

Project Title:	Enhancement of Beef Subprimals Prior to Aging and Retail Display
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Background

Enhanced (i.e. injected with a marinating solution) pork and chicken products are commonplace in the retail fresh/frozen meat case. Previous studies have shown that a majority of consumers overcook their beef to temperatures that might lead to a less than desirable eating experience. Beef cuts injected with solutions designed to keep the cut tender and juicy even at higher cooked temperatures might lead to more consistently good consumer eating experiences.

Enhanced beef products are becoming more widespread in the retail marketplace. In most cases, beef is pumped with a variety of compounds designed to enhance its texture, flavor, and consistency. The ingredients typically include salt, phosphate, sodium lactate, and seasoning and flavorings that both protect flavor stability (reduce oxidation) and enhance flavor.

The objectives of this study were to:

- Compare tenderness of injected versus non-injected beef cuts;
- Determine the best aging times to maximize tenderness; and
- Measure shelf-life of injected versus non-injected beef cuts.

Methodology

Phase I: Twenty USDA Choice and 20 Select, “A” maturity, beef carcasses were randomly selected from the National Beef Company in Liberal, KS. At approximately 48 hours postmortem, paired samples (n = 20 pairs) of USDA Choice and Select strip loins (IMPS # 180), shoulder clods (IMPS #114), and top sirloin butts (IMPS #184) were individually identified and tagged prior to carcasses disassembly. The subprimals were vacuum packaged and transported to Oklahoma State University for further analysis.

Upon arrival to the Food and Agricultural Products Center located on the Oklahoma State University campus, paired subprimal samples were assigned randomly to one of two enhancement treatments. One-half of the subprimals were enhanced at 110% of their original weight with a solution of 0.3% sodium chloride, 0.3% sodium tripolyphosphate, and 0.1% rosemary oleoresin. Steaks (n = 7) were then fabricated from enhanced and non-enhanced subprimals. One steak from each subprimal was assigned randomly to a postmortem aging treatment of 1, 3, 6, 9, 12, 15, or 18 days. Samples were allowed to age for the respective storage period at refrigeration (39°F) temperatures. At the conclusion of each storage period, steaks were then frozen at -4°F until Warner-Bratzler shear force analysis was conducted.

Steaks were cooked to an internal temperature of 70°C (160°F) and allowed to cool before being subjected to Warner-Bratzler shear force testing. Up to six cores were obtained per steak and Warner-Bratzler shear force values were calculated for each sample as a measurement of tenderness.

Phase II: Carcasses and paired subprimals (n=15 pairs) were selected as in Phase I. Upon arrival to the Food and Agricultural Products Center located on the Oklahoma State University campus, paired subprimal samples were assigned randomly to postmortem aging and enhancement/non-enhancement treatment combinations. Half of the subprimals were enhanced using the same procedure in Phase I. All subprimals were then aged in vacuum-packaged bags for either 7, 14, or 21 days. After aging was completed, 1 inch thick steaks were fabricated from the subprimals, and put into a high oxygen (80% oxygen/20% carbon dioxide) modified atmosphere barrier plastic tray system to determine the effect of storage time and enhancement on shelf life. Steaks were displayed in retail-style coffin cases under fluorescent lighting at 36 to 39°F for 7 days.

Retail display steaks were evaluated using objective and subjective measures. Trained personnel from Oklahoma State University subjectively evaluated steaks each day to assess differences in lean color, fat color, discoloration, and overall acceptability. On day 1 and 8 of retail display color was measured on the cut surface of the steak using a CR-300 Minolta Chromameter. Steaks were allowed to bloom for a period of 20 minutes prior to instrumental color analysis.

Findings

Tenderness

Warner-Bratzler Shear Force Values by Quality Grade and Enhancement Application				
Steak Type	USDA Choice		USDA Select	
	Enhanced	Non-Enhanced	Enhanced	Non-Enhanced
Strip Loin	2.80*	3.40	2.98*	3.82
Top Sirloin	3.67*	3.90	3.61*	4.61
Shoulder Clod	3.16*	3.70	3.44*	3.98

Note: Lower Warner-Bratzler shear force values indicate easier to cut (i.e. more tender) steaks.

* Means for "Enhanced" steaks significantly lower than for "Non-Enhanced" steaks (p<.05)

Overall, enhanced beef steaks were more tender than their non-enhanced counterparts. The effects of enhancement are most apparent on strip loin steaks; USDA Select strip loins that were enhanced were actually more tender than non-enhanced USDA Choice strip loins. This same pattern holds true for the other two steak cuts, but the differences in shear values were not statistically significant. In other words, USDA Select Strip Loins benefit more from enhancement than their Choice counterparts, while top sirloin and clod steaks benefit equally by quality grade.

Overall Appearance

Panelists rated the overall appearance of the steaks at retail display. Overall appearance ratings differed by steak cut and enhancement/non-enhancement as follows:

Strip Loin Steaks: Non-enhanced strip loin steaks had higher overall appearance ratings than enhanced strip loin steaks; this was true for both USDA Choice and Select quality grades. Enhanced USDA Select strip loin steaks had a greater amount of discoloration on all days of retail display than non-enhanced steaks of the same quality grade. Enhancement had little influence on discoloration during retail display for USDA Choice strip loin steaks.

Top Sirloin Steaks: Enhancement of USDA Select top sirloin steaks significantly decreases the overall appearance compared to non-enhanced steaks, whereas enhanced USDA Choice top sirloin steaks were not significantly different in overall appearance rating versus their



non-enhanced counterparts. The effects of enhancement on top sirloin steaks differed by USDA quality grade: Enhanced USDA Choice top sirloin steaks had significantly less discoloration during retail display compared to non-enhanced steaks, whereas enhanced USDA Select top sirloin steaks had significantly more discoloration versus enhanced steaks.

Shoulder Clod Steaks: The effects of enhancement on shoulder clod steaks differed by length of post-enhancement storage time. Enhanced shoulder clod steaks stored 7 days had significantly higher overall appearance ratings than their non-enhanced counterparts. However, non-enhanced shoulder clod steaks stored 21 days had significantly higher overall appearance ratings than enhanced shoulder clod steaks. The effects of enhancement on shoulder clod steaks differed by USDA quality grade: Enhanced USDA Select shoulder clod steaks had significantly less discoloration during retail display compared to non-enhanced steaks. There were no significant differences in discoloration between enhanced and non-enhanced USDA Choice shoulder clod steaks.

Lipid Oxidation

Shelf-life of fresh beef can be increased by reducing lipid oxidation over time. One indicator of lipid oxidation is the presence of thiobarbituric acid reactive substance (TBARS). In order to reduce oxidation, an anti-oxidant such as rosemary oleoresin can be injected into beef cuts with the enhancement solution. The results of this study show that fresh beef cuts (i.e. strip loin, top sirloin, and shoulder clod steaks) injected with a solution containing rosemary oleoresin had significantly lower TBARS levels on the last day of retail display for all storage periods.

Aging Recommendations to Maximize Tenderness and Shelf-Life

The results of this study suggest that to best maximize tenderness and shelf-life of enhanced subprimals no aging is required and fewer days stored will result in longer shelf-life. For non-enhanced subprimals, the following recommendations are indicated.

- Strip Loin: Age 15 days or more to maximize tenderness. Product should maintain acceptable appearance for 6 days when stored for 14 days postmortem.
- Top Sirloin Butt: Age 24 days or more to maximize tenderness. Product should maintain acceptable appearance for 3 days when stored for 14-, 21- or 28-days postmortem.
- Shoulder Clod: Age 19 days or more to maximize tenderness. Product should maintain acceptable appearance for 5 days when stored for 14 days postmortem, and 1 less day for each additional week of storage.

Implications

Needle injected or enhanced beef products may be one method that affords the consumer a more consistent eating experience. The findings of this study suggest the following:

- Enhanced beef steaks may be more tender than non-injected steaks of similar USDA grade.
- The addition of rosemary oleoresin in enhancement solutions contributes to longer shelf-life due to less oxidation during retail display.

However, there were differences in overall appearance and discoloration between enhanced and non-enhanced beef steaks. This suggests that the overall appearance of enhanced beef cuts may be different depending specific cut and quality grade.