

## Project Summary

### **Round Muscle Profiling: Management of Tenderness and Sensory Improvements of Specific Muscles with Aging**

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**Study Completed  
May 2007**



*Funded by The Beef Checkoff*

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### **Background**

Muscles originating from the beef round are generally less tender than the higher value cuts originating from the rib and loin. Muscle profiling data supported by The Beef Checkoff indicates that several round muscles appear promising to market as individual cuts if they can deliver consistent tenderness. Information is still needed to determine how these muscles tenderize. This project was designed to determine potential mechanisms underlying differences in tenderness. It also served to characterize some of the postmortem biochemical processes that define the tenderization process of muscles and provide a clearer understanding of the fundamental mechanisms underlying meat tenderization.

The objectives of this project were to:

1. Determine the differences in tenderness development of specific, economically important muscles of the beef round.
2. Obtain a better understanding of the underlying biochemical differences that govern tenderness and palatability of specific, underutilized muscles of the round.

### **Methodology**

Muscles were removed from both sides of 10 beef carcasses at 24 hours post-harvest. Muscles removed included the longissimus dorsi (LD; control), and the following muscles from the round: gracilis (GR), adductor (AD), semimembranosus (SM), Sartorius (SAR), vastus lateralis (VL) and vastus intermedius (VI). Muscles were cut into 1 inch or 0.25 inch thick steaks, vacuum packaged and aged at 4°C for 24 hours, 72 hours, 7 days or 14 days. Because the LD is commonly used as a whole muscle foodservice and retail cut, it was used as the reference sample and served as an internal control for each carcass.

Within Objective 1, the 1 inch thick vacuum packaged steaks from each muscle/aging period were used for star probe shear force measurements and for trained sensory panel analysis. Within Objective 2, the 24 hour 0.25 inch thick steaks were used for determination of calpastatin activity, amount of autolysis of  $\mu$ -calpain at 24 hour (relative to its rate of activation) and degradation of Troponin-T and desmin. Degradation of these proteins is linked to  $\mu$ -calpain activity and to overall postmortem proteolysis and tenderness.

### **Findings**

#### **Objective 1**

Star probe measurements were taken on d 1, 3, 7, and 14 as an objective measurement of tenderness. On day 1, star probe analysis found that VL required more force to penetrate than VI, SAR, and GR and the VI had a lower force than the LD. On day 7, the LD, AD, and VL all required more force than the GR, SAR, and VI. On day 14, the VL required more force than all other muscles except the AD, and the AD required more force than the GR, SAR, and VI. In addition, 24 hour pH measurements were significantly higher for the VI as compared to all other muscles which may impact sensory characteristics.

Trained panel tenderness was consistent with star probe values. At day 1, the SAR and VI both had higher tenderness scores than the AD, SM, and VL. On day 7, the SAR, LD, and VI had higher tenderness scores than the SM and VL and on day 14, the LD, SAR, GR, and VI had higher tenderness scores than the SM and VL. Also, chewiness scores were consistent with sensory panel results.

No differences in beef flavor were seen at any time period. Given that the GR, SAR and VI displayed similar sensory characteristics as the LD in juiciness, tenderness and chewiness, there is potential to add value to these muscles by merchandising them as individual muscles or cuts.

### Objective 2

The calpain enzyme system serves as the main source of postmortem protein degradation during aging. The calpain system contains the isomers  $\mu$ -calpain and m-calpain, and  $\mu$ -calpain appears to be responsible for much of the proteolysis linked to tenderization. A greater portion of  $\mu$ -calpain catalytic subunit present as the 76 kDa autolysis product indicates that a greater proportion of  $\mu$ -calpain has been active. Presence of the 78 kDa indicates prior activation of  $\mu$ -calpain and unautolyzed 80 kDa indicates less calpain has been previously active. At 24 hour postmortem there were no differences between muscles in the proportion of the catalytic subunit present as the unautolyzed 80 kDa subunit. However, differences were detected between muscles in the proportion of the  $\mu$ -calpain catalytic subunit present as a 76 kDa and 78 kDa bands. The Ad, GR, and LD had the higher percentage of the 76 kDa band than the VI and SAR, suggesting that  $\mu$ -calpain had been activated to a greater extent at 24 hours in those muscles. The AD and SAR both had high amounts of the 76 kDa band and low calpastatin activity, suggesting that a significant amount of proteolysis is occurring at 24 hours postmortem.

Troponin T is also a substrate of the calpain system and is strongly related to beef tenderness. On day 1, its 30 kDa was less intense than GR, LD, and VI and its UI band of VI was less intense than the AD, GR and LD. On day 7, the 30 kDa band of LD was more intense than all other muscles sampled.

### **Implications**

These data indicate that physical and biochemical differences exist between individual muscles of the round and provide insight into how the individual muscles of the round are tenderizing during aging. The GR, SAR and VI had tenderness and juiciness values similar to or better than the LD, suggesting that they may be able to be removed and sold as individual cuts to add value to the carcass.

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