Project Title: Effect of Moisture Enhancement on Sensory Attributes and Shear Force of Choice and Select Grade Beef Cuts from the Chuck and the Round

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Completion Date: 2005

Background

The 2000 National Beef Quality Audit demonstrated that there is an increase in the percentage of beef carcasses grading USDA Select and low Choice. Lower grading carcasses have less intramuscular fat, which can contribute to less desirable flavor profiles and juiciness. Consumer satisfaction is dependent on consistency in beef palatability, especially tenderness. The development and adoption of postharvest technologies to improve beef palatability and tenderness has the potential to increase the consistency of beef products.

Moisture enhancement is one technology that is used to improve consistency in fresh beef products, yet further research is needed to optimize this technology in a wide range of muscle groups both from the middle (rib and loin) meats, as well as end (round and chuck) meats. Increasing tenderness and consistency through further processing will also minimize the effects of different breed types on the quality and consistency of beef products. This will allow cattle producers to select for breeds that best fit their environment, rather than emphasizing carcass quality as a primary selection criteria.

Moisture enhancement of poultry and pork products via the addition of a brine solution comprised of salt, phosphates and other additives has been a commercial success as the technology allows for enhanced color stability, improved moisture retention during cooking and a marked improvement in consumer satisfaction.

The objective of this study was to examine the effect of high pressure moisture enhancement on grade and initial tenderness, color, palatability, ultimate tenderness and shelf-life of fresh beef steaks in the retail case from the shoulder clod (*triceps brachii*), top sirloin (*gluteus medius*), knuckle side (*vastus lateralis*) and knuckle tip-center (*rectus femoris*).

Methodology

Eighty *triceps brachii, gluteus medius, vastus lateralis* and *rectus femoris* samples from low USDA Choice and low USDA Select beef carcasses were obtained 48 hours postmortem from a commercial slaughter facility. Three steaks were removed from the center of each roast for negative control samples three, seven and 14 days postmortem. Three days postmortem, a steak from each roast was evaluated for initial Warner-Bratzler shear force (WBSF). Each roast was ranked for initial WBSF and divided into one of two treatment groups (tough and tender). Each roast was divided in half with each half receiving one of two treatments:

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1. Roasts from each muscle group were injected with a brine solution of 2.5 percent sodium lactate, 0.35 percent sodium tripolyphosphate and 0.65 percent sodium chloride.
2. Roasts were needle tenderized using the high pressure multi-needle injector, but no brine solution was administered.

The brine injected roasts were enhanced to 110 percent of their initial weight. Roasts from both treatment groups were held for 24 hours prior to the steaks being fabricated. The 2.54 cm steaks were divided into two treatment groups and aged for seven, 14 or 21 days and then frozen at 20°C until further analysis. Two samples were also removed to determine chemical composition (pH, moisture content, lipid, nitrogen and organic matter) by proximate analysis and drip loss.

Steaks from the control group and the two experimental treatments were also evaluated for tenderness using Warner Bratzler shear force. One steak was retained from each of the treatments and was used in a trained sensory panel evaluation. Panelists evaluated the steaks for initial tenderness, sustained tenderness, initial juiciness, sustained juiciness, beef flavor intensity and overall acceptability using a 10-point scale.

Subjective and objective color analyses were performed using the remainder of the roast after all other treatment steaks were removed. Steaks were fabricated from the roasts and were placed in refrigeration to mimic a retail display case. A trained panel determined subjective color measurements. Objective color measurements for L* (brightness), a* (red-green spectrum) and b* (yellow-blue spectrum) were obtained with a Minolta Chroma Meter.

Findings

Steaks from the brine injected roasts had higher pH values, which agreed with past research that reported that pH is elevated when sodium chloride, sodium lactate or sodium tripolyphosphate are introduced into meat. Drip loss percentages increased over time in retail storage regardless of treatment. Needle tenderized steaks had a higher percent drip loss across aging times (seven and 14 days postmortem) than steaks from brine injected roasts. Ultimate pH has been reported to have an effect on drip loss. Higher pH values cause myofibrillar repulsion, and a shift in free water to become bound, which decreases drip loss percentage. In this study, the addition of sodium chloride, sodium lactate and sodium tripolyphosphate increased pH and decreased drip loss. Treatment differences for protein paralleled drip loss as needle tenderized steaks were higher in protein concentration than brine injected steaks. Steaks from brine injected roasts were higher in ash concentration, which is facilitated by an increase in organic matter concentration. The increase in ash, increase in pH and reduction of drip loss in steaks from brine injected roasts indicated that the moisture enhancement processing method was successful.

Paralleling other findings for moisture retention and reduced cook loss, brine injected steaks had lower cook loss percentages than needle tenderized steaks. Treated brine injected roasts required less force shear in all of the muscles evaluated (*triceps brachii, gluteus medius, vastus lateralis and rectus femoris).*

Brine injected steaks required less force to shear after either seven, 14 or 21 days of aging. Previous research has indicated that consumers experience a positive eating experience 94 percent of the time if the product has a Warner Bratzler shear force of four kilograms or less. In this study, steaks were sorted into “tough” or “tender” groups based on an initial WBSF value prior to treatment. In all four muscles, brine injected steaks from

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both the tough and tender treatments were more tender at 14- and 21-days postmortem than the needle tenderized steaks and the untreated control steaks.

The trained sensory panel found that differences existed for all muscles for initial tenderness, sustained tenderness, initial juiciness, sustained juiciness, beef flavor intensity and off flavor. Steaks from brine injected roasts across all muscles were initially more tender than steaks from needle tenderized roasts. Additionally, the brine injected steaks across all muscles sustained higher tenderness values during chewing. In this study, steaks from the brine injected roasts were initially more juicy than steaks from needle tenderized roasts and sustained higher juiciness values during chewing across all muscles.

The panelists also found differences in flavor with the brine injected steaks having higher beef flavor values. This agreed with previous research in which phosphate and salt-based solutions used to enhance beef and pork resulted in improved flavor or unaffected flavor. The brine injected steaks were also rated higher for overall acceptability.

In consumer preference studies, color is rated as one of the predominant factors for consumer acceptance when purchasing beef at the retail level. Changes in retail color during retail display may negatively alter a consumer's perception if the product is discolored and consumers believe that the discoloration is due to spoilage. In this study, steaks from brine injected roasts were more stable in their color values. Differences between initial (one day post storage) color readings compared to final (eight day post storage) color readings were less in treated brine injected steaks than needle tenderized steaks during the retail storage period for all of the muscles evaluated. As expected, the subjective color ratings by a trained panel decreased in consumer acceptance over the five-day period. The *vastus lateralis* and *triceps brachii* that were enhanced with the brine solution received higher panel scores and were more acceptable in visual color. Overall, the interaction between treatment and day indicated that needle tenderized steaks were initially preferred potentially due to a brighter appearance. By the third day, after the products had undergone their initial bloom, panelists preferred brine injected steaks for retail color.

Implications

In this study, the use of high pressure multi-needle injection of a brine solution into fresh beef cuts improved mechanical tenderness (WBSF), sensory panel scores (tenderness, juiciness, beef flavor and overall acceptability), color stability (L*, a*, b* values) and color panel ratings (beyond three days of retail display). Moisture enhancement reduced drip loss, as well as cook loss. Processing methods such as brine injection can be used to create beef products that will better meet consumer and retailer expectations by improving palatability and shelf life. This application is especially appropriate for carcasses grading low USDA Choice or below.

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