

Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 314

2001

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Recommended Citation

Andrews, B.S. and Unruh, John A. (2001) "The effects of quality grade, postmortem aging, and blade tenderization on Warner-Bratzler shear force and cookery traits of biceps femoris steaks," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 1. <https://doi.org/10.4148/2378-5977.1717>

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THE EFFECTS OF QUALITY GRADE, POSTMORTEM AGING, AND BLADE TENDERIZATION ON WARNER-BRATZLER SHEAR FORCE AND COOKERY TRAITS OF BICEPS FEMORIS STEAKS

B. S. Andrews and J. A. Unruh

Summary

We used 108 top sirloin butts to determine the influence of quality grades, postmortem aging periods, and blade tenderization passes on percentages of thawing and cooking losses and Warner-Bratzler shear (WBS) force of biceps femoris muscles. Top sirloin butts that qualified for either USDA Select (SEL, n=36), USDA Choice (CHO, n=36), or Certified Angus Beef™ Program (CAB, n=36), were aged for 14 or 21 days and blade tenderized zero (0X), one (1X), or two (2X) times. Steaks with higher quality grades (CHO and CAB) aged for 21 days had lower thawing losses than steaks aged 14 days and than SEL steaks aged for 21 days. Steaks aged for 14 days and not blade tenderized (0X) had higher thawing losses than steaks aged for longer periods (21 days) and tenderized 0X, 1X, and 2X. Lower quality grade steaks (SEL) blade-tenderized 2X had longer cooking times than other quality grade×blade tenderization treatments. More blade tenderization passes (1X and 2X) for higher quality grades (CHO and CAB) appear to lower WBS values. The most tender treatments were CHO steaks blade tenderized 2X and CAB steaks blade tenderized 1X and 2X. Biceps femoris tenderness was inconsistent among all treatments, although aging, blade tenderization, and higher quality grades reduce variation. For reliable, acceptable quality this muscle should not be included in top sirloin butt steaks.

(Key Words: Quality, Blade Tenderization, Postmortem Aging, *Biceps femoris*, Tenderness.)

Introduction

Consumers are willing to pay a premium for cuts of meat they know are tender. Of steaks offered in a restaurant setting, those from the top sirloin butt are among the more variable, less tender cuts. To help alleviate this problem and decrease variation in tenderness, the cap (*biceps femoris*, BF) muscles are removed from the top sirloin butts prior to fabrication into steaks. The BF is considered highly variable in tenderness and is a tougher muscle, which reduces the eating satisfaction of sirloin steaks, compared to the main muscle of the top sirloin butt, (*gluteus medius*, GM). Postmortem technologies such as aging and blade tenderization can improve tenderness uniformity and overall acceptability of the BF. This might allow the BF to remain on the top sirloin during fabrication into steaks. Our objective was to determine the influence of quality grades, postmortem aging, and blade tenderization passes on tenderness of BF muscle.

Experimental Procedures

One hundred eight top sirloin butts (IMPS 184A) that qualified for either the Certified Angus Beef™ Program (CAB; n=36), USDA Choice (CHO; n=36), or USDA Select (SEL; n=36) were tested. Top sirloin butts were sent to a commercial fabrication plant and aged for 14 or 21 days postmortem at 32°F. After aging, they were either not blade tenderized (0X) or passed through a blade tenderizer (Model T7001, Ross Industries Inc., Midland, VA) one (1X) or two (2X) times. The BF muscle was removed from each top sirloin butt, labeled for identification, then individually vacuum packaged (Model M860, Multivac Inc.,

Calhoun, Germany) and frozen for 40 min at -35°F in a spiral freezer. Once frozen, BF were transported to Kansas State University Meat Laboratory and stored at -29°C until analysis.

Each BF muscle was sawed into 1 inch thick steaks, weighed, and thawed at 37°F for 24 hours. Steaks were cooked to 160°F internally by a Blodgett dual-air-flow gas convection oven. Internal steak temperature was monitored by a 30-gauge, type-T thermocouple attached to a Doric 205 temperature recorder. Steaks were allowed to cool overnight in a refrigerator at 37°F. Six, ½ inch cores were taken parallel to the muscle fibers and sheared perpendicular to the core using an Instron Universal Testing Machine with a V-shaped blade on a Warner-Bratzler Shear force (WBS) attachment. Percent thawing losses [(Frozen wt.-Thawed wt.)/Frozen wt.]×100 and percent cooking loss [(Thawed wt.-Cooked wt.)/Thawed wt.]×100 were calculated. Results were analyzed in a 3×2×3 factorial design using the SAS General Linear Model procedure.

Results and Discussion

Steaks aged 14 and 21 days had similar ($P>0.05$) percentages of cooking loss, cooking times, and WBS values (Table 1). Neither quality grade nor number of blade tenderization passes influenced cooking loss ($P>0.05$). However, both aging period × quality grade and aging period × number of blade tenderization passes interactions ($P<0.05$) were observed for percentage of thawing losses (Table 2). Choice and CAB steaks aged 21 days had lower ($P<0.05$) thawing losses than SEL steaks aged 21 days and all steaks aged 14 days regardless of quality grades. Steaks aged 21 days and blade tenderized 0X and 2X had lower ($P<0.05$) thawing losses than steaks aged 14 days and blade tenderized 0X and 2X, re-

spectively. Also, steaks aged 21 days and blade tenderized 1X had less ($P<0.05$) thawing loss than steaks aged 14 days and blade tenderized 0X. Higher quality grades (CHO and CAB) combined with prolonged aging (21 days) resulted in lower thawing losses. Longer aging periods (21 days) resulted in less thawing loss for steaks blade tenderized for 0X or 2X.

A quality grade × blade tenderization pass interaction ($P<0.05$) was observed for cooking time and WBS values. Select steaks blade tenderized 2X had the longest ($P<0.05$) cooking times, while CAB steaks tenderized 1X cooked in the shortest time ($P<0.05$). Blade tenderizing improved ($P<0.05$) WBS of CHO and CAB steaks but not SEL steaks ($P>0.05$). Choice steaks blade tenderized 2X were the most tender, while CAB steaks not blade tenderized were the toughest.

For foodservice, a WBS value of 8.6 lbs. or less has been used as a threshold for a rating of at least “slightly tender.” All SEL steaks aged 21 days and blade tenderized 2X and CAB steaks aged 21 days and blade tenderized 1X or 2X had WBS values below 8.6 lbs (Table 3). All choice steaks aged 14 days and blade tenderized 2X had WBS values below 8.6 lbs. While not conclusive, retailers could maximize the probability of “slightly tender” steaks by utilizing higher quality steaks, aged for at least 21 days, and blade tenderized 2X. Purveyors can use postmortem aging and blade tenderization technologies to increase the acceptability of BF steaks. However, steaks from the BF were tougher than steaks originating from the GM (KSU Cattleman’s Day, 2000) in all treatments. Because postmortem aging and blade tenderization technologies fail to increase the tenderness of the BF muscles to a level equal to the GM, removing the BF to reduce the variation in tenderness of top sirloin butt steaks is still recommended.

Table 1. Thawing Losses (TL), Cooking Losses (CL), Cooking Time (CT), and Warner-Bratzler Shear Force (WBS) Means of Biceps Femoris Steaks of Different Quality Grades, Aging Periods, and Blade Tenderization Passes

	USDA Quality Grade ^a			Aging Period		Blade Tenderization			SE
	SEL	CHO	CAB	14	21	0X	1X	2X	
TL, % ^b	* ^d	*	*	*	*	*	*	*	*
CL, %	30.4	29.1	28.6	29.9	29.8	30.2	28.2	29.7	0.67
CT, ^c Min/100 g	* ^d	*	*	14.7	14.6	*	*	*	0.57
WBS, kg ^c	*	*	*	3.51	3.47	*	*	*	0.08

^aQuality Grades (SEL=Select, CHO=Choice, CAB=Certified Angus BeefTM); Blade Tenderization (0X= Not blade tenderized, 1X=Blade tenderized one time, 2X=Blade tenderized two times).

^bQuality Grade × Postmortem Aging Period and Blade Tenderization Pass × Postmortem Aging Period interactions.

^cQuality Grade × Blade Tenderization Pass interaction.

^dInteraction means are presented on Table 2.

Table 2. Thawing Loss (TL), Cooking Time (CT), and Warner-Bratzler Shear Force (WBS) Means of Biceps Femoris Steaks as Affected by Interactions (P<0.05) of Quality Grade, Aging Period, and Blade Tenderization Passes^d

	Quality Grade × Postmortem Aging Period						SE
	SEL		CHO		CAB		
	14 days	21 days	14 days	21 days	14 days	21 days	
	14 days	21 days	14 days	21 days	14 days	21 days	
TL, %	6.74 ^b	6.70 ^b	6.16 ^b	4.87 ^a	6.40 ^b	4.69 ^a	0.31

	Postmortem Aging × Blade Tenderization Passes						
	14 days			21 days			
	0X	1X	2X	0X	1X	2X	SE
TL, %	7.10 ^c	5.95 ^{abc}	6.24 ^{bc}	5.28 ^a	5.70 ^{ab}	5.27 ^a	0.31

	Quality Grade × Blade Tenderization Passes									SE
	SEL			CHO			CAB			
	0X	1X	2X	0X	1X	2X	0X	1X	2X	
CT, Min/100 g	14.13 ^{ab}	15.10 ^b	18.94 ^c	15.06 ^b	14.99 ^b	12.27 ^{ab}	13.00 ^{ab}	11.48 ^a	12.27 ^{ab}	1.19
WBS, kg	3.43 ^{bc}	3.69 ^{bc}	3.66 ^{bc}	3.68 ^{bc}	3.54 ^{bc}	2.95 ^a	3.84 ^c	3.33 ^{ab}	3.27 ^{ab}	0.17

^{a,b,c} Means within a row with different superscripts differ (P<0.05).

^dQuality Grades (SEL=Select, CHO=Choice, CAB=Certified Angus BeefTM); Blade Tenderization (0X=not blade tenderized, 1X=blade tenderized one time, 2X=blade tenderized two times).

Table 3. Percent of “Slightly Tender” Steaks with Warner-Bratzler Shear Force (WBS) Values Below 8.6 Lbs

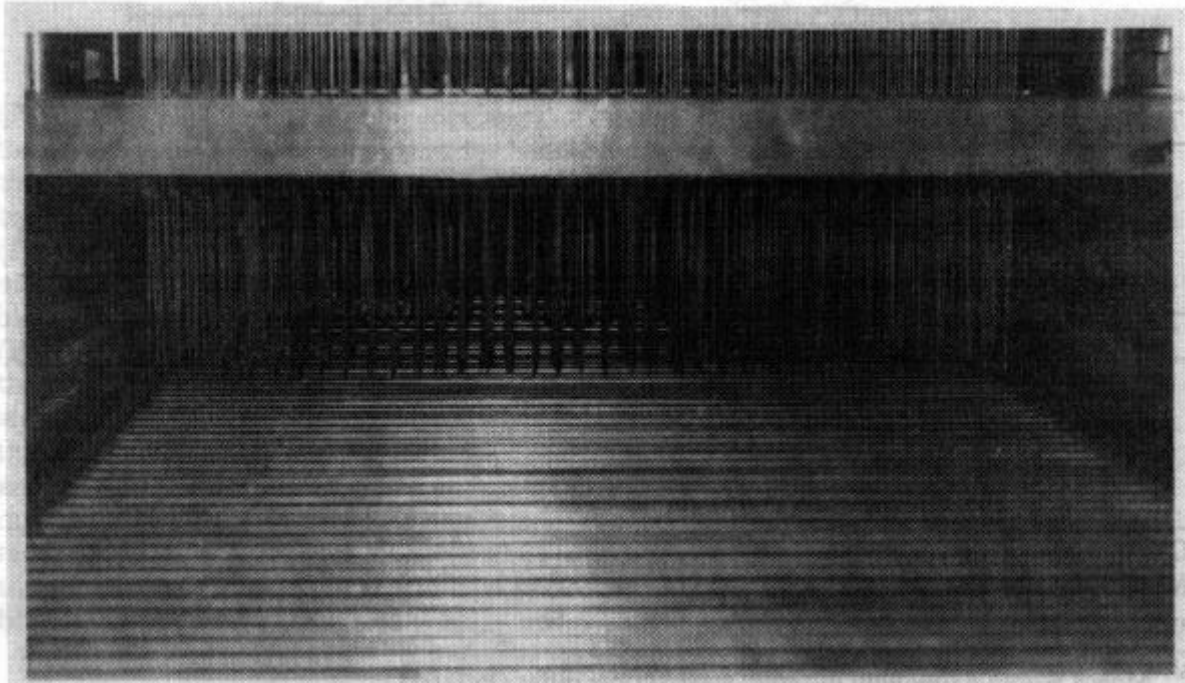
B l a d e	Passes ^b	SEL ^a		CHO		CAB		Total
		14 ^c	21	14	21	14	21	
0X	83 ^d	83		50	50	67	33	22
1x	67	83		83	67	67	100	28
2x	67	100		100	83	83	100	32
Total	72	89		78	67	72	78	76

^aSEL=Select, CHO=Choice, CAB=Certified Angus Beef Program*.

^b0X=Not blade tenderized, 1X=Blade tenderized once, 2X=Blade tenderized twice.

^cAging period

^dn=6 for each cell, total of 108 steaks is represented in this table.



During blade tenderization, meat is carried under the blades and the blades move up and down, penetrating the meat. During a single pass, the blades make about 35 penetrations per square inch.