Graduate Student Research Poster Competition

Ph.D. DIVISION

Evaluation of Konjac Blends and Soy Protein Isolate (SPI).

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Increased demand for low-fat meat products has lead to the development of a variety of fat substitutes. Konjac blends (KB) consisting of konjac flour, carrageenan, and starch offer potential as fat replacements. Substitution of a portion of the meat protein with SPI without detrimental effects on quality could result in reduced costs. Thus, the objective of this study was to evaluate the effects of levels (0.5 and 1.0%) of KB (KSS and KNC) and SPI (0 and 2%) on the characteristics of low-fat bologna (LFB, < 2%, fat) when compared to the control (30% fat). Control bologna had higher pH, less moisture and protein (%), expressible moisture (EM, %), and more fat (%). All KB samples were darker and more red ($P < .05$) than the control, while those with 2% SPI had similar Hunter yellowness. Compared to the control, LFB samples with 0.5% KB were harder, springier and more cohesive, while 1% KB were lower in fracturability. No differences ($P > .05$) in textural properties were observed with addition of 2% SPI. Comparisons between levels found 0.5% to be lighter, more yellow, harder, and gummier than the 1% level. LFBs containing KSS had more EM and vacuum purge, and were lighter and more yellow as compared to those with KNC, but no differences in TPA parameters were apparent. Sensory comparisons with the control indicated only small variations in flavor, taste, and textural attributes, however KB combinations were saltier ($P < .05$) than the control. Sodium dodecyl sulfate gel electrophoresis (SDS-PAGE) showed differences in salt soluble protein fractions between low-fat and control bologna upon cooking. Ultrastructural comparisons (scanning electron micrographs) of LFB containing KB and SPI, and the control showed differences among the protein, fat, and polysaccharide components.

Determination of the Relative Roles of Muscle Protein Synthesis and Protein Degradation in Callipyge-induced Muscle Hypertrophy.

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To determine the mechanism of muscle hypertrophy in callipyge lambs, lambs (n = 38) were slaughtered serially at 5, 8, and 11 wk of age and callipyge phenotype was determined. At slaughter, *longissimus thoracis et lumborum* (LTL) and *biceps femoris* (BF), hypertrophied by the callipyge phenotype, and *infraspinatus* (IS) and *supraspinatus* (SS), not hypertrophied by the callipyge phenotype, were sampled for quantification of muscle calpastatin activity, DNA, RNA, and protein. Eight wk lambs were infused with [$^2H_5$]-phenylalanine to determine in vivo protein synthesis rate by mass spectrometry. Regardless of slaughter weight, callipyge phenotype elevated ($P < .05$) protein:DNA in LTL and BF but not IS and SS. Regardless of slaughter weight, LTL and BF calpastatin activity were elevated ($P < .05$) and LTL RNA:protein tended to be decreased ($P < .10$) for callipyge. Phenotype did not affect ($P > .05$) IS and SS calpastatin activity or RNA:protein. Fractional protein accretion rate (%/d) did not differ ($P > .05$) between phenotypes for the four muscles. Fractional protein synthesis rate was decreased by 22% in callipyge LTL ($P = .0398$) and 16% in callipyge BF ($P = .0424$) when compared to non-callipyge controls. Fractional protein degradation rate (FDR) was decreased by 35% in callipyge LTL ($P = .0176$) and 34% in callipyge BF ($P = .0052$), while FDR between callipyge and non-callipyge controls in IS and SS was similar ($P > .05$). These indirect and direct measures of muscle growth provide evidence that callipyge-induced muscle hypertrophy is due to decreased muscle protein degradation.

Evaluation of Multiple Hurdles for Beef Carcass Decontamination.

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Spray-washing/rinsing treatments were evaluated individually and in sequence, as multiple hurdle interventions, for their efficacy in reducing high and low levels of microbial contamination on beef carcass samples. Brisket adipose tissue samples were inoculated with a suspension of cells of *Escherichia coli* (ATCC 11370) and then spray-washed at simulated pre- and post-evisceration time intervals and/or rinsed with an acetic acid solution (2%) or hot water (80°C) in a model spray-washing cabinet. Samples were evaluated for aerobic plate counts (APC), total coliform counts (TCC), and *E. coli* counts (ECC). Data were analyzed using analysis of variance by the general linear models procedure of SAS®. All of the treatments were effective in reducing the bacterial contamination of the brisket adipose tissue inoculated at a high contamination level (7.4 log CFU/cm^2) by at least 1 log CFU/cm^2 for APC, TCC, and ECC, with reductions ranging from 1.09 to 4.25 log CFU/cm^2. Similarly, most treatments were effective in reducing APC, TCC, and ECC of samples inoculated at a low level of contamination (3.7 log CFU/cm^2) by 0.11 to 1.65 log CFU/cm^2. In general, combinations involving three or four decontamination treatments in sequence were more effective in reducing bacterial contamination than single treatments or when a combination of two treatments were applied.

Key words: Beef Carcass, Decontamination, Spray-washing

Muscle Characterization, Including Fat, Color, Water Holding Capacity and Shear Force of Muscles from Boars, Barrows and Gilts.

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Marketability of pork shoulder cuts has remained low partly because of a lack of thorough knowledge of muscle characteristics, which has hindered development of new processing techniques. Boars (BO), barrows (BA), and gilts (G) were fed high or low protein diets and were slaughtered at 110 kg. The *biceps femoris* (BF), *semimembranosus* (SM), *semitendinosus* (ST), *quadriceps intermedius* (QDI) and *rectus femoris* (QDRF), *gluteus medius* (GM), *longissimus thoracis et lumborum* (LM), *psoas major* (PS), *infraspinatus, supraspinatus, serratus ventralis* (SV), *pectoralis profundus* (PP) and *triceps brachii* were dissected from each carcass. Across muscles, BA had higher ($P < .05$) ether extract (EE) than BO and G. All sexes and diets had similar ($P > .05$) water holding capacity (WHC) and shear force. Sex by diet interactions ($P < .05$) were observed for L* and a* values. The SV had higher ($P < .05$) EE than all other muscles. The QDRF had lower ($P < .05$) EE than all other muscles except PP, PS, GM, and SM. The QDRF and LM had higher ($P < .05$) WHC than BF, PP, QDI, and ST. The BF had higher ($P < .05$) shear force than all other muscles except SM and SV. The ST had higher ($P < .05$) L* values and QDI had higher ($P < .05$) a* values than all other muscles. Simple Pearson correlations between muscles for EE and a* were significant between LM and most ham muscles. For EE the highest coefficient was between LM and BF ($r = .87$, $P < .001$). For a* the highest coefficient was between LM and GM ($r = .81$, $P < .001$). Correlations for EE and a* between LM and other muscles indicate measurement of the LM should provide an estimate of EE content and a* values of the ham and shoulder. Numerous differences among muscles for EE, WHC, color, and shear force may help identify new pork marketing techniques.

Rheological and Water Holding Properties of Mixed Protein Systems Containing Salt Soluble Muscle Proteins and Whey Proteins.

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The heat-induced gelation properties of mixed protein systems containing chicken breast muscle salt-soluble proteins (SSP) and β-lactoglobulin (β-lg) or SSP and an α-lactalbumin (α-la) enriched fraction in 0.6M NaCl, pH 6.5, were investigated using dynamic rheology. At 70°C, SSP had greater storage modulus (G') values than mixtures containing SSP/β-lg. However, at 90(C, mixtures containing 80:20 and 60:40 SSP: β-lg had higher G' values than SSP alone, indicating that denaturation of β-lg directly or indirectly facilitates the formation of a more rigid gel structure. On subsequent cooling to 20°C, the extent of structure formation was greater for SSP than for mixtures containing SSP/β-lg, which suggests that the denatured β-lg is unable to interact with the SSP during cooling. Mixtures containing SSP and an α-la enriched fraction had lower G' values than SSP at 90°C and on subsequent cooling to 20°C, which reflects the poor gelling properties of α-la. A fibrous network was observed when the microstructure of the SSP and 40:60 SSP: α-la gels were examined using scanning electron microscopy, while aggregated networks were seen in the β-lg and 40:60 SSP: β-lg gels. No significant differences ($p > 0.05$) were observed between the water holding capacity (WHC) of SSP and SSP/β-lg gels. Gels formed from SSP/α-la enriched fraction had lower WHC than the SSP gels. Furthermore, it was observed that the myosin heavy chain was a major contributor to gel structure formation in all the mixed gel systems.

Storage Stability and Interventions for Ground Pork Containing Meat from an Advanced Meat Recovery System.

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Pork from advanced meat recovery systems, referred to as pork trim-finely textured (PTFT), has increased surface area and elevated iron content versus ground pork which may cause decreased storage stability. The objectives of this study were to: 1) determine storage stability of ground pork patties containing PTFT and 2) explore storage stability interventions on retail packaged ground pork from chubs containing PTFT. Fresh ground pork patties containing 10% or 20% fat and 0, 5, 10, or 15% PTFT were evaluated for lipid oxidation (TBARS), color, aerobic plate count (APC), coliform count, and sensory acceptability over 4 days retail display and frozen patties for TBARS over 8 weeks. Chubs of coarse ground pork with 0 or 15% PTFT and 0 or 3.3 % sodium lactate (NaL) were held 14 days at -2°C then made into retail packs by grinding 0.48 cm, portioning, and overwrapping (OW) or modified atmosphere packing (MAP). Retail packs were sampled on day 0, 2, and 4 of retail display for color, microbial counts, and TBARS. PTFT did not increase fresh or frozen patty TBARS or effect fresh patty sensory attributes or microbial counts. PTFT increased ($P < .05$) patty redness. Retail packs of OW and MAP had increased ($P < .05$) TBARS during display, but on day 4, NaL lowered TBARS in OW below MAP. PTFT had no effect on retail pack APC ($P > .05$) and increased ($P < .05$) TBARS by day 4 which was controlled by NaL. MAP had lower APC on day 4 than OW ($P < .05$). Color became darker ($P < .05$) in OW while MAP maintained lightness and redness. Metmyoglobin content was higher in OW than MAP by day 4 ($P < .05$). Up to 15% PTFT did not adversely affect ground pork patty shelf stability. MAP or NaL are necessary to acheive 4 days retail display of ground pork retail packs from chubs with 15% PTFT. Shelf stability of retail packs can be maintained 2 days without interventions.