Kansas Agricultural Experiment Station Research Reports

Volume 4
Issue 1 *Cattlemen's Day*

Article 20

2018

# Relationship of Myofibrillar Fragmentation Index to Warner-Bratzler Shear Force and Palatability Tenderness of Longissimus Lumborum and Semitendinosus Steaks

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# Relationship of Myofibrillar Fragmentation Index to Warner-Bratzler Shear Force and Palatability Tenderness of Longissimus Lumborum and Semitendinosus Steaks

**Abstract**

**Objective:** The objective of this study was to determine the relationship between the myofibrillar fragmentation index, Warner-Bratzler shear force and sensory traits of *longissimus lumborum* (strip loin), and the *semitendinosus* (eye of round) steaks.

**Study Description:** Forty beef strip loins and 40 eye of rounds were collected, divided into anatomical location, and cut into steaks. Steaks used for Warner-Bratzler shear force and sensory panel review were cooked to 160°F. For Warner-Bratzler, six 1-in cores were sheared with a Warner-Bratzler shear head. Sensory steaks were served to panelists trained according to American Meat Science Association guidelines for sensory evaluation. Procedures described by Culler et al. (1978) were used to determine myofibrillar fragmentation index.

**The Bottom Line:** The correlation between myofibrillar fragmentation index, Warner-Bratzler shear force, and sensory measures of tenderness were weak, indicating myofibrillar fragmentation index was not a reliable indicator of beef tenderness for the muscles evaluated.

**Keywords**

beef, myofibrillar fragmentation index, tenderness



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K-STATE Research and Extension

CATTLEMEN'S DAY 2018

# Relationship of Myofibrillar Fragmentation Index to Warner-Bratzler Shear Force and Palatability Tenderness of *Longissimus Lumborum* and *Semitendinosus* Steaks

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## Introduction

In the beef industry, tenderness, juiciness, and flavor are associated with beef palatability and overall eating experience (Smith and Carpenter, 1974). The odds of overall palatability failing when tenderness is acceptable is 10%, whereas the odds of overall palatability failing when tenderness is unacceptable is 69% (O'Quinn et al., 2016). The industry always strives to improve beef quality and palatability; thus, it is important to study tenderness in order to improve consumer satisfaction. Myofibrillar fragmentation index is a measure of tenderness that has previously been associated with sensory tenderness ratings (Olson et al., 1977). However, to our knowledge, little research has evaluated myofibrillar fragmentation differences within and between muscles. Therefore, the objective of this study was to determine the correlation between the myofibrillar fragmentation index, Warner-Bratzler shear force, and sensory traits of strip loins (*longissimus lumborum*) and the eye of round (*semitendinosus*) steaks.

## Experimental Procedures

Forty beef strip loins (Institutional Meat Purchase Specifications #180) and 40 eye of rounds (Institutional Meat Purchase Specifications #171C) were collected from a Midwest beef processor and transported to the Kansas State University Meats Laboratory, Manhattan, KS. Sub-primals were divided into anatomical location (anterior, medial, and posterior for *longissiumus lumborum*; proximal and distal for *semitendinosus*) and cut into three 1-in thick steaks and aged 14 days. Within location, steaks were randomly assigned to Warner-Bratzler shear force, trained sensory panel evaluation, or myofibrillar fragmentation index analysis. Steaks used for Warner-Bratzler shear force and the trained sensory panel review were cooked to an internal temperature of 160°F on electric clamshell grills (Cuisinart Griddler Deluxe, Cuisinart, East Windsor, NJ). Steaks used for Warner-Bratzler shear force were chilled overnight at 40°F, and six 0.4-in cores were removed parallel to the orientation of the muscle fiber and sheared once perpendicular to the muscle fiber orientation through the center using an Instron testing machine (Model 5569, Instron Corp., Norwood, MA) with a Warner-Bratzler shear head. Sensory panel steaks were cut into 0.5 × 0.5 × 1-in cubes

and immediately served to sensory panelists trained following American Meat Science Association guidelines for sensory evaluation (2016). Myofibrillar fragmentation index was determined using procedures described by Culler et al. (1978). Data were analyzed as a completely randomized design with muscle as the fixed effect. Sub-primal location data were analyzed independent of muscle and as a completely randomized design with anatomical location as the fixed effect.

## Results and Discussion

When comparing muscles, there were muscle differences ($P<0.05$) for all variables measured as shown in Table 1 except for off-flavor intensity. Steaks from *longissimus lumborum* had lower ($P<0.05$)Warner-Bratzler shear force, sensory panel connective tissue amount, and myofibrillar fragmentation index values than *semitendinosus* steaks. Additionally, *longissimus lumborum* steaks had higher ($P<0.05$) myofibrillar tenderness and overall tenderness sensory panel scores. There were location effects ($P<0.05$) for sensory and Warner-Bratzler shear force values of both muscles. Warner-Bratzler shear force values of all three locations within the *longissimus lumborum* were different ($P<0.05$) from one another (Table 2). Panelists rated anterior steaks higher ($P<0.05$) for myofibrillar and overall tenderness than middle and posterior steaks, which were not different ($P>0.05$) from each other. Panelists detected less ($P <0.05$) connective tissue in anterior steaks when compared to middle and posterior steaks, which were not different ($P>0.05$) from each other. In the *semitendinosus*, proximal steaks had higher ($P<0.05$) Warner-Bratzler shear force values and sensory connective tissue amounts than distal steaks (Table 3). Proximal steaks had less ($P<0.05$) myofibrillar and overall tenderness than distal steaks. Within each sub-primal, anatomical location had no effect ($P>0.05$) on myofibrillar fragmentation index value. Myofibrillar fragmentation index was correlated ($P<0.05$) to myofibrillar tenderness ($r=-0.18$), connective tissue ($r=0.11$), and overall tenderness ($r=-0.15$); however, myofibrillar fragmentation index was not correlated ($P=0.056$) to Warner-Bratzler shear force.

## Implications

In *longissimus lumborum* and the *semitendinosus*, myofibrillar fragmentation index was not dependent upon anatomical location. Moreover, the correlation between myofibrillar fragmentation index, Warner-Bratzler shear force, and sensory measures of tenderness were weak, indicating myofibrillar fragmentation index was not a reliable indicator of beef tenderness for these muscles.

## References

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**Table 1. Effect of the *longissimus lumborum* (strip loin) and *semitendinosus* (eye of round) muscles on myofibrillar fragmentation index, Warner-Bratzler shear force, and sensory characteristics**

| | Muscle | | | |
|---|---|---|---|---|
| Item | *Longissimus lumborum* | *Semitendinosus* | Standard error | P-value |
| Myofibrillar fragmentation index | 45.71[b] | 65.13[a] | 8.02 | 0.03 |
| Warner-Bratzler shear force, lb | 7.52[b] | 9.92[a] | 0.07 | < 0.01 |
| Sensory attribute[1] | | | | |
| Initial juiciness | 60.14[a] | 45.98[b] | 1.00 | < 0.01 |
| Sustained juiciness | 46.58[a] | 32.71[b] | 1.16 | < 0.01 |
| Myofibrillar tenderness | 73.71[a] | 44.17[b] | 1.31 | < 0.01 |
| Connective tissue amount | 9.13[b] | 28.83[a] | 1.09 | < 0.01 |
| Overall tenderness | 70.72[a] | 35.90[b] | 1.45 | < 0.01 |
| Beef flavor intensity | 36.91[a] | 33.10[b] | 0.59 | < 0.01 |
| Off-flavor intensity | 1.04 | 1.33 | 0.22 | 0.27 |

[a,b]Within a row, means without a common superscript differ (P<0.05).

[1]0 = extremely dry, extremely dry, extremely tough, none, extremely tough, extremely unbeef-like, and extremely bland; 100 = extremely juicy, extremely juicy, extremely tender, abundant, extremely tender, extremely beef-like, and extremely intense.

**Table 2. Effect of steak location within the strip loin (*longissimus lumborum*) on myofibrillar fragmentation index and Warner-Bratzler shear force and sensory characteristics**

| | Location | | | Standard | |
|---|---|---|---|---|---|
| Item | Anterior | Middle | Posterior | error | P-value |
| Myofibrillar fragmentation index | 44.20 | 45.95 | 46.99 | 9.61 | 0.98 |
| Warner-Bratzler shear force, lb | 7.03[c] | 7.54[b] | 8.00[a] | 0.08 | < 0.01 |
| Sensory attribute[1] | | | | | |
| Initial juiciness | 59.99 | 61.92 | 58.51 | 1.27 | 0.09 |
| Sustained juiciness | 45.85 | 48.78 | 45.11 | 1.49 | 0.09 |
| Myofibrillar tenderness | 76.84[a] | 72.32[b] | 71.86[b] | 1.37 | 0.01 |
| Connective tissue amount | 7.28[a] | 9.81[b] | 10.31[b] | 0.78 | 0.01 |
| Overall tenderness | 74.29[a] | 69.31[b] | 68.56[b] | 1.55 | 0.01 |
| Beef-flavor intensity | 35.16[a,c] | 38.46[b] | 37.11[b,c] | 0.86 | 0.02 |
| Off-flavor intensity | 0.68 | 1.14 | 1.30 | 0.28 | 0.26 |

[a,b,c]Within a row, means without a common superscript differ (P<0.05).

[1]0 = extremely dry, extremely dry, extremely tough, none, extremely tough, extremely unbeef-like, extremely bland, and extremely bland; 100 = extremely juicy, extremely juicy, extremely tender, abundant, extremely tender, extremely beef-like, extremely intense, and extremely intense.

**Table 3. Effect of steak location within the eye of round (*semitendinosus*) on myofibrillar fragmentation index and Warner-Bratzler shear force and sensory characteristics**

| | Location | | Standard | |
|---|---|---|---|---|
| Item | Proximal | Distal | error | P-value |
| Myofibrillar fragmentation index | 66.77 | 63.49 | 11.79 | 0.78 |
| Warner-Bratzler shear force, lb | 10.69[a] | 9.17[b] | 0.09 | < 0.01 |
| Sensory attribute[1] | | | | |
| Initial juiciness | 42.79[b] | 49.16[a] | 1.29 | < 0.01 |
| Sustained juiciness | 29.53[b] | 35.90[a] | 1.41 | 0.01 |
| Myofibrillar tenderness | 34.81[b] | 53.54[a] | 1.63 | < 0.01 |
| Connective tissue amount | 37.20[b] | 20.45[a] | 1.64 | < 0.01 |
| Overall tenderness | 24.95[b] | 46.85[a] | 1.70 | < 0.01 |
| Beef flavor intensity | 32.54 | 33.65 | 0.69 | 0.26 |
| Off-flavor intensity | 1.04 | 1.62 | 0.34 | 0.24 |

[a,b]Within a row, means without a common superscript differ (P<0.05).

[1]0 = extremely dry, extremely dry, extremely tough, none, extremely tough, extremely unbeef-like, extremely bland, and extremely bland; 100 = extremely juicy, extremely juicy, extremely tender, abundant, extremely tender, extremely beef-like, extremely intense, and extremely intense.