

Project Summary

The Impact of Cutting Procedures on the Tenderness Properties of Muscles from the Beef Knuckle

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Project Summary

Background

Current fabrication methods to remove the round from the sirloin typically entail cutting across muscles of the knuckle, leaving the Beef Round Knuckle (MANP #167) on the round and the Beef Loin Bottom Sirloin Butt, Ball Tip (NAMP #185B) on the loin. This has two consequences. First, the muscle nomenclature changes, depending on where the muscles are located after they are cut. Second, the value of the various muscle pieces is affected.

Part of this pricing differential may depend on the naming of the cut. While the knuckle is often labeled a sirloin tip at retail, it retains the beef round nomenclature – e.g., Beef Round, Sirloin Tip (following Uniform Retail Meat Identity Standards (URMIS) guidelines). This can be avoided if the knuckle is separated from the round before the round-loin break is made, thereby leaving the knuckle on the loin. Under this fabrication scenario, the knuckle can be named Beef Loin, Sirloin Tip at retail. To accomplish this, some packers drop the beef knuckle prior to the break, sometimes even while the muscle is in the pre-rigor state. An alternative is to cut a diamond cut round, which leaves the full knuckle on the round and essentially removes the ball tip from the loin.

The objectives of this project were:

1. Evaluate the effects on tenderness of separating the pre-rigor beef knuckle from the round (but remaining intact with the remainder of the loin).
2. Evaluate the effect of USDA grade on tenderness properties of the various muscles in the beef knuckle.
3. Map the tenderness across the primary muscles of the beef knuckle, anterior to posterior, for the various cutting scenarios.

Methodology

There were 12 USDA Choice and 12 USDA Select carcasses chosen for this study. Alternating sides were pre-fabricated and maintained as a control. The pre-fabricated (HOT) treatment consisted of cuts on the hot carcass which followed the natural seams between the knuckle and the surrounding muscles. Skeletal attachments to the bones were not cut.

After 2 d of chilling, internal knuckle temperature was measured and whole knuckles (including the ball tip) were removed from the carcass. They were vacuum-packaged and aged for 7 d. On d 7, the knuckles were cut into 1-inch steaks. There were six steaks, from the proximal to the distal end. The proximal end corresponds to the ball tip and the distal end was near the location of the patella (kneecap).

Steaks from the knuckle possess two primary muscles - the rectus femoris and the vastus lateralis. Measurements of color and Warner-Bratzler shear force (WBSF) were made in the posterior, middle, and anterior locations within a steak for the rectus femoris and within the posterior and anterior locations within a steak for the vastus lateralis. Taste panel sensory ratings were made on every other steak, disregarding locations within a steak (due to sample size requirements).

The steaks were allowed to bloom for 1 hr. Color (L^* , a^* , and b^*) was measured with a Hunter Colorimeter, using the 10 degree standard observer and illuminant A, on each steak. Higher values

for L^* are indicative of lightness while higher values for a^* indicated greater redness. Higher b^* values indicated a more yellow, less blue color.

Steaks were then individually vacuum packaged and frozen until shear force or taste panel analyses were conducted on every other steak. Prior to cooking, steaks were thawed over night at 1 C. They were cooked to an internal temperature of 70 C on Farberware Open Hearth broilers - a table-top broiler with an open heat element. For shear force, cooked steaks were wrapped in plastic and allowed to cool to room temperature before removing 3 cores from each location (posterior, middle, and anterior for rectus femoris and posterior and anterior for the vastus lateralis). For the taste panels, a trained panel evaluated 1 x 1 x 1 cm cubes of meat for juiciness, tenderness, and amount of connective tissue using 8-point rating scales (where 1 was the least desirable and 8 was the most desirable). Off-flavor intensity was also scored on an 8-point scale, but here 1 represented no off-flavor and 8 was extreme off-flavor intensity.

Findings

Pre-fabricated knuckles were 0.45 F colder after 48 hr of chilling. This can be regarded as a favorable result because it indicates pre-fabrication can speed chilling to the internal portion of the knuckle. This would be expected to reduce purge. In fact, the purge in the vacuum packages of pre-fabricated knuckles after 7 d of aging was 0.19% while the control knuckles had 0.39% purge ($P < 0.005$).

Rectus Femoris

General Observations:

1. The distal (shank) end of the rectus femoris was less tender than the ball tip (by shear force and taste panel). The middle of the rectus femoris was intermediate to the ends for shear force, taste panel tenderness, and connective tissue. All shear force values and taste panel ratings were desirable (< 10.0 kg of force, and on the desirable end of the sensory scale).
2. Pre-fabricated muscles were slightly less tender than the control for U.S. Choice only (by 0.28 taste panel units, not different by shear force).
3. The distal (shank) end had higher sensory connective tissue amount and more off-flavor.
4. The intensity of red color (a^*) diminished from the proximal end (ball tip) to the distal end (shank).
5. As a general rule, meat next to the bone was less tender than other sampling locations.

General Conclusions:

1. There were far greater differences in tenderness and color from one end of the rectus femoris to the other than from the pre-fabrication treatment to the control, which implies the pre-fabrication treatment is feasible.
2. The tenderness of the ball tip is quite similar to the middle of the rectus femoris; the shank end is less tender and less desirable than the rest. Overall, the rectus femoris is tender and desirable, based on shear force and sensory ratings.

Recommendations:

1. There is logic to name the knuckle in a fashion similar to the ball tip, but there are often differences in shear force, sensory tenderness and connective tissue ratings. Accordingly, care must be taken to indicate the overall desirability of the muscle, despite the differences, when petitioning for a name change.
2. Pre-fabrication offers some advantages to the knuckle and should be considered by meat packers.

Vastus Lateralis

General Observations:

1. The distal (shank) end of the vastus lateralis was less tender than the proximal end (by shear force and taste panel). The middle of the muscle is similar to the proximal end (ball tip) end for taste panel tenderness and off-flavor but different in shear force.
2. The intensity of red color (a^*) and lightness (L^*) diminished from the proximal end toward the distal (shank) end.
3. There were few differences in shear force and lightness (L^*) between pre-fabricated knuckles and the controls, from end to end.
4. The pre-fabricated treatment was lighter (L^*) than the control for USDA Select only.
5. The distal (shank) end had higher sensory connective amounts and more intense off-flavor than the proximal (ball tip) end.
6. As a general rule, meat next to the bone was less tender than other sampling locations.

General Conclusions:

1. There were far greater differences in tenderness and color from one end of the vastus lateralis to the other than from the pre-fabrication treatment to the control, which implies the pre-fabrication treatment is feasible.
2. The tenderness of the proximal end (ball tip end) is similar to the middle of the vastus lateralis for most of the taste panel traits; the distal (shank) end is distinctly less tender and less desirable than the rest.

Recommendations:

1. Sensory ratings were similar between the proximal (ball tip) end to the middle of the knuckle, which would support valuing the two portions of the muscle the same (and thereby support a name change). However, shear forces were usually different, suggesting that care must be taken to point out this is the smaller muscle of the knuckle (compared to the rectus femoris) when petitioning for a name change.
2. Pre-fabrication offers some advantages to the knuckle and should be considered by meat packers.

Implications

This project measured the tenderness of the beef knuckle from the sirloin end to the shank end. The tenderness of the middle of the knuckle is intermediate to the ends; the shank end is distinctly less tender and less desirable than the rest. In all cases, the rectus femoris (knuckle center) was desirable. There were far greater differences in tenderness and color from one end of the knuckle to the other than from the pre-fabrication treatment to the control, again implying that the fabrication treatment is feasible. Pre-fabrication of the beef knuckle offers some advantages in temperature and tenderness and should be considered as an alternative fabrication method for packers.

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