PROJECT SUMMARY
PRODUCT QUALITY

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Factors Affecting Palatability Characteristics of Beef Top Sirloin Steaks

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Background

The beef top sirloin steak is an important foodservice cut, and is often served at a lower cost than other foodservice steaks. Yet, in further comparison to steaks from the rib and loin, the top sirloin often fails in delivering consistent and satisfactory eating experiences to foodservice clientele. As stated by Wheeler et al. (1990), increased use of brand-identified retail beef products by beef packers and processors has resulted in more emphasis on the production of beef steaks that meet high standards of quality. The top sirloin butt is a specific cut of concern when discussing steaks that can meet these high standards of quality and further benefit branded programs and markets. When consumer expectations are not met in the foodservice sector, the effects can be felt across the entire beef industry. Essentially, lower desirability for certain cuts can decrease overall demand for beef. This study aimed to evaluate the effects of various factors on the palatability of top sirloin steaks, in an effort to increase the desirability and demand of a readily available cut.

Objectives

The goal of this project was to evaluate various factors that may affect sirloin characteristics. This was done through three separate objectives: 1) to determine if consumer satisfaction improves by blade tenderizing today's more inherently tender beef, 2) to evaluate the use of freezing of top sirloin butts during the subprimal storage period to see if it will enhance tenderness of steaks, and 3) to assess whether short aging periods for top sirloin butts would produce steaks equal to or better than those from top sirloin butts aged for the traditional extended periods.

Materials and Methods

USDA Choice paired top sirloin butts (*n* = 60 total pieces), similar to USDA (2014) Institutional Meat Purchasing Specifications (IMPS, 184A), with the *M. gluteus profundus* and *M. gluteus accessorius* removed, were collected from a major beef supplier. During fabrication, each sirloin was deboned and trimmed to predetermined specifications so that the *M. gluteus profundus* and *M. gluteus accessorius* were removed, and all fat was trimmed from the outer sirloin surfaces. Subprimals then were individually vacuum packaged, with the labels visible, and packed five sirloins to a box, to limit any variation in heat transfer. The boxes were then shipped under refrigerated conditions to a collaborating beef purveyor in Texas for subsequent aging periods, with "Day 0" being defined as the day of fabrication and vacuum packaging.

Blade Tenderized vs Non-Blade Tenderized

For this trial, a total of 10 USDA Choice, paired top sirloin butts (*n* =10 pairs or *n* = 20 total pieces) were used. All products were aged under refrigeration (~ -1 °C) for 14 days, then removed from their packaging and trimmed of any visible discoloration or remaining surface fat. All subprimals from the left side of the carcasses were assigned to the blade tenderization (BT) treatment. Subprimals, dorsal side facing up, were run once through a commercial blade tenderizer. Subprimals from the right sides received no treatment (non-blade tenderized; NBT) and served as the control.

All subprimals were cut perpendicular to muscle fibers into 5 Portions (2.5 cm thick) using a Grasselli (NSL 800, Albinea, Italy) slicer. Portions were identified as 1, 2, 3, 4, and 5 with Portion 1 always starting on the cranial side. Portions 2 and 3 were used for this project. Three steaks (~170 g or 6 oz) were hand cut from each of these two portions. Steaks from Portion 2 were identified as A, B, C, and steaks from Portion 3 were identified as D, E, F. The first steak from Portion 2, steak A, was assigned to subsequent Warner-Bratzler Shear (WBS) force. Steaks B, C, D, and E were assigned to subsequent consumer sensory analysis, and steak F was held in reserve.

All steaks were individually vacuum packaged in rollstock, labeled, boxed, placed into insulated containers with ice packs, and transported to the Kleberg Animal and Food Science Center, Texas A&M University, College Station, Texas. Upon arrival, steaks were refrigerated (~ 0°C) until subsequent cooking and consumer sensory analysis and WBS force testing.

Refrigeration vs Frozen Aging

For this trial, a total of 10 USDA Choice, paired top sirloin butts (*n* =10 pairs or *n* = 20 total pieces) were used. All products were aged under refrigeration (~ -1 °C) for 14 days. One top sirloin butt from the pair remained under refrigeration (~ -1 °C) for a total of 35 days. The other top sirloin butt from each pair was frozen and held frozen (-20 °C) for 14 days, and then moved to a refrigerated area (~ -1 °C) and held for seven more days to undergo thawing for a total of aging period of 35 days.

After aging, top sirloin butts were cut into portions and steaks as described above. Steaks then were individually vacuum packaged in rollstock, boxed, placed in insulated containers with ice packs, and transported to Rosenthal Meat Science and Technology Center, Texas A&M University, College Station, Texas. Upon arrival, boxes were stored (~ 0 °C) until subsequent cooking for consumer sensory analysis and WBS force testing.

14-day vs 35-day Aging

For this trial, a total of 10 USDA Choice, paired top sirloin butts (*n* = 10 pairs or *n* = 20 total pieces) were used. One top sirloin butt of each pair was aged under refrigeration (~ -1 °C) for 14 days before cutting into steaks (~170 g or 6 oz), as outlined above. The other subprimal from the pair was aged under refrigeration (~ -1 °C) for 35 days before cutting into steaks (~170 g or 6 oz), as outlined above.

After aging, all steaks were individually vacuum packaged in rollstock and flash frozen (-40 °C). After freezing, steaks were boxed, placed in insulated containers with ice packs, and transported to Rosenthal Meat Science and Technology Center, Texas A&M University, College Station, Texas. Upon arrival, all steaks were stored frozen (~-23 °C) until subsequent thawing for consumer panel analysis and WBS force testing.

Cooking of steaks

For the BT vs NBT and refrigeration vs frozen objectives, cooking for consumer sensory analysis and for WBS force testing were both completed within three days of the steaks arriving in College Station. For the 14-day vs 35-day treatment objective, all steaks were frozen. Frozen steaks were thawed under refrigerated conditions (~ 0 °C) for 48 h before cooking. Steaks for all three objectives were cooked on a Star International commercial flat top grill (Max Model 536-tgf, St. Louis, MO). The grill was preheated to 176° C +/- 2° C, with internal steak temperatures being monitored using thermocouple readers (Model HH506A; Omega Engineering, Stanford, CT) and 0.02 cm diameter copper-constantan Type-T thermocouple wire (Omega Engineering) inserted into the geometric center of each steak. Steaks were cooked to 35 °C, flipped, and cooked to a final endpoint temperature of 70 °C. Raw out of package weight, initial internal temperature, grill temperature, time on, final internal temperature, time off, and final cook weight were all collected on each steak.

Warner-Bratzler Shear Force Analysis

Cooked steaks were stored (2 to 4° C) after cooking for 12 to 18 hours before WBS force analysis. Steaks were allowed to equilibrate to room temperature before being trimmed of visible connective tissue to expose muscle fiber orientation. Six, 1.3 cm cores removed from each *M. gluteus medius* were used. Connective tissue and excess fat were avoided when coring as much as possible. Cores were removed parallel to the muscle fibers and sheared once, perpendicular to the muscle fibers, on a United Testing machine (United SSTM-500, Huntington Beach, CA) at a cross head speed of 200 mm/min using a 10-kg load cell, and a 1.02 cm thick V-shape blade with a 60°angle and a half-round peak. The peak force (kg) needed to shear each core was recorded, converted to Newtons (N), and the mean peak shear force of the cores was used for statistical analysis. The equipment was calibrated before the start of sample data collection, and calibration was checked after shearing every 60 cores.

Consumer Sensory Analysis

Procedures were approved by the Texas A&M Institutional Review Board for Use of Humans in Research (IRB2016-0227M).

Steaks were cooked as described above. Once a steak reached 70 °C, it was wrapped in food-grade aluminum foil and held in a preheated commercial warming oven until every member of the corresponding group was ready for that sample. Steaks did not stay in the warming oven for more than 20 minutes to limit variability after cooking.

Consumer panelists (*n* = minimum of 80 per trial) were recruited from the Bryan/College Station area using an existing consumer database. Upon arrival at the sensory facility, panelists completed a demographic survey. Panelists were randomly divided into 5 groups, each consisting of 4 panelists. Each group received two matched pairs for sampling, served in a previously assigned blind and random order.

Steaks were cut into fourths. Each sample (one-fourth of a steak) was presented on a plastic plate labeled with the three-digit ID number of the corresponding steak, along with a metal steak knife and a plastic fork. This serving style allowed panelists to cut into the product, which sometimes influences consumer acceptability. A new fork was provided for with each sample, along with unsalted saltine crackers and deionized water for palate cleansing. The serving order of samples was randomized for each group to eliminate first-order bias. Samples were served through a breadbox-style sensory booth to individually seated panelists, where red theater lighting was utilized to prevent panelist bias for degree of doneness. Panelists were asked to evaluate the samples using 9-point scales: overall liking (1 = dislike extremely; 9 = like extremely), flavor liking (1 = dislike extremely; 9 = like extremely), tenderness liking (1 = dislike extremely; 9 = like extremely), and juiciness liking (1 = dislike extremely; 9 = like extremely).

Important Findings

Today's inherently more tender beef has been positive for the beef industry, and because of this, traditional practices of postmortem aging, blade tenderization, and freeze/thawing need to be revisited to ensure that their benefits are still worthwhile. This study showed that longer aging periods (e.g., up to 35 days) are not necessary from a tenderness standpoint and that shorter aging periods (e.g., 14 days) may be sufficient in producing adequate tenderness. Freezing subprimals during the storage/aging period was thought to in part tenderness, but this work did not show palatability differences between refrigerated and frozen treatments. Finally, blade tenderization did improve sensory panel overall like and tenderness like ratings compared to the non-blade tenderized controls. Even though WBS force values were similar between treatments, those improvements in sensory panel ratings with blade tenderization shows that this long-used practice is still beneficial for the top sirloin steak.

Impact on the Beef Industry

Findings still support the use of blade tenderization to enhance consumer acceptance of steaks from the top sirloin butt. The use of freezing did not impact quality, which suggest that freezing is still an effective way to store meat in the industry. Employing shorter rather than longer postmortem aging periods may reduce inventory storage requirements and improve shelf-life parameters without sacrificing the palatability characteristics of top sirloin steaks.

Reference

Wheeler, T. L., R. K. Miller, J. W. Savell, and H. R. Cross. 1990. Palatability of chilled and frozen beef steaks. J. Food Sci. 55: 301-304.

Graphs/Tables

Table 1. Least squares means and SEM for sensory panel ratings and Warner-Bratzler shear force values for top sirloin steaks from three subprimal treatments: blade tenderized vs not blade tenderized, refrigeration vs frozen aged, and 14-day vs 35-day aged.

		Sensory panel ratings[2]				
Treatment[1]	*n*	Overall like/ dislike	Tenderness like/dislike	Flavor like/ dislike	Juiciness like/dislike	Warner-Bratzler shear force, N
Blade tenderized	10	6.7[a]	6.7[a]	6.7	6.4	26.4
Non blade tenderized	10	6.3[b]	6.0[b]	6.5	6.1	28.2
SEM		0.1	0.2	0.1	0.2	1.6
P-value		0.0407	0.0077	0.0621	0.1527	0.4099
		Sensory panel ratings[2]				
Treatment[3]	*n*	Overall like/ dislike	Tenderness like/dislike	Flavor like/ dislike	Juiciness like/dislike	Warner-Bratzler shear force, N
Refrigeration aged	10	6.3	6.0	6.4	6.1	26.8
Frozen aged	10	6.1	5.8	6.2	5.8	30.8
SEM		0.2	0.2	0.1	0.2	1.7
P-value		0.2329	0.2995	0.3449	0.2745	0.1180
		Sensory panel ratings[2]				
Treatment[4]	*n*	Overall like/ dislike	Tenderness like/dislike	Flavor like/ dislike	Juiciness like/dislike	Warner-Bratzler shear force, N
14-day aged	10	6.1	5.7	6.3	5.6	29.8
35-day aged	10	6.0	5.9	6.0	5.7	28.4
SEM		0.2	0.2	0.1	0.1	1.6
P-value		0.8557	0.4664	0.1418	0.7945	0.5534

[a,b] Least squares means in the same column without common superscript letters differ ($P < 0.05$).

[1] Treatment: blade tenderized = top sirloin butts were run once through a blade tenderizer before cutting into steaks; Non blade tenderized = top sirloin butts were not blade tenderized before cutting into steaks.

[2] Sensory panel ratings: 9 = like extremely; 1 = dislike extremely.

[3] Treatment: Refrigeration aged = top sirloin butts stored for 35 days under refrigeration (~ –1 °C) before cutting into steaks; Frozen aged = top sirloin butts stored for 14 days under refrigeration (~ –1 °C), frozen (~ – 6.7 °C) for 14 days, and stored for 7 days (~ –1 °C) for a total of 35 days before cutting into steaks.

[4] Treatment: 14-day aged = top sirloin butts were stored for 14 days under refrigeration (~ –1 °C) before cutting into steaks; 35-day age = top sirloin butts stored for 35 days under refrigeration (~ –1 °C) before cutting into steaks.