CHARACTERIZATION OF BEEF AT RETAIL: OKLAHOMA MARKET STUDY

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Story in Brief

Thirty-three retail outlets were surveyed in Oklahoma (n = 24), Kansas (n = 5), and Texas (n = 4) to assess the tenderness and physical characteristics of six beef retail steaks and to determine the proximate composition of four advertised fat levels of ground beef. Boneless steaks (eye of round, top round, top sirloin butt, top loin, chuck arm, and mock tender) and ground beef (regular, lean, extra lean, and diet lean) were purchased from each store in three replications. Quality grades for the steaks purchased were 33.7% U.S. Choice and 66.3% No-Roll. Mean subcutaneous fat thickness was less than .25 inches for all steaks. Mean steak thickness was similar for retail cuts from the loin and chuck, but thinnest for steaks from the round. Peak shear force values were lowest for top loin, intermediate for chuck arm, mock tender, and top round, and highest for eye of round steaks. No differences were noted in shear force between U.S. Choice and No-Roll categories. However, the replication x retail cut type interaction was significant for shear force; top round, top sirloin butt, and mock tender steaks were the most variable in shear force over the three sampling periods. Directionally consistent statistical differences were noted between advertised ground beef fat levels for mean percentages of lipid and moisture. However, the variation in actual lipid content within advertised fat levels was quite large and highly dependent upon the store being surveyed. Results of this study indicate that research is needed to improve both consistency and level of tenderness in beef retail cuts, especially top sirloin butt, eye of round, and top round steaks.

(Key Words: Beef, Tenderness, Market Surveys)

Introduction

Consumer preferences were identified as the major driving force for the beef industry during the decade of the 80's. Demands focused on reducing fat while maintaining eating quality. A National Beef Market Study conducted in

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1989 (Savell et al., 1991) reported that fat trim levels for beef at retail averaged .25 inches. Retailers had responded to the war on fat by reducing the amount of plate waste (excess fat and bone) offered on beef cuts. The industry approved a change in the USDA beef quality grade standards to change the name of U.S. Good to U.S. Select to appease those consumers stressing leanness over palatability. Additionally, many researchers hoped this grade change would reduce the marketing of No-Roll beef and encourage multiple grade sales at retail. A subsequent National Tenderness Survey (Morgan et al., 1991) revealed considerable variation in the tenderness of beef offered at retail, even within a single quality grade.

Unfortunately, Oklahoma was not included in either of the national surveys. Accordingly, this study was conducted to assess the progress of Oklahoma retailers relative to regional markets in Kansas and Texas for retail beef fat levels, quality grade policy, and tenderness.

Materials and Methods

Retail outlets were selected in Oklahoma (n = 24), Kansas (n = 5), and Texas (n = 4) based on volume of red meat sales. Oklahoma was divided into four regions, east and west by Interstate 35 and north and south by Interstate 40. Oklahoma cities included Ada, Ardmore, Bartlesville, Enid, Guymon, Lawton, McAlester, Oklahoma City, Tulsa, and Woodward. Regional cities consisted of Dallas-Fort Worth, Texas as well as Kansas City and Dodge City, Kansas. Data were collected from each retail outlet in three replications (Rep 1 = October 1990 to January 1991, Rep 2 = April to June 1991, and Rep 3 = August to September 1991).

During each store visit, all fresh beef retail items (full and self service) were inventoried. Retail cuts were characterized by OSU personnel for external fat thickness, cut thickness, quality grade, and bone-in versus boneless availability. Boneless retail steaks from the top round (*semimembranosus* and *adductor* muscles), eye of round (*semitendinosus*), top sirloin butt (*gluteus medius*), top loin (*longissimus*), chuck arm (*triceps brachii*), and mock tender (*suspraspinatus*) were randomly selected and purchased (when available) to represent the quality grades available at each retail outlet. Likewise, ground beef was purchased based on advertised labelling of regular, lean, extra lean, and diet lean to represent availability at each retail store. All product was placed on ice and transported to the OSU Meat Laboratory in steel belted coolers.

Physical characteristics of external fat thickness and cut thickness (both measured in three locations and averaged), product weight, and price per pound were recorded. Steaks were crust frozen at -22°F for approximately 18 minutes, vacuum packaged, and stored (-22°F) until all steaks were collected for a given replication. Two patties (0.25 lb each) were formed from each ground beef sample, similarly crust frozen, vacuum packaged and frozen (-22°F).

Steaks were grouped by muscle type and cooked in random order for each replication. Steaks were thawed (34 +/- 2°F) for 24 hr and subsequently cooked on open-hearth broilers to a medium degree of doneness (155°F). After steaks cooled to room temperature (72°F), six 0.5 inch diameter cores were removed for peak shear force determination. One ground beef patty representing each purchase was thawed (34°F) for 6 hr and subsequently broiled in an impingement oven for approximately 6.5 minutes. Proximate analysis was conducted on the cooked as well as the remaining raw ground beef patties and each cooked steak to determine percentage moisture, lipid, and protein (AOAC, 1988).

The statistical model used for steaks included main effects of cut-type, quality grade, replication and all appropriate interactions. The model for ground beef included replication, ground beef type (advertised composition) and the two-way interaction. Least squares means were partitioned to account for unequal numbers of steaks or ground beef types.

Results and Discussion

Eighty-six percent of the beef retail cuts surveyed in this region were boneless. This is approximately 10% higher than the number of boneless cuts reported in the National Beef Market Basket Survey (Savell et al., 1991). Additionally, 88 steak types, 51 roasts, 51 special cuts, and 29 forms of ground beef were noted in the retail case inventories. This diverse selection of retail beef provides the consumer with substantial variety, however it may also create confusion relative to selection and proper cookery; labelling was not always consistent from store to store.

Steak Results

Approximately two-thirds of the steaks purchased (374 of 564) were No-Roll and one-third (190 of 564) were U.S. Choice. Only two of the retail stores surveyed offered U.S. Select quality beef and they changed to No-Roll after the second replication of sampling. Therefore, these were pooled with the No-Roll category for analyses. Physical characteristics of retail steaks sampled are presented in Table 1. All retail steaks averaged less than 0.25 inch of external fat thickness. As expected, mock tender steaks were the trimmest ($P < .05$) among all steaks sampled. This is the result of the mock tender being a deep muscle chuck cut surrounded by seam fat, whereas the other cuts are covered by subcutaneous fat. Relative to steak thickness, cuts from the round were the thinnest ($P < .05$) while the steaks from the loin and chuck were thickest. Steak thickness differed ($P < .05$) between Choice and

Table 1. Least squares means for physical characteristics, tenderness values and proximate composition of cooked steaks stratified by steak type.

Trait	Eye of round	Top round	Top butt	Top loin	Mock tender	Chuck arm
Fat thickness, in.	$.13^{d}$	$.14^{d}$	$.23^{b}$	$.22^{b}$	$.04^{e}$	$.18^{c}$
Steak thickness, in.	$.71^{d}$	$.59^{e}$	$.91^{c}$	1.02^{b}	$.98^{bc}$	$.98^{bc}$
Shear force, lb.	10.14^{b}	9.81^{bc}	9.46^{cd}	7.89^{f}	9.08^{de}	8.73^{e}
Tender steaks, %[a]	49.2	53.6	65.2	84.5	74.5	76.8
Very tender steaks, %[a]	15.5	28.6	36.0	66.7	32.7	45.8
Lipid, %	5.05^{d}	3.91^{d}	5.04^{d}	7.44^{b}	5.75^{cd}	6.35^{c}
Moisture, %	59.7^{c}	62.4^{b}	60.9^{bc}	59.3^{c}	61.2^{bc}	61.1^{bc}
Protein, %	34.5^{b}	33.1^{c}	31.8^{d}	31.3^{d}	32.2^{cd}	32.1^{d}

[a] Tender = shear force of 10.0 lb or less; Very Tender = shear force of 8.5 lb or less.

[b,c,d,e,f] Means in a row lacking a common superscript letter differ ($P < .05$).

No-roll categories, however there were no ($P > .05$) differences noted among quality levels for fat thickness (Table 2). The steak type x quality grade interaction revealed that chuck arm steaks were thicker ($P < .05$) than their No-Roll counterparts; however, no ($P > .05$) differences were noted among round, loin, and mock tender steaks between quality grades.

Peak shear force values were highest for cuts from the round, intermediate for the top sirloin butt, chuck arm, and mock tender, and lowest for top loin steaks (Table 1). These values are consistent with values reported by Morgan et al. (1991) in a National Tenderness Survey. Likewise, previous researchers (Savell et al., 1977, 1980; Wheeler et al., 1990) have found top sirloin butt steaks to be less tender than top loin steaks.

Similar trends were noted when steaks were categorized to estimate percentage tender (shear force of 10.0 lb or less) and very tender (shear force of 8.5 or less) levels (Shackelford et al., 1991). Tenderness categories presented in Figure 1 reflect that top loin steaks were the most tender (84.5%) and that approximately 75% of the chuck arm and mock tender steaks could be perceived as tender. Conversely, it should be noted that approximately one of every two round steaks purchased would have the possibility of being perceived as tough. Therefore, if broiling is chosen as a cooking method, some form of postmortem tenderization should be applied to all round steaks.

Table 2. Least squares means for physical characteristics and tenderness of retail beef steaks stratified by quality grade.

Trait	Quality grade: Choice	No-Roll
Fat thickness, in.	.15	.16
Steak thickness, in.	.91[b]	.83[c]
Shear force, lb.	9.06	9.33
Tender steaks, %[a]	69.7	65.9
Very tender steaks, %[a]	39.2	35.9

[a] Tender = shear force of 10.0 lb or less; Very Tender = shear force of 8.5 lb or less.

[b,c] Means in a row lacking a common superscript letter differ ($P < .05$).

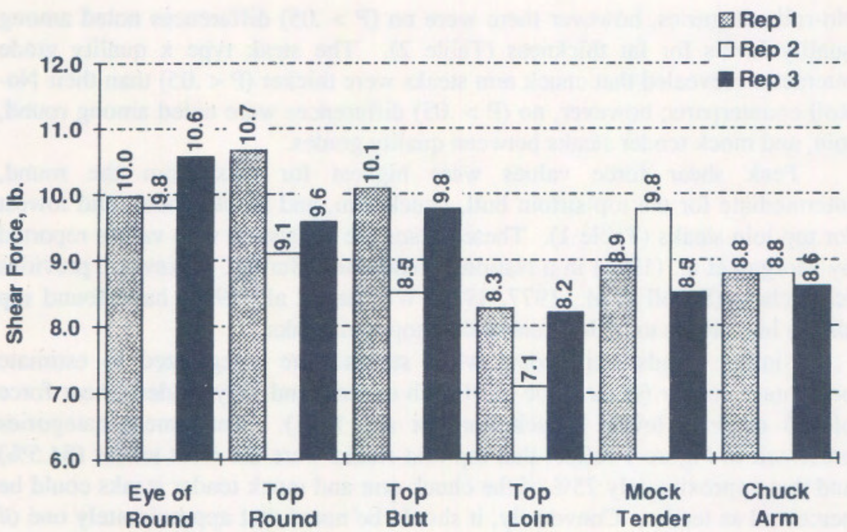

Figure 1. Shear force values stratified by steak type and replication.

Quality grade did not substantially influence shear force, percentage tender, or percentage very tender ratings. Moreover, the quality grade x steak type and quality x replication interactions were unrelated ($P > .05$) to peak shear force. Considering the steaks surveyed, these results do not support the basis for quality grading to predict tenderness. Unfortunately for our industry, the replication x steak type interaction was significant. No ($P > .05$) differences were noted in shear force among chuck arm steaks, however, shear values varied the most for steaks from the loin. Additionally, round and mock tender steaks had similar shear values for two replications and then one replication in which shear values were tougher ($P < .05$). This variation in tenderness supports evidence reported by Morgan et al. (1991) that beef retail steaks vary in degree of tenderness both between and within muscle types.

Proximate composition for cooked steaks is presented in Table 1. Lipid content was highest ($P < .05$) for top loin steaks and lowest ($P < .05$) for top round steaks. These data coincide with normal intramuscular fat differences noted in cuts from the loin versus those from the round. Round steaks also possessed higher ($P < .05$) levels of protein than cuts from the loin or chuck. Lipid content did vary ($P < .05$) between U.S. Choice (6.51%) and No-Roll (4.82%) grades.

Ground Beef Results

Raw Composition. Ground beef samples were analyzed for proximate composition. There were directionally consistent statistical differences noted between advertised ground beef fat levels for percentages of lipid and moisture (Table 3). These values were directionally consistent with advertised labelling for a majority (97.0%) of the stores surveyed. However, the variation in actual lipid content within advertised fat levels was quite large and highly dependent upon the store being surveyed (Table 4). Ground beef lipid contents noted in this survey were consistent with values reported by Savell et al. (1991).

Cooked Composition. Cooking properties of ground beef are also reported in Table 3. Shrink loss for ground beef patties was similar ($P > .05$) for regular, lean and diet lean ground beef; however, extra-lean ground beef patties had the highest ($P < .05$) values for cooking shrinkage. Lipid and moisture composition tended to follow a pattern similar to that noted for raw patties. As with steak tenderness, replication was a significant effect for ground beef composition (Table 5). Ground beef purchased during the second replication contained less ($P < .05$) lipid and more ($P < .05$) moisture than samples obtained in the third replication.

Table 3. Least squares means for raw and cooked properties of ground beef stratified by advertised fat level.

Trait	Ground beef type			
	Regular	Lean	Extra lean	Diet lean
Number of samples	90	57	62	31
Raw composition:				
Lipid, %	25.32[b]	17.71[c]	12.60[d]	9.93[e]
Moisture, %	57.14[e]	62.72[d]	67.14[c]	69.16[b]
Cooked properties:				
Cook shrink, %[a]	31.0[b]	30.0[b]	28.7[c]	30.6[b]
Lipid, %	24.07[b]	19.74[c]	15.27[d]	13.51[e]
Moisture, %	51.63[d]	54.39[c]	57.58[b]	58.51[b]
Protein, %	23.05[d]	24.63[c]	25.98[b]	26.81[b]

[a] ((Raw weight - cooked weight)/raw weight)*100.

[b,c,d,e] Means in a row lacking a common superscript letter differ ($P < .05$).

Table 4. Mean, standard deviation, minimum, and maximum values for lipid content of raw and cooked ground beef stratified by advertised fat level.

Trait/Ground beef type	Mean	SD	Minimum	Maximum
Raw lipid content, %				
Regular	25.38	4.89	13.40	40.87
Lean	17.81	4.91	7.74	30.14
Extra Lean	12.52	4.84	3.08	30.15
Diet Lean	10.07	3.55	2.89	17.23
Cooked lipid content, %				
Regular	24.00	2.83	15.09	29.83
Lean	19.79	3.76	10.08	26.97
Extra Lean	15.26	4.32	5.18	24.87
Diet Lean	13.69	4.05	5.31	19.92

Table 5. Least squares means for cooked proximate composition of ground beef stratified by replication.

Trait	Replication 1	Replication 2	Replication 3
Lipid, %	18.23^{ab}	17.26^{b}	18.96^{a}
Moisture, %	55.68^{ab}	56.01^{a}	54.90^{b}
Protein, %	24.80^{b}	25.52^{a}	25.04^{ab}

^{a,b} Means in a row lacking a common superscript letter differ ($P < .05$).

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