Effects of Different Cooking Methods on Cooking Yields, Fat, and Moisture Change in Retail Beef Cuts

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Introduction

❖ Dietitians and consumers often need information regarding food plans, food preparation, and nutrient values for meats (before and after cooking). Therefore, data for beef has been developed, with a focus on cooking yields, moisture, and fat change.
❖ Cooking yields describe changes in food weight due to moisture loss, water absorption, or net fat gains/losses during food preparation and cooking.
❖ To address needs for up-to-date beef data, a nationwide Nutrient Data Improvement (NDI) study was recently conducted by the USDA Nutrient Data Laboratory (NDL), Colorado State University, Texas A&M University, and Texas Tech University with support from National Cattlemen's Beef Association.

Objectives

❖ To determine moisture and fat content of raw and cooked cuts and calculate cooking yield, moisture and fat change.
❖ To determine the effect of cooking methods (roasting, grilling, braising) on cooking yield, fat change, and moisture change in beef roasts and steaks.

Methodology

❖ Roasts (2" thick) and steaks (1" thick) from chuck, rib, and loin were collected from six US regions using a statistical sampling plan designed so that it represented quality grade, yield grade, genetic type, and gender proportions in retail beef.
❖ 15 chuck, rib, and loin cuts (n=36 animals per cut) were cooked according to study protocols developed by NDL.
❖ Data (n=15 cuts) were compared for roasts and steaks cooked by 3 different methods: 3 cuts were roasted to 60^{0}C internal temperature in a non-stick aluminum roasting pan with rack, 9 cuts were grilled to 70^{0}C internal temperature using a two-sided electric grill, and 3 cuts were braised to 120^{0}C internal temperature in a non-stick Dutch oven with water added.
❖ Raw and cooked weights and proximate data were used to calculate cooking yield, fat and moisture change. Tables 1 and 2 show the fat and moisture values of raw cuts.
❖ Quality control: Analytical quality control was assured by using standard reference materials and in-house control materials.
❖ Data were analyzed by multi-way mixed model analysis of variance to test for cut differences within cooking method in cooking yields, fat and moisture content, and fat and moisture change. Critical value for p is 0.05.

Calculations

❖ Cooking yields were calculated using the following formula

$$Yield\ \% = \frac{cooked\ sample\ ckd\ weight}{cooked\ sampled\ raw\ weight} \times 100$$

❖ Percent moisture and fat change were calculated using the following formula, where EP is edible portion

$$\frac{[\frac{\text{g water ckd EP}}{\text{100 g ckd EP}} \times \text{g ckd EP}] - [\frac{g\ water\ raw\ \text{EP}}{\text{100 g raw EP}} \times \text{g raw EP}]}{\text{g raw cut as marketed}}$$

Conclusion

❖ Cooking yield, fat, and moisture changes differ by specific cut and cooking method. Cooking factors such as moist vs dry heat, and internal end point temperature influence moisture and fat change during cooking.
❖ These data are useful for researchers, dietitians, and consumers, such as for obtaining nutrient values and for making raw to cooked portion weight calculations use in food plan decisions.
❖ These data are used to determine adequate quantities needed for food purchase and preparation.
❖ As a result of the NDI study, nationally representative beef data for the public will be released in the USDA National Nutrient Database for Standard Reference (SR) and the USDA Cooking Yields for Meat and Poultry tables available at http://www.ars.usda.gov/ba/bhnrc/ndl .

Figure 1: Cooking Yield For 3 Different Cooking Methods

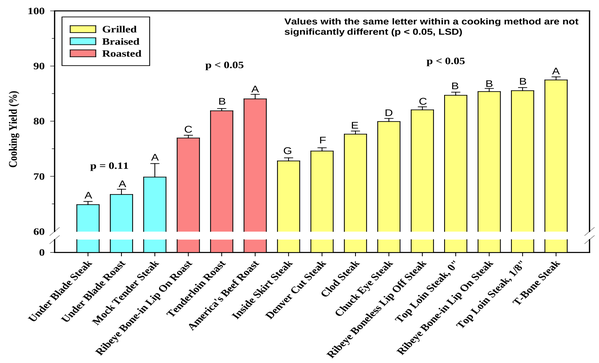

Figure 2: Percent Moisture Change For 3 Different Cooking Methods

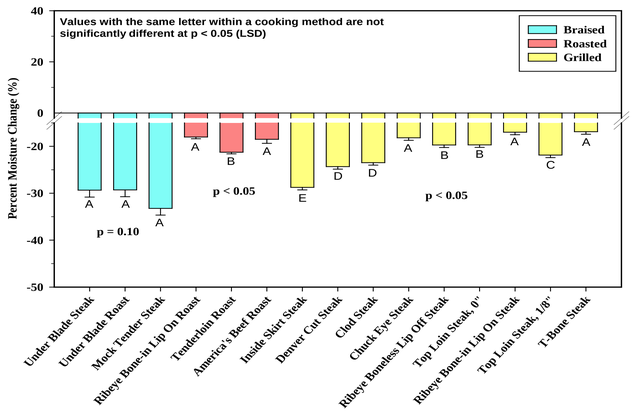

Figure 3: Percent Fat Change For 3 Different Cooking Methods

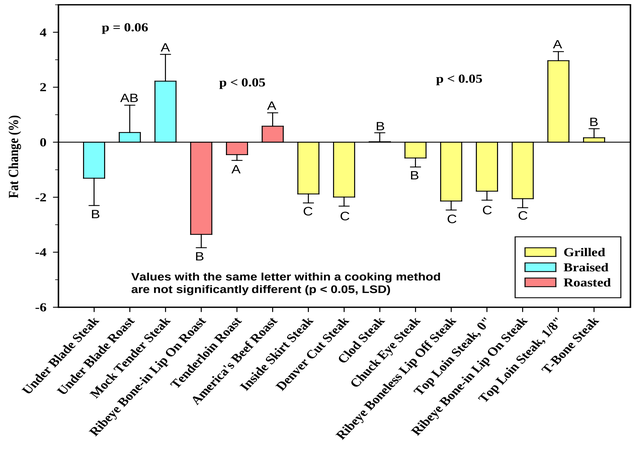

TABLE 1: MOISTURE CONTENT OF RAW AND COOKED CUTS

Cut Name[1]	Raw Moisture (g/100g)[2] (SE)	Cooked Moisture (g/100g) (SE)
Under Blade Steak	67^{b}(0.38)	54^{b}(0.52)
Under Blade Roast	67^{b}(0.38)	53^{b}(0.62)
Mock Tender Steak	73^{a}(0.38)	57^{a}(0.36)
Ribeye Bone-in Lip On Roast	60^{c}(0.52)	53^{c}(0.59)
Tenderloin Roast	72^{a}(0.17)	64^{a}(0.28)
America's Beef Roast (Chuck Eye Roast)	69^{b}(0.52)	60^{b} (0.65)
Inside Skirt Steak	67^{c}(0.42)	56^{c}(0.38)
Denver Cut Steak	68^{bc}(0.44)	59^{b}(0.38)
Clod Steak	73^{a}(0.24)	64^{a}(0.38)
Chuck Eye Steak	64de(0.38)	55^{cd}(0.38)
Ribeye Boneless Lip Off Steak	63^{f}(0.47)	56^{c}(0.38)
Top Loin Steak	69^{b}(0.24)	60^{b}(0.38)
Ribeye Bone-in Lip On Steak	60^{g}(0.50)	53^{e}(0.38)
Top Loin Steak, 1/8" fat trim	65^{d}(0.23)	56^{c}(0.38)
T-Bone Steak	64^{ef}(0.37)	54^{d}(0.38)

[1] Each cut is 0" fat trim unless otherwise stated
[2] Means with the same letter within each cooking method are not significantly different (p < 0.05, LSD)

TABLE 2: FAT CONTENT OF RAW AND COOKED CUTS

Cut Name[1]	Raw Fat (g/100g)[2] (SE)	Cooked Fat (g/100g) (SE)
Under Blade Steak	13^{a}(0.64)	18^{b}(0.82)
Under Blade Roast	13^{a}(0.64)	20^{a}(0.83)
Mock Tender Steak	5^{b}(0.20)	10^{c}(0.80)
Ribeye Bone-in Lip On Roast	21^{a}(0.66)	23^{a}(0.75)
Tenderloin Roast	7^{c}(0.27)	8^{c}(0.37)
America's Beef Roast (Chuck Eye Roast)	12^{b}(0.64)	15^{b}(0.59)
Inside Skirt Steak	12^{e}(0.43)	14^{e}(0.47)
Denver Cut Steak	12de(0.57)	14^{e}(0.47)
Clod Steak	5^{g}(0.23)	7^{g}(0.47)
Chuck Eye Steak	16^{bc}(0.46)	20^{bc}(0.47)
Ribeye Boneless Lip Off Steak	17^{b}(0.64)	19^{c}(0.47)
Top Loin Steak	8^{f}(0.34)	11^{f}(0.47)
Ribeye Bone-in Lip On Steak	21^{a}(0.64)	24^{a}(0.47)
Top Loin Steak, 1/8" fat trim	13^{d}(0.30)	18^{d}(0.47)
T-Bone Steak	15^{c}(0.42)	20^{b}(0.47)

[1] Each cut is 0" fat trim unless otherwise stated
[2] Means with the same letter within each cooking method are not significantly different (p < 0.05, LSD)

Results

❖ Moisture content varied from 60 to 73 g/100g for raw cuts whereas moisture was 53 to 64g/100g for cooked cuts. Fat content varied from 5 to 21 g/100g for raw cuts whereas fat was 8 to 24 g/100g for cooked cuts. (Table 1 and 2)
❖ Among 3 different cooking methods, braised cuts had lowest yield and grilled cuts had highest yield on average. (Figure 1)
❖ Percent fat and moisture change after cooking varied among cuts in roasting and grilling ($p < 0.05$), but did not significantly vary among cuts which were braised. (Figures 2 and 3)
❖ The highest mean moisture loss occurred in braising (31%), compared to roasting (19%) and grilling (21%) ($p < 0.05$). (Figure 2)
❖ Percent fat change differed from cut to cut and within cooking methods: 9 cuts showed a net fat loss and 6 cuts had a net fat gain per 100 grams. (Figure 3)

References

❖ Martin J.N, Brooks J.C, Thompson L.D, Savell J.W, Harris K.B, May L.L, Haneklaus A.N, Schutz J.L, Belk K.E, Woerner D.R, Legako J.F, Luna A.M, Douglass L.W, Douglass S.E, Howe J., Duvall M., Patterson K.Y, and Leheska J.L. (2013). Nutrient database improvement project: The influence of U.S.D.A. quality and yield grade on the separable components and proximate composition of raw and cooked retail cuts from the beef rib and plate. Meat Science 95 (2013) 486-494.

❖ **Support is from the Beef Checkoff**