

Project Summary

Evaluation of Beef *rectus femoris* and *vastus lateralis* Steaks as Substitutions for Beef Top Sirloin Steaks in Foodservice Applications

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Background

Traditional foodservice steak offerings have been composed of steaks from muscles in the rib and loin regions of the beef carcass. Of these, the top sirloin (*gluteus medius*) steak has been marketed as a cost effective offering. Unfortunately, the top sirloin has been associated with a lack of consistency with regard to tenderness that could ultimately result in consumer dissatisfaction and loss of market share. Preliminary research suggests that *rectus femoris* and *vastus lateralis* muscles could have tenderness characteristics amenable to foodservice applications as a potential top sirloin alternative. If this muscle is found to meet consumer expectations, its use in foodservice establishments would allow more economic entrees to be offered without compromising customer satisfaction. Additionally, the greater use of this muscle would improve the marketability of the beef round.

The objectives for this project were to:

1. Characterize portion controlled steak yields of intact *rectus femoris* and *vastus lateralis* muscles in comparison to the steak yields of *gluteus medius*.
2. Determine the tenderization effect in response to extended aging periods in beef *rectus femoris* and *vastus lateralis* muscles relative to the top sirloin.
3. Evaluate consumer acceptance of *rectus femoris* and *vastus lateralis* steaks when presented in a foodservice setting relative to the top sirloin.

Methodology

Beef, round, knuckle, full (IMPS #167B; n = 150) and beef loin, top sirloin butt (cap-off, IM; IMPS # 184E; n = 150) were selected from the fabrication tables of a large commercial beef processing facility. Subprimals then were transported to the facilities of a large foodservice purveyor. Subprimals were aged until 21, 35, or 49 d postmortem before being portioned into steaks.

After the appropriate aging time, subprimals were weighed in the vacuum bags and then opened and a second weight was obtained on the unpackaged subprimal. Bag weights were obtained to facilitate calculation of purge loss. Each subprimal was then subjected to a single pass through a blade tenderizer (TC700M, Ross Industries, Inc., Midland, VA). After blade tenderization, a third weight was taken to assess losses due to blade tenderization. Losses due to blade tenderization were negligible, and consequently, were combined with purge loss in subsequent calculations.

Top sirloin subprimals were divided in half (anterior to posterior along the sciatic ligament). The two halves of each subprimal were trimmed of heavy connective tissue and external fat exceeding 0.64 cm. Intact knuckle subprimals were separated along the natural seams to produce *rectus femoris* and *vastus lateralis* muscles. The *vastus medialis* and *vastus intermedius* muscles were regarded as trim. The resulting muscles were trimmed of heavy connective tissue. The weight of pre-trimmed muscles and associated trimmings were determined. All muscle pieces were portioned into 7 or 9 oz steaks by an automated portioning machine (model # IPM-03-X600, Marel Food Systems, Inc., Lenexa, KS). To ensure the resulting steaks were suitable for consumer or trained sensory panel evaluation, parameters required steak thickness be at least 2.0 and not more than 4.1 cm-thick. Finally, the steak weights and trim weights were determined after steak cutting. All steaks were vacuum packaged and immediately frozen (-20°C) until further analysis.

Consumer evaluations were conducted during meals in a simulated upscale restaurant environment using methodology similar to Hoover et al. (1995). Panelists (n = 300) were recruited from civic organizations in the Lubbock, TX area. Additional steaks were utilized for trained sensory panel evaluation, sarcomere length determination and Western blotting of desmin.

Findings

Purge loss was higher ($P < 0.05$) for top sirloin subprimals. This is attributable to a large portion of external fat and connective tissue being removed when the *gluteus medius* was removed from the hip bone and when the cap (proximal portion of the *biceps femoris*) was removed from the *gluteus medius* at the processing plant. In contrast, external connective tissue was largely undisturbed on the knuckle subprimals. Purge loss also increased ($P < 0.05$) progressively in both muscles with increased aging time.

Pre-trimmed *gluteus medius* muscles were heavier ($P < 0.05$) than pre-trimmed *vastus lateralis* muscles, which were slightly heavier ($P < 0.05$) than pre-trimmed *rectus femoris* muscles. These differences in pre-trimmed muscle weights corresponded to differences in the number of steaks obtained from each muscle. Steak yields of the *vastus lateralis* were higher ($P < 0.05$) than those of the *gluteus medius*, which had greater ($P < 0.05$) steak yields than the *rectus femoris*. As expected, the percentage of trimmings obtained from pre-trimmed muscles inversely corresponded to percentage steak yield.

These findings suggest that, at current prices, the whole knuckle would be an economically feasible alternative to center-cut top sirloin butts. Additionally, if individual *rectus femoris* and *vastus lateralis* muscles were made available, their cutting yields would compare favorably to those of center-cut top sirloin butts.

The *rectus femoris* received ratings for tenderness, juiciness; beef flavor intensity, and off-flavor intensity that were similar to those given to *gluteus medius* steaks. Steaks from both of these muscles received much higher ($P < 0.05$) ratings for tenderness than *vastus lateralis* steaks.

Vastus lateralis steaks received lower ($P < 0.05$) juiciness ratings than *gluteus medius* or *rectus femoris* steaks; though this difference (0.3 panel units) may not be large enough to be of practical importance. *Vastus lateralis* flavor intensity and off-flavor intensity ratings were statistically lower ($P < 0.05$) than those for *gluteus medius* and *rectus femoris* steaks, but these differences were extremely small (0.1 panel units). Increasing aging time from 21 to 35 d produced a modest (0.4 panel unit) increase ($P < 0.05$) in tenderness ratings. Further increasing aging time from 35 to 49 d caused another small (0.2 panel unit) improvement in tenderness ratings, regardless of muscle. These data suggest that *rectus femoris* steaks possessed palatability characteristics that were equal to those of the *gluteus medius*. However, *vastus lateralis* steaks may not possess sufficient tenderness and juiciness characteristics to meet consumer demands.

The *rectus femoris* had the longest ($P < 0.05$) sarcomere lengths of the three muscles evaluated. Sarcomere lengths were shortest ($P < 0.05$) in *gluteus medius* steaks. *Vastus lateralis* steaks had intermediate sarcomere lengths.

Consumers rated the tenderness and juiciness of *gluteus medius* steaks slightly higher ($P < 0.05$) than *rectus femoris* steaks and both received much higher ($P < 0.05$) tenderness and juiciness ratings than *vastus lateralis* steaks. Additionally, flavor ratings were lower ($P < 0.05$) for *vastus lateralis* steaks than

for *gluteus medius* and *rectus femoris* steaks. Overall like ratings were in agreement with the trained sensory panel ratings because *gluteus medius* steaks did not differ ($P > 0.05$) from *rectus femoris* steaks. However, steaks from both muscles received higher ($P < 0.05$) overall like ratings than *vastus lateralis* steaks.

Only five percent of *gluteus medius* steaks were unacceptably tough. The percentage of *rectus femoris* steaks that were unacceptably tough was slightly higher. However, a much greater proportion of the *vastus lateralis* steaks were determined to be unacceptable with regard to tenderness by consumers. The percentage of consumers indicating that *vastus lateralis* possessed overall palatability characteristics that were unacceptable was three-fold greater than the percentage that was unsatisfied with the *gluteus medius* or *rectus femoris*.

Implications

Overall, the trained sensory panel and consumer panel ratings suggest that *rectus femoris* steaks would be a sufficient substitute for *gluteus medius* steaks on foodservice menus. Furthermore, at current prices, the portion controlled cutting yields would be economically favorable to purveyors. However, in order for knuckle subprimals to be cost-effective to purveyors, the *vastus lateralis* must be marketed as a steak item. The findings of the present experiment indicate that, unfortunately, the palatability characteristics of *vastus lateralis* steaks are not adequate to consistently meet consumer expectations for tenderness, even when blade tenderized. Further research is needed to identify tenderization strategies that will improve vastus lateralis tenderness.

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