

Graduate Student Poster Competition

Interactions Among Post-Mortem Muscle Temperature, pH and Structural Damage on Beef Quality

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The effects of pH, temperature and structural damage of muscle early post-mortem on the quality of beef are confounded. A 2 x 2 x 2 factorial design was used to separate and evaluate the interaction of these factors on meat tenderness. Sixty-four *semitendinosus* muscles, excised pre-rigor from Charolais steer carcasses, were secured in a device to control muscle length and placed in a controlled environment. Muscles were subjected early post-mortem to high (HT, 31°C) or low (LT, 20°C) temperature aging, high (control) or low (electrically stimulated) pH and low (resting length) or high (extended 125% of resting length) structural damage early post-mortem. Temperature, pH, sarcomere length, HunterLAB colour reflectance, shrink, shear force, fragmentation index and solubilities of collagen and protein of the muscles were measured after 7 d aging at 2°C. Aging at HT significantly ($P < .05$) shortened sarcomeres, decreased pH and protein solubility, and increased shear force, fragmentation index and colour reflectance. Stimulation only increased sarcomere length of HT aged muscles. Extension reduced collagen solubility in HT, stimulated muscles, shear force of LT muscles and muscle shortening during aging. Colour and shear force were correlated ($P < .05$) to protein solubility, implying that colour reflectance may indicate tenderness. Stepwise multiple regression indicated that temperature accounted for 25% of shear force variation. Results suggested that structural damage due to extension should be considered because of its effect on shear force and that moderate, rather than high, carcass temperature early post-mortem may produce more tender meat.

The Use of RFLPs for Fatty Acid-Binding Protein Gene Analysis of Marbling and Subcutaneous Adipose Tissue Deposition

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A fatty acid-binding protein (FABP) cDNA was used to identify restriction fragment length polymorphisms (RFLPs) in bovine DNA. FABP activity has been demonstrated in a number of bovine tissues, including adipose tissue, heart and

skeletal muscle and is related to the ability of those tissues to metabolize lipids. Blood was collected in the abattoir from purebred Brahman ($n = 14$) and Hereford steers ($n = 17$) and crosses, Brahman x Hereford ($n = 13$) and Hereford x Brahman ($n = 14$). DNA was extracted from leukocytes, which were isolated from the blood following lysis of the erythrocytes. DNA digested with *Pvu* II was separated by electrophoresis on 1% agarose gels and transferred to Zeta-Probe® nylon membranes. The pBR322 plasmid containing the murine adipocyte pAL422 FABP sequence was labeled with ^{32}P -dCTP and used for all hybridizations. After hybridization, filters were exposed to X-ray film with intensifying screens for 4 to 10 days. Analysis of the resulting autoradiograms confirmed the hybridization of the labeled pAL422 probe to several discrete bands within the DNA of all cattle tested. RFLPs were evident for the FABP gene both within breeds and across breeds. The *Pvu* II digests exhibited polymorphisms in the 4.4, 6.6 and 23 kb regions. Other, less pronounced RFLPs also were apparent in the DNA digest. Crossbred cattle exhibited more (4-7 sites) endonuclease sites than purebred cattle (3-5 sites). Thus, the use of the murine adipocyte pAL422 has demonstrated RFLPs for the FABP gene family in cattle, which may be associated with differences in lipid metabolism observed between breeds.

Evaluation of Attributes that Affect Longissimus Muscle Tenderness in *Bos taurus* and *Bos indicus* Cattle

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An investigation to biologically explain tenderness differences of *longissimus dorsi* (LD) muscles between *Bos indicus* and *Bos taurus* breeds was conducted. Approximately equal numbers of steers and heifers of Hereford x Angus (HxA, $n = 10$), 3/8 Sahiwal x H, A or HxA (3/8 SAH, $n = 6$) and 5/8 Sahiwal x H, A or HxA (5/8 SAH, $n = 11$) crosses were utilized. Samples were obtained within 1 h and at 24 h post-mortem from the LD for calcium dependent protease (CDP) -I and -II and CDP inhibitor (INH) activity determinations. At d 1 and d 14 post-mortem, LD samples were removed for determining cathepsin B and B + L activity, soluble and total collagen, shear-force, sensory panel evaluation, sarcomere length and fiber histochemistry. Data were analyzed using least-squares procedures with fixed effects of breed, sex and their interaction. No significant breed effects were observed

for carcass traits and rates of pH and temperature decline. HxA steaks had lower ($P < .05$) shear-force values and higher ($P < .05$) sensory scores for tenderness at 1 and 14 d post-mortem. Correspondingly, 5/8 SAH had lower ($P < .05$) myofibrillar fragmentation indices at 1, 3, 7 and 14 d post-mortem than HxA. Breed effects were not significant for sarcomere length, percentage fiber type, percentage-area of fibers, soluble and total collagen at d 1 and d 14, cathepsin B and B+L specific activity at 1 and 14 d, CDP-I and -II activity at 0 and 24 h post-mortem, and INH activity at 0 h post-mortem. However, INH total activity/100 g of muscle was higher ($P < .05$) at 24 h post-mortem for 5/8 SAH (208.8 ± 14.8) and 3/8 SAH (195.6 ± 19.3) than for HxA (136.3 ± 14.9). For HxA, SDS-PAGE revealed that by d 1 desmin had been subjected to proteolysis and by 14 d desmin could not be detected but a 30,000-dalton component was clearly evident. However, in 5/8 SAH, desmin remained visible at d 14 without a 30,000 dalton component appearing. This reduced protein hydrolysis may account for less tender meat in SAH, and INH apparently influences this process.

Myofibrillar Solubilization and the Calcium Dependent Protease System in Post-Mortem Beef Tenderization

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Ten each, fullblood Hereford and American Grey Brahman steers were fed a typical feedlot diet and slaughtered when ultrasound measurements indicated that they had approximately 1 cm of fat thickness at the 12th rib. *Longissimus* muscle samples were taken at 10 min. post-exsanguination (0 d), and at 1, 7 and 14 d post-mortem (PM) for determination of the effect of ionic strength on myofibrillar protein solubilization, and at 0 and 1 d PM for determination of calcium dependent proteases (CDP I and II) and CDP inhibitor activities. Sensory evaluations were made after 7, 14, 21, 28 or 35 d PM aging. *Longissimus* muscle from Brahman cattle was less ($P < .05$) tender than that from Hereford cattle after 7, 14, 21 or 28 d PM aging, but not different after 35 d PM aging. Myofibrillar protein solubility was higher ($P < .05$) at .3 than .1 M ionic strength regardless of breed or time PM. At 1 d PM, myofibrillar proteins from Brahman *longissimus* muscle solubilized more readily ($P < .05$) at .1 M ionic strength and .3 M ionic strength than did Hereford myofibrillar proteins and less readily ($P < .05$) at 7 d PM. At optimum conditions for enzyme activity (pH 7.5, 25°C), immediately PM Brahman *longissimus* muscle had significantly lower CDP I activity and higher CDP inhibitor activity than did Hereford muscle. At muscle conditions measured immediately PM (pH 6.8 and 39°C), a similar effect was found for CDP I, although all activities were lower ($P < .05$) at muscle conditions than at optimal conditions. At 1 d PM, there were no differences ($P > .05$) in any component of the CDP system due to breed or assay conditions. SDS-PAGE indicated that the 30 kD protein was much more apparent from 1 d Hereford muscle than from 1 d Brahman muscle. Transmission elec-

tron microscopy indicated more frequent myofibril tearing at the Z-line in Hereford muscle. These data suggest that the mechanisms responsible for the initial toughness and slower aging response of meat from Brahman steers may include CDP I and CDP inhibitor activities and the effect of PM muscle ionic strength on myofibrillar solubilization.

Effects of Exogenous Somatotropin on the Distribution of Untrimmed and Trimmed Wholesale Cuts and on the Proportions of Separable Lean and Fat Within Trimmed Wholesale Cuts of Pork

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Twenty-two barrows were injected daily with 0, 50, 100, 150, or 200 μg somatotropin (ST) per kg body weight from 30 kg live weight until slaughtered at approximately 90 kg live weight. The proportion of the chilled carcass as untrimmed or trimmed ham, loin, picnic and spareribs were significantly ($P < .05$) increased in response to ST. Conversely, the proportion of untrimmed and trimmed jowl decreased ($P < .05$) while the proportion of belly and butt tended to decrease. Moreover, the trimmed ham, loin, picnic and butt were found to contain up to 16% more separable lean ($P < .05$) and as much as 60% less separable fat ($P < .05$) in response to ST. The belly showed a similar trend ($P > .05$). In summary, ST increased the proportion of the chilled pork carcass as ham, loin and picnic and increased the separable lean percentage while decreasing the separable fat percentage in the 4 lean cuts.

Effects of Cimaterol on Preweaning Lamb Growth and Composition of Gain

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Objectives were to determine if 21-day administration of cimaterol alters growth performance or composition of gain in milk-fed lambs. Thirty-two Finn-Dorset ram lambs 10 days of age were randomly assigned to one of three treatment groups: 1) baseline slaughter group; 2) milk replacer only, or 3) milk replacer plus cimaterol at 200 $\mu\text{g}/\text{kg}$ body weight per day. Cimaterol did not alter daily gain (380 vs 390 $\text{g}\cdot\text{d}^{-1}$ for controls) or feed conversion (.95 $\text{kg DM}\cdot\text{kg}^{-1}$ body weight gain vs .98 $\text{kg DM}\cdot\text{kg}^{-1}$ for controls). Carcass weight and dressing percentage were unaltered. Kidney and pelvic fat was reduced 30% ($P < .01$) and ommental fat was reduced 22% ($P < .05$) with cimaterol. Cimaterol did not increase *biceps femoris*, *semitendinosus* or *longissimus* muscle mass, but they were larger ($P < .05$) when expressed as a percentage of carcass weight. Cimaterol did not alter protein gain (47 vs 42 $\text{g}\cdot\text{d}^{-1}$ in controls), water gain (187 vs 177 $\text{g}\cdot\text{d}^{-1}$) or lipid gain (93 vs 112 $\text{g}\cdot\text{d}^{-1}$) (all $P < .1$).

Influence of Sarcomere Length on the Binding of Fluorescent Myosin Heads and α -actinin to Bovine Myofibrils

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The degree of post-mortem muscle shortening strongly affects meat tenderness, but the reason for its influence remains obscure. We have examined myofibrillar structure over a range of sarcomere lengths, taking advantage of the high affinity of the myosin head (subfragment-1, S1) for actin and of α -actinin for the Z-line. Bovine myofibrils were incubated with fluorescent conjugates of S1 and α -actinin and the binding sites were located by epifluorescence microscopy. At sarcomere lengths greater than 2.6 μ m, S1 bound to actin throughout the myofibril except at the Z-line, whereas α -actinin bound solely to the Z-line. Most of the S1 was bound to the I-band, but binding was also observed in the actin-myosin overlap region, where actin was not saturated with the myosin heads of the myofibril. At lengths of 2.0-2.6 μ m more S1 was observed in the center of the A-band, and there was a decrease in the I-band width with a concomitant decrease in the width of the S1 binding in this region. At still shorter lengths, the width of the S1 binding in the A-band increased. The pseudo-H-zone showed more intense binding than the flanking A-band regions due to the overlap of opposing thin filaments in a region of the myofibril which is devoid of myofibrillar myosin heads. Phase-contrast micrographs are difficult to interpret in sarcomeres of less than 2.0 μ m, so the fluorescence technique is particularly suitable for study in the sarcomere-length range associated with toughness.

Relationship Between Pyridinoline Concentration and Thermal Stability of Bovine Intramuscular Collagen

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Semimembranosus muscle collagen (IMC) from 49 Holstein beef animals, representing all maturities (A-E), was evaluated in powdered muscle for heat labile collagen solubility (% Sol) and isolated in the frozen state for determination of thermal shrinkage temperature (T_s), enthalpy (H_s) changes and mature crosslink (pyridinoline) content. These measures were obtained to elucidate a relationship between pyridinoline content of IMC and beef maturity as well as relate IMC thermal stability (% Sol, T_s , and H_s) to pyridinoline content. With increasing maturity, % Sol decreased ($P < 0.01$) and T_s increased ($P < 0.01$), whereas H_s showed no change. Thus, IMC melted at increasing temperatures but the amount of energy required to induce this endothermic change re-

mained constant throughout maturation. The pyridinoline content of IMC increased ($P < 0.01$) linearly with maturity, indicating this heat-stable mature crosslink enhances thermal stability of IMC as beef muscle matures. Strong correlations between pyridinoline content and maturity ($r = .56$, $P < 0.001$) and between the former and T_s ($r = .34$, $P < 0.05$) also support this contention.

Effects of External Fat Trim, Bone Removal and Endpoint Cooking Temperature on Composition and Tenderness of Pork Center Loin Roasts and Chops

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The effects of external fat trim, bone removal and endpoint cooking temperature on fat, protein, moisture, cholesterol, iron and tenderness of pork center loin roasts and chops were investigated. Ninety-six center loin roasts were prepared for a 2 x 2 x 4 factorial design [bone-in (B) or boneless (NB); .6 cm external fat (F) or total trim (NF); and roasting endpoints of 65.6, 71.1, 76.7 or 82.2°C]. Fifty-six center loin chops were prepared for a 2 x 2 x 2 factorial design (B or NB; F or NF; and broiling endpoints of 71.1 or 76.7°C). Broiled NB chops contained a higher ($P < .05$) percentage of fat and were more ($P < .01$) tender than B chops. Boneless roasts were more ($P < .05$) tender than B roasts, but did not contain more fat. Total trim roasts had lower ($P < .05$) protein and fat percentages and higher ($P < .05$) percent moisture than F roasts. There were no differences in protein, fat or moisture percentages in chops due to external fat trim. Higher internal temperature significantly decreased percent moisture and increased protein percentage of roasts and chops and increased percent fat of roasts. Fat percentage of chops was not altered ($P > .10$) by internal temperature. Cholesterol and iron contents of broiled chops were not affected ($P > .10$) by the presence or absence of bone or external fat or by internal temperature. Boneless roasts contained 6% more ($P < .05$) cholesterol and 11% more ($P < .05$) iron than B roasts. Level of external fat trim had a greater effect on composition of cooked roasts than on broiled chops.

The Evaluation of a Streamlined Processing Procedure for Beef Carcasses

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New fabrication techniques must be developed to maximize the economic potential of the chuck, while meeting

consumer demands for little or no plate waste. The purpose of this study was to develop a system for efficient fabrication of muscles from the beef chuck and thin cuts, while permitting quality grading of the high value middle meats. Twenty steers were slaughtered and alternating carcass sides were assigned to a control (CL) and streamlined (SL) treatment. All carcasses were low-voltage electrically stimulated; additionally, SL sides were high-voltage stimulated and fabricated when loin pH reached 5.8. Prior to chilling, streamlined sides were trimmed of subcutaneous fat in excess of .7 cm, then muscles of the chuck, plate and flank were boned and denuded. The SL pistola hinds and the CL sides were quality graded 24 h post-mortem. Pistola hinds were immediately fabricated, whereas CL sides were fabricated similar to SL sides at 48 h post-mortem. *Triceps brachii* (TB), deep *pectoral* (DP) and IMPS 189A, 112A, 180 and 168 were packaged and stored for 21, 21, 7, 14, 28 and 56d, respectively. Total lean yield did not differ between treatments ($P < .05$). The SL sides had whiter fat ($P < .01$) and softer lean ($P < .05$) than CL sides, but there were no treatment differences in other grade factors. The TB and DP muscles from SL sides were darker in lean color during primal and retail evaluation ($P < .01$) than corresponding CL cuts, and CL 112A and DP samples were more normally shaped ($P < .01$). The SL treatment did not affect sensory scores ($P < .05$). The SL treated TB and DP samples had shorter sarcomere lengths ($P < .05$), yet lower Warner-Bratzler shear values ($P < .05$), than their CL counterparts. Treatment did not affect tenderness of other cuts. The SL pistola hinds required 35% less BTU to chill than CL sides, and mean streamlining time was 33% faster for SL than for CL sides.

Physical and Sensory Characteristics of Sarcoplasmic Protein-Extracted Utility Beef

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The abundance of cows culled from herds and sent to market creates opportunities for new product development, yet products from Utility grade beef are often considered darker in color, less tender, less juicy and possess an intense flavor and aroma. The purpose of this study was to address the problems inherent to restructured Utility grade beef with the development of a product with acceptable color, adequate texture and acceptable fat source. Major muscles were removed from the chucks of Utility grade carcasses and denuded 24 h post-slaughter. Ground lean (2.5 x 5.1 cm 3-hole kidney plate, 1.9 cm or 1.3 cm round hole plate) was mixed with equal weight of deionized water and drained for sarcoplasmic protein extraction (SE). Ten percent water was added to non-extracted (NE) lean. SE and NE were mixed with a fat source (edible fat from Choice carcasses (CF) or Utility carcasses (UF)), .75% sodium chloride and .25% sodium tripolyphosphate. The SE treatment was higher ($P < .05$) in moisture content compared to NE treatment only

at the smallest particle size. The protein content of the SE treatment was lower ($P < .05$) than the NE treatment at each particle size. In the raw state, TBA values were not different ($P < .05$) between SE and NE treatments containing CF. However, raw SE steaks containing UF had lower ($P < .05$) TBA values compared to NE steaks. Cooked NE steaks had significantly higher TBA values than SE steaks when formulated with CF. Color analysis indicated SE steaks were higher ($P < .05$) in "L" (lightness) and "b" (yellowness) values and lower ($P < .05$) in "a" (redness) values compared to NE steaks. Sensory evaluation indicated the cooked NE steaks possessed a more intense beef flavor ($P < .05$) compared to SE steaks. Kramer shear force values showed the SE treatment of the smallest particle size was more tender ($P < .05$) than NE.

Evaluation of Electromagnetic Scanning in Predicting Pork Carcass Composition and Primal Cut Yield

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The accuracy of electromagnetic scanning for estimating composition and yield of primal cuts was studied on carcasses from 122 pigs, 85-140 kg live weight. Warm carcass weight, length and temperature were measured prior to scanning. Conductivity was measured with an AgMed, Inc. HA-2 scanner, at 64 equidistant intervals, providing an asymmetric bell shaped curve. The curve peaks when maximum lean mass is in the electromagnetic field. The height and area of curve segments were analyzed to determine relationships to various carcass components. After an overnight chill, right sides and cuts were dissected into lean, fat, bone and skin. Regression equations were developed for predicting 10% fat-standardized lean (kg) within ham ($R^2 .91$, RSD .25), loin ($R^2 .80$, RSD .29), shoulder ($R^2 .89$, RSD .22) and total carcass ($R^2 .91$, RSD 1.47); and for predicting weight (kg) of ham ($R^2 .88$, RSD .30), loin ($R^2 .75$, RSD .37) and shoulder ($R^2 .89$, RSD .24). Results suggest that electromagnetic scanning accurately estimates total carcass lean as well as yield and composition of carcass primal cuts. This technology may have application in determining total carcass value.

The Prediction of Pork Carcass Composition

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Determination of percent chemical fat in pork carcasses is costly and time consuming, as well as being very detrimental to the retail value of the product. In an attempt to find an easy

and economical method of determining percent fat and protein in pork carcasses, 47 market weight pigs were slaughtered and the right half was analyzed for carcass composition. Selected weights, measurements and specific gravity measurements were taken on the left side to evaluate their value as indicators of carcass composition. The hams and 8-9-10 rib loin sections were removed from the left side of each carcass and dissected into subcutaneous fat, seam fat, individual muscles, skin and bone. Weights were taken and chemical analysis was performed. Percent chemical fat and protein of each ham, loin section and carcass was determined and correlated with the weights and measurements taken. Stepwise regression was used to formulate prediction equations. The single best indicator of percent chemical fat or protein in the pork carcass was specific gravity of the carcass half and the resulting equations had an R^2 value of .64 and .73 for predicting fat and protein, respectively. The best ($R^2 = .67$ and $.56$, respectively) equation for predicting fat and protein in the carcass using carcass measurements included 10th rib fat thickness and marbling. The ham and loin section proved to be much more troublesome and less accurate for use as predictors of pork carcass composition.

Acceptability of Bacon as Influenced by the Feeding of Elevated Levels of Monounsaturated Fats to Growing-Finishing Swine

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Sixty barrows and gilts were assigned to one of five dietary treatments consisting of a control diet of corn and soybean meal and four similar test diets that contained a 10% replacement of either animal fat, safflower oil, sunflower oil or canola oil in order to determine the effects of high levels of oleic acid in the diet on the processing, visual and sensory characteristics of pork bellies and bacon. Slicing yields and sensory scores for overall palatability and flavor quality were lower for the canola oil treatment than for all other treatments ($P < .05$). A higher percentage of panelists detected off-flavors in the canola oil treatment than in all other treatments ($P < .05$). The off-flavor of the canola oil treatment was verified by capillary volatile profile analysis and is directly attributable to the linolenic acid content of canola oil. The oleic acid content of the sunflower oil treatment was 15.4% higher than the control while the amount of polyunsaturated fat was only 1.0% higher. Canola oil resulted in a higher percentage of slice breakage than all other treatments, whereas the control diet exhibited the whitest fat color ($P < .05$). Consumer panel scores for visual and eating quality were highest in the control and the safflower oil treatment. Results indicated that feeding 10% canola oil to swine produced bacon that was unacceptable in all sensory, physical and yield parameters, but both sunflower and safflower oils produced bacon of high quality and acceptability.

The Effect of Salt, pH, Soy Protein and/or Carrageenan on Low-Fat Frankfurters

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Seventeen batches of beef frankfurters were made ranging from 5 to 30% fat, 0.5 to 3.0% salt, and pH 4.5 to 7.5 arranged in a central composite design. Twenty-four additional batches of frankfurters were made with fat levels of 12 and 18%, salt levels of 1.3 and 2.0% and either soy protein levels of 1.3 and 3.0% or carrageenan levels of 0, 0.2 and 0.4% arranged in two $2 \times 2 \times 3$ factorial designs. Sensory evaluation was performed by a six-member, trained taste panel using a 15 cm unstructured scale with descriptive anchors at either end of the scale. Instron texture profile analysis and Warner-Bratzler shear force determinations were performed on all samples. Data was analyzed using response surface techniques. Results from this study indicate that frankfurters with acceptable sensory characteristics can be made with 12% fat and 1.3% salt at pH 6.0. The addition of either soy protein or carrageenan to frankfurters increased both sensory and Instron hardness values at low (1.3%) salt levels, decreased moisture and increased off-flavor intensity under all test conditions.

Influence of Protein Composition on Meat By-product Functionality in Model System Frankfurters

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Information on the functional properties of byproduct proteins is limited. The objective of this study was to develop a knowledge base of meat by-product composition and functionality in a model frankfurter system. Frozen mechanically deboned chicken meat (MDCM) and by-products (pork lung lobes, pork liver, beef lung lobes, beef spleen, beef heart) were studied. MDCM and by-products varied in their proximate composition, amount of the three major protein fractions (low ionic strength soluble, salt soluble, insoluble) and collagen content. Frankfurter reheat yield was positively correlated with the quantity of salt soluble proteins ($r = 0.78$) and the percentage myosin ($r = 0.64$) and actin ($r = .79$) in the salt soluble protein fraction. Stress and strain at failure were inversely correlated to the amount of low ionic strength soluble proteins ($r = -0.85$ and -0.82 , respectively) and positively correlated with the percentage of myosin and actin in the by-products ($r = 0.80$ and 0.61 , respectively). Quantity of insoluble protein in the meat by-products was not strongly correlated with any parameters measured. The distribution of protein fractions in meat by-products was related to the bind and texture imparted to a comminuted meat product.

The Effects of Cimaterol and Its Withdrawal on Muscle and Carcass Characteristics of Broiler Chickens

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The objectives of this study were to examine the effects of Cimaterol (CIM) and its withdrawal on muscle and carcass characteristics of broiler chickens. Three-week old broiler chickens were randomly assigned to one of nine treatments (TRT). Treatments were *ad libitum* fed a control (CON) diet (0ppm CIM) or a diet containing CIM (1ppm). Six TRT consisted of birds fed CON or CIM for 2, 3, or 4 wk prior to slaughter. Two TRT were fed CIM 2 wk, followed by the CON diet for 1 or 2 wk before slaughter. The final TRT was fed CIM 3 wk, followed by the CON diet for 1 wk before slaughter. Birds (12/TRT) were measured for breast, leg and whole body composition (fat, moisture, and protein), breast and leg cathepsin B+L activity, and breast muscle shear force values (SFV). Fractional synthesis rates (FSR) were measured (6/TRT) in the breast and leg muscle. Dietary TRT were compared within age groups (5, 6 and 7 wk of age at slaughter) using single degree of freedom contrasts. The percentage of body wt as leg was elevated by CIM feeding at 5, 6 and 7 wk and breast percentage was greater at 5 wk. Reduced fat content was found in leg muscles at 5 and ($P < .05$) 6 wk in CIM-fed birds when compared to CON-fed birds. Withdrawal from CIM increased leg and breast fatness above birds continuously fed CIM. Whole body fat did not differ ($P > .05$). Feeding CIM elevated protein content of the leg at 6 and 7 wk, increased protein in the breast at 5 and 7 wk, and improved protein content of the whole body at 5 wk of age. Withdrawal from CIM removed these differences in protein content ($P > .05$). Breast muscle SFV was higher in 6 and 7 wk CIM-fed birds ($P < .05$). Withdrawal from CIM for 1 wk at 5 and 6 wk lowered SFV of the breast when compared to CIM-fed birds ($P < .05$). No differences ($P > .05$) were found in total cathepsin B+L activity or FSR in the breast and leg. Results of this study suggest that birds fed CIM have increased muscle protein accretion, decreased fat deposition, and heavier muscle wt as a percentage of whole body wt. Also, CIM-fed birds have reduced meat tenderness. Withdrawal from CIM minimizes these differences.

Functionality of Dry-Cured Ham Proteins

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The *semimembranosus* of 100 d dry-cured hams and fresh hams was removed, ground twice through a 3.1 mm

plate and thoroughly mixed. Three extractions were performed using: 1) 0 M NaCl; 2) 0.3 M NaCl; or 3) 0.6 M NaCl. Solutions also contained 0.01 M NaH_2PO_4 , 1mM MgCl_2 and 0.02% sodium azide. Twenty grams of DC or FR muscle was blended (15 sec. 4°C) with 150 ml of the appropriate solution, held for 1 h and centrifuged (15 min @ 10,000 x g). Supernatant was analyzed for protein content, emulsion capacity and water-binding. DC salt levels of approximately 5.0% increase the actual salt concentrations of DC extractions to 0.19, 0.49 and 0.79 molar. As salt concentration increased above 0.49M, FR protein was more soluble than DC protein appears to begin salting out. Emulsion capacity was higher for FR than DC at all NaCl concentrations and thick, creamy emulsions were never fully formed by any DC protein extracts. FR water binding was superior to DC at NaCl concentrations above 0.3 M while none of the heated DC extracts formed continuous phase gels. These data indicate that the functionality of DC proteins have been severely reduced.

The Effect of Five Chloride Salts on the Stability, Texture and Microstructure of Poultry Batters

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The stability, texture and microstructure of six mechanically deboned chicken meat batters were examined. Five isoionic strength batters were made with 2.5% NaCl, MgCl_2 , CaCl_2 , KCl and LiCl; the other contained 1.5% NaCl. The MgCl_2 batter showed the poorest fat binding in the uncooked state. The monovalent salts produced stable cooked batters whereas both divalent salts did not. CaCl_2 produced a less stable batter than MgCl_2 . High correlations ($P < .01$) were found between water, fat and total cook-out losses from cooked batters. Texture was significantly affected by the salt used. The divalent chloride salt batters had similar textures but were different from the more stable monovalent chloride salt batters. Textural differences were also found between monovalent chloride salt batters. Cohesiveness was inversely correlated to fat loss prior to cooking ($P < .05$), and springiness to liquid loss during cooking ($P < .01$). Springiness was related to pH ($P < .05$) and hardness to total cook-out losses ($P < .05$). Scanning and Transmission Electron Microscopy revealed microstructural differences between treatments resulting from differences in the stability of the protein film around fat globules and protein matrix structure. The protein matrices of the monovalent chloride salt batters were similar except LiCl, which produced a more tightly interwoven matrix. Extensive coalescence which resulted in the formation of fat channels was evident in the batters made with MgCl_2 and CaCl_2 . In addition, their protein matrices were highly aggregated. Batter stability and texture appeared to depend on matrix structure and integrity as well as the formation of a stable protein film around fat globules.

Effect of PSE Pork and Non-Meat Proteins on Muscle Protein Gels

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Thermally induced gels were made of extracted salt-soluble proteins from normal hogs and stress susceptible hogs determined to be PSE. Effects of protein concentration (23, 34, 48 and 54 mg/mL), heating rates (17, 39 and 93° C/hr) and addition of non-meat binders (2% soy protein isolate and 2% sodium caseinate) were evaluated. Gel strength of PSE extracts was 45% of the controls at equivalent protein concentration. Gel strength of control and PSE-muscle protein gels increased with increasing protein concentrations at all heating rates; however, gel strength was greater for slow heating rates than for fast heating rates. Percent of water loss decreased with higher protein concentration. There was no heating rate effect for water loss in both cases. Protein loss was lower at low salt-soluble protein concentrations than at high protein content in the range studied for both PSE and control. Slow heating rates resulted in lower protein loss while faster heating rates gave higher protein losses in the exuded water. Gel strength from PSE samples containing soy protein isolate was the same as PSE control, 3.1 N/cm², when sodium caseinate was added gel strength decreased to 2.8 N/cm². Percent water loss for PSE extracts was less when sodium caseinate was used (39%), intermediate for soy isolate (52%) and highest for the PSE control (57%). Protein loss for PSE extracts was least for the PSE control (3.6 mg/mL), intermediate for soy isolate (5.1 mg/mL) and highest for sodium caseinate (10.2 mg/mL).

Methods of Sodium Tripolyphosphate Addition in Preblended Fine-Chopped and Coarse-Ground Sausages

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Methods of sodium tripolyphosphate (STPP) application to sausage preblends were investigated with fine-chopped and coarse-ground pork sausages. Lean pork trim and fat pork trim were preblended and held for 20 hr prior to further sausage production. Treatments included the addition of STPP to the 80% lean pork preblend, STPP to the 50% lean pork preblend, STPP to both the 80% and 50% lean pork preblend, STPP added during final batching, and a control with no STPP used in either preblend. Preblends with STPP were higher in pH than the control; however, there were no differences in the ultimate raw sausage pH among STPP treatments. Neither STPP nor its method of application to preblends caused improvement of processing or final product characteristics of fine-chopped sausages. With coarse-ground sausages, preblending with STPP improved processing yield and final product characteristics of fat, texture and consumer cookout. Links from the STPP added to the 80% lean pork preblend treatment of coarse-ground sausages were the firmest, had greatest final product moisture and fat, while having the least amount of consumer cookout. Generally, there were no differences in oxidative rancidity among any of the treatments for fine-chopped or coarse-ground products during a six-week test period. Therefore, STPP added to preblends for coarse-ground sausage manufacture improves production and product characteristics, while no improvements were observed with fine-chopped sausages.