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Steak-Quality Meat from the Beef Heel

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Summary

*This study was conducted to measure the shear force of beef heel (*m. gastrocnemius*) and to characterize the uncooked m.* gastrocnemius *for pH, water holding capacity, composition, and color. Ten heels were cut into steaks (for grilling) from the proximal to the distal end. Twenty additional heels were separated into lateral and medial portions; half were oven roasted and half were grilled as roasts. The proximal end steak was always less tender than the distal end steak. There were no differences in shear force between lateral and medial sides for any cooking treatment. The lateral side of heel has many connective tissue seams which were carefully avoided during shear force measurement. Heel roasts contained approximately 6% fat, had a pH of 5.59 and a mean shear force around 8.14 lb. Given the connective tissue distribution and tenderness properties, the medial side of the m.* gastrocnemius *appears to be of steak quality.*

Introduction

Beef heel muscle is associated with the extension and relaxation of the hock and stifle joint. The resulting connective tissue content of the m. *gastrocnemius* generally leads people to conclude the muscle is only suitable for grinding. This may be true for the lateral side of the muscle, but the medial side appears to be lean and relatively free of connective tissue seams. In addition, the muscle has not been well characterized chemically. Accordingly, this study was conducted to measure the shear force of beef heel (m. *gastrocnemius*) and to characterize the uncooked m. *gastrocnemius* for pH, water holding capacity, composition, and color.

Procedure

Thirty beef heel muscles were obtained from a commercial packing plant. The m. *digital flexor*, a long, thin, high connective tissue muscle located on the internal side of the m. *gastrocnemius* next to the bone, was removed. Ten heels were cut into steaks (for grilling) from the proximal to the distal end. The center steak was used for chemical characterization and the others were frozen, thawed for 24 hours in a 39°F cooler, and cooked on a Hamilton Beach indoor-outdoor grill, turning over once at 95°F, until they reached an internal temperature of 160°F. Internal temperature was monitored using an OMEGA thermometer with a type T thermocouple. Twenty additional heels were separated into lateral and medial portions; after freezing and thawing, half were oven roasted in a 350°F oven and half were grilled as roasts. Roasts were removed from the oven when the internal temperature reached 158°F, thereby reaching 170°F with the post-cooking rise in temperature. Grilled heel roasts were removed from the grill when the internal temperature reached 158°F, but there was no meaningful post-cooking rise in temperature. After cooking, roasts were allowed to cool at room temperature so dimension and weight could be recorded. They were then chilled in a cooler overnight and sectioned into 1-inch slices. Cores (1/2-inch in diameter) were removed parallel to the fiber axis and sheared on an Instron universal testing machine using a Warner-Bratzler shear attachment. Before coring each steak, pictures were taken to map the fiber direction of the lateral and medial portions of heel muscle. Angles were measured by using a protractor on each steak.

A sample of raw m. *gastrocnemius* was used to test water holding capacity, and a centrifuge method was used at 32,500 × G for 15 min at 4°C to determine the expressible moisture. Color also was measured using a Hunter Lab Miniscan® XE Plus Model 45/0-L colorimeter with a 1-inch sample port, illuminant A, and the 10-degree standard observer settings. The remaining muscle was frozen, powdered in liquid nitrogen, and used for measurement of pH and composition (fat, moisture, and ash). The pH was determined by suspending 3-5 g of powdered meat in 50 mL of double distilled water using a Polytron blender for 30 seconds. Moisture and ash were determined using a LECO Thermogravimetric analyzer. Fat was measured using ether extraction.

Table 1. Warner-Bratzler shear force (lb) of the lateral and medial areas of the heel muscle[1].

	Area		
	Lateral	Medial	*P*-value
Oven roasted heel	9.46	9.08	0.34
Grilled steaks	9.04	8.58	0.41
Grilled heel roast	8.95	8.98	0.98

[1]Areas were similar at the given *P*-values.

Results

When shear force was measured, care was taken to avoid the connective tissue seams, which are quite tough and can elevate the shear force readings. For all three cooking methods, there were no differences between the lateral and medial lean tenderness as measured by Warner-Bratzler shear force (Table 1). We hypothesized that the perceived tenderness of the lateral portion would be lower because of the connective tissue that cannot be avoided during consumption.

For two of the three cooking methods, there was a significant tenderness gradient from the proximal to distal end of the muscle (Table 2). For oven-roasted heels and grilled heel steaks, the proximal end of the muscle was less tender than the distal end. It should be noted that the mean shear force value of m. *gastrocnemius* steaks is about 8.14 lb. It has been reported

(Continued on next page)

Table 2. Warner-Bratzler shear force (lb) of steaks from proximal to the distal end.

	Steaks (from the proximal to the distal)				
	1	2	3	4	*P*-value
Oven roasted heels	10.23[a]	9.22[ab]	9.02[b]	8.65[b]	0.04
Grilled steaks	10.74[a]	8.21[b]	8.18[b]	8.14[b]	0.006
Grilled heel roasts[1]	9.28[a]	9.13[a]	9.04[a]	—	0.73

[a,b]Means in the same row having different superscripts are significant at their *P*-values.
[1]Only 3 steaks were obtained from grilled heel roast.

Table 3. Chemical composition (percentage) of beef heel (m. *gastrocnemius*).

	Area		
	Lateral	Medial	*P*-value
WHC[1]	37.52	37.13	0.83
pH	5.56	5.61	0.22
Fat	6.33	5.92	0.46
Ash	2.42	2.51	0.57
Moisture	73.41	73.29	0.76

[1]WHC = water holding capacity.

Table 4. Objective color of lateral and medial areas of uncooked heels (m. *gastrocnemius*).

	Area		
	Lateral	Medial	*P*-value
L* (lightness)	35.70	33.93	0.06
a* (redness)	23.96[b]	25.36[a]	0.03
b* (yellowness)	18.49	19.42	0.17

[a,b]Means having different superscripts within are different.

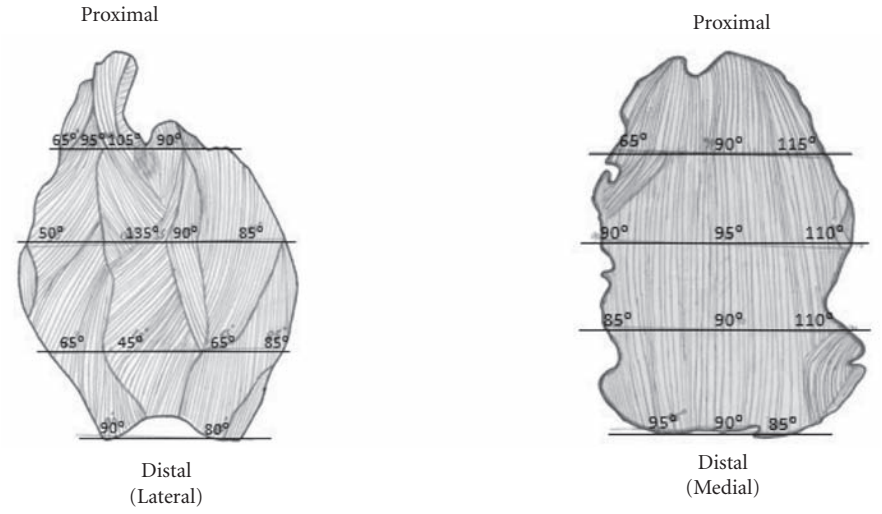

Figure 1. Fiber direction of lateral and medial areas of heels (m. *gastrocnemius*).

that the WBSF values for tenderness levels are described as "tender" for <8.47 lb, "intermediate" ranges from 8.47 to 10.75 lb, and "tough" for >10.75 lb (Von Seggern et al., 2005, *Meat Science*, 71: 39-51). Thus, the m. *gastrocnemius* appears to be acceptably tender for steak. This represents a significant value-added option for the beef heel.

Generally the m. *gastrocnemius* is about 6% fat and has a pH value of 5.6 (Table 3). Both of these values are in the normal range for beef cuts. Similarly, the water holding capacity of the heel seems to fall within the normal range. These data suggest the m. *gastrocnemius* could be used for a lean steak item that would have properties comparable to traditional steak meats.

Fiber angles from the medial portion of heels were somewhat consistent among steaks, but those measured from the lateral portions of heels were quite variable. The muscle fibers appear to be originating from each connective tissue lining in the lateral portion, so there is no regular fibrous structure (Figure 1).

The lateral portion of the raw heel is less red in color than the medial portion (Table 4). It may be that the connective tissue seams located in this region of the muscle contribute to the less intense red color.

Conclusion

Taken collectively, the results of this study indicate the medial side of the m. *gastrocnemius* found within the beef heel is of steak quality in tenderness, which represents a significant value-added opportunity for the heel.

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