UPDATING THE UNITED STATES NATIONAL NUTRIENT DATABASE WITH NUTRIENT DATA FOR EIGHT COOKED BEEF CUTS

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Abstract – Beef nutrition is a topic of interest to the beef industry and its consumers. The objective of this study was to obtain nutrient data for eight beef rib and plate cuts in order to update the USDA National Nutrient Database for Standard Reference (SR). Seventy-two carcasses representing national composite of yield grade, quality grade, gender and genetic type were identified across the U.S. Beef plates and ribs (IMPS #109 and #121 C and D) were collected and shipped to three universities for retail fabrication, cooking, dissection, and nutrient analysis. Samples were analyzed for proximate composition (fat, moisture, protein), long chain and trans-fatty acids, and total cholesterol. Overall, few differences were noted between quality grades. Total fat and monounsaturated fatty acid values were influenced ($P \leq 0.1$) by USDA quality grade in cooked skirt steaks. Similarly, moisture and protein content were greater ($P < 0.05$) in USDA Choice boneless ribeye steaks and roasts.

Key Words – beef, composition, nutrition

I. INTRODUCTION

The USDA National Nutrient Database for Standard Reference (SR) is managed by the Nutrient Data Laboratory of the USDA Agricultural Research Service. Updating nutrient data within the SR is an ongoing process as live animal management, carcass fabrication procedures, and cooking methods are constantly changing. Transitions in cuts available at retail have been previous noted. The National Consumer Retail Beef Study [1] and the National Beef Market Basket Survey [2]. demonstrated that consumers preferred cuts with less exterior fat and retail cuts were increasing in leanness. These changes have validated the need to update and maintain current the nutritional data in the SR. Updates to the SR in the 21st century have resulted in the declaration of 29 beef cuts as lean, indicating they contain less than 10 g of total fat, 95 mg cholesterol, and 4.5 g or less of saturated fat (per 100 g serving; [3]) or that they possess no more than 10% fat by weight [4].

The retail cuts in this study were targeted for investigation due to either missing data, the need for updated data, or reduced external fat since the last survey [3]. The objectives were to provide updated nutrient data for inclusion in the SR as well as examine nutritional differences due to USDA quality grade. Updated nutrient data will provide accurate and readily available information for consumer and industry use.

II. MATERIALS AND METHODS

A. Product Selection.

Prior to sampling, thirty-six sampling criteria were generated to represent the following characteristics: 67% USDA Choice, 33% USDA Select; 50% USDA Yield Grade 2, 50% USDA Yield Grade 3; 67 % steers, 33% heifers; and 11.1% dairy, 88.9% non-dairy. To assure sufficient amounts of product were obtained, two carcasses ("A" and "B") were selected for each criteria (n = 72 total) from seven packing plants in six different regions of the U.S. The "A" carcasses were assigned to bone-in cuts while the "B" carcasses were used to generate boneless cuts. Because there were only four dairy steers, Select was 8.3% while Choice was 12.5% dairy.

B. Product Collection and Retail Fabrication
The rib and plate (IMPS #103, IMPS #121C, IMPS #121D) were obtained from the selected carcasses and shipped to one of three U.S. universities.

Fabrication into eight retail cuts (Table 1) occurred within 14 to 21 d postmortem. After fabrication, cuts were vacuum packaged and stored (0- 2 °C) until 21 d postmortem at which time they were frozen (-20 °C) until cooking.

Table 1 Beef retail cut identification, trim level, and cooking method

Retail Cut	IMPS	Trim level, in	Cooking Method
Bone-in lip-on ribeye steak	1103	1/8	Grill
Bone-in lip-on ribeye roast	109E	1/8	Roast
Boneless lip-on ribeye steak	1112A	1/8	Grill
Boneless lip-on ribeye roast	112A	1/8	Roast
Inside skirt steak	1121	0	Grill
Outside skirt steak	1121	0	Grill
Back ribs	124	1/8	Braise
Boneless lip-off ribeye steak	112	1/8	Grill

C. Cooking of Retail Cuts.
Retail cuts were tempered (0-4 °C) for 24 to 48 h prior to cooking using three cooking methods (Table 1). Raw weight (0.1 g) and temperature were recorded prior to cooking. Cuts assigned to grilling were grilled on two-sided electric grills (Model GRP99), preheated to 195 °C, until an internal temperature of 70 °C or 80 °C (inside and outside skirt only) was obtained. Final temperature and cooked weight (0.1 g) were recorded immediately.

Cuts assigned to roasting were roasted in a conventional oven, preheated to 160 °C, until an internal temperature of 60 °C was obtained. Temperature upon removal, peak temperature, and weight (0.1 g) after 30 min of rest were recorded. Cuts assigned to braising were placed in Dutch oven pans (Calphalon Everyday Non-stick), covered with distilled water, and braised for 150 min at 120 °C. The volume of liquid (mL) added prior to and remaining after cooking was recorded. Product weight (0.1 g) after 30 min of rest at room temperature was recorded. After cooking, all samples rested uncovered at 2-4 °C for at least 12 h before dissection.

D. Retail Cut Dissection and Homogenization.
Individual cooked pieces from each retail cut were dissected into separable components (refuse, separable lean, seam fat, external fat). Components from individual cooked pieces were weighed separately prior to combining with like components from the same retail cut and animal.
Separable lean from each cut was frozen in liquid nitrogen, homogenized, and blended using a Robot Coupe BLIXER (Robot Coupe USA, Inc., Ridgeland, MS). An aliquot for further compositing was stored at -80 °C.

Seam and external fat from all retail cuts were mixed, separately, in a commercial mixer (Koch Supplies, Inc., Kansas City, MO) for 3 min. Random samples were taken from the mixture to create a 2000-g homogenate which was stored at -80°C until analysis.

E. Compositing.
Compositing of lean and fat homogenates was performed to represent USDA Choice and Select quality grades for each retail cut. Six composites were made (USDA Choice, n = 4 composites; USDA Select, n = 2 composites) and six animals were represented in each composite. Composite samples for nutrient analysis were stored at -80 °C.

F. Proximate analysis.
Moisture analyses (AOAC oven-drying method 950.46 and 934.01 [5]) were performed in duplicate. Percent moisture (% MC) was calculated as: ((wet weight-dry weight/wet weight) x 100). Protein analysis was performed by combustion using the AOAC method 992.15 [1]. All analyses were performed in duplicate and percent protein was calculated by multiplying total percentage nitrogen by a factor of 6.25. Total fat analysis was performed using a modified Folch et al. [6] chloroform:methanol method. Analyses were performed in triplicate and % fat calculated as: [(Total volume of chloroform:methanol)/10 x final lipid weight)/sample weight] x 100.

G. Cholesterol analysis.
Cholesterol analysis was performed using methods described by Dinh et al. [7] or Rule et al. [8].

H. Fatty acid analysis.
Fatty acid methyl esters (FAMEs) were determined using the gas chromatographic method described by Parks and Goins [9]. Individual FAMEs were quantified as a percentage of total FAMEs analyzed.

I. Experimental design and analysis.
A mean for each composite was computed for statistical analysis. The model defined Quality Grade as a fixed effect and the Residual variation as a random effect. Means were weighted or composite proportions were used to achieve the desired mix of quality grades, yield grades, genders, and genetics.

III. RESULTS AND DISCUSSION

Comparisons of nutrients between quality grades for each cut yielded few differences. No differences due to quality grade were noted for bone-in and boneless lip-on ribeye steaks ($P > 0.05$; Table 2). Wahrmund-Wyle et al. [10] reported similar results. Monounsaturated fat content was higher in Choice outside and inside skirt steaks when compared to Select skirt steaks ($P < 0.001$). No differences in cooking loss between quality grades were observed among grilled retail beef cuts ($P > 0.05$; Table 2).

Protein and moisture content of roasted boneless lip-on ribeye roasts and grilled boneless lip-off ribeye steaks were higher in Select compared to Choice ($P < 0.05$; Table 3) quality grades. Interestingly, though no differences in moisture or fat were noted for bone-in ribeye roasts; Choice roasts had a lower cooking yield ($P < 0.05$) than Select Roasts. Unlike lip-on ribeye steaks, USDA quality grade affected the protein content of boneless lip-off ribeye steaks with Choice steaks containing less protein ($P < 0.05$) than Select steaks.

IV. CONCLUSION

Previously available nutrient information does not adequately represent beef currently sold at retail. These data exhibit the influence of trim level and quality grade on the nutrient profile of retail beef. The inclusion of this data in SR 24 (*accessed at http://www.ars.usda.gov/ba /bhnrc/ndl*) provides accurate and updated nutritional information that benefits all facets of the beef industry.

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Table 2 Effect of USDA quality grade on the lipid, moisture, protein, cholesterol, and fatty acid content of reconstructed[1] cooked beef rib and plate cuts.

	Bone-in lip-on ribeye steak[2]				Boneless lip-on ribeye steak[2]				Outside skirt steak[3]				Inside skirt steak[3]			
Nutrient	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value
n	2	4	-	-	2	4	-	-	2	4	-	-	2	4	-	-
Total fat (g/100g)	24.0	24.0	1.6	0.93	19.0	23.0	1.7	0.20	16.4	18.8	0.8	0.10	10.7	13.9	0.6	0.03
Moisture (g/100g)	52.8	52.8	0.8	0.99	55.4	53.2	0.9	0.14	52.8	52.1	0.7	0.49	58.1	55.9	0.6	0.06
Protein (g/100g)	23.2	22.9	0.6	0.68	24.7	23.4	0.7	0.22	28.5	27.0	0.6	0.13	30.0	28.7	0.5	0.12
Cholesterol, mg	80.0	82.0	1.5	0.23	81.0	79.0	2.8	0.62	98.0	104.0	7.3	0.57	91.0	93.0	2.8	0.59
Saturated fatty acids (g/100g)	10.7	10.5	0.9	0.90	8.7	10.3	0.8	0.23	6.9	7.7	0.6	0.34	4.3	5.5	0.5	0.16
Monounsaturated fatty acids (g/100g)	10.0	10.1	0.7	0.96	8.2	9.8	0.7	0.15	6.6	7.7	0.2	0.01	4.7	6.2	0.1	<0.001
Polyunsaturated fatty acids (g/100g)	0.87	0.89	0.04	0.80	0.79	0.85	0.02	0.10	0.94	1.06	0.09	0.37	0.47	0.59	0.06	0.21
Total trans-fatty acids (g/100g)	1.80	1.70	0.18	0.81	1.40	1.70	0.18	0.20	0.90	1.05	0.12	0.48	0.60	0.76	0.11	0.27
Cooking yield (%)	86.0	86.0	2.8	0.89	83.0	84.0	4.3	0.32	67.0	69.0	1.3	0.19	73.0	73.0	1.6	0.45

[1] Cuts were reconstructed using the following: [(nutrient content of lean x % lean) + (nutrient content of seam fat x % seam fat) + (nutrient content of external fat x % external fat)] / (% lean + % seam fat + % external fat).
[2] Grilled to an internal temperature of 70 °C.
[3] Grilled to an internal temperature of 80 °C.

Table 2 (*cont*) Effect of USDA quality grade on the lipid, moisture, protein, cholesterol, and fatty acid content of reconstructed[1] cooked beef rib and plate cuts.

	Boneless lip-on ribeye roast[2]				Bone-in lip-on ribeye roast[2]				Boneless lip-off ribeye steak[3]				Backribs[4]			
Nutrient	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value	Select	Choice	SEM	*P*-value
n	2	4	-	-	2	4	-	-	2	4	-	-	2	4	-	-
Total fat (g/100g)	19.0	23.0	1.5	0.12	21.0	23.0	2.7	0.66	16.0	20.4	1.1	0.46	26.0	30.0	1.9	0.21
Moisture (g/100g)	55.3	52.8	0.9	0.01	54.0	52.5	1.0	0.42	57.2	54.5	0.7	0.06	47.7	45.6	0.6	0.06
Protein (g/100g)	25.1	24.1	0.2	0.03	24.0	23.5	1.0	0.90	26.4	23.9	0.4	0.01	25.0	23.6	1.1	0.26
Cholesterol, mg	80.0	82.0	2.1	0.59	79.0	83.0	2.5	0.28	-	-	-	-	-	-	-	-
Saturated fatty acids (g/100g)	8.5	10.0	0.8	0.20	10.0	10.0	1.4	0.78	-	-	-	-	-	-	-	-
Monounsaturated fatty acids (g/100g)	7.9	9.6	0.6	0.11	9.0	9.8	1.0	0.54	-	-	-	-	-	-	-	-
Poly-unsaturated fatty acids (g/100g)	0.81	0.97	0.07	0.26	0.80	0.85	0.08	0.54	-	-	-	-	-	-	-	-
Total trans-fatty acids (g/100g)	1.40	1.60	0.16	0.38	1.50	1.60	0.27	0.93	-	-	-	-	-	-	-	-
Cooking yield (%)	78.0	75.0	4.2	0.06	77.9	76.3	0.9	0.13	81.0	83.0	2.4	0.03	74.4	75.9	1.0	0.11

[1] Cuts were reconstructed using the following: [(nutrient content of lean x % lean) + (nutrient content of seam fat x % seam fat) + (nutrient content of external fat x % external fat)] / (% lean + % seam fat + % external fat).
[2] Roasted in a conventional oven to an internal temperature of 60 °C.
[3] Grilled to an internal temperature of 70 °C.
[4] Braised for 150 min in a conventional oven at 120 °C.