

Project Summary

Identification of Threshold Levels for Warner-Bratzler Shear Force of Beef Value Cuts

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Background

Checkoff-funded muscle profiling research established new beef value cuts developed from underutilized muscles of the beef chuck and round. These cuts are comprised of single muscles that each have their own unique qualities and vary in tenderness, juiciness and flavor. Consumer perception of tenderness is thought to be influenced by flavor and juiciness. Therefore, tenderness threshold values may reflect variation among muscles and result in different threshold levels for different muscles of the beef carcass. The objective for this project was to investigate the relationship between threshold levels of Warner-Bratzler shear force and consumer panel tenderness ratings of beef value cuts.

Methodology

USDA Choice and Select subprimals (n=560) were purchased from a commercial processing facility. The subprimals selected were Beef chuck, Outside Shoulder (Clod; IMPS #114); Beef Round, Tip (Knuckle; IMPS #167A); Beef Round, Outside Round (Flat; IMPS #171B); Beef Loin, Strip Loin, Boneless (IMPS #180); and Beef Loin, Top Sirloin Butt, Center-Cut, Boneless (IMPS #184B). Forty USDA Choice and forty USDA Select subprimals were obtained for each selected subprimal.

Beef shoulder clods, knuckles and outside rounds were fabricated according to the 2001 Beef Value Cuts Guidelines. All external and internal fat and connective tissue were removed from the following muscles: *infraspinatus*, *triceps brachii*, *vastus lateralis*, *rectus femoris* and *biceps femoris*. The *gluteus medius* from the top sirloin butt was completely denuded and the muscle was cut lengthwise along the seam parallel to with the sciatic nerve to separate the larger portion of the *gluteus medius* from the smaller portion. Only the larger portion of the *gluteus medius* was used for the remainder of the study.

Three one-inch thick steaks were cut from each muscle. Two steaks were assigned randomly for consumer sensory testing and one steak was assigned randomly for Warner-Bratzler shear force (WBSF) determination. Objective color was measured and steaks were vacuum packaged and aged 14 days before freezing. Steaks were thawed and cooked according to the 2001 Beef Value Cuts Cooking Instructions for consumer panel testing and WBSF determination.

Consumers were randomly called and screened through telephone recruitment. Participants were required to consume meat at least 5 times per week and most were between the ages of 22 and 65. Each consumer panelist evaluated 14 samples using an 8-point scale for overall like/dislike of the sample, overall like/dislike of juiciness, level of juiciness, overall like/dislike of tenderness, level of tenderness, overall like/dislike of flavor, level of flavor and acceptable/unacceptable tenderness.

Findings

The USDA Choice *longissimus lumborum* received the highest ratings for overall like; however, it was not different from USDA Choice and Select *infraspinatus* and USDA Select *longissimus lumborum*. The USDA Select *biceps femoris* received the lowest consumer ratings for overall like. For juiciness like, the USDA Choice and Select *infraspinatus* received the highest consumer ratings and the USDA Choice and Select *infraspinatus* received the highest consumer ratings. The USDA Choice and Select *vastus lateralis*, along with the USDA Select *biceps femoris*, received the lowest ratings. The USDA

Choice and Select *infraspinatus* received the highest ratings for level of juiciness while the lowest ratings were given to the USDA Select *vastus lateralis*.

The USDA Choice and Select *infraspinatus* and the USDA Select *longissimus lumborum* received the highest ratings for tenderness like. The muscle rated as the least desirable in tenderness was the *biceps femoris*. For level of tenderness, the USDA Choice and Select *infraspinatus* were rated highest and the USDA Select *biceps femoris* rated lowest. The highest ratings for flavor like were designated to the USDA Choice and Select *infraspinatus* and *longissimus lumborum*. The lowest ratings for flavor like were given to the USDA Select *vastus lateralis* and *biceps femoris*.

Overall, the USDA Choice and Select *longissimus lumborum* and *infraspinatus* ranked high for all sensory attributes, whereas the USDA Choice and Select *vastus lateralis* and *biceps femoris* ranked low. The USDA Choice and Select *gluteus medius*, *rectus femoris* and *triceps brachii* tended to be intermediate for all sensory attributes.

For the *biceps femoris*, the tenderness acceptability generally decreased as the tenderness like ratings decreased. The largest decrease in tenderness acceptability occurred between ratings 5 and 4 with decrease from 83.65% to 44.44%. For the *gluteus medius*, the largest decrease in tenderness acceptability occurred between ratings 4 and 3 with a decrease from 75.86 to 40.32%. The *infraspinatus* had high acceptability for tenderness ratings 4 and 3 and the tenderness acceptability ratings dropped from 86.96 to 50.00%. The *rectus femoris* tenderness acceptability typically decreased as the tenderness ratings decreased. The *triceps brachii* showed the largest decrease in tenderness acceptability between tenderness ratings 4 and 3 with a decrease of 72.22 to 40%. The *vastus lateralis* showed a decrease in tenderness acceptability of 90.70 to 64.91% at tenderness ratings 5 and 4.

For all muscles, the tenderness acceptability was relatively high for tenderness ratings 5 through 8. However, several muscles displayed a high percentage of tenderness acceptability for tenderness rating 4. The high acceptability at tenderness rating 4 of some muscles suggests that muscle specific attributes other than tenderness may influence the tenderness acceptability of a steak.

Results of the correlation between consumer sensory attributes show that tenderness, juiciness and flavor had a strong influence on consumer satisfaction. For all 7 muscles evaluated, all attributes displayed a strong positive relationship with overall like. For the *biceps femoris* and *gluteus medius*, tenderness like had the highest correlation with overall like. For the *infraspinatus*, *longissimus lumborum*, *rectus femoris* and *triceps brachii*, flavor like was the attribute most highly correlated to overall like. For the *vastus lateralis*, tenderness like and flavor like were most highly correlated to overall like. For the *vastus lateralis*, tenderness like and flavor like were most highly correlated to overall like.

For the *infraspinatus* and *rectus femoris*, juiciness like was the attribute with the second highest correlation to overall like. Both flavor and juiciness like expressed high correlations to tenderness like for all muscles. This shows that flavor and juiciness can influence consumer perception of tenderness.

The USDA Choice and Select *infraspinatus* had the lowest (most tender) WBSF values compare to all other muscles. The USDA Choice and Select *vastus lateralis* and USDA Select *biceps femoris* had the highest (least tender) WBSF values compared to all other muscles.

The low correlation found between WBSF and consumer panel tenderness ratings in this study could be a result of lack of variation in tenderness of steaks evaluated, as well as differences among consumer preference and scale usage. As a result of this low correlation, threshold WBSF levels could not be determined.

The majority of all steaks evaluated fell into the 95% confidence level created by Shackelford et al. (1991). All of the *infraspinatus* steaks evaluated in this study met the WBSF requirement for the 95% confidence level. More than 92% of the *gluteus medius*, *longissimus lumborum*, *rectus femoris* and *triceps brachii* steaks met the WBSF requirements for the 95% confidence level. The *longissimus lumborum*, *rectus femoris* and *vastus lateralis* muscles exhibited mean WBSF values which increased as the tenderness like ratings decreased.

Implications

Threshold WBSF levels could not be determined due to the low correlation between consumer tenderness ratings and WBSF. After analyzing the consumer ratings, tenderness acceptability and WBSF values, it was apparent that there may not be a single WBSF threshold value suitable for all muscles. Research indicates that there may be muscle-specific WBSF threshold levels; these values were not established from this research.

Reference

Shackelford, S.D., Morgan, J.B., Cross, H.R., Stiffler, D.M., Wise, J.W., Griffin, D.B. & Smith, G.C. 1991. Identification of threshold levels for Warner-Bratzler shear force in beef top loin steaks. *Journal of Muscle Foods*, 2, 289-296.

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