds was lower ($P < 0.05$) than the incidence in dairy rounds. In all rounds, 95.2% and 89.0%, of all lesions were clear lesions (older lesions comprised primarily of connective tissue) or woody calluses (infiltrated with connective tissue and fat), respectively. Incidence of clear lesions and woody calluses in beef and dairy rounds in 1998, 1999, and 2000 was higher ($P < 0.05$) than incidence of cystic, nodular, or metallic lesions. However, still of concern were the 4.8%, 3.3%, and 4.1% of cystic lesions (encapsulated lesions containing fluid) that were found in beef rounds in 1998, 1999, and 2000, respectively, and the 4.1%, 2.3%, and 2.2% of cystic lesions that were found in dairy rounds in 1998, 1999, and 2000, respectively. Incidence of cystic lesions in beef vs. dairy rounds did not differ ($P > 0.05$). Monitoring of the incidence of injection-site lesions in beef and dairy rounds allows educational efforts of state and national BQA programs to target, more definitively, management practices of producers that can minimize occurrence of such defects in end-products.

Key Words: Injection-site lesion, beef and dairy rounds, tissue damage

265 Bison grain fed and grass fed top loin taste test. J. L. Lanier*[1], C. D. Smith[1], P. Chapman[2], and T. Grandin[3], [1]*Lanier Animal Systems,* [2]*Dept. of Statistics, Colorado State University,* [3]*Grandin Livestock Handling Systems, Ltd.*.

A study was conducted to determine consumer preference/acceptance for grass-fed and grain-fed bison steaks. Twenty-five top loin steaks, (longissimus lumborum) from each treatment group (grass-fed or grain-fed; 6 producers each treatment), were cooked to an internal temperature of 60°C. Warner-Bratzler shear force values were determined on 21 steaks (10 grass-fed, 11 grain-fed). Customers (n=144; 53% women) of two Alfalfa's Market in northern Colorado participated in an "untrained consumer taste panel" to evaluate overall like or dislike, flavor, tenderness, and juiciness. Ninety percent of the panelists were Caucasians and the average age was late 30's. Contribution to health was the primary factor in choosing products for a main meal, while taste was the primary factor for a special meal ingredients. Interest in purchasing bison meat to be cooked at home was slightly greater than ordering bison meat at a restaurant. Sixty-two percent of the panelists would prefer to purchase grass-fed bison steaks rather than grain-fed steaks, with the most frequent reason given as "grass-fed are more natural". Grain-fed steaks had a greater acceptance rating for flavor ($P<.01$) adjusted for thickness of the steak and income of the panelist, and overall

acceptance (P=.02), adjusted for thickness. There was evidence of variability among animals from different producers within both feed-types for tenderness (est. sigma = .075; glm test P=.02), and juiciness (est. sigma = .017; glm test P=.02). A lack of consistency within grass-fed and grain-fed producers for juiciness and tenderness (P= .02), as well as marginal consistency for flavor and overall acceptability within feed-types was found. Thicker grain-fed steaks had a higher probability of preference (P=.02) than thinner grain-fed steaks. Thickness was not a condition of acceptance for grass-fed steaks. If a customer was male, the odds of not preferring grass-fed steak decreased by a multiple of .471 (P=.03). Mechanical analysis of tenderness found all bison loin steaks grilled to an internal temperature of 60°C to be tender, with no difference between feed-types.

Key Words: Bison, Consumer taste test, Meat

266 Influence of feeding malting industry byproducts to feedlot cattle on longissimus muscle sensory traits and tenderness. C. R. Dahlen*[1], K. Hachmeister[4], C. M. Zehnder[1], M. Dikeman[4], G. C. Lamb[3], L. R. Miller[1], H. Chester-Jones[2], and A. DiCostanzo[1], [1]*University of Minnesota, St. Paul,* [2]*Southern Research and Outreach Center, Waseca,* [3]*North Central Research and Outreach Center, Grand Rapids,* [4]*Kansas State University, Manhattan.*

Loins from 48 crossbred steers were used to evaluate effects of feeding malting industry byproducts (MBP) on sensory traits, color, and Warner-Bratzler (WB) shear force. Pens (two heavy and two light replicates; 5 steers/pen) were allocated to receive one of four dietary treatments consisting of a corn grain-based diet (Control) where corn gluten feed (CGF), MBP, or MBP and thin stillage (MBPTS) substituted for a portion of corn silage and/or corn. Steers in heavy or light replicates were harvested after 110 or 138 d on feed, respectively; 97 d after receiving a single steroid implant. Loins were aged at 2 C for 14 d postmortem, cut into steaks (2.54 cm thick) and analyzed for WB shear force, sensory, and color evaluation. Neither cooking loss nor WB shear force were affected (P > .05) by treatment. Steaks from steers fed CGF had more desirable scores for myofibrillar tenderness than those from steers fed Control (P = .004) or MBPTS (P = .08). A similar trend (P = .06) was observed for overall tenderness. Steaks were found to be moderately juicy and intense in flavor, with practically no connective tissue or off-flavors regardless of treatment (P > .05). Steaks from steers fed MBPTS tended (P = .06) to be redder (higher 630/580 ratios) during display than those from CGF steers, whereas steaks from steers fed Control tended (P = .06) to be darker (lower L* values) than those from MBPTS steers. Steaks from steers fed CGF tended (P = .07) to be less red (lower a * values) than those fed Control, and less red (P < .05) than steaks from steers fed MBPTS. Feeding steers MBP had no adverse effects on longissimus muscle tenderness or sensory traits.

Key Words: Tenderness , Beef, Byproducts

267 Tenderness improvement through prerigor muscle stretching of Holstein cow carcasses. J.R. Claus[1], H. Wang[2], and N.G. Marriott*[2], [1]*University of Wisconsin-Madison,* [2]*Virginia Polytechnic Institute and State University.*

The objective was to determine if prerigor muscle stretching would improve the tenderness of beef from Holstein cow carcasses. In a commercial packing plant, carcasses were suspended in the common vertical position and nine carcasses (approx. 365 kg each) were selected, with one side randomly designated for the Tendercut treatment (TC) with the counterpart as a control (C). After 35 min postmortem, the 12th thoracic vertebra, Multifidus dorsi, and connective tissues of the TC sides were completely severed, leaving only the Longissimus muscle (LM) intact in this area. Both sides were chilled in a cooler that utilized spray chilling at 4 C for 24 h. The LM between the 2nd lumbar and 9th thoracic vertebrae was removed, vacuum packaged, and aged for 10 days (4 C). After aging, samples were frozen and stored (-31 C). The LM was cut into 25.4 mm steaks. Steaks were thawed and cooked to an internal temperature of 70 C. The LM of TC treated carcasses had longer (P<0.05) sarcomeres than the C samples in both the anterior (2.55 vs. 1.70 μm) and posterior regions (2.13 vs. 1.62 μm). In the anterior portion of the LM, the Warner-Bratzler shear force (WBS) of the TC steaks (4.75 kg) was lower (P<0.05) than the C samples (5.54 kg). The posterior region of the LM was not different (P>0.05) in WBS between TC and C which was attributable to the farther distance from the treatment site. Lee-Kramer shear force data were similar to the results of WBS. Trained sensory panelists determined that TC steaks had higher (14.8%, P<0.05) scores for myofibrillar tenderness and overall tenderness (13.9%) than C steaks. TC steaks were not different (P>0.05) in sensory juiciness or connective tissue score compared to the C samples. Prerigor carcass muscle stretching can improve the tenderness of beef from Holstein cows.

Key Words: Holstein, Prerigor, Tenderness

268 Composition and consumer perception of fresh beef bonded with Activa^{TM} TG-RM . D.S. Kolle*, B.L. Kolle, and J.W. Savell, *Texas A&M University, College Station, TX.*

Objectives were to determine the effects of removing kernel fat from ribeye rolls (n = 24 treated; n = 24 control) and connective tissue from top blades (n = 24 treated; n = 24 control) on percent dissectible components, chemical analyses, energy measurements, and consumer evaluations of steaks. For treated cuts, the kernel fat that lies within the ribeye between the *Spinalis dorsi* and the *Longissimus thoracis* was removed. For the top blade, the *Infraspinatus* was cut open and the heavy connective tissue within the muscle was removed. Control cuts were left intact. A 0.5% dry-sprinkle application of Activa^{TM} TG-RM/sodium caseinate mixture was applied to treated cuts to serve as a binding agent. Steaks were assigned randomly to: 1) raw analysis; 2) cooked analysis; or 3) in-home sensory evaluation. Steaks were dissected into separable lean, fat, connective tissue, and inseparable tissue. Chemical analyses were conducted to determine moisture, fat, and protein content, and results were determined for protein calories, fat calories, and total calories. Additional ribeye rolls (n = 12 treated; n = 12 control) and top blade roasts (n = 10 treated; n = 10 control) were used for a consumer retail case study. Modified raw ribeyes were higher ($P < 0.05$) in percent dissectible lean, chemical protein, and chemical moisture, in addition to being lower in percent dissectible fat, chemical fat, and total energy. Treatment increased the percent dissectible lean and percent chemical protein, while reducing the percent dissectible connective tissue for raw top blades. Cooked data for both cuts were similar to the findings for the raw data. In-home sensory evaluations showed consumers rated modified ribeye steaks higher for leanness. The removal of kernel fat did not negatively affect evaluations for tenderness, juiciness, and flavor. Consumers rated treated top blade steaks higher than controls for all sensory characteristics. Consumer case data suggested that consumers chose treated ribeyes over control ribeyes due to leanness, and treated top blade steaks over control steaks because of perceived marbling. Modifying retail cuts to remove excessive seam fat and connective tissue appears to be an effective tool in increasing the nutritional composition and purchasing characteristics of steaks.

Key Words: Beef, Consumer preferences, Composition

269 The effects of calcium loading on tenderness of beef *Longissimus, Supraspinatus* and *Semitendinosus* muscles. D.J. Hanson*[1], C. R. Calkins[1], and J.M. Horton[2], [1]*University of Nebraska-Lincoln,* [2]*Kemin Industries, Inc., Des Moines, IA.*

Calcium is needed for postmortem proteolysis of muscle. This experiment was designed to evaluate the hypothesis that high calcium, oral drench administered immediately prior to slaughter would hasten the effects of aging and/or increase overall muscle tenderness of beef *Longissimus, Semitendinosus*, and *Supraspinatus* muscles. Forty-two (n=14/treatment) crossbred steers were treated 35 to 125 min prior to slaughter with one of three solutions. One group served as a control and received 1 L of distilled water; the other two groups were drenched with 1 L of calcium chloride or calcium propionate (NutroCAL^{TM}), that provided 150 g of elemental calcium. The muscles were removed about 24 h postmortem and 2.54 cm steaks were removed after 2, 5, 7, 14, and 21 d postmortem for Warner-Bratzler shear force determination, except that the size of the *Supraspinatus* prevented sampling after 7 d. Calcium chloride-treated steers had higher serum calcium levels (P<.10) than controls or calcium propionate treated steers. *Longissimus* muscles from calcium propionate-treated steers tended to have higher levels of muscle calcium than controls and calcium chloride-treated steers and numerically lower shear force values at 2, 5, 7, and 14 d than controls. No differences in muscle calcium or shear force values were detected among treatments for *Semitendinosus* and *Supraspinatus* muscles. Sarcomere lengths were not different among treatment groups, indicating that differences in muscle calcium did not create differences in muscle

shortening. These data suggest subtle benefits to *Longissimus* tenderness from calcium propionate (NutroCAL^{TM}) treatment of steers prior to slaughter.

Key Words: Beef, Tenderness, Calcium

270 Inhibition of lipid oxidation with encapsulated phosphates in muscle foods. J.R. Claus*[1], H. Wang[2], N.G. Marriott [2], and W.N. Eigel[2], [1]*University of Wisconsin-Madison,* [2]*Virginia Polytechnic Institute and State University*.

The objective was to determine if encapsulation would improve the antioxidative property of phosphate in cooked muscle foods. Encapsulation of phosphate was done to protect the phosphate from endogenous phosphatases during the raw meat manufacturing steps. An initial experiment involved incorporation of encapsulated phosphates (0.5% sodium tripolyphosphate, STP or 0.5% sodium acid pyrophosphate, SAPP; meat weight basis) into ground beef patties that were immediately heat processed before storage (3 C). Phosphates were encapsulated with a hydrogenated vegetable oil designed to melt at 74 C (STP) or 60 C (SAPP). Unencapsulated STP samples had the lowest ($P<0.05$) cooking loss. Thiobarbituric Acid Reactive Substances (TBARS) were lower ($P<0.05$) for the phosphate treatments compared to control samples (no phosphate) on day 0 and 6. Unencapsulated STP samples had lower ($P<0.05$) TBARS than the other phosphate treatments on day 0. However, there were no differences ($P>0.05$) in TBARS among the phosphate treatments on day 6. A subsequent experiment involved delay of heat processing after phosphate encapsulation. Ground turkey meat with 1% NaCl was incorporated with unencapsulated STP (0.3% or 0.5%), encapsulated STP (0.3% or 0.5% phosphate), or a blend of unencapsulated (0.3%) and encapsulated (0.2%) phosphate and compared to a control. Treated ground turkey was stored (4 and 24 h, 3 C) before cooking to two different endpoints (74 and 79 C). Cooked turkey was stored (3 C) for 0, 5, and 10 days. An improvement of 77% and 80% in the reduction of TBARS was found with the 0.3% and 0.5% encapsulated STP, respectively, in comparison to the unencapsulated STP. TBARS on day 10 from samples stored 24 h before cooking were higher ($P<0.05$) than the samples stored 4 h prior to cooking. Encapsulation of phosphates has the potential to retard lipid oxidation in further processed meats that required an extended raw meat processing time prior to cooking.

Key Words: Encapsulated phosphate, Lipid oxidation, Meat

271 Future for red meat consumption cannot be accurately evaluated by using per capita: A different approach, per adult human unit versus per capita. S. Hasimoglu*[1], [1]*Continental Analytical Cervices Inc. Salina, KS*.

While the world's population has doubled in the past century, its appetite for meat quadrupled reaching 200 million tons. Even though the World Bank is discussing normalization of per capita (PC) consumption, its erroneous use has rarely been challenged, as if it is the most viable unit that should be used in the evluation of meat consumption. However, PC does not address detailed anthropometrics criteria. When data are presented on PC basis, the assumption must be made that a 6-month-old baby will consume as much meat as a mature person. Aiming to reduce the magnitude of errors inherent PC, a method has been developed for analyzing production and consumption in populations that accounts for variations among age groups within populations. Per adult human use (PAHU) allows standardization of any population and eliminates the "one size-fits-all" PC concept. Application of the PAHU and calculated age groups conversion factors are used in obtaining data presented below. The calculation of the PAHU of the USA population (1985 and 1995) indicated that consuming and producing 239 and 265 million PC was reduced to standardized 199 and 222 million PAHU populations, respectively. Considering equally populated Sweden and Zimbabwe (8.3 million in 1985) and the world PC average meat consumption 29.6 kg/yr, their meat requirements would be 240 000 and 167 000 t/yr respectively. Percentage unit (PU) deviations of PAHU red meat consumption from PC were significantly different; 14.8 and 32.8 PU for Sweden and Zimbabwe respectively. The methodology underlying PC estimate of red meat consumption is an indirect procedure of arriving at a conclusion by disregarding not only the younger but the older portion of the population and the calculated unintended faulty level is not less than 15.86 PU as compared to PAHU. Simply, on the red meat consumption and production predictions, we are trying to find the right answer with the wrong unit, PER CAPITA.

ASAS Nonruminant Nutrition: Amino Acids, Vitamins, and Minerals in Finishing Pigs

272 Evaluation of synthetic L-Lysine use in finishing pigs. D.C. Kendall*[1], G.L. Allee[1], and J.L. Usry[2], [1]*University of Missouri-Columbia,* [2]*Ajinomoto Heartland Inc.*.

An experiment was conducted with finishing pigs (n=150 PIC C-22 x 337; initial BW = 70 kg) to evaluate the use of synthetic L-Lys on pig performance and carcass characteristics. Pigs were fed one of five dietary treatments with 6 replicates and housed at 5 pigs/pen. Pigs were fed an early finishing diet (EF) until 93 kg and late finishing diets (LF) until 115.5 kg. Diets consisted of a corn-soy positive control, a corn-soy negative control, .15% added L-Lys, .225% added L-Lys, and .30% added L-Lys. Dietary CP for the EF period were 16.1, 14.8, 13.1, 12.3 and 11.5%, respectively, and 13.9, 13.0, 11.2, 10.5, and 9.7%, respectively, for the LF period. True ileal digestible (TID) lysine levels were .71 and .57% for the positive control in the EF and LF. All other diets were formulated at .63 and .51% TID Lys for EF and LF. Ratios of TID Thr and Trp values were maintained relative to lysine of .63 and .20 in EF, .68 and .185 in LF with the addition of synthetic L-Thr or L-Trp. All diets were formulated to be equal on a modified ME basis. Pigs were weighed biweekly to determine average daily gain, average daily feed intake and feed efficiency. In addition, ultrasound measurements were taken on d 0 and at slaughter to determine tenth rib backfat depth and loin eye area. During the EF phase, no differences were observed in ADG or ADFI, however G:F was poorer in pigs fed diets containing .225 and .30% added L-Lys (.335) compared to the positive control (.353; $P\leq.05$). During the LF phase and for the overall finishing period, no differences in growth performance were detected between the diets. Ultrasound measures of tenth rib back fat depth, loin eye area, and percent lean at slaughter did not differ between treatments. At no point were the growth performance or carcass characteristics different between the negative control and diets with added L-Lys. This study shows that finishing swine diets containing up to .30% synthetic L-Lys, supplemented with L-Thr and L-Trp, does not affect growth performance or carcass characteristics.

Key Words: Pigs, Reduced crude protein, Lysine

273 Heat-damaged protein has reduced ileal true digestibility of cystine and aspartic acid in chicks. E.L. Miller*[1], Y.X. Huang[1], S. Kasinathan[1], B. Rayner[1], U. Luzzana[2], V.M. Moretti[2], F. Valfr[2], K. R. Torrissen[3], H.B. Jensen[4], and J. Opstvedt[5], [1]*University of Cambridge,* [2]*Universit degli Studi di Milano, Italy.,* [3]*Institute of Marine Research, Norway.,* [4]*University of Bergen, Norway.,* [5]*Norwegian Herring Oil and Meal Industry Research Institute, Norway.*.

Low temperature fish meal (LT) has better digestibility than regular fish meal (R) in mink. Model systems have shown heat processing of fish muscle between 70 and 120C reduces SH groups and causes racemization of L to D aspartic acid. The objective was to determine the SH content, the extent of racemization of aspartic acid and ileal true digestibility (TD) of amino acids in chicks of Norse LT 94® compared with regular NorSeaMink®. Reactive SH was determined using three methods: 1) reaction with dithiodipyridine, 2) reaction with monobromobimane, and 3) reaction with 4-vinyl pyridine and HPLC separation. Values (mmoles/100 g CP) were LT 2.38, 2.57, 2.11; R 0.62, 0.70, 0.13 by methods 1, 2, 3 respectively. The proportion of D-aspartate (D/D+L) was determined by HPLC separation of the isomers following hydrolysis with 6M HCl at 100C for 6 h to minimize hydrolysis-induced racemization. D/D+L aspartate was 0.004 in freeze dried fish muscle compared with 0.030 in LT and 0.056 in R. Hydrolysis corrected values were LT 0.026, R 0.052. Ileal true digestibility was determined by slaughter of 11 day old chicks fed diets with 0 (200 enzyme hydrolysed casein plus amino acids), 150, 200, 250 g CP/kg of each fish meal as the sole protein