January 2008

Mapping Tenderness of the *Serratus Ventralis*

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Summary

*Serratus ventralis muscles from eight USDA Choice and eight Select carcasses were obtained. Samples were enhanced with a marination or left as controls, then blade tenderized once as whole muscles and cut into steaks. Enhanced steaks were then blade tenderized individually. Odd-numbered steaks were cooked, cored, and sheared for Warner-Bratzler (***WBS***) shear force determination. Tenderness was found to vary sporadically throughout the muscle with the posterior end being the most tender, regardless of grade. Enhanced samples produced lower WBS values than controls. The serratus ventralis does respond to enhancement techniques, and steaks could especially be fabricated from the posterior end.*

Introduction

Muscle profiling projects have revealed that many unconventional muscles of the chuck and round have the potential to be marketed as steaks at the retail and restaurant level. One such muscle is the *serratus ventralis* (**SV**), a "fan-shaped" muscle found in the chuck of beef carcasses. The SV has been reported to vary significantly in tenderness randomly throughout the muscle. Also, previous studies have concluded that the SV is not ideal for use as single-muscle steaks, and aging the muscle did not improve tenderness. Marination and mechanical tenderization effects have not been studied in the SV. Therefore, the objectives of this study were to map the tenderness of the SV, examine the effects of marination and mechanical tenderization on the tenderness of this muscle, and evaluate USDA grade effects that might possibly exist.

Procedure

Sample Processing and Data Collection

The left and right side *serratus ventralis* muscles from eight USDA Choice and eight USDA Select carcass were obtained (32 total) from modified arm chucks, with the brisket and shoulder clod removed, that were shipped to the University of Nebraska meat laboratory. *Serratus ventralis* muscles were removed from the chucks. USDA Select carcass muscles were labeled 1 through 8 and left or right side (of the carcass), with the right side of odd-numbered *SV* being pumped and vacuum tumbled with a 12.5% solution containing beef broth, salt, phosphate, and rosemary extract; the left side of odd-numbered muscles were the control. In contrast, the left sides of even-numbered muscles were enhanced with the 12.5% solution, and the right sides were labeled as controls. USDA Choice carcass muscles were labeled 9-16, and followed the same enhancement procedures as the USDA Select muscles.

Both control and enhanced muscles were then blade tenderized once as a whole muscle. All muscles were then cut into halves by a medial cut from dorsal to ventral, splitting the muscles into anterior and posterior halves. The halves were then cut into steaks by lines from anterior to posterior creating 4 to 8 steaks per anterior and posterior halves. All steaks of the enhanced muscles were then blade tenderized individually. After blade tenderizing, all steaks were vacuum packaged and frozen. Odd-numbered steaks from each half were packaged together for the purpose of WBS determination.

Odd-numbered steaks were then cooked to an internal temperature of 158°F on Hamilton Beach grills, covered and allowed to cool to room temperature. After cooling, 0.50 inch diameter cores were removed parallel to the muscle fibers and finally sheared on an Instron Universal Testing Machine with a WBS attachment to obtain shear force values. Cores were taken approximately every inch from anterior to posterior throughout the steak and data was recorded. Cook time, beginning and end temperature, and cook loss were also recorded. Figure 1 shows how the muscles were cut

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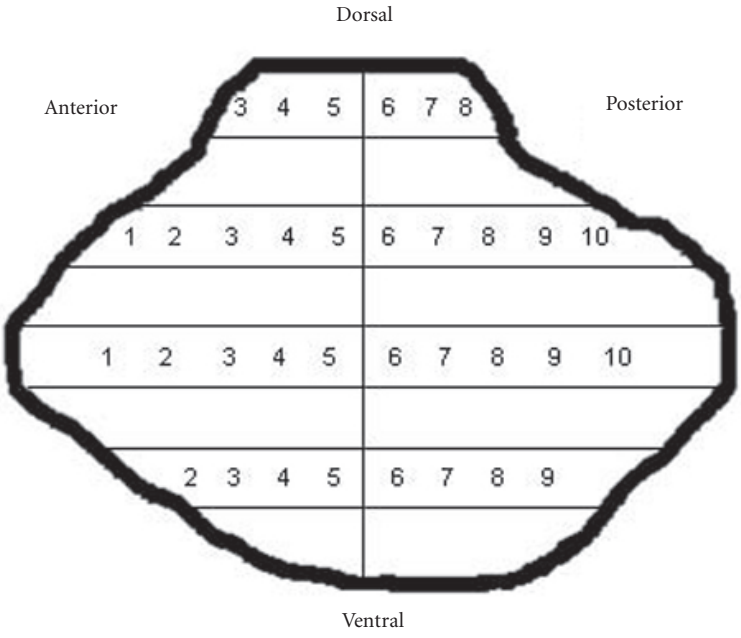

Figure 1. Fabrication of the *Serratus ventralis.*

in half, the steaks were fabricated, and approximately where the cores were obtained.

Statistical Analysis

An analysis of variance (**ANOVA**) using the GLIMMIX procedure of SAS (Version 9.1, Cary, N.C., 2002) was used to analyze the data. Data were blocked by treatment, grade, and steak position. Core location shear force data were analyzed as a split-split-split plot. When indicated significant by ANOVA ($P \leq 0.050$) main effects (grade, treatment, position, and location) were separated using the LSMEANS, DIFF, and LINES functions, while simple effects of interactions were generated using the LSMEANS, SLICE, and SLICEDIFF functions, respectively. Due to minimal observations from core position 1 and 10, those present were dropped from the analysis. Very few muscles produced more than six steaks per half; therefore, those observations were dropped from the analysis. Adjacent core positions were averaged together as follows: 2 and 3; 4 and 5; 6 and 7; 8 and 9.

Results

The WBS values varied sporadically throughout the muscles, partially due to heavy sheets of connective tissues and changing fiber direction. Enhanced samples produced significantly lower WBS values ($P < 0.0001$) than controls, decreasing WBS on average from 8.49 to 6.59 lb. USDA Choice samples showed significant differences between cores regardless of steak position ($P < 0.0001$), with the posterior portions requiring less force to shear. USDA Select muscles showed significant differences between cores only in steak 5 (most ventral) with the most anterior core position resulting in greater shear force values ($P < 0.0001$).

Table 1. Mean shear force values from USDA Choice *Serratus ventralis* muscles.

	Core Location			
Steak Position	2-3	4-5	6-7	8-9
1 (Dorsal)	7.47^{ab}	8.29^{a}	6.33^{b}	6.13^{b}
3 (Medial)	9.50^{a}	7.67^{b}	6.02^{c}	6.31^{bc}
5 (Ventral)	8.91^{a}	8.44^{a}	6.50^{b}	7.39^{ab}

[a,b,c]Means in the same row with different superscripts differ.

Table 2. Mean shear force values from USDA Select *Serratus ventralis* muscles.

	Core Location			
Steak Position	2-3	4-5	6-7	8-9
1 (Dorsal)	7.83^{xy}	7.36	7.23	7.74
3 (Medial)	7.05^{y}	7.21	8.44	7.25
5 (Ventral)	9.59^{ax}	7.91^{b}	7.03^{b}	7.25^{b}

[a,b]Means in the same row with different superscripts differ.
[x,y]Means in the same column with different superscripts differ.

Implications

The *serratus ventralis* responds favorably to enhancement and multiple blade tenderization applications. It appears that steaks could be cut from the posterior portion of the *serratus ventralis*, as this end required less force to shear and WBS values were in the acceptable range. Consumer studies are needed to determine acceptability.

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[2]This project was funded in part, by beef and veal producers and importers through their $1-per-head checkoff and was produced for the Cattlemen's Beef Board and state beef councils by the National Cattlemen's Beef Association.