

# Graduate Student Research Poster Competition

## M.S. DIVISION

### Effects of pH and Water Activity on the Shelf Stability of Beef Snack Sticks.

T.L. Harbolt, L.W. Hand, H.G. Dolezal, F.K. Ray,  
J.B. Morgan, J.L. Briggs, M.J. Richardson, M.B. Solomon  
Oklahoma State University  
104 Animal Science, Stillwater, OK 74078

Beef stick products are convenient snack foods that can be utilized where cold storage conditions are not available. Therefore, the objective of this research was to develop an acceptable beef stick that will maintain microbial integrity, sensory qualities and textural properties for three years at 26.5°C. Fermented beef sticks (rep = 3) were manufactured in a 3x3 factorial arrangement of pH (4.5, 4.7, 4.9) and water activity ( $a_w$ ) levels (.85, .87, .89), with a control (pH 5.1,  $a_w$  .91), using bottom rounds. After mixing, each batch was reground, stuffed, fermented and cooked to 60°C, and dried until the desired water activities were reached. Treatments were packaged and then analyzed for pH,  $a_w$ , texture and total plate count. Shelf life was accelerated by incubating for one month at 48.8°C. The shelf life study was performed on one replication per month and sampled on a weekly basis (d 0, 7, 14, 21, 28) for pH,  $a_w$ , sensory properties, texture analysis and aerobic plate counts. A trained sensory panel (n = 10) was provided samples from day 0, 14 and 28 and assigned scores for acidity, mouthfeel, texture and juiciness using a 10 cm unstructured line scale ranging from desirable to undesirable. Ultimate pH values tended to be higher than their target pH values (4.5 = 4.74, 4.7 = 4.87, 4.9 = 5.12 and 5.1 = 5.29 for target versus actual pH respectively). However, differences were evident ( $P < 0.05$ ) between adjacent pH groups. Actual  $a_w$  values were similar to their targeted  $a_w$  (.85 = .852, .87 = .872, .89 = .886 and .91 = .894 target versus actual  $a_w$ , respectively). Total aerobic plate counts appeared to be more highly influenced by pH than  $a_w$ . Plate counts for all treatments decreased over time ( $P < 0.05$ ). Control beef sticks (pH 5.1) had higher bacterial counts from day 0 to day 21 ( $P < 0.05$ ) as compared to the treatment group of pH 4.5. Analysis of the sensory texture values as well as the mechanical punch and die measurements indicated a decrease in firmness as storage time increased ( $P < 0.05$ ). A positive correlation ( $r = .71$ ;  $P < 0.05$ ) was observed between the sensory panel and the punch and die firmness values. Water activity tended to be the influ-

encing factor on firmness values. Over storage time, beef stick treatments with lower  $a_w$  (.85) maintained greater product firmness ( $P < 0.05$ ) than high  $a_w$  treatments (.89, .91). Results indicated a pH of 4.5 and  $a_w$  of .85 produce beef sticks having low bacterial counts and highest sensory ratings for texture, juiciness and mouthfeel.

### Determination of the Optimal Level of Rumen Escape Protein Supplementation for Maximum Efficiency and Rate of Protein Deposition in Growing Lambs.

O.H. Cheng, D.H. Beermann, T.F. Robinson,  
K.D. Finnerty, K. Weingardt, A.P. Moloney, D.E. Hogue  
Cornell University  
B53 Morrison Hall, Animal Science, Cornell University  
Ithaca, NY 14853-4801

Twelve Suffolk-sired ram lambs weighing  $21 \pm 2.7$  kg were used to determine the effects of incorporation of increasing amounts of rumen-escape protein, as fishmeal, on nitrogen (N) metabolism and efficiency of N use for growth. An incomplete Latin Square design was used in which half of the lambs were randomly assigned to receive three of the six treatments (n=6 per treatment), which consisted of the presence of 0, 2, 4, 6, 8 and 10% fishmeal in complete, mixed isonitrogenous diets. Diets were formulated to contain approximately 85% concentrates and 15% ground hay and approximately 16% crude protein and 3.4 MCal digestible energy/kg. Treatment periods lasted 14 days, d1 to d7 for adjustment to the diet, and d8 to d14 for sample collection. Amount of fishmeal in the diet did not influence dry matter intake or digestibility, N digestibility, or fecal N excretion. However, urinary N excretion decreased and N balance (retention) increased with increasing amounts of fishmeal up to 8% (both  $P < 0.05$ ). Efficiency of N use for growth was similarly increased to a maximum when diets contained 8% fishmeal. It is concluded that mass and or amino acid composition of absorbed N is improved with incremental substitution of fishmeal for an equal amount of soy plus corn protein, to accommodate provision of amino acid supply or availability to better match tissue requirements in growing lambs.

## Low-fat, High Added-Water Frankfurters: Effects of Connective Tissue/Acidic Phosphate Preblends.

C.M. Calhoun, S.J. Eilert, R.W. Mandigo  
University of Nebraska-Lincoln  
Animal Science Department, P.O. Box 830908, UNL  
Lincoln, NE 68583-0908

Preblending modified connective tissue with concentrated amounts of an acidic, specially processed sodium pyrophosphate may alter modified connective tissue characteristics and improve the quality of the product in which it is incorporated. Frankfurters were formulated at two USDA fat/added water (AW) levels: 30% fat/10% AW and 10% fat/25% AW. Each formulation was manufactured according to one of four modified connective tissue treatments: 1) no phosphate, no modified connective tissue (CONT); 2) modified connective tissue added alone (CT); 3) acidic phosphate and modified connective tissue preblended (PB); or 4) acidic phosphate and modified connective tissue preblended + alkaline phosphate (ALK). The experimental design was a randomized complete block, replicated three times. Treatment had no effect ( $P>0.05$ ) on hardness, chewiness, springiness or consumer acceptability. The PB treatments had the lowest emulsion stability and smokehouse yields ( $P<0.01$ ). Addition of alkaline phosphate improved smokehouse yields to the level of CONT and significantly increased emulsion stability. Purge was lowest ( $P<0.05$ ) for the CT treatment, and preblended treatments did not differ from CONT. Preblending did not affect collagen solubility ( $P>0.05$ ). The ALK treatment had the lowest cured color intensity. Color of the 10% fat/25% AW formulations improved during storage. Preblending modified connective tissue with this acidic phosphate provided few advantages to frankfurter quality. Preblending, with subsequent addition of alkaline phosphate, created a product similar to the control. Preblending may facilitate processing schedules and aids in handling modified connective tissue. Utilization of connective tissue improves profitability of desinewing operations generating this by-product.

## Physiological and Sensory Characteristics of Sheep Expressing the Callipyge Phenotype.

C.R. Kerth, S.P. Jackson, C.B. Ramsey, M.F. Miller  
Texas Tech University  
PO Box 42162, Lubbock, TX 79409-2162

Sixteen callipyge (CAL) and normal (NOR) crossbred wethers were slaughtered at 59-kg to evaluate histological and sensory characteristics of the supraspinatus (SU), longissimus (LM), and semitendinosus (ST) muscles. Sarcoplasmic protein ( $P = .009$ ), calpastatin ( $P = .0001$ ), and m-calpain ( $P = .0001$ ) levels were higher in wethers expressing the CAL

phenotype compared to the NOR. Sarcomere lengths in the SU ( $2.1 \mu\text{m}$ ) were longer than those in the LM ( $1.6 \mu\text{m}$ ), but shorter than those in the ST ( $2.7 \mu\text{m}$ ,  $P<0.05$ ). Initial and sustained juiciness scores given by the trained sensory panel were higher ( $P<0.05$ ) for NOR chops than for CAL chops from both the ST and LM. Initial and sustained tenderness scores were higher for NOR LM chops ( $P<0.05$ ) and lower for CAL LM chops compared to either phenotype within the ST or SU. Overall mouthfeel was scored .4 unit higher for NOR than for CAL phenotype wethers ( $P = .05$ ). CAL LM chops sheared 5.5 kg, almost twice as high as any other muscle of either phenotype. More ( $P = .01$ ) NOR LM and SU chops (91 and 93%) were rated acceptable for juiciness compared to CAL LM and SU chops (73 and 79%). Consumers rated 28% more NOR LM chops acceptable than CAL SU chops ( $P = .0001$ ). Nine percent fewer CAL SU chops were rated acceptable for flavor than NOR LM chops (97 vs. 88%,  $P<0.05$ ). Overall acceptability of ST chops was not different between phenotypes, but NOR LM and SU chops were more acceptable (92 and 96%) compared to CAL chops (79 and 81%). These data show that the CAL genotype adversely affected histological and sensory characteristics of loin muscles while limited effects were found in the muscles of the leg and shoulder.

## Determining Consumer Acceptability Levels for Beef Tenderness in the Home and Restaurant Dining Environments.

K.L. Huffman, M.F. Miller, L.C. Hoover,  
K.C. Wu, H.C. Brittin  
Texas Tech University  
PO Box 42162, Lubbock, TX 79409

Retailers and restaurateurs put a high value on beef tenderness and rate it a top concern. Establishing a tenderness acceptability level for consumer markets could lead to more focused marketing efforts and higher customer satisfaction. The purpose of this study was to determine consumer tenderness acceptability levels for beef steaks consumed in the home and a restaurant. Loin steaks were eaten by 67 consumers over a 14-week period ( $n = 739$  consumer observations). The acceptability levels for tenderness were established based on Warner-Bratzler Shear (WBS) force values, tenderness ratings, and judgment of tenderness and overall acceptability by consumers. Mean WBS values for each point on the tenderness scale showed that as WBS value decreased, the tenderness score generally tended to increase (indicating more tenderness). This suggests that consumers were able to detect changes in tenderness levels similar to instrumental measurement. Results based on WBS values and acceptability percentages at each tenderness rating indicate that the beef industry should target production of beef steaks that have a WBS force value of 4.1 kg or less to insure high levels (98%) of consumer acceptability. Results suggest that an acceptable level of beef tenderness can be determined and

WBS values may be used as criteria for determining which steaks will be considered acceptable in tenderness by consumers before distribution to retail outlets. Recognition of acceptability levels should enable retailers and restaurateurs to implement strategies to better meet the demands and expectations of their customers.

## **Lactate Dehydrogenase as Indicator of Proper Heat Processing and Death of *Escherichia coli* O157:H7 and *Salmonella* in Ground Beef.**

A. Orta-Ramirez, D.M. Smith, C.H. Wang,  
M.M. Abouzied, J.F. Price  
Michigan State University  
106 G.M. Trout Food Science Bldg.  
Department of Food Science and Human Nutrition  
East Lansing, MI 48824-1224

Thermal inactivation of *Escherichia coli* O157:H7, *Salmonella senftenberg* and lactate dehydrogenase (LDH) in ground beef was compared at 53°, 58°, 63° and 68°C. LDH was most heat-resistant, suggesting that it might be used as

an indicator of proper heat processing in ground beef. Monoclonal antibodies against bovine muscle LDH were produced and a sandwich enzyme-linked immunosorbent assay (ELISA) was developed using monoclonal and polyclonal antibodies. Ground beef patties containing 13.6% fat were cooked on a grill to internal temperatures of 62.8°, 65.6°, 68.3° and 71.1°C. Additionally, patties containing 10.7% or 19% fat were cooked to 68.3°C. Extracts of the patties were tested using the sandwich ELISA to detect differences in LDH concentration. Differences ( $P < 0.05$ ) were found between patties cooked to 62.8° and 65.6°C, but no differences ( $P > 0.05$ ) were found among patties cooked to internal temperatures of 65.6°, 68.3° and 71.1°C. Fat content did not influence ( $P > 0.05$ ) LDH concentration after cooking. Variability in LDH concentration of patties was caused by differences in cooking time due to cycling of grill thermostat. To better control both processing time and temperature, ground beef was heated between 62° and 74°C at 2°C intervals in a water bath. The sandwich ELISA detected differences ( $P < 0.05$ ) in LDH concentration within 2°C in the 66-74°C range. The results suggested that a maximum concentration of about 3 µg LDH/g meat might indicate that ground beef was heated to 70°C or above.