

General Posters

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Co-Editors

Improving Pork Quality by Reducing the Incidence of Pale Soft Exudative (PSE) Pork

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Pigs (N=120) were killed to determine the effects of pre-slaughter rest and hot-fat trimming on palatability, muscle quality and processing characteristics. Pigs were rested 0, 1, 2, or 3 h prior to slaughter and then slaughtered in a major packing house, using standard industry procedures. Live temperatures were taken immediately prior to slaughter. One side of each carcass was hot-fat trimmed to remove all skin and fat in excess of 6mm. Temperature and pH decline were measured on each carcass side hourly, and at 9.5 and 24.5 h post-mortem. For pH, measurements were taken at the 10th and 11th rib interface hourly for the first 5 h and at 24 h post-mortem. At the end of the 24 h chilling period, wholesale cuts were fabricated from the carcass, and the hams and loins from each carcass side were collected. Color was subjectively measured on the inside ham muscles as well as the loins at the 10th rib. Boneless, center-cut loins from each carcass side were vacuum packed and stored for 7 d at 2°C. Then each loin was divided into two pieces. One half was vacuum packed and returned to storage for an additional 7 d of aging (14 d total). Then each loin was cut into 1-inch thick chops for sensory evaluation and Warner-Bratzler shear force determination for each aging treatment. The results show pigs rested before slaughter had an average preslaughter skin temperature over 5°F higher and muscle temperature about 2°F higher after slaughter than pigs rested 1, 2 or 3 h; 1 hour was sufficient to lower body temperature to the level after 3 h of rest. Muscle pH was higher the first 3 h of carcass chilling if the pigs were rested 1 h than a shorter or longer time. Hot-fat trimming accelerated (P<.01) carcass chilling rate 8°F/h for the first 6 h of chilling, but did not affect rate of pH decline. Hunter L values of loin muscles were highest and L values of ham muscles were intermediate if the pigs were not rested before slaughter. Ham muscles

had higher L values if the pigs were rested 3 h rather than 1 or 2 h. Length of rest period did not affect palatability traits of loin chops after 7 d of aging. However, after 14 d of aging, pigs not rested had lower sensory panel ratings for overall palatability than pigs rested 1 or 2 h before slaughter. Thus, pigs should be rested 1 h before slaughter to lower body temperature, induce a slower muscle pH decline during the critical early post-mortem chilling period, and improve muscle appearance and palatability. Hot-fat trimming should be practiced to reduce costs of chilling carcasses and labor costs during fabrication.

Application of Antioxidant Vitamins E and C to Fresh Pork: Effect on Shelf-life

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The objective of this study was to determine changes in shelf-life characteristics of fresh pork chops after dipping applications of vitamins E and C. Fifteen boneless, trimmed chops from each of 6 pigs were allocated to non-dipped, dipping in sterile water, 0.1% vitamin E in gum acacia (E), 3% ascorbic acid as sodium ascorbate (C), or a combination of E and C (EC). Chops were displayed under simulated retail conditions for 1, 4 or 7 days, and cores were removed from chops of 5 of 6 pigs for total plate counts at completion of each storage period. Pigs varied significantly in all parameters measured (P<0.001). Non-dipped chops had higher overall TBARS than C and EC, but were lower than sterile water (P<0.05). All dipping treatments increased Hunter color L values (P<0.001), while non-dipped chops had higher Hunter color a values (P<0.05). Hunter color b values were not affected by dipping, but storage time increased Hunter color a and b values (P<0.01). Moisture was reduced in E and EC versus non-dipped chops (P<0.10). Storage time reduced moisture (P<0.05), with the lowest moisture in E chops. Storage increased total plate counts (P<0.0001), but dipping treatments did not affect total plate counts (P>0.10). Dipping with C and EC improved shelf-life characteristics, but dipping with E had no effect. Treatments had no antimicrobial effects in this study.

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The Role of the Calpain/Calpastatin System in the Muscle Hypertrophy Associated with Double-Muscling in Beef

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Five normal-muscled (NM; Angus) steers and five double-muscled (DM; Piedmontese) bulls were used to study the role of the calpain/calpastatin system in the muscle hypertrophy associated with double-muscling. The cattle were pen fed, by breed type (NM or DM), a high-energy diet from weaning to slaughter. The NM steers were slaughtered at a fat constant endpoint (1.0 cm). As a NM steer reached the endpoint, the heaviest DM bull was pair-slaughtered. Calpains and calpastatin activities (in 50 g of fresh muscle); as well as shear force after 1, 7 and 14 days aging were measured in the *longissimus dorsi* (LD) and *biceps femoris* (BF) muscles. Carcass yield and quality grade data were collected after a 24 h chill. Data were analyzed using analysis of variance. The models for carcass traits, calpains/calpastatin activities and shear force included main effects of breed type, breed type and muscle (LD and BF), and breed type, muscle and aging time (1, 7 or 14 days), respectively. The DM cattle had significantly heavier carcasses and higher dressing percentages (59.1% vs 65.7%). The DM carcasses also had less ($P < .01$) backfat, larger ($P < .01$) ribeye areas (71.4 vs 110.4 cm²), lower ($P < .01$) yield grades (2.8 vs 0.4), and lower ($P < .01$) marbling scores (Sm⁴⁸ vs Tr⁷⁶) than the NM carcasses. μ -Calpain activity was higher ($P = .02$) in the DM cattle than in the NM cattle, while calpastatin was not affected ($P = .77$) by breed type. Shear force was not affected by breed type ($P = .55$) or muscle ($P = .45$); however, shear force decreased ($P < .01$) from 1 to 7 and 1 to 14 days. These data show the typical differences in carcass characteristics between NM and DM cattle. Furthermore, it does not appear that the muscle hypertrophy associated with double-muscling in beef is related to the calpain system, as has been shown in other hypertrophic models, specifically with β -adrenergic agonist-treated cattle.

Functionality of Mechanically Recovered Beef Neck Bone Lean

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Mechanical systems that recover lean tissue from split, attached, two to six cervical vertebrae portions have been introduced. This technology has led to questions concerning functional differences in tissue obtained by this process versus lean tissue obtained by hand-trimming. The objective was to characterize basic chemical and functional differences among mechanically-recovered neck bone lean, hand-trimmed neck bone lean and standard 85% lean trim. Beef neck bone marrow was also analyzed to investigate its contribution to func-

tionality of mechanically-recovered neck bone lean. Proximate analysis, metmyoglobin reducing ability, oxidation-reduction potential, pH, water-holding capacity and total pigment data were collected for three replications of the experiment. Mechanically-recovered lean had higher ($P < 0.05$) metmyoglobin-reducing ability and total iron than the control and higher ($P < 0.05$) fat than hand trim. Values for pH were higher ($P < 0.05$) for mechanically-recovered lean than for hand trim or the control (6.68, 6.33 and 5.80, respectively). Mechanically-recovered lean also had higher ($P < 0.05$) nonheme iron, total pigment and water-holding capacity. Bone marrow and higher ($P < .05$) ash, cholesterol, total iron, total pigment and pH than all lean types. If mechanically-recovered lean from beef neck bones is incorporated into a ground beef formulation, color stability may be improved through increased metmyoglobin-reducing ability. Increased pH of mechanically-recovered neck bone lean could increase water-holding capacity and yield of processed meat products.

Realignment of Cold-Extruded Pork Chop Muscle Fibers as Determined by Scanning Electron Microscopy

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A study by Kuber and Mandigo (1993) found that pork chops manufactured by twin screw cold extrusion produced pork chops that when cooked (72°C) were rated by a consumer panel as being more desirable ($P < 0.01$) in texture than boneless control pork chops. It was hypothesized that the extrusion process may partially realign the fibers of the extruded pork chops, thereby causing the observed increase in consumer panel scores for texture. The objective of this study was to determine the degree of muscle fiber alignment in cooked extruded pork chops. Scanning electron micrographs were obtained from cooked extruded pork chop samples made from approximately 12-15 extruded ropes containing chunked pork blade loin meat (2.54 cm) and desinewed pork shank meat (5 mm) that had been mixed (20 or 40 min) and extruded through a 10-mm diameter extruding horn at 200 or 400 rpm. Treatment samples were obtained from randomly selected extruded ropes, at the interface junction of three or four extruded ropes, and areas containing desinewed meat from the cut surface of all pork chop treatments. Cryofractured extruded and control samples (2 mm³ pieces) were fixed in a 1.25% glutaraldehyde solution (12-16 hr), washed (2X) in a buffered solution and post-fixed (1 hr) in 1% osmium tetroxide. Samples were serially dehydrated in graded ethanol, critical point dried, mounted and sputter-coated with 300Å of gold/palladium. An accelerating voltage of 10KV and a 100 μ aperture was used to obtain scanning electron micrographs at magnifications from 100-400X. Electron micrographs of cooked extruded sample interfaces were shown to be composed of areas of overlapping and linearly arranged fibers and areas of ground, emulsion-like less-ordered material. The partial realign-

ment of extruded chop muscle fibers may contribute to the more desirable textural attributes compared to control chops.

Determination of Consumers' Threshold for Beef Tenderness in the Home

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Consumer threshold for beef tenderness in the home and restaurant environment was determined. Steaks from the loin were eaten by 70 consumers to determine the consumer threshold for beef tenderness in both the home and the restaurant. The consumer panelists represented a wide range of ethnic origins, income groups and education levels. Steaks were fabricated into 2.0 cm thick portions and consumed by each panelist in their home and in a "white table cloth" restaurant. Each consumer rated each steak for tenderness and overall palatability on an 8-point scale. The rating scale threshold for steaks consumed at home and in the restaurant occurred between a 3 (moderately tough) and a 3 (slightly tough). The threshold for beef tenderness in the home was between 5.4 kg and 6.4 kg of Warner-Bratzler Shear Force (WBS) values. Consumers determined the threshold for beef tenderness under restaurant conditions occurs between 5.7 and 6.6 of WBS. These results indicate that the same consumers will tolerate a slightly tougher steak in the restaurant compared to the home as the threshold levels.

Modeling of Loin Fat Thickness for an Automatic Loin Puller

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The backfat on rough-cut fresh pork loins is removed to produce commodity loins. Ideally, it is desired to leave a fat layer of 0.3 cm. remaining. Currently, the trimming is done manually with curved loin-pulling knives, and this process is inaccurate. The resulting wasted lean or the shipment of unnecessary fat, combined with the intense labor required, are all costly. If the entire loin fat thickness could be accurately predicted from the probing of a few specific points, the trimming process could be automated. Machine vision was used to create images of 52 loins. The loins were cut into 2.5 cm thick slices, and the fat thickness was determined at 4 locations on each slice, T1 to T4, with T1 located at the midline of the back and T4 located at the belly edge. SAS was used to model each of these four locations along the length of the loin. The sample of loins was randomly divided into two groups, and one group was then used to predict the model for the other. The model uses the mean fat thickness at each position, and a minimum number of known probed positions to

predict the fat thicknesses at the remaining positions along the length of the loin. The resulting model uses four known fat thicknesses at each location (T1 to T4), for a total of 16 probed points on each loin. When the model was used on the second half of the sample loins, the correlation coefficients between actual and predicted thicknesses were .61, .64, .74, and .81 for the four lateral locations. Average predicted cutting positions were within 0.3 cm of the desired position with RMSE <.41, resulting in minimal losses.

Detection of Foreign Objects in Ground Meat Using MRI

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Foreign objects in processed meats are a serious concern, both for quality and safety reasons. The feasibility of using magnetic resonance imaging in quality control applications was investigated. If successful, a low-cost machine could eventually be developed for use in the food industry. An MRI system consisting of a 4.7 Tesla superconducting magnet operating at 200 MHz was used to identify plastic, paper, bone, fat and glass fragments within ground lean pork. The sample jars were approximately 5 cm in diameter and 10 cm in height, and 11 slices were taken along the center of each jar, 0.7 cm apart. Proton density weighted images were created, with echo time, TE = 18 ms, and repetition time, TR = 3.3 seconds. The foreign objects gave virtually no signal, making their shapes easily detectable within the larger signal from the meat. The results show that objects of characteristic shape can be identified. The limiting size of detectable fragments of foreign objects is the size of the void spaces within the processed meat sample.

Efficacy of Using Image Processing for Determining the Fat Content of Ground Beef

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The purpose of this study was to evaluate image processing and its capability to measure fat content in ground beef. An accurate, fast determination of fat content in ground beef is important. Image processing systems are used to capture color images that are converted to a distribution curve in the HSI scale (hue, intensity, and saturation). Hue describes a pure color, intensity is the overall intensity of the color for a particular hue and saturation is a measure of the degree in which a pure color is diluted by white light. The HSI color model is useful because hue and saturation are related to the way humans perceive color. Two lots of beef trim (estimated at 10% and 40% fat) were formulated into meat blocks repre-

senting nine different fat percentages. Random samples ($n=3$) from each block were taken after grinding through a 5 mm plate and subjected to an image capturing system. Patties were made from the remainder of each ground meat block and three patties were randomly selected for image capture. All samples were analyzed for fat content. Actual fat content of the meat blocks was 8.1% and 32.5% compared to the estimate of 10% and 40% fat, resulting in a 2.7% fat spread between each of the nine formulations. Hue, saturation and intensity means and the third moment (SKEW3) of the distribution curves were evaluated. Mean hue and SKEW3 values were highly correlated ($r = .98$ and $.97$, respectively) with estimated fat percentage in patty form. In the ground form, r values were decreased for hue mean ($.89$). Correlating mean hue and SKEW3 values with actual fat percentages of patties resulted in r -values of $.97$ and $.96$, respectively. These data suggest that image processing may be a useful objective method for monitoring ground beef composition.

Effects of Different Preparation Methods and Core Location on Beef *Longissimus Lumborum* Warner-Bratzler Shear Force

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The effects of cooking method, fiber orientation and post-cooking core time on beef *longissimus lumborum* (LL) Warner-Bratzler Shear (WBS) values were studied in a randomized complete block with a 2x2x2 factorial arrangement. Thirteen strip loins were cut into eight consecutive 2.54 cm thick steaks and randomly assigned to one of the eight different treatments. Steaks were cooked to an internal temperature of 70°C using either a Blodgett Convection Air Oven or a Farberware Open Hearth Grill. Six 1.3 cm cores were obtained either perpendicular to the steak surface (mechanically cored) or parallel to the muscle fibers (hand cored). Steaks were allowed to cool at 1.67°C for either 2 or 24 h post-cooking. Steaks prepared in a Convection Air Oven had ($P < .01$) lower WBS values (3.58 vs 4.00) and less weight loss due to cooking (23.9% vs 30.9%) than steaks prepared on an Open Hearth Grill. Neither post-cooking core time nor fiber orientation influenced ($P > .10$) WBS or cooking loss. An additional study was conducted to determine the effect of core location on WBS. The lateral ventral, mid-point ventral and lateral dorsal cores had higher ($P < .05$) WBS values (4.07, 4.03, and 4.02, respectively) than the mid-point dorsal, medial ventral and medial dorsal cores. The mid-point dorsal and medial ventral cores had WBS values of 3.69 and 3.58, respectively and were higher ($P < .05$) than the medial dorsal location which had a shear force of 3.29. Thus, cooking method and core location can influence WBS values.

The Effects of Acetic Acid and Pulsed Power Electricity on the Microbiological Properties of Beef

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In 1989, Todd estimated 12.6 million foodborne cases annually cost the U.S. \$8.4 billion. Thus, foodborne illness has become an important issue facing the beef industry. Therefore, the objectives of this study were to determine the effects of 2% acetic acid (AA) at 37°C and pulsed power electricity (PP) in reducing *Escherichia coli* O157:H7, coliforms, *Salmonella typhimurium*, and aerobic plate counts (APC) in beef. In study I, 3.8 cm x 2.5 cm x 2.5 cm steaks ($n=10$ /treatment) were inoculated with 1 ml of *E. coli* O157:H7 (10^5 /ml) for 2 min and then treated with 2% AA, PP, or a combination of AA and PP. Compared to the control steaks, a significant reduction in *E. coli* O157:H7 was found in steaks treated with 2% AA and AA + PP. In addition, those steaks treated with AA and AA + PP were significantly lower in total coliforms than the control steaks. However, a significant reduction was not found in APCs for any of the treated steaks. In Study II, 3.8 cm x 2.5 cm x 2.5 cm steaks ($n=5$ /treatment) were inoculated with 1 ml of *Salmonella typhimurium* (10^5 /ml) for 2 min and then treated with 2% AA at 37°C, PP or AA + PP. The steaks then were evaluated for the presence of *Salmonella typhimurium* and APCs. Those steaks treated with PP or AA + PP had reductions ($P < .05$) of *Salmonella typhimurium*. Compared to the control steaks, those which were treated did not differ in APCs. These data support the need for both acetic acid washes and pulsed power facilities in beef plants to reduce the microflora on the surface of beef carcasses which cause foodborne illness.

Proteinase Activity in Porcine Skeletal Muscle During Protein Deprivation and Subsequent Recovery

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Regulation processes of protein degradation and synthesis determine the efficiency of protein deposition and thus meat production. However, knowledge about protein degradation of skeletal muscle is limited. An experiment was conducted to investigate the relation between proteinase activity and protein degradation of skeletal muscle during protein deprivation and a subsequent recovery period. Forty-eight barrows (about 35 kg BW at d0) were randomly divided over 3 dietary treatments: control diet (21% of ME consisted of protein; control group), protein free/carbohydrate-rich diet (PF/CH group), and protein-free/fat-rich diet (PF/F group) during 14 days. At day 14, 8 barrows in each treatment were slaughtered and 2 muscle

samples were taken: *longissimus* (L) and *masseter* (M). The remaining 8 barrows in each treatment received the control diet for another 7 days after which they were slaughtered and both muscles were sampled. Barrows were fed 2.5 times energy for maintenance during the whole experiment (twice a day). The following proteinase activities were analyzed in both muscles: calpastatin, μ - and m-calpain, and multicatalytic proteinase (MCP). During the protein deprivation period, growth rates differed between treatments ($P < .05$). During the recovery period, growth rate was similar between both PF-groups. From d14 to d17 growth rates of these groups were significantly higher than that of the control group at similar body

weight. This indicates a compensatory growth during these days of the recovery period. However, during the total recovery period, no differences were seen in growth rates between both PF-groups and the control group. Proteinase activities (units/g muscle) did not show any differences between treatments both during the protein deprivation period and recovery period. These preliminary results suggest that under the present circumstances, proteinase activity is not influenced by composition of the diet; although growth rate differed between treatments and periods. Data of skeletal muscle protein degradation and carcass composition are not yet available.