SURVEY OF US RETAIL BEEF SHEAR FORCE

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Introduction

The first National Beef Tenderness Survey (Morgan *et al.*, 1991) determined beef tenderness of beef in US retail cases. Neely *et al.*, (1999) showed that tenderness is a major and contributing factor to consumers' perception of taste. With tenderness problems found in beef and the elapsed time since that survey, it became clear that it was important to update the information. Morgan *et al.*, (1991) focused solely on the retail sector; however, with the increasing prevalence of foodservice, the 1998 Tenderness Survey included a foodservice portion (Brooks *et al.*, 2000). The 1998 Tenderness Survey found that retail cuts from the round still required more attention in processing and preparation to ensure acceptable tenderness, while chuck cuts improved in tenderness. Providing a benchmark for beef palatability allows the industry to identify where improvements have been made and where tenderness issues may still exist. Thus, a new survey was conducted to determine the tenderness of beef from the retail case based on Warner-Bratzler shear (WBS) force.

Materials and Methods

Collaborators sampled retail stores in eleven U. S. cities: Seattle, WA; Los Angeles, CA; San Francisco, CA; Denver, CO; Houston, TX; Chicago, IL; Kansas City, MO; Atlanta, GA; Tampa, FL; Philadelphia, PA; and New York City, NY. Retail cut types were taken and shipped via overnight delivery in insulated containers containing commercial ice packs and processed under refrigerated conditions (2 to 4°C). Each steak was individually identified, individually vacuum packaged, and frozen (-23°C). Steaks were thawed in a 4°C cooler for 48 h before cooking. Grated, non-stick electric grills were preheated for 15 min to a temperature of 177°C. During cooking, all steaks were turned after reaching 35°C and cooked to a final internal temperature of 70°C. Cooked steaks were removed from the grill and allowed to cool for approx. 4 hours. At least six cores (1.3 cm in diameter) were removed parallel to the muscle fibre orientation and sheared once, perpendicular to the muscle fibres, on a Warner-Bratzler shear machine (United 5STM-500, Huntington Beach, CA) using an 11.3 kg load cell. Means were separated using the p-diff option of PROC GLM of SAS. The percentages of steaks stratified into tenderness categories were analyzed using PROC FREQ of SAS.

Results and Discussion

The WBS values for retail cuts are presented in Table 1. Clod steaks had lower WBS values than bottom and eye of round steaks ($P < 0.05$). Brooks *et al.* (2000) found WBS values for the clod, bottom round, and eye of round to be 3.01, 5.09, 4.19 kg, respectively. Morgan *et al.* (1991) reported WBS values for the clod, bottom round, and eye of round to be 4.01, 4.38, and 4.67 kg, respectively. However, these workers braised the steaks to an internal temperature of 85°C, compared to 70°C in our study and the 1998 tenderness study. The bone-in strip steak, bone-in ribeye steak, and t-bone steak had the lowest WBS values found in our study. Brooks *et al.* (2000) reported the t-bone and porterhouse steaks to have the lowest WBS values.

Tenderness categories developed by Belew *et al.*, (2003) and Shackelford *et al.* (1991) are based on WBS values and were used to determine percentages of retail cuts that fell into each group (Table 2). Top round, bottom round, and eye round steaks were the only cuts shown to have WBS values over 4.6 kg. These percentages are much lower than those found by Brooks *et al.* (2000) and Morgan *et al.*, (1991). Our study had lower percentages for all cuts exceeding 3.9 kg WBS values. Consistent cooking methods allowed for the determination of tenderness between all cuts sampled in this study and the previous 1998 tenderness study. However, the single cooking method did not allow for the use of other cooking methods that may optimize the palatability of cuts that contain higher connective tissue levels (Brooks *et al.*, 1998).

Table 1: Least squares means and standard errors for WBS values.

Retail Cut	n	Mean, kg	Standard Error
Clod Steak	23	2.83^{b}	0.12
Ribeye Steak	81	2.37^{bcd}	0.06
BI Ribeye Steak	19	2.16^{bcde}	0.13
Strip Steak	8	2.34^{bcd}	0.20
BI Strip Steak	15	2.14^{bcde}	0.14
T-Bone Steak	48	2.27^{bcde}	0.08
Porterhouse Steak	32	2.32^{bcd}	0.10
Top Sirloin Steak	70	2.51^{bc}	0.07
Top Round Steak	39	3.02^{b}	0.09
Bottom Round Steak	27	3.67^{a}	0.11
Eye Round Steak	29	3.38^{a}	0.10

[a,b,c,d,e] Means lacking a common letter differ ($P < 0.05$).

Table 2: Percentage of retail cuts stratified into tenderness categories.

Retail Cut	Very Tender (WBS <3.2 kg)	Tender (3.2 kg > WBS < 3.9 kg	Intermediate 3.9 kg > WBS < 4.6 kg	Tough WBS <4.6 kg
Clod Steak	69.57	30.43		
Ribeye Steak	95.06	4.94		
BI Ribeye Steak	100.00			
Strip Steak	87.50	12.50		
BI Strip Steak	100.00			
T-Bone Steak	97.02		2.08	
Porterhouse Steak	93.75	6.25		
Top Sirloin Steak	87.14	12.86		
Top Round Steak	61.54	25.64	10.26	2.56
Bottom Round Steak	22.22	48.15	18.52	11.11
Eye Round Steak	34.48	55.17	6.90	3.45

Conclusions

Comparing WBS values from this survey to those reported by Morgan *et al.* (1991) and Brooks *et al.* (2000) show that tenderness of US beef retail cuts appear to be improving over time. For the most part, cuts sampled from the chuck, rib, and loin had very desirable WBS values and only some round cuts had WBS values that were categorized as "intermediate" and "tough."

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