



## PROJECT SUMMARY PRODUCT QUALITY

**BEEF**  
RESEARCH

# Consumer Thresholds for Beef Tenderness and Juiciness

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# Consumer Thresholds for Beef Tenderness and Juiciness: Project Summary

## Background

Tenderness thresholds were originally developed by Shackelford et al. (1991). They took data from the National Consumer Beef Retail Study conducted in 1984-85 and established tenderness thresholds based on 50, 68 and 95% confidence intervals. These thresholds have been extensively used including use in development of instrument grading for tenderness to segmenting beef into very tender, tender, slightly tough and tough categories. The USDA Agricultural Marketing Service (AMS) is using tenderness thresholds for label verification for “guaranteed tender” product label claims. However, there is concern that consumer thresholds have changed in the last 30 years. Beef consumers are many times classified as light-, moderate- or heavy-beef consumers with the knowledge that they also consume pork and chicken. As beef consumers eat protein from other sources that differ in tenderness, consumption of these proteins may impact acceptability ratings or thresholds for beef tenderness. Additionally, beef tenderness has been shown to have improved and to be less variable based on beef tenderness surveys conducted since 1989. As beef has slowly improved in tenderness and tenderness variation is less, consumer thresholds for tenderness may have changed. Consumer behaviors toward food and meat have also changed. The Millennial generation has been shown to differ in attitudes toward food, to eat out more, to be more adventurous with food choices, and to not consume as much beef. The question is “have beef tenderness thresholds changed since 1985?” While consumer trends change slowly, it is not unreasonable to hypothesize that beef tenderness thresholds have changed in the last 30 years. The objective of this study is to establish current tenderness and juiciness thresholds using consumer and trained descriptive tenderness and juiciness attributes, and Warner-Brazler shear force.

## Objective


Due to decreasing variability of beef tenderness and changing consumer trends, the overall goal of this study is to identify the relationship of consumer perception of beef juiciness and tenderness. This goal is met through the objective of establishing current consumer tenderness and juiciness thresholds using consumer and trained descriptive tenderness and juiciness attributes, and Warner-Bratzler shear force.

## Methods

Data analyzed for this project were previously collected through two Beef Checkoff projects. In the first study, Choice top loins, high pH top loins (pH  $\geq$  6.0), Select top sirloin butts, Choice tenderloins, Select bottom rounds, and Choice bottom rounds from 10 beef carcasses were collected. Top loin steaks were cooked to 58°C or 80°C utilizing a George Forman grill (Choice top loin, High pH top loin, Select top sirloin and Choice tenderloin steaks) set at 191 °C, a flat food-service grill at 232 °C (Choice top loin, High pH top loin, Select top sirloin and Choice tenderloin steaks), or crock-pot (Select bottom round and Choice bottom round roasts). Trained beef descriptive flavor and texture attributes and gas chromatography-mass spectrometry-olfactometry (GC-MS-O) were utilized to measure flavor. Warner Bratzler shear force was determined. Consumer evaluations were collected through central location testing (n = 80 per city in Olathe, KS; State College, PA; and Portland, OR) where participants that ate beef three or more times per week were selected. Consumers rated tenderness, juiciness, and overall liking using 9-point hedonic scales and beef varied extensively in tenderness and juiciness. Consumer demographics including age, income, consumption frequency of beef, pork, chicken and fish, preparation methods and purchase decision information were collected. These data were defined as Study 1.

Study 2 was conducted similarly to Study 1. In this study, millennial and non-millennial consumers that were either light (eat beef 2 to 4 times per month) or heavy (eat beef 3 or more times per week) beef eaters in four cities (n=120 per city; Portland, OR; Olathe, KS; College Park, PA; Atlanta, GA) were used. USDA Choice beef top strip loin (cooked to 58 or 80°C on a commercial electric flat grill) and Select bottom round flats roasts (cooked to 58 or 80°C in a crock-pot) were used. Top loin steaks were cooked on a commercial electric grill set at 232°C. Trained descriptive flavor attributes and volatile chemical compounds were also determined. First data for top strip loin steaks were evaluated. In a second analysis, beef steaks from all meat used in each study was analyzed.

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Data from Study 1 and 2 were analyzed to answer the following hypotheses:

1. Tenderness and juiciness thresholds for the combined populations using beef top loin steaks and for all beef cuts.
2. Tenderness and juiciness thresholds for heavy beef eaters vs. light beef eaters.
3. Tenderness and juiciness thresholds for millennials versus non-millennials.
4. Tenderness and juiciness thresholds for predominately beef protein eaters versus predominately other protein eaters (pork and chicken).

## Important Findings

The average WBSF value was 2.57 kg. WBSF averages have decreased over the previous 30 years compared to the average reported by Shackelford et al. (1991), 3.8 kg, which is currently used as a standard for determining beef tenderness classification. In addition, this new mean falls within the “Very Tender” classification, insisting the average steak consumed today is predicted to be very tender, based on standards placed in 1991.

For steaks rated very tender or greater, predicted WBSF was 2.20 or lower indicating that for beef steaks to be classified as tender, WBSF values of 2.20 or less would be needed. For very juicy or juicier beef steaks, the predicted WBSF was 2.19. These results indicate that using a WBSF value of 2.20 or less for all beef cuts would encompass some assurance for juiciness as well as tenderness

Demographic categories did not affect regression equations used to predict consumer attributes for heavy beef eaters verse light beef eaters, millennials verse non-millennials, or predominately beef eaters verse predominately other protein eaters.

Consumer attributes are not strong predictors of WBSF. Overall liking is moderately and strongly correlated to consumer attributes, mostly strongly flavor liking ( $R^2=0.78$ ). WBSF is more highly related to trained descriptive tenderness ratings then to consumer evaluations of tenderness liking, juiciness liking and overall liking ( $R^2=0.25$ ). Overall consumer liking is difficult to predict using trained descriptive attributes and WBSF values and is most highly related to consumer sensory liking ratings for tenderness and juiciness. Juiciness ratings, either trained or consumer, did not appreciably improve predictability of regression equations to predict either WBSF or consumer overall liking.

## Industry Impact

Findings support the decrease in steak tenderness variability and the overall lowering of the average WBSF values of beef steaks, ultimately identifying the need to update tenderness thresholds currently used as program guidelines. Industry attention should continue to identify methods to identify expected consumer perception of tenderness liking, juiciness liking, and overall liking in order to maintain or improve consumer satisfaction of beef product.

## Reference

Shackelford, S., J. Morgan, H. Cross, and J. Savell. 1991. Identification of threshold levels for Warner-Bratzler shear force in beef top loin steaks. *Journal of Muscle Foods* 2:289-296.