



PROJECT SUMMARY PRODUCT QUALITY

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National Beef Tenderness Survey – 2015

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National Beef Tenderness Survey – 2015: Project Summary

Background

Maintaining consumer satisfaction of beef products serves as an imperative objective of the beef industry. Many factors contribute to the overall palatability of beef steaks. Consumer demands are highly dependent on each individual's needs and perceptions. This creates a wide variation in consumer preferences that differ in perceived importance based on the specific needs of each consumer. Regardless of the variation in consumers and their preferences, the most important product attributes have been shown to include tenderness, flavor, and juiciness.

The National Beef Tenderness Surveys (NBTS) serve as a beneficial resource to the beef industry by providing consistent data on tenderness across the United States for the retail and foodservice sectors. Additionally, the ability to compare the most recent Survey to historical data provides insight into the improvements the industry has made, as well as identify additional variables that, once improved, will continue to increase consumer satisfaction for beef.

Objective

The over-arching goal of the National Beef Tenderness Surveys is to provide periodic benchmark data on U.S. beef tenderness. This goal is met through two objectives: (1) determining the tenderness of U.S. foodservice and retail steaks through the evaluation of Warner-Bratzler Shear Force (WBSF) and consumer sensory panels, and (2) collecting aging, brand, grade, tenderization, and enhancement information from store visits and product packaging.


Methods

Retail cities were chosen to represent a broad geographical range and to maintain some historical linkage with cities that have been used in previous surveys. Cities included New York, NY; Philadelphia, PA; Los Angeles, CA; Denver, CO; Las Vegas, NV; Tampa, FL; Atlanta, GA; Kansas City, MO; Houston, TX; Chicago, IL; and Seattle, WA. Representatives of the National Cattlemen's Beef Association's retail marketing team assisted with identifying and obtaining permission from the retail chains surveyed.

Each city was sampled over a 12-month time period. In each city, two to three retail chains, representing at least one-third of the total area market share were selected, with four stores per chain being sampled. Thus, product was obtained from a total of 8 to 12 supermarket stores per metropolitan area. In addition, if a membership club retail chain existed in a city and was not included in the one-third market share, one store of each club chain present was sampled. In an effort to accurately represent consumer demographics in a given region, corporate retail contacts were asked to identify individual retail stores of their respective chain. Store managers were notified of the impending sampling visit dates to allow coordination between each individual store and the university responsible for sampling. In some circumstances, it was necessary to purchase products from stores that had not been contacted or who did not wish to participate in the full scope of the survey (e.g., access to back room, separate analyses of their information, etc.).

Within each store, brand names and grades of product available were recorded. Post-fabrication dates were recorded from locations who granted permission to access the back room. Retail cuts were shipped to Texas A&M University in insulated containers with refrigerant materials and were stored under refrigerated conditions (2 to 4°C) upon arrival. Within two days after arrival, steaks were removed from store packaging and all information available including brand designation, marketing claims, enhancement with percentage pumped, and any other important features was recorded. External fat trim was determined by calculating the average of three different fat thickness locations in order to represent the entire steak. Steak thickness was measured in the same manner at three different thickness locations and an average was calculated. All steaks were identified individually, vacuum-packaged, and stored frozen (-40°C).

The following retail cuts were sampled from the retail case: Top Blade Steak; Ribeye Steak, lip on, boneless; Ribeye Steak, lip on, bone-in; Top Loin Steak, boneless; Top Loin Steak, bone-in; T-bone Steak; Porterhouse Steak; Top Sirloin Steak, boneless, cap off; Top Round Steak; and Bottom Round Steak. Steaks were assigned randomly for either for WBSF evaluation or consumer sensory panels. After freezing, retail steaks assigned to consumer sensory panels were



assigned to one of five collaborating universities (North Dakota State University, Oklahoma State University, Texas A&M University, Texas Tech University, and the University of Florida). An effort was made to equally distribute retail cuts across universities. Steaks then were shipped overnight in insulated containers with refrigerant material to each designated university.

In six cities (Houston, TX, Dallas, TX, Tampa, FL; Denver, CO; Las Vegas, NV; Philadelphia, PA), collaborators also sampled one foodservice establishment. Due to lack of available product in Houston, Dallas was identified as a supplemental city within the same region with similar demographics for procurement of products not obtained in Houston. Prime, Top Choice, Choice, and Select USDA quality grades were collected for the following cuts: Ribeye Roll Steak, boneless; Top Loin Steak, boneless; and Top Sirloin Butt Steaks, center-cut, boneless. Post-fabrication times were recorded, along with brand designation, marketing claims, enhancement with percentage pumped, and any other important features. Steaks were shipped to Texas A&M University and handled in the same manner as provided above for the retail cuts.

Texas A&M University randomly assigned foodservice steaks for either WBSF evaluation or consumer sensory panels. Foodservice steaks were shipped overnight in insulated containers with refrigerant material to the University of Missouri, where all foodservice WBSF and consumer sensory evaluations were conducted.

Steaks were thawed in a 4°C cooler for 48 hours before cooking. All retail steaks were cooked on a grated, open-hearth, non-stick electric grill (Hamilton Beach™ Indoor/Outdoor Grill, Southern Pines, NC). The grills were pre-heated for 15 minutes to an approximate temperature of 177°C. Foodservice steaks were cooked on a Garland™ gas grill, pre-heated before cooking to a surface temperature of approximately 232°C. Cooking yields were determined from the weights of the steaks recorded prior to and after cooking. Internal temperature was monitored with a thermocouple reader (Omega™ HH506A, Stamford, CT) using a 0.02 cm diameter, copper constantan Type-T thermocouple wire. All steaks were flipped once the internal temperature reached 35°C and were removed once the internal temperature of the steaks reached 70°C. The total cook time was recorded for each individual steak in addition to the weight of each steak prior to and after cooking. Cooking yields were determined using the before and after cooking weights.

Steaks destined for WBSF determination were placed on trays in a manner to avoid any overlapping and were covered with plastic wrap and placed in a cooler for approximately 12 to 18 hours at 2 to 4°C. Steaks were allowed to equilibrate at room temperature before being trimmed of any visible connective tissue to expose muscle fiber orientation. Cores were removed parallel to the muscle fibers. Six 1.3 cm cores were removed from each major muscle in the steak and sheared once, perpendicular to the muscle fibers. Six cores from the *M. longissimus lumborum* and four cores from the *M. psoas major* were used to uniformly sample T-bone and Porterhouse Steaks.

Procedures were approved by the Texas A&M Institutional Review Board for Use of Humans in Research (Protocol no. IRB2015-0393M). Consumer sensory panels were conducted at Texas A&M University, Oklahoma State University, Texas Tech University, University of Florida, University of Missouri, and North Dakota State University. Each panelist evaluated 8 samples, which were served warm, and were given unsalted saltine crackers and double distilled deionized water between each sample. A four-minute time delay occurred between each sample, except between the 4th and 5th sample, in which a ten-minute break occurred in order to reduce sensory fatigue. Samples were characterized using a 10-point scale for overall like (10 = like extremely; 1 = dislike extremely), overall like of tenderness (10 = like extremely; 1 = dislike extremely), intensity of the tenderness (10 = extremely tender; 1 = extremely tough), overall like of the flavor (10 = like extremely; 1 = dislike extremely), level of beef flavor (10 = extreme intense; 1 = extremely bland/no flavor), overall like of juiciness (10 = like extremely; 1 = dislike extremely), and level of juiciness (10 = extremely juicy; 1 = extremely dry).

Findings

Approximately 34.5% of retail cuts were labeled with a store brand or packer label. This is less than the 43% reported in the 2005 and 2010 Surveys, which found 64% of retail steaks labeled with a packer/processor or store brand. For the retail sector, the average post-fabrication aging time was 25.9 days with a range of 6 to 102 days (Table 1). Compared to the results of the 1998, 2005, and 2010 Surveys, the current Survey resulted in the highest post-fabrication average aging time. The mean percentage of subprimals with a post-fabrication aging time less than 14 days decreased to 11.9% compared to 35.7% in the 2010 survey. The overall average post-fabrication aging time for foodservice cuts was 31.5 days with a range of 3 to 91 days. The 2010 Survey reported a lower average of 28.1 days and a more narrow range of 9 to 67 days.

Average steak thickness, external fat thickness, and steak weights can be found in Table 2. Results similar to previous Surveys are seen, as retail cuts from the round were generally the thinnest. In addition, Top Sirloin Steaks possessed the least external fat thickness compared to Ribeye and Top Loin Steaks from the foodservice sector.

For the retail sector, Top and Bottom Round Steaks had higher (less tender) WBSF values compared to the Top Loin, boneless; Top Loin, bone-in; Ribeye, boneless; Ribeye, bone-in; Top Sirloin; and Top Blade Steaks (Table 3). Foodservice Top Sirloin Steaks showed higher WBSF values compared to the Ribeye and Top Loin Steaks (Table 4).

Similar to findings from previous Tenderness Surveys, Top Blade Steak was given among the highest panelist ratings, whereas Top Round and Bottom Round Steaks received among the lowest (Table 5). Top Sirloin Steaks received lower consumer sensory panel ratings compared to Ribeye and Top Loin Steaks in the foodservice portion of this survey.

Industry Impact

Findings support the importance of monitoring beef tenderness through consumer sensory panels and Warner-Bratzler shear force periodically. Industry attention should continue to focus on increasing post-fabrication aging times in order to increase consumer acceptance of beef steaks.

Graphs/Tables

Table 1. Post-fabrication storage or aging times for subprimals audited in the cold storage facilities of retail stores and

Item	No. of cases	Days				Age < 14d, %
		Mean	SD	Minimum	Maximum	
Retail						
Shoulder Clod	57	19.6	8.0	6	50	24.6
Top Blade	9	26.4	6.4	13	34	11.1
Ribeye boneless	225	29.2	13.5	6	101	8.4
Bone-in ribeye	171	28.1	9.8	16	91	0.0
Strip Loin	296	27.2	14.3	6	101	11.8
Bone-in Strip Loin	83	26.0	16.2	11	102	2.4
Short Loin	92	24.0	10.7	7	55	19.6
Top Sirloin	265	26.6	12.1	6	75	9.1
Top Round	186	23.2	11.0	8	100	5.9
Bottom Round	140	21.5	11.8	8	74	40.7
Overall	1524	25.9	12.7	6	102	11.9
Foodservice						
Ribeye	21	32.2	18.1	3	84	14.3
Top Loin	17	34.6	17.1	16	91	0.0
Top Sirloin	17	27.6	11.4	4	46	11.8
Overall	55	31.5	16.0	3	91	9.1

Table 2. Least squares means \pm SE for steak thickness, external fat thickness, and steak weights for steaks from retail stores and foodservice operations

Source/steak	<i>n</i>	Steak thickness, cm	External fat thickness, cm	Steak weight, kg
Retail				
Top Blade	102	2.30 ^d (\pm 0.06)	0.21 ^e (\pm 0.02)	0.18 ^f (\pm 0.01)
Ribeye, lip on, boneless	311	2.87 ^b (\pm 0.03)	0.45 ^c (\pm 0.01)	0.40 ^c (\pm 0.01)
Ribeye, lip on, bone in	100	2.60 ^c (\pm 0.06)	0.46 ^{bc} (\pm 0.03)	0.51 ^b (\pm 0.01)
Top Loin	321	2.97 ^a (\pm 0.03)	0.55 ^a (\pm 0.01)	0.36 ^d (\pm 0.01)
Top Loin, bone in	71	2.48 ^c (\pm 0.07)	0.56 ^a (\pm 0.03)	0.37 ^{cd} (\pm 0.02)
T-bone	119	2.51 ^c (\pm 0.05)	0.58 ^a (\pm 0.02)	0.50 ^b (\pm 0.01)
Porterhouse	79	2.43 ^{cd} (\pm 0.07)	0.52 ^{ab} (\pm 0.03)	0.55 ^a (\pm 0.01)
Top Sirloin, boneless, cap off	307	2.79 ^b (\pm 0.03)	0.25 ^e (\pm 0.01)	0.39 ^c (\pm 0.01)
Top Round	105	2.28 ^d (\pm 0.06)	0.07 ^f (\pm 0.02)	0.55 ^a (\pm 0.01)
Bottom Round	86	1.92 ^e (\pm 0.06)	0.37 ^d (\pm 0.03)	0.29 ^e (\pm 0.01)
<i>P</i> -value		<0.0001	<0.0001	<0.0001
Foodservice				
Ribeye	160	2.91 ^a (\pm 0.03)	0.50 ^a (\pm 0.01)	0.43 ^a (\pm 0.01)
Top Loin	136	2.80 ^b (\pm 0.03)	0.47 ^a (\pm 0.02)	0.35 ^b (\pm 0.01)
Top Sirloin	136	2.47 ^c (\pm 0.03)	0.04 ^b (\pm 0.02)	0.31 ^c (\pm 0.01)
<i>P</i> -value		<0.0001	<0.0001	<0.0001

^{a-f}Least squares means in the same column and within the same steak source without common superscript letters differ ($P < 0.05$).

Table 3. Least squares means and SE for Warner–Bratzler shear force values (N) of retail and foodservice steaks

Source/steak	<i>n</i>	Mean	SE
Retail			
Top Blade	32	20.8 ^{cd}	4.5
Ribeye, lip on, boneless	122	20.5 ^d	2.3
Ribeye, lip on, bone in	42	23.1 ^{cd}	3.9
Top Loin	123	19.9 ^d	2.3
Top Loin, bone in	26	22.9 ^{cd}	4.9
T-bone	49	29.1 ^{bc}	3.6
Porterhouse	32	23.3 ^{cd}	4.5
Top Sirloin, boneless, cap off	129	22.8 ^{cd}	2.2
Top Round	51	40.2 ^a	3.5
Bottom Round	35	36.4 ^{ab}	4.3
<i>P</i> -value		<0.0001	
Foodservice			
Ribeye	80	29.6 ^a	0.7
Top Loin	68	24.6 ^b	0.8
Top Sirloin	68	29.4 ^a	0.8
<i>P</i> -value		<0.0001	

^{a-d}Least squares means in the same column and within the same steak source without common superscript letters differ ($P < 0.05$).

Table 4. Least squares means \pm SE for sensory panel ratings¹ for retail steaks

Steak	<i>n</i> ²	Overall like/dislike	Tenderness like/dislike	Tenderness level	Flavor like/dislike	Juiciness like/dislike
Top Blade	67	6.9 ^a (\pm 0.2)	7.5 ^a (\pm 0.2)	7.7 ^a (\pm 0.2)	6.5 ^{ab} (\pm 0.2)	7.1 ^a (\pm 0.2)
Ribeye, lip on, boneless	167	6.8 ^a (\pm 0.1)	7.0 ^b (\pm 0.1)	6.9 ^{bc} (\pm 0.1)	6.5 ^{ab} (\pm 0.1)	6.4 ^b (\pm 0.2)
Ribeye, lip on, bone in	55	6.6 ^{ab} (\pm 0.2)	6.6 ^{cd} (\pm 0.2)	6.6 ^{cd} (\pm 0.2)	6.6 ^{ab} (\pm 0.2)	6.1 ^{bc} (\pm 0.2)
Top Loin, boneless	188	6.9 ^a (\pm 0.1)	7.0 ^{bc} (\pm 0.1)	7.0 ^{bc} (\pm 0.1)	6.7 ^a (\pm 0.1)	6.5 ^b (\pm 0.1)
Top Loin, bone in	38	6.8 ^a (\pm 0.2)	6.8 ^{bcd} (\pm 0.2)	6.8 ^{bcd} (\pm 0.2)	6.8 ^a (\pm 0.2)	6.4 ^{bc} (\pm 0.3)
T-bone	67	6.6 ^{ab} (\pm 0.2)	6.8 ^{bcd} (\pm 0.2)	6.7 ^{cd} (\pm 0.2)	6.5 ^{ab} (\pm 0.2)	6.2 ^{bc} (\pm 0.2)
Porterhouse	43	6.9 ^a (\pm 0.2)	7.3 ^{ab} (\pm 0.2)	7.3 ^{ab} (\pm 0.2)	6.6 ^{ab} (\pm 0.2)	6.5 ^{ab} (\pm 0.2)
Top Sirloin, boneless	168	6.4 ^b (\pm 0.1)	6.6 ^d (\pm 0.1)	6.5 ^d (\pm 0.1)	6.2 ^b (\pm 0.1)	6.0 ^{bc} (\pm 0.1)
Top Round	53	5.5 ^c (\pm 0.2)	5.1 ^e (\pm 0.2)	4.9 ^e (\pm 0.2)	5.8 ^c (\pm 0.2)	5.2 ^d (\pm 0.2)
Bottom Round	49	5.4 ^c (\pm 0.2)	5.1 ^e (\pm 0.2)	4.9 ^e (\pm 0.2)	5.6 ^c (\pm 0.2)	5.8 ^{cd} (\pm 0.2)
<i>P</i> -value		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

^{a-e}Least squares means in the same column without common superscript letters differ ($P < 0.05$).

¹Sensory panel ratings for like/dislike: 10 = like extremely, 1 = dislike extremely; tenderness: 10 = very tender, 1 = not at all tender; juiciness: 10 = very juicy; flavor: 10 = extreme amount, 1 = none at all.

²Number of steaks.

Table 5. Least squares means \pm SE for sensory panel ratings¹ for foodservice steaks

Steak	<i>n</i> ²	Overall like/dislike	Tenderness like/	Tenderness level	Flavor like/dislike	Juiciness like/
Ribeye	79	7.0 ^a (\pm 0.1)	6.9 ^a (\pm 0.1)	6.8 ^a (\pm 0.2)	7.0 ^a (\pm 0.1)	6.4 ^a (\pm 0.2)
Top Loin	65	7.1 ^a (\pm 0.2)	7.1 ^a (\pm 0.2)	7.0 ^a (\pm 0.2)	7.0 ^a (\pm 0.1)	6.5 ^a (\pm 0.2)
Top Sirloin	67	6.5 ^b (\pm 0.2)	6.3 ^b (\pm 0.2)	6.2 ^b (\pm 0.2)	6.5 ^b (\pm 0.1)	5.5 ^b (\pm 0.2)
<i>P</i> -value		0.0100	0.0040	0.0063	0.0107	<0.0001

^{a-b}Least squares means in the same column without common superscript letters differ ($P < 0.05$).

¹Sensory panel ratings for like/dislike: 10 = like extremely, 1 = dislike extremely; tenderness: 10 = very tender, 1 = not at all tender; juiciness: 10 = very juicy; flavor: 10 = extreme amount, 1 = none at all.

²Number of steaks.

Photos



Figure 1. Recording steak thickness, external steak fat, and steak weight.



Figure 2. Recording in-store retail box data.