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## CHARACTERIZATION OF CERTIFIED ANGUS BEEF STEAKS FROM THE ROUND, LOIN AND CHUCK

Pages 24-31

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### **Story in Brief**

Beef carcasses comprising three quality levels (Certified Angus Beef, U.S. Choice and U.S. Select) were randomly selected to determine the effects of quality level on palatability of end meat cuts. Steaks from six like subprimals per carcass were cooked and evaluated using Warner-Bratzler shear force and trained sensory panelists as indicators of overall tenderness and palatability, respectively. Steaks from Select carcasses were more variable in Warner-Bratzler shear force than Certified Angus Beef and Choice steaks, while sensory evaluation indicated that Certified Angus Beef and Choice steaks were generally more juicy, had more pronounced beef fat flavor and had more intense flavor than Select steaks. Data from Warner-Bratzler shear force and sensory evaluation suggest that marbling appears to be more influential on the tenderness of middle meat cuts than that of end meat cuts.

Key Words: Quality Grade, Tenderness, Certified Angus Beef

### **Introduction**

For nearly 25 years it has been repeatedly established that consumers place strong emphasis on tenderness when determining the "quality" of a cooked beef steak (Forbes et al., 1974; Savell et al., 1987, 1989). More recently, it was documented that consumers are willing to pay a premium for beef that is "guaranteed tender" (Boleman et al., 1997). Data from the National Beef Quality Audit (NCA, 1996) indicate that carcasses are leaner and are producing potentially less palatable products. Excluding various changes in genetics and management practices, the new target for producing leaner beef has been partially attributed to the demands of a more health-conscious society. The beef industry fears that increasing leanness will contribute to decreases in palatability; eliminating "waste" while sacrificing "taste". Hence, to remain competitive with other food protein sources, an objective of the beef industry must be to provide a uniform, tender product to consumers that will result in pleasant eating experiences.

The need for this objective was substantiated by results of the 1995 National Beef Quality Audit. Low overall consistency, inadequate tenderness and low overall palatability were the top three "quality" concerns noted by beef purveyors, restaurateurs, retailers and packers surveyed in the audit (NCA, 1996). Transitions from thick roast to thin steak cuts of the chuck and round could increase toughness and decrease consumer satisfaction (Morgan et al.,

1991). Data from the National Livestock and Meat Board indicate that steaks from carcasses with U.S. quality grades of at least Average Choice generally were more desirable than steaks from lower quality grading carcasses. These findings combined with the evidence that increased marbling degrees provide beef with "insurance" against drying out or being less tender when cooked to higher degrees of doneness (Smith and Carpenter, 1974) provides part of the basis for the Certified Angus Beef Program □ one of the most well known branded beef programs.

Boneless, closely trimmed beef subprimals from the round and chuck account for 21.4% of carcass weight, yet these same subprimals represent 26.6% of the total carcass value (Dolezal, 1998). The potential exists to increase value of beef carcasses by identifying carcass characteristics that yield more palatable end cuts. Currently there is limited data relative to palatability of end cuts. The current research was conducted to 1) determine base-line tenderness values and sensory panel ratings, 2) assess variation in tenderness, and 3) compare the mean values and variation for tenderness and sensory characteristics among Certified Angus Beef, U.S. Choice (commodity) and U.S. Select steaks from the round, loin and chuck.

### Materials and Methods

**Sample Collection.** Carcasses (n=150) from steers of unknown origin were selected randomly over a 6-mo period at a commercial meat processing facility. Fifty Certified Angus Beef (CAB), U.S. Choice (Choice) and U.S. Select (Select) carcasses were selected to represent the yield grade by quality grade distribution reported in the National Beef Quality Audit (NCA, 1996). Following carcass data collection, six subprimals comprised of the clod or *triceps brachii* (IMPS 114), strip loin or *longissimus dorsi* (IMPS 180), top sirloin butt or *gluteus medius* (IMPS 184), inside round or *semitendinosus* (IMPS 168), round flat or *biceps femoris* (IMPS 171a), and knuckle or *quadriceps femoris* complex (IMPS 167a) (USDA, 1996) from the left carcass side were removed, vacuum packaged, and aged 14 d postmortem at approximately 2°C. Subsequent to the aging period, three 2.54 cm steaks were removed from each subprimal and assigned to Warner-Bratzler shear force determination or sensory panel evaluation. Samples were subsequently stored at □28°C.

**Warner-Bratzler Shear Force.** Steaks were assigned randomly to a cooking order within subprimal. Seventy-five steaks were allowed to temper daily at 4°C 24 h prior to broiling in an impingement oven at 180°C to an internal temperature of 70°C. After steaks were cooled for at least 2 h to 25°C, a minimum of six cores (1.27 cm diameter) were removed parallel to the muscle fiber orientation and sheared once using a Warner-Bratzler head attached to an Instron Universal Testing Machine. The peak load (kg) of the cores was recorded and analyzed.

**Sensory Analysis.** Seventeen panel members were trained for sensory analysis as outlined by American Meat Science Association (1995). Subprimal sensory ratings were obtained in the order of strip loin, clod, inside round, knuckle, round flat and top sirloin butt. Steaks were assigned randomly to a cooking order within subprimal. No more than 16 steaks per day were tempered at 4°C 24 h prior to broiling similar to steaks used for shear force determinations. Two cubed sections (1.3 cm x 1.3 cm x cooked steak thickness) from each steak were served warm to the panelists and the average score for each section was recorded.

**Statistical Analysis.** Data were analyzed by least squares analysis of variance as a split-plot design. Quality level served as the main plot with ID within quality level as the appropriate error term. Subprimal and quality level by subprimal served as the subplot with residual error as the appropriate error term. Tenderness variances not homogeneous for quality level or subprimal effects were identified using the Levenes test and analyzed using least squares analysis of variance.

## Results and Discussion

**Carcass Characteristics and Meat Traits.** Carcass data are presented in Table 1. By design, marbling score differed ( $P < .05$ ) among quality levels. Certified Angus Beef carcasses were slightly fatter and consequently had a higher ( $P < .05$ ) numeric yield grade than Select carcasses. Certified Angus Beef and Choice carcasses had more youthful lean maturity scores than Select carcasses, however overall maturity was similar ( $P > .05$ ) among quality levels. No differences ( $P > .05$ ) in carcass weight, ribeye area or percentage kidney, pelvic and heart fat were observed when stratified by quality level.

**Warner-Bratzler Shear Force.** A significant ( $P < .05$ ) quality level by subprimal interaction was observed for Warner-Bratzler shear force (Figure 1). With the exception of one quality level and subprimal combination (Choice clod), the strip loin was the most tender subprimal. Within the strip loin, all quality levels differed ( $P < .05$ ); CAB was the most tender, Select was the least tender, and Choice was intermediate. In a similar study, Claborn (1996) reported Certified Angus Beef strip loin steaks to be more tender than U.S. Choice and U.S. Select strip loin steaks. Steaks from Select carcasses in the present study were more variable in shear force ( $P < .05$ ) than either CAB or Choice steaks, which agrees with previous data where Warner-Bratzler shear values increased in variability as marbling score decreased (Smith et al., 1984). Within the top sirloin butt, CAB steaks had lower ( $P < .05$ ) shear force values than either Choice or Select which were similar ( $P > .05$ ). Select steaks from the clod and flat had higher ( $P < .05$ ) shear force values than steaks from either CAB or Choice carcasses; no differences ( $P > .05$ ) were noted between CAB and Choice for these two subprimals. Knuckle steaks of Choice quality were more tender than those

from Select; CAB knuckle steaks were intermediate and did not differ ( $P>.05$ ) from either Choice or Select. No differences ( $P>.05$ ) were observed in shear force for inside round steaks regardless of quality level. Among the six subprimals, the strip loin was the most variable and the knuckle was the most consistent in shear force. The inside round, round flat, top sirloin butt and clod were intermediate and did not differ ( $P>.05$ ) in Warner-Bratzler shear force variability.

**Sensory Analysis.** A significant ( $P<.05$ ) quality level by subprimal interaction was observed for overall tenderness (Figure 2). Strip loin steaks were rated more ( $P<.05$ ) tender than all other subprimals. Within the strip loin subprimal, CAB steaks were the most tender ( $P<.05$ ), Select steaks were the least tender ( $P<.05$ ) and Choice steaks were intermediate ( $P<.05$ ), yet means for all quality levels were within the "slightly tender" category. Claborn (1996) found Certified Angus Beef strip loin steaks to be superior in sensory panel tenderness when compared with U.S. Choice and U.S. Select strip loin steaks. For the present study, CAB and Choice clod steaks did not differ ( $P<.05$ ), but were more tender than all other steaks from the top sirloin butt, inside round, and flat, and were more tender than CAB and Select knuckle steaks. CAB and Choice knuckle steaks had higher ( $P<.05$ ) tenderness scores than Select knuckle steaks, and CAB and Choice knuckle steaks were more tender than top butt, inside round and flat steaks across all quality levels. Overall tenderness differences for the top butt and inside round subprimals were minimal. No differences ( $P>.05$ ) were noted among quality levels within the top butt subprimal, although numerically, CAB steaks superceded Choice steaks which superceded Select steaks. Within the inside round subprimal, CAB and Select steaks did not differ ( $P>.05$ ) and Select and Choice steaks did not differ ( $P>.05$ ), but CAB inside round steaks were more ( $P<.05$ ) tender than Choice inside round steaks. Steaks from the round flat were the least tender ( $P<.05$ ) of all subprimals. Within the round flat subprimal, quality level did not statistically affect sensory panel overall tenderness scores, although the mean rating for Select flat steaks was in the "moderately tough" category while the mean ratings for CAB and Choice round flat steaks were rated in the "slightly tough" category. Unlike Warner-Bratzler shear force, the sensory panel did not detect differences in tenderness variation due to quality level or subprimal.

Juiciness, beef fat flavor and beef flavor intensity scores were all affected ( $P<.05$ ) by quality level. CAB and Choice steaks had higher ( $P<.05$ ) juiciness, beef fat flavor and beef flavor intensity scores than Select steaks, though no differences were noted between CAB and Choice for these attributes. No differences ( $P>.05$ ) were apparent across quality level for connective tissue amount or off flavors. When all quality levels were pooled, sensory panel attribute differences were most noticeable relative to connective tissue amount; all subprimals differed in the amount of detectable connective tissue. The round flat had the highest connective

tissue amount followed by the inside round, top sirloin butt, knuckle, clod and strip loin. Subprimal effects on juiciness scores were slightly varied from that of tenderness and connective tissue; strip loin steaks had the highest juiciness scores while inside round and top sirloin butt steaks were the driest. Juiciness scores for clod, knuckle and flat steaks were intermediate, but all differed ( $P < .05$ ) in a decreasing manner, respectively.

The present study indicates that steaks from carcasses qualifying for the Certified Angus Beef program generally have improved tenderness and palatability ratings when cooked to a medium degree of doneness ( $70^{\circ}\text{C}$ ). Steaks of at least U.S. Choice quality are less variable in tenderness, even though marbling accounted for a minimal amount of Warner-Bratzler shear and sensory panel tenderness variation. The effect of marbling on tenderness was more evident in middle meat cuts than in end cuts, particularly in the round. Methods alternative to the current quality grading system that identify differences in the tenderness and palatability of end cuts should be explored further.

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### Acknowledgements

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**Table 1. Carcass traits stratified by quality level.**

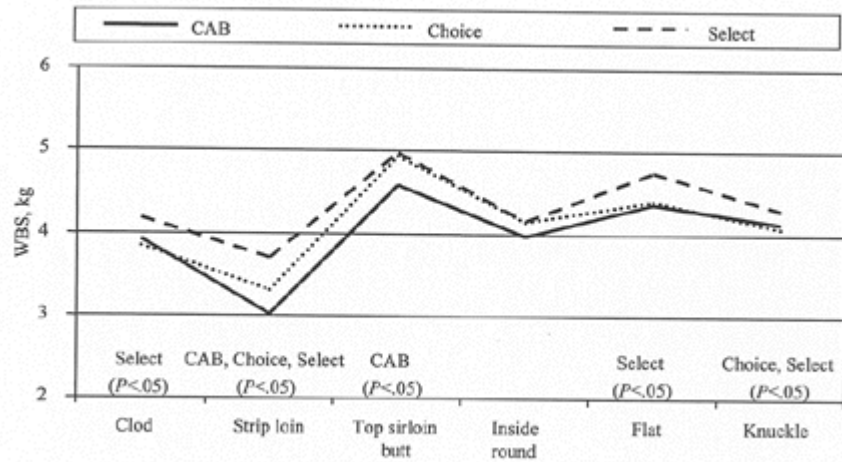
Trait	Quality level			SE
	CAB	Choice	Select	
Number of carcasses	50	50	50	
Carcass maturity <sup>a</sup>				
Skeletal	160.4	155.9	153.3	2.99
Lean	146.9 <sup>d</sup>	148.1 <sup>d</sup>	154.2 <sup>c</sup>	2.17
Overall	153.7	152.0	153.8	2.17
Marbling score <sup>b</sup>	570.3 <sup>c</sup>	480.9 <sup>d</sup>	348.8 <sup>e</sup>	6.00
Quality grade, %				
High Choice	24.0	6.0	--	
Average Choice	76.0	18.0	--	
Low Choice	--	76.0	--	
High Select	--	--	34.0	
Average Select	--	--	28.0	
Low Select	--	--	38.0	
Fat thickness, cm	1.14 <sup>c</sup>	1.07 <sup>c</sup>	.90 <sup>d</sup>	.06
Adjusted fat thickness, cm	1.35 <sup>c</sup>	1.27 <sup>cd</sup>	1.14 <sup>d</sup>	.06
Ribeye area, cm <sup>2</sup>	84.2 <sup>c</sup>	87.2 <sup>cd</sup>	87.5 <sup>d</sup>	1.31
KPH, %	2.3	2.2	2.3	.07
Hot carcass weight, kg	343.7	355.1	343.1	4.17
Yield grade	2.99 <sup>c</sup>	2.84 <sup>cd</sup>	2.62 <sup>d</sup>	.09
1, %	6.0	10.0	20.0	
2, %	46.0	46.0	52.0	
3, %	48.0	44.0	28.0	

<sup>a</sup>Carcass maturity scores: 100-199 = approximately 9 to 30 mo chronological age at time of slaughter (USDA, 1997).

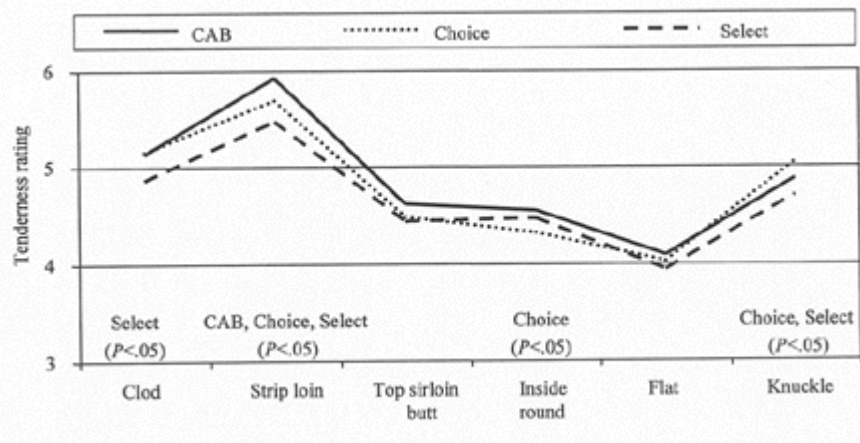
<sup>b</sup>Marbling score: 300-399 = "Slight", the amount required for U.S. Select; 400-499 =

"Small", the amount required for U.S. Low Choice; 500-599 = "Modest", the amount required for U.S. Average Choice (USDA, 1997).

<sup>c,d,e</sup> Means with a common superscript letter in a row do not differ ( $P > .05$ )



**Figure 1.** Warner-Bratzler shear force by quality level and subprimal.



**Figure 2.** Sensory panel overall tenderness ratings by quality level and subprimal.



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[1999 Research Report - Table of Contents](#)

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