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Abstract

We used 162 strip loins to determine the influence of different quality grades, aging periods, blade tenderization passes, and degree of doneness on thawing and cooking loss and Warner-Bratzler shear force (WBS, tenderness). Select (SEL), Choice (CHO), and Certified Angus Beef™ (CAB) strip loins were aged for 7, 14, or 21 days and not tenderized (0X) or blade tenderized one (1X) or two (2X) times. Steaks from each strip loin were assigned randomly to final endpoint cooking temperatures of 150, 160, and 170°F. For steaks aged 7 days, all quality grade and blade tenderization treatments had similar ($P>.05$) WBS. For steaks aged 14 days, CHO steaks had lower ($P<.05$) WBS than SEL steaks, CAB tended ($P=.07$) to have lower WBS than SEL, 2X steaks had lower ($P<.05$) WBS than 1X steaks, and 1X steaks had lower ($P<.05$) WBS than 0X steaks. For steaks aged 21 days, CAB steaks had lower ($P<.05$) WBS than CHO steaks, CHO steaks had lower ($P<.05$) WBS than SEL steaks, and 2X steaks had lower ($P<.05$) WBS than 1X steaks. Among the 0X and 2X groups, CAB and CHO steaks had lower ($P<.05$) WBS than SEL steaks. For the 1X group, only CAB steaks had lower ($P<.05$) WBS than SEL steaks. Blade tenderization improved tenderness of strip steaks but should be combined with high quality grades, increased aging, and lower endpoint cooking temperatures to achieve maximum tenderness.

Keywords

Cattlemen's Day, 2000; Kansas Agricultural Experiment Station contribution; no. 00-287-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 850; Beef; Tenderness; Blade tenderization; Aging; Quality grade

EFFECTS OF QUALITY GRADE, AGING PERIOD, BLADE TENDERIZATION, AND DEGREE OF DONENESS ON TENDERNESS OF STRIP LOIN

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Summary

We used 162 strip loins to determine the influence of different quality grades, aging periods, blade tenderization passes, and degree of doneness on thawing and cooking loss and Warner-Bratzler shear force (WBS, tenderness). Select (SEL), Choice (CHO), and Certified Angus Beef™ (CAB) strip loins were aged for 7, 14, or 21 days and not tenderized (0X) or blade tenderized one (1X) or two (2X) times. Steaks from each strip loin were assigned randomly to final endpoint cooking temperatures of 150, 160, and 170°F. For steaks aged 7 days, all quality grade and blade tenderization treatments had similar (P>.05) WBS. For steaks aged 14 days, CHO steaks had lower (P<.05) WBS than SEL steaks, CAB tended (P=.07) to have lower WBS than SEL, 2X steaks had lower (P<.05) WBS than 1X steaks, and 1X steaks had lower (P<.05) WBS than 0X steaks. For steaks aged 21 days, CAB steaks had lower (P<.05) WBS than CHO steaks, CHO steaks had lower (P<.05) WBS than SEL steaks, and 2X steaks had lower (P<.05) WBS than 1X steaks. Among the 0X and 2X groups, CAB and CHO steaks had lower (P<.05) WBS than SEL steaks. For the 1X group, only CAB steaks had lower (P<.05) WBS than SEL steaks. Blade tenderization improved tenderness of strip steaks but should be combined with high quality grades, increased aging, and lower endpoint cooking temperatures to achieve maximum tenderness.

(Key Words: Beef, Tenderness, Blade Tenderization, Aging, Quality Grade.)

Introduction

Tenderness is one of the most important palatability factors to beef consumers. Inconsistent and inadequate tenderness is a major concern of the beef industry. A challenge of the industry is to incorporate technologies that reduce variation and improve tenderness. Different quality grades, aging periods, blade tenderization passes, and endpoint cooking temperatures can affect tenderness. Our objective was to determine the influence of these variables on tenderness of strip loin steaks.

Experimental Procedures

We purchased 162 strip loins (IMPS 180) from a commercial packing facility, 54 USDA Select (SEL), 54 USDA Choice (CHO), and 54 Certified Angus Beef (CAB). They were aged for approximately 7, 14, or 21days at 32 to 34°F. After aging, strip loins were not tenderized (0X) or passed through a blade tenderizer (model T7001, Ross Industries Inc., Midland, VA) one (1X) or two (2X) times, then wrapped in film and crust frozen at -35°F for 30 to 40 min in a spiral freezer. Strip loins were cut into 1-inch- thick strip loin (longissimus muscle) steaks, individually vacuum packaged, and frozen for 30 to 40 min at -35°F in the spiral freezer. Frozen steaks were transported to the Kansas State University Meat Laboratory and stored at -20°F until analysis.

Steaks from each strip loin were assigned to endpoint cooking temperatures of 150, 160 and 170°F, representing medium rare, medium, and well done. Steaks were thawed for 24 hours at 37°F and cooked in a Blodgett dual-air-flow gas convection oven preheated to 325°F. Temperature was monitored by 30-gauge, type-T thermocouples inserted into the geometric center of steaks and attached to a temperature recorder. After cooking, steaks were stored overnight at 37°F. A minimum of six 1/2-inch-diameter cores were taken parallel to the muscle fiber orientation. Cores were sheared perpendicular to the muscle fiber orientation using an Instron Universal Testing Machine with a V-shaped blade on a Warner-Bratzler Shear (WBS) attachment. Thaw weight loss was analyzed as a 3×3×3 factorial design using the GLM procedure of SAS (1998). Cooking loss and WBS were analyzed as a 3×3×3 factorial design with a split plot using the Mixed procedure of SAS (1998). Main effects were grade, aging period, and blade tenderization passes with endpoint cooking temperature serving as the split plot. All interaction and main effect means were separated (P<.05) using the Least Significant Difference procedure when the respective F-tests were significant (P<.05).

Results and Discussion

Percentages of thawing loss were slightly higher (P<.05) for SEL steaks than CHO or CAB steaks and for steaks aged for 14 days than 7 and 21 days (data not shown). As endpoint temperature increased (Table 1), percentage of cooking loss increased (P<.05). A quality grade × blade tenderization interaction (P<.05) was observed for cooking loss (Table 2). For CAB steaks, steaks blade tenderized 2X had more (P<.05) cooking loss than steaks blade tenderized 1X and tended to have more (P=.05) cooking loss than untenderized steaks. However, number of passes through the blade tenderizer did not (P>.05) influence cooking loss for SEL and CHO steaks. For the 0X group, CHO steaks had more (P<.05) cooking loss than CAB steaks. For the 1X group, SEL and CHO steaks had more (P<.05) cooking loss than CAB steaks. For the 2X group, SEL steaks had more (P<.05) cooking loss than CHO steaks.

Interactions (P<.05) of USDA quality grade × blade tenderization × aging period, and aging period × blade tenderization (Table 2) were observed for WBS. Select steaks had similar (P>.05) WBS values regardless of treatment. Choice steaks blade tenderized 2X had lower (P<.05) WBS values than CHO steaks not tenderized or blade tenderized 1X. Furthermore, CAB steaks blade tenderized 2X had lower (P<.05) WBS values than CAB steaks not tenderized and tended (P=.08) to have lower WBS values than those tenderized 1X. Overall, CAB and CHO steaks blade tenderized 2X had lower (more tender) WBS values (<2.8 kg) than the other quality grade × blade tenderization combinations.

For steaks aged 7 days, WBS values were similar (P>.05) among all quality grades. For steaks aged 14 days, CHO steaks had lower (P<.05) WBS values than SEL steaks, and CAB steaks tended (P=.07) to have lower WBS values than SEL steaks. Finally, for steaks aged 21 days, CAB steaks had lower (P<.05) WBS values than either CHO or SEL, and CHO steaks had lower (P<.05) WBS values than SEL steaks. The CAB steaks aged 21days had the lowest (most tender, P<.05) WBS values compared to all other quality grade × aging period means. Only the CAB and CHO steaks aged for 21 days had WBS values less than 6.6 lbs (3 kg). Overall, the higher quality grade steaks aged for 21 days had the highest probability of being tender.

Steaks aged 7 days had similar (P>.05) WBS values for all treatments. For steaks aged 14 days, the 2X group had lower (P<.05) WBS values than the 0X and 1X groups, and the 1X group had lower (P<.05) WBS values than the 0X group. For steaks aged 21 days, the 2X group had lower (P<.05) WBS values than the 1X group. Overall, the improvement in WBS for increased blade tenderization was observed only for steaks aged 14 days. However, steaks blade tenderized 2X and aged for 21 days had the lowest (most tender) WBS mean.

As endpoint cooking temperature increased (Table 1), WBS values increased (P<.05). Our results indicate a strong relationship between increasing endpoint cooking temperature and increased toughness of strip steaks. When muscle is heated, the muscle fibers shrink and become tougher.

A WBS value of 6.6 lbs (3 kg) or less will have a 100% consumer acceptance rating for tenderness. Certified Angus Beef™ steaks aged 21 days and blade tenderized 2X included only one above 6.6 lbs (3 kg) at any endpoint temperature studied (Table 3). High quality (CAB) combined with longer aging (21 days) and also high quality grades (CHO and CAB) combined with blade tenderizing 2X maximized tenderness of loin strip steaks. Purveyors could select CAB strip loins, age them for at least 21 days, and blade tenderize them 2X to guarantee tenderness. This combination could justify an "always tender" statement on the product.

Table 1. Cooking Loss and Warner-Bratzler Shear (WBS) Force Means of Strip Loin Steaks at Different Endpoint Cooking Temperatures

Item	Endpoint Cooking Temperature, °F			
	150	160	170	SE
Cooking loss, %	20.34^{b}	24.13^{c}	29.71^{d}	.27
WBS, kg	2.74^{b}	3.04^{c}	3.41^{d}	.05

[a]Blade tenderization*endpoint cooking temperature interaction.

[b,c,d]Means within a row with different superscripts differ (P<.05).

Table 2. Cooking Loss (CL) and Warner-Bratzler Shear (WBS) Means of Strip Loin Steaks as Affected by Interactions (P<.05) of Different Quality Grades, Aging Periods, and Blade Tenderization Passes[a]

	Quality Grade / Blade Tenderization Passes									
	SEL			CHO			CAB			
Item	0X	1X	2X	0X	1X	2X	0X	1X	2X	SE
CL, %	24.6^{cdef}	25.5^{ef}	25.7^{f}	25.4^{ef}	24.9^{def}	24.2^{cde}	23.8^{cd}	23.2^{c}	25.2^{def}	.52
WBS, kg	3.27^{g}	3.24^{fg}	3.28^{g}	3.02^{ef}	3.20^{ef}	2.72^{c}	3.06^{ef}	2.98^{de}	2.77^{cd}	.09
	Quality Grade / Aging Period									
	SEL			CHO			CAB			
	7 d	14 d	21 d	7 d	14 d	21 d	7 d	14 d	21 d	SE
WBS, kg	3.10^{e}	3.36^{f}	3.33^{f}	3.01^{de}	3.10^{e}	2.82^{d}	3.07^{e}	3.14^{ef}	2.59^{c}	.09
	Aging Period / Blade Tenderization Passes									
	7 days			14 days			21 days			
	0X	1X	2X	0X	1X	2X	0X	1X	2X	SE
WBS, kg	2.95^{cd}	3.12^{de}	3.11^{de}	3.49^{f}	3.20^{e}	2.92^{cd}	2.91^{cd}	3.10^{de}	2.74^{c}	.09

[a]Quality Grades (SEL=Select, CHO=Choice, CAB=Certified Angus Beef™); Blade Tenderization (0X=not blade tenderized, 1X=blade tenderized one time, 2X=blade tenderized two times).

[c,d,e,f,g]Means within a row with different superscripts differ (P<.05).

Table 3. Number of Strip Loin Steaks with Warner-Bratzler Shear Force Values Greater than 6.6 lbs (3 kg)

Blade	Cooked	SEL[a]			CHO			CAB			
Tend.[b]	Temp., °F	7[c]	14	21	7	14	21	7	14	21	Total
OX	150	2[d]	4	2	3	3	1	2	3	1	21
	160	2	6	5	2	2	1	4	4	0	26
	170	2	6	5	4	6	3	2	6	2	36
1X	150	3	2	3	2	2	2	2	1	1	18
	160	3	4	4	2	5	4	4	4	1	31
	170	5	5	6	3	5	6	4	4	2	40
2X	150	1	2	2	1	0	0	3	1	0	10
	160	4	4	4	2	1	1	3	1	0	20
	170	4	5	4	4	4	3	5	3	1	33
Total		26	38	35	23	28	21	29	27	8	235

[a]SEL=Select, CHO=Choice, CAB=Certified Angus Beef Program™.

[b]0X=Not blade tenderized, 1X=Blade tenderized once, 2X=Blade tenderized twice.

[c]Aging Days.

[d]n=6 for each cell; a total of 486 steaks is represented in this table.