Project Summary

Influence of Enhancement and Blade Tenderization on Beef Subprimals of Beef of Known Categories of Tenderness

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Background

Meeting consumer expectations for tenderness and quality attributes remains an important part of maintaining and growing consumer demand for beef. Several augmentation methods applied after harvest, such as blade tenderization, enhancement solutions and aging, have been shown to improve beef quality and subsequently consumers' eating experiences.

The pork industry, has for some time applied enhancement solutions containing sodium chloride (NaCl) and phosphate to improve palatability of the final product. Past research has shown that applying a similar enhancement solution to beef strip loin steaks improved shear force, sensory tenderness and juiciness.

Researchers from Oklahoma State University conducted a study to determine the impact enhancement solutions and blade tenderization had on the shear force value of multiple beef subprimals throughout the carcass.

Methodology

U.S. Choice and Select paired samples of the following subprimals were obtained from three federally inspected beef processing facilities:

- Strip loin (IMPS/NAMP 180)
- Knuckle (IMPS/NAMP 167)
- Top sirloin butt (IMPS/NAMP 184)
- Clod (IMPS/NAMP 114)
- Inside round (IMPS/NAMP 169)

Prior to fabrication, the paired samples were sorted into predicted beef tenderness categories of "tender" or "tough" using BeefCam, an instrument grading system. All subprimals were individually identified and tagged before being vacuum packaged and shipped at approximately 48 hours after harvest to the laboratory facilities at Oklahoma State University.

The paired samples were randomly assigned into one of two groups. The first group served as a control. Steaks were fabricated from the subprimals and were randomly assigned to an aging treatment of seven, 10, 14 or 21 days.

Subprimals in the second group were cut into equal halves and were randomly assigned to either an enhancement solution or blade tenderization treatment group. The enhancement solution contained 0.36 percent sodium chloride, 0.45 percent sodium tripolyphosphate and 0.1 percent rosemary oleoresin and the subprimal halves were enhanced to 110 percent of their original weight. After enhancement, steaks were fabricated from each subprimal section and randomly assigned to an aging treatment of either seven or 14 days.

The remaining subprimal halves were mechanically tenderized, twice, using a needle tenderizer. Steaks were fabricated from the subprimals and were randomly assigned to an aging treatment of seven or 14 days.

All of the samples were vacuum packaged and aged for their respective storage periods at refrigeration temperatures (39°F). At the conclusion of each storage period, each steak was frozen (-4°F) until researchers had an opportunity to analyze the samples for Warner Bratzler shear force values.

Warner-Bratzler shear force value measurements were collected for each sample as a measurement of tenderness.

Findings

Strip Loin

In both the control and blade tenderized strip loin steaks, no differences in tenderness were observed between U.S. Choice and U.S. Select steaks. However, a marked improvement (on average 10.4 percent and 16.0 percent for Choice and Select, respectively) in tenderness was observed when strip loins were subjected to the enhancement process. Strip loin steaks classified as tough through the instrument grading showed the most marked improvement, based on Warner-Bratzler shear force values, over all aging periods. After 14 days, enhanced tough and tender strip loin steaks possessed lower, more desirable Warner-Bratzler shear force values than did tough and tender blade tenderized and control strip loin steaks. Enhancement of strip loin steaks to improve Warner-Bratzler shear force values proved to be the most effective tenderization process regardless of aging period. For all aging periods, with the exception of the "tough" steaks aged for seven days, blade tenderization displayed minimal improvement in strip loin steaks.

Tough strip loin steaks, however did not respond to the aging process. As expected though, blade tenderization and enhancement lowered the percentage of "tough" strip loin steaks compared to the control group. The odds of having a bad eating experience decreased with the enhancement application from two in five occurrences, to a rate of one in five.

Knuckle

For tough knuckle steaks, it appeared that a minimum of 14 days of postmortem aging was required to improve initial Warner-Bratzler shear force values. Blade tenderization proved to contribute little to the improvement of knuckle steak tenderness. However, regardless of aging time, enhancement of knuckle steaks significantly improved tenderness ratings. In fact, enhanced knuckle steaks aged for only seven days were more tender than control steaks aged for 21 days.

Clod Steaks

Regardless of U.S. quality grade or tenderness category, enhancement of clod steaks produced lower, more desirable Warner-Bratzler shear force values than blade tenderized and control clod steaks. For the most part, clod steaks did not respond to the postmortem aging process.

Top Sirloin

For steaks aged seven days, both blade tenderization and enhancement lowered the percentage of top sirloin steaks being classified as tough by 25 percent. As anticipated, the tough top sirloin steaks responded to the postmortem aging process, decreasing the percentage of tough steaks from 52 to 41 percent.

Inside Round
Both tender and tough steaks responded little to any of the experimental treatments. Enhancement of short aged (seven days) inside round steaks did have some value as the product became more tender.

Implications
Based on the results of this study, the researchers made the following recommendations for the incorporation of enhancement, blade tenderization and aging to improve the tenderness and consistency of various subprimals.

Table 1. Recommendations to achieve maximum tenderness for strip loin (IMPS/NAMP 180) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	Age ≥ 14 days
Enhancement	Compared to other treatments, 15% improvement in tenderness
Blade Tenderization	No additional benefit compared to postmortem aging

Table 2. Recommendations to achieve maximum tenderness for knuckle (IMPS/NAMP 167) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	Age ≥ 14 days
Enhancement	20% improvement in tenderness when compared to postmortem aging
Blade Tenderization	When compared to postmortem aging, no additional tenderness benefits

Table 3. Recommendations to achieve maximum tenderness for clod (IMPS/NAMP 114) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	Age ≥ 14 days
Enhancement	20% improvement in tenderness when compared to postmortem aging
Blade Tenderization	Compared to postmortem aging, 12% improvement in tenderness

Table 4. Recommendations to achieve maximum tenderness for eye of round (IMPS/NAMP 171C) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	No improvement in tenderness
Enhancement	15% improvement in tenderness when compared to postmortem aging
Blade Tenderization	Compared to postmortem aging, 8% improvement in tenderness

Table 5. Recommendations to achieve maximum tenderness for inside round (IMPS/NAMP 169) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	Age ≥ 14 days
Enhancement	10% improvement in tenderness when compared to 7 days postmortem aging
Blade Tenderization	No improvement in tenderness was achieved when compared to postmortem aging

Table 6. Recommendations to achieve maximum tenderness for top sirloin (IMPS/NAMP 184) subprimals classified as "tough" by instrument grading.

Treatment	Recommendation
Conventional Aging	Age ≥ 14 days
Enhancement	20% improvement in tenderness when compared to postmortem aging
Blade Tenderization	Compared to postmortem aging, 12% improvement in tenderness

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