THE BEEF NUTRIENT DATABASE IMPROVEMENT PROJECT: RETAIL CUTS FROM THE RIB AND PLATE

A Thesis

by

LAURA LEIGH MAY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2010

Major Subject: Animal Science

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Approved by:

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	Kerri B. Harris
Committee Member,	Kerry K. Litzenberg
Head of Department,	Gary R. Acuff

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ABSTRACT

The Beef Nutrient Database Improvement Project: Retail Cuts

From the Rib and Plate. (December 2010)

Laura Leigh May, B.S., Texas A&M University

Co-Chairs of Advisory Committee: Dr. Jeffrey W. Savell
Dr. Kerri B. Harris

The purpose of this study was to collect and analyze retail cuts from the beef rib and plate that had been identified as needing nutrient composition updates in the United States Department of Agriculture's (USDA) National Nutrient Database for Standard Reference (SR). Twenty beef carcasses were selected from three different regions of the United States, and the rib and plate were collected for shipment via refrigerated truck to the Rosenthal Meat Science and Technology Center. Each rib and plate was fabricated 14 to 21 d postmortem into the appropriate retail cuts to be used for this study. The cuts were dissected, either raw or cooked (braised, grilled, roasted), into four separable components: separable lean, seam fat, external fat, and refuse. Bone and heavy connective tissue were considered refuse. Percent total chemical fat, moisture, protein, and ash analyses were conducted on the separable lean component obtained from dissection.

Cooking yields were evaluated for each of the three cooking methods utilized in this study. Grilled cuts had the highest numerical yield followed by roasted and braised cuts. Dissection data showed single muscle cuts had a higher percentage of separable

lean than retail cuts composed of multiple muscles. Boneless and lip-off retail cuts contained a higher percentage of separable lean when compared to their bone-in and lip-on counterparts. Finally, proximate analysis data showed that as retail cuts increased in the percentage of total chemical fat, the percentage of moisture decreased. When percentage of total chemical fat was stratified by USDA quality grade, most cuts showed differences between USDA Choice and Select quality grades.

This study was a collaborative project; therefore, the results and discussion of this thesis are only based on findings from Texas A&M University's data. The final project results will be published in the USDA's National Nutrient Database SR.

DEDICATION

To my grandfathers, Winfield Smith and the late Ray May. Thank you for your constant love and support. Thank you for being the amazing men and role models that you are and for encouraging me to reach for the stars. Papaw, I am so thankful that you are here to see me accomplish my dreams. Gran, I miss you every day but know that you are constantly watching over me. I love you both.

ACKNOWLEDGEMENTS

I first thank Dr. Jeff Savell, for seeing past my shyness and offering me the opportunity to attend graduate school in meat science. I have been blessed with incredible opportunities that I would have never been able to experience otherwise. Next, I thank Dr. Kerri Harris for serving as my committee co-chair. Her constant support and patience helped to guide me through this project and prepare me for a successful future in the meat industry. To Dr. Kerry Litzenberg, thank you for your encouragement during my graduate studies. Finally, I thank Dr. Davey Griffin for allowing me the opportunity and privilege to serve as a judging coach. It was definitely an experience that I will treasure.

A simple thank you really does no justice in truly thanking the many graduate and undergraduate students who helped with this project. Without the help of Ashley Haneklaus, Scott Langley, John Arnold, Miles Guelker, Jacob Lemmons, Will Wiederhold, Brittany Laster, Kyle Segner, Amanda Smith, Julianne Riley, Kelly Thompson, Haley Grimes, Kayla Nelson, and Maggie Albrecht, I would not have been able to complete this project. Thank you all so very much. I am thankful to have been able to meet each and every one of you during my tenure as a graduate student at Texas A&M.

I am truly blessed with a wonderful family. To my parents, Steve and Vivian, thank you for making me the person I am today. Without your constant support and words of wisdom, I would never have been able to accomplish all that I have so far. To

my brother, Josh, thank you for keeping me laughing and encouraging me through the stressful times.

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TABLE OF CONTENTS

CHAPTER Page

LIST OF FIGURES

LIST OF TABLES

TABLE Page

CHAPTER I

INTRODUCTION

Proper nutrition is an important part of everyday life. In fact, most people are concerned about nutrition and the foods they consume in some form or fashion. Just take a look at the number of health food choices in the supermarket, weight loss centers, and dieting tips discussed in magazines. In the 1980s, a huge dieting and healthy living era began in the United States that continues with consumers being more health conscious than ever. With people looking for healthy alternatives, many food companies are taking new approaches to reach consumers. Much of the available nutrient composition data are outdated as foods are changing and new items are introduced. One of the major food items that is being updated is meat products, specifically beef cuts. Meat purchases that consumers are making show that these food items are no exception to the health conscious hype. Consumers are in search of the leanest meat products available. Therefore, it is very important to update the National Nutrient Database for Standard Reference (SR) from the United States Department of Agriculture (USDA) with current information so that individuals and professionals using the database can make informed decisions about beef in the diet. In the past, some people were informed that beef was not a healthful food to consume in their diet; however, if the nutrient data would have been updated to reflect the actual cuts available to consumers, people would have been

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This thesis follows the style of *Meat Science*.

able to see that beef products are in fact healthy and good for them. In order to properly update the SR, National Cattlemen's Beef Association (NCBA) formed the Beef Nutrient Database Improvement Project. This four-part project is a collaboration between Texas A&M University, Texas Tech University, Colorado State University, NCBA, and the Nutrient Data Laboratory. The objectives of this phase of the multi-year study were to identify and collect beef retail cuts from the rib and plate that needed nutrient composition updates in the USDA SR, to generate proximate data for all cuts collected by animal, and to prepare samples for further nutrient analysis testing. The results and discussion of this thesis are only based on findings from Texas A&M University's data, and the combined results will be published in the USDA National Nutrient Database SR.

CHAPTER II

REVIEW OF LITERATURE

2.1. History of the National Nutrient Database

For over 115 years, the United States Department of Agriculture (USDA) has been in charge of reporting the nutritional makeup of the U.S. food supply. The first food composition tables were published in 1891 by W.O. Atwater and C.D. Woods. These tables contained only 6 nutrients for 200 different foods. Then, in 1896, the first official publication USDA Bulletin No. 28 "The Chemical Composition of American Food Materials" was released (USDA, 2009). An update to USDA Bulletin No. 28 was released in 1906; however, it would be almost another twenty years before USDA would release another publication related to the composition of beef. In 1926, USDA Circular No. 389 "Proximate Composition of Beef" was released (USDA, 2009). Since the 1920s, several other circulars and publications that included beef products have been released including Circular No. 549 "Proximate Composition of American Food Materials" and Publication No. 572 "Tables of Food Composition in Terms of Eleven Nutrients."

However, the handbook considered most important in nutritional composition is Handbook No. 8 "Composition of Foods: Beef Products; Raw, Processed, Prepared." This handbook, commonly referred to as Agriculture Handbook 8-13, was originally released in 1950 with updates in 1963, 1986, and 1990. Data published in the 1963 and 1986 Handbook 8-13 updates were based on external fat trim levels of 1.27 cm or less, and the 1990 update, external fat trim levels for retail cuts were reduced to 0.63 cm. The

change in the fat trim level was based on research conducted at Texas A&M University (Savell et al., 1989, Savell, Harris, Cross, Hale, & Beasley, 1991).

While much of the research mentioned above was being conducted, USDA released the original version of the USDA National Nutrient Database for Standard Reference (SR). The Nutrient Data Laboratory (NDL) is responsible for developing the SR used in food policy, research and nutrition monitoring (USDA, 2009). Prior to 1992, most of the information from the database was published in the form of Agriculture Handbook 8 (AH-8), which is no longer available in printed form (USDA, 2009). To date, USDA has released twenty-two updated versions of the National Nutrient Database SR. Each new release incorporates more nutrients and many more foods. Currently, the database has information for approximately 130 nutrients and over 7,000 foods.

The database is used by both the government for programs such as the dietary guidelines and in the private sector (Haytowitz, & Gebhardt, 1996). Many professionals, such as registered dietitians, use the database to formulate diets for patients, and food companies use it to create food labels. It is extremely important to continue to update the nutritional values for foods already in the database since they have changed drastically over the last twenty years when the database started. In addition to up-to-date nutrient values, it is important to keep the database updated to reflect consumer trends and changes. Therefore, the database has incorporated grass fed beef nutrient information (Leheska et al., 2008) and a ground beef calculator.

2.2. Industry and consumer changes

From 1986 to 1989, Savell et al. (1987, 1989) conducted the National Consumer Retail Beef Study in three metropolitan cities around the nation. The purpose was to study the relationship between taste, price, and fat trim level to determine consumer acceptability of retail cuts from the four major beef primals: chuck, rib, loin, and round. This study was one of the initial works to indicate that fat measurements should be reduced in data used by the National Nutrient Database. Customers were invited to participate in a simulated retail experience where they were allowed to purchase meat products of different fat trim levels and quality grades. After returning home, the consumers provided feedback on their eating experiences with the products.

The study discovered that consumers liked the taste of USDA Choice and the leanness of USDA Select. In addition, the study discovered that there were regional differences between the amount of intramuscular fat that consumers preferred (Savell et al., 1987). This study was one of the first to conclude that the beef industry must start producing leaner products to be able to compete with the health movement that was in full swing. At the time, the average external fat trim on beef cuts was 0.64 cm, which was lower than the 1.27 cm external fat level used in Agriculture Handbook 8-13.

The purpose of the National Beef Market Basket Survey (Savell et al., 1991) was to further investigate the findings of the National Consumer Retail Beef Study (Savell et al., 1987) as it was believed retail stores had begun to trim beef cuts more, and these data were not represented in Handbook 8-13. The survey was done by selecting twelve cities based on region and population. The fat levels were measured in the stores, and then the

products were purchased and dissected to into the separable components of external fat, seam fat, lean, and bone (Savell et al., 1991).

When the first National Beef Market Basket Survey was conducted in 1987 and 1988, it was found that retailers had adopted a new trimmer policy on beef cuts. Savell et al. (1991) found that retailers were trimming products to approximately 0.38 cm. This was a significant reduction from what had been reported just a few of years before in the National Consumer Retail Beef Study, and a significant reduction from the trim level of 1.27 cm that was used in the Agriculture Handbook 8-13 and the National Nutrient Database. In addition, over 42% of the beef retail cuts had no external fat, and approximately 75% of all cuts were boneless (Savell et al., 1991).

Based on information obtained from the National Consumer Retail Beef Study, two tenderness surveys have been conducted. Morgan et al. (1991) and Brooks et al. (2000) conducted National Beef Tenderness Surveys to determine the average tenderness and sensory ratings of beef subprimal cuts sold in retail cases across the United States. Fourteen cities were selected for the first survey, while only eight were selected for the second survey. Many of these cities were used in the National Beef Market Basket Surveys and the National Consumer Retail Beef Study. Two to three retail chains or foodservice facilities were selected per city to participate. Retail cuts were purchased from the stores and then cooked so that shear values and meat tenderness could be evaluated. In addition, approximately twenty-five percent of the cooked retail cuts were selected randomly for sensory evaluation (Morgan et al., 1991). A consumer panel then evaluated the retail cuts for overall like, juiciness, and

tenderness. In the National Beef Tenderness Survey-1998, the mean external fat level for steaks was found to have decreased even more from what was recorded by the first National Beef Market Basket Survey.

Another research study that developed from the National Consumer Retail Beef Study was Jones et al. (1992a, 1992b, 1992c). Jones et al. (1992a) used various steaks and roasts and divided them up into three different treatments. The three treatments consisted of raw or cooked and different levels of trimness ranging from 0.0 cm to 0.6 cm. The 0.6 cm trim level came from the information obtained from the National Consumer Retail Beef Study.

According to Jones et al. (1992a), dissection data revealed that trimming boneless retail cuts to 0.0 cm before cooking increased the percentage separable lean. Therefore by trimming all of the external fat, a leaner product could be produced for the health conscious population of the United States. In addition, the cooked cuts showed that if all external fat were removed before cooking, the cuts had a lower percentage of chemical fat (Jones et al., 1992b). Finally, Jones et al. (1992c) looked at the influence of external fat on the cooking yield. The cuts that had 0.6 cm of external fat usually had a higher cooking yield than cuts that were trimmed completely of external fat. The data collected from this study were used to update beef cuts values in Agriculture Handbook 8-13.

Further research was conducted by Wahrmund-Wyle et al. (2000a, 2000b) to follow up on the Jones et al. studies. The objectives from part one of the study were to calculate cooking yields of beef cuts and update percentages of the lean, fat, and waste

components (Wahrmund-Wyle et al., 2000a). The cuts from USDA Choice and Select quality grade were assigned to external fat thickness levels of 0.0 cm, 0.3 cm, and 0.6 cm. Then, cuts were either dissected raw or after cooking to determine the proper percentages of lean, fat, and waste. The only raw dissections conducted were on fat levels of 0.3 cm. According to Wahrmund-Wyle et al. (2000a), USDA quality grade or trim level did not significantly affect the cooking yields of most cuts. This was different from the results on cooking yield that Jones et al. (1992c) had found.

In the second portion of the project, proximate analysis of beef cuts was conducted to look for differences in USDA quality grade and trim level of external fat (Wahrmund-Wyle et al., 2000b). Proximate analysis of the separable lean was done to determine fat, moisture, protein, and ash content. The study found that removing the external fat had few differences in the proximate results. The fat content was higher in USDA Choice grading cuts than the same cuts from USDA Select grading carcasses. This would be expected as the amount of intramuscular fat is higher in USDA Choice grading carcasses. The lipid content for most cuts was found to be lower than the value recorded in the National Nutrient Database, and therefore, the values were updated in the database (Wahrmund-Wyle et al., 2000b).

The second National Beef Market Basket Survey was conducted in 2006 by Mason et al. (2009). The survey was performed in many of the same ways as the original one. Eleven cities were selected with all but one having been surveyed in the last market basket. In the more recent survey, many more beef cuts were evaluated than the first market basket survey.

With the results seen from this survey, it was very important to make sure that all nutrient values from beef cuts in the National Nutrient Database be completely up-to-date. Therefore, NCBA created the Beef Nutrient Database Improvement Research project. This is a multi-phase project with collaboration among Texas A&M University, Texas Tech University, Colorado State University, NCBA, and National Data Laboratory to update beef cuts from the chuck, rib, loin, and round. In 2008, the first phase began with retail cuts from the chuck (West, 2009). NCBA hopes to be able to add additional cuts to their marketing campaign: "29 Cuts of Lean Beef." For a cut to be considered lean, it must contain less than 10 g total fat, 4.5 g or less saturated fat, and less than 95 mg cholesterol per 3.5 oz. serving (NCBA, 2010). The government places this distinction on a food based on cooked servings. All results from the first phase will be released in the 23rd release of the SR during the fall of 2010.

CHAPTER III

MATERIALS AND METHODS

3.1. Carcass selection

A total of twenty carcasses were selected from three different regions of the United States (Green Bay, Wisconsin; Tolleson, Arizona; and Corpus Christi, Texas) according to selection criteria found in Table 1. Carcasses were selected to represent the following characteristics: 70% USDA Choice and 30% USDA Select (USDA, 1997); 50% USDA Yield Grade 2 and 50% USDA Yield Grade 3 (USDA, 1997); 60% steers, 40% heifers; and 40% dairy, 60% non-dairy. Carcasses also had to be "A" maturity (USDA, 1997), have an appropriate hot carcass weight (318 to 408 kg for steers and 295 to 386 kg for heifers), and be free of any other defects including bruises, calloused eye, blood splash, dark cutter, or major fat tears. Individual carcass data collected from this project can be found on Table 2. In order to ensure enough sample to represent all retail cuts was collected, two carcasses were selected. The two carcasses were termed "A" and "B" for each animal number within the sampling matrix. Carcasses that qualified for selection were appropriately identified.

3.2. Subprimal collection

After identification of carcasses fitting the sampling matrix, sides of the carcasses (Right/Left) were identified and labeled for cooking designation according to

Table 1
Packing plant location and animal assignments

City	Animal #	Carcass weight (kg)	USDA Quality grade[a]	USDA Yield grade[a]	Gender	Genetics
Green Bay	1	318 to 408	Upper Choice	2	Steer	Dairy
Green Bay	2	295 to 385	Upper Choice	3	Heifer	Non-dairy
Green Bay	3	295 to 385	Lower Choice	2	Heifer	Non-dairy
Green Bay	4	318 to 408	Lower Choice	3	Steer	Dairy
Green Bay	5	318 to 408	Select	2	Steer	Non-dairy
Corpus Christi	19	318 to 408	Upper Choice	3	Steer	Non-dairy
Corpus Christi	21	295 to 385	Lower Choice	3	Heifer	Non-dairy
Corpus Christi	22	295 to 385	Select	2	Heifer	Non-dairy
Tolleson	20	318 to 408	Lower Choice	2	Steer	Dairy
Tolleson	23	318 to 408	Select	3	Steer	Dairy

[a]USDA (1997)

Table 2
Carcass data collected on each animal selected for this study

City	Carcass weight (kg)	Ribeye area (cm^2)	Fat thickness (cm)	USDA Yield grade[a]	Marbling score[b]	
Green Bay	350.9	78.7	0.5	2.6	690	680
Green Bay	347.0	75.5	0.6	2.8	690	680
Green Bay	361.7	94.8	1.6	3.1	520	570
Green Bay	314.3	87.1	1.7	3.3	570	540
Green Bay	360.8	84.5	0.5	2.6	490	480
Green Bay	346.1	90.9	1.2	2.8	460	460
Green Bay	357.0	77.4	0.6	3.0	480	490
Green Bay	362.0	63.9	1.0	3.7	420	430
Green Bay	381.9	103.8	0.9	2.3	350	360
Green Bay	361.5	98.7	1.0	2.0	380	370
Corpus Christi	407.6	89.0	1.4	3.7	610	610
Corpus Christi	395.3	91.6	1.5	3.4	530	540
Corpus Christi	385.6	80.6	0.4	2.7	480	480
Corpus Christi	351.1	87.7	0.4	2.3	420	430
Corpus Christi	321.6	78.7	1.4	3.2	450	460
Corpus Christi	314.8	83.2	1.4	3.3	460	450
Tolleson	312.8	83.2	1.3	2.7	380	390
Tolleson	334.8	100.6	1.4	2.7	370	340
Tolleson	364.2	81.9	0.8	3.2	390	390
Tolleson	372.9	79.3	0.7	3.1	350	370

[a]USDA (1997)
[b]Slight 0-90 = 300-390, Small 0-90 = 400-490, Modest 0-90 = 500-590, Moderate 0-90 = 600–690

Table 3
Fabrication and cooking assignments

Animal #	Raw	Cooked	Large End (Rib 10, 11, 12)	Middle (Rib 8, 9, 10)	Small End (Rib 6, 7, 8)
1	Left	Right	Steak	Steak	Roast
2	Right	Left	Steak	Steak	Roast
3	Left	Right	Steak	Roast	Steak
4	Right	Left	Roast	Steak	Steak
5	Right	Left	Steak	Roast	Steak
19	Left	Right	Roast	Steak	Steak
20	Right	Left	Steak	Steak	Roast
21	Left	Right	Steak	Steak	Roast
22	Right	Left	Steak	Steak	Roast
23	Left	Right	Steak	Roast	Steak

the identification plan (Table 3). Beef subprimals collected for this project were fabricated to comply with Institutional Meat Purchase Specifications (IMPS) as described by USDA (2010). The rib and plate (IMPS #103, IMPS #121C, IMPS #121D) from the selected carcasses were identified and tagged on the interior and exterior of the needed subprimals to assure identification integrity through fabrication. Subprimals collected in Tolleson, Arizona and Corpus Christi, Texas were fabricated into IMPS #109E before leaving their respective plant. Subprimals collected from Green Bay, Wisconsin were fabricated into IMPS #107. All rib subprimals from the three plants were trimmed to a 5.08 cm lip at the plant. After fabrication, the rib and plate from the selected carcasses were vacuum packaged and shipped via refrigerated truck to the Rosenthal Meat Science and Technology Center at Texas A&M University, College Station, Texas. Temperatures were verified upon delivery to ensure that cuts were kept at 0° to 4°C. The subprimals were stored in the absence of light at 0° to 4°C until fabrication.

3.3. Retail cut fabrication

After the subprimals arrived, fabrication into retail cuts occurred within 14 to 21 d postmortem. Retail cut fabrication of the beef ribs began with the fabrication of the rib primal (IMPS #107) into the subprimal (IMPS #109E). The weight of the rib was measured to the nearest 0.1 kg. In order to meet the retail cut requirements, “A” carcasses were utilized for bone-in retail cuts from the rib while “B” carcasses were utilized for boneless cuts. The retail cuts obtained from the rib include: back ribs (UPC

#1182), bone-in lip-on ribeye steak (UPC #1197), bone-in lip-on ribeye roast (UPC #1193), boneless lip-on ribeye steak (UPC #1203), boneless lip-on ribeye roast (UPC #1194), and boneless lip-off ribeye steak (UPC #1209). A prescribed identification plan (Table 3) was used to determine the location of where the roast was to be removed from the rib and identification was made by scoring the intact rib (Figure 1). Ribeye roasts consisted of a three-rib section with small-end roasts containing ribs 6 through 8, middle roasts containing ribs 8 through 10, and large-end roasts containing ribs 10 through 12. Ribeye steaks of 2.54 cm thickness were cut from the remaining portion of the rib not utilized as a roast. Back ribs were derived from fabrication of the boneless ribs.

3.3.1. Bone-in rib retail cut fabrication. After scoring the appropriate location for roast removal, ribs with "A" designation were fabricated into bone-in lip-on ribeye roasts (UPC #1193) and bone-in lip-on ribeye steaks (UPC #1197). Prior to fabrication, the subprimal weight was recorded to the nearest 0.1 g. Upon removal of the roast, the remaining portions were cut into 2.54 cm thick ribeye steaks. External fat was trimmed to 0.3175 cm. The weight of all remaining lean trimmings, fat trimmings and refuse were measured and recorded to the nearest 0.1 g. Retail cuts were properly numbered (Figure 1), identified (Figure 2), vacuum packaged in a high barrier vacuum bag and placed in the absence of light at -20°C until dissection or cooking.

3.3.2. Boneless rib retail cut fabrication. After scoring the appropriate location for removal of roasts, ribs with "B" designation were fabricated into boneless lip-on ribeye roasts (UPC #1194), boneless lip-on ribeye steaks (UPC #1203), boneless lip-off

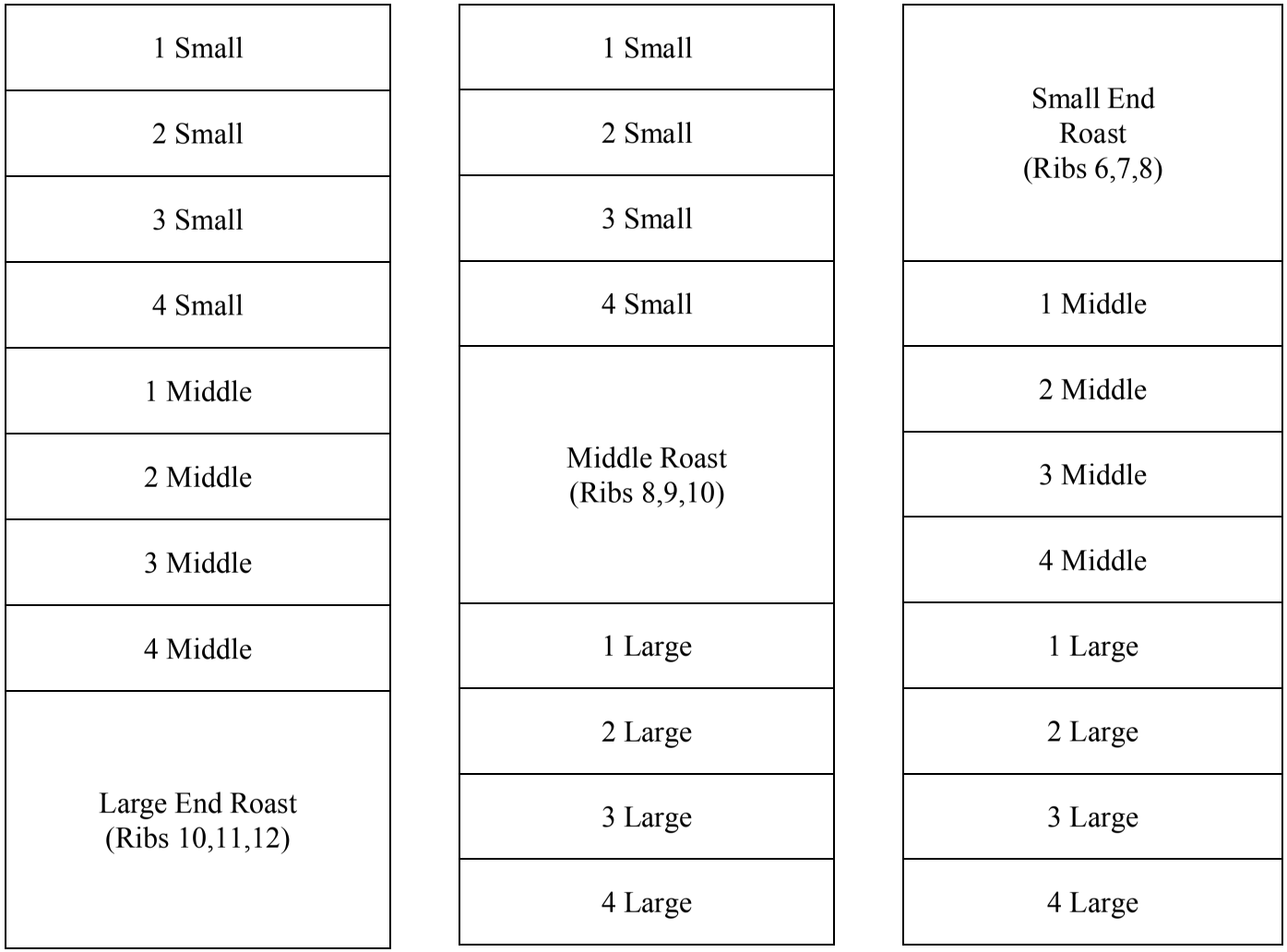

Figure 1
Fabrication and numbering scheme for intact rib

28950-P2
9/14/09

AM-B-10-R-1 Middle
Ribeye Steak
Cooked-Grilled

1. Project # (28950-P2)
2. Date of carcass collection
3. University (AM)
4. Carcass A or B
5. Animal # (1-5, 19-23)
6. Side of carcass (R/L)
7. Steak Identification
8. Retail Cut name
9. Cooked/ Raw
10. If cooked, cooking method (grilled, roasted, braised)

Figure 2
Identification of retail cuts

ribeye steaks (UPC #1209), and back ribs (UPC #1182). Prior to fabrication, the subprimal weight was recorded to the nearest 0.1 g. Back ribs were removed from the rib by separating along the lateral edge of the ribs, leaving a portion of the finger meat on the ribeye roll. External fat was trimmed to 0.3175 cm. After removal of the roast, the remaining portions were cut into 2.54 cm thick ribeye steaks. Steaks were numbered (Figure 1). Those steaks with "odd-number" identification were classified as lip-off and the entire lip was removed. The weight of the removed lip was measured and recorded with the "lip weight." Those steaks with "even number" identification were not altered. The weight of all remaining lean trimmings, fat trimmings and refuse were measured and recorded to the nearest 0.1 g. Retail cuts were properly numbered (Figure 1), identified (Figure 2), vacuum packaged in a high-barrier vacuum bag and placed in the absence of light at -20°C until dissection or cooking.

3.3.3. Beef plate retail cut fabrication. All plates, regardless of "A" or "B" designation, were fabricated into inside skirts (UPC #1607) and outside skirts (UPC #1612). Before fabrication, the weight of the subprimal was recorded to the nearest 0.1 g. Fabrication began with removal of any visible connective tissue or membrane from the product. Additionally, any large clumps of fat were removed. The weights of any external fat trimmings and refuse were measured and recorded. Retail cuts were weighed to the nearest 0.1 g, identified (Figure 2), placed in a high-barrier vacuum bag, and placed in the absence of light at -20°C until dissection or cooking.

3.4. Cooking of retail cuts

Retail cuts were tempered in a single layer in 0° to 4°C refrigeration for 24 to 48 h. Upon thawing, each individual cut was opened and raw temperature was recorded. Each cut then was blotted to remove any purge prior to taking the weight to the nearest 0.1 g. The weights of ribeye steaks and ribeye roasts were recorded individually. Before measuring temperature and weight of inside and outside skirts, samples were portioned so that resulting cuts would fit on grill surfaces. In addition, a 2.54 cm lip was formed by reducing the lip ventral to the *M. longissimus thoracis* on any cut with a lip. The weight of the lip was recorded to the nearest 0.1 g. The temperature and weight of each individual skirt portion was recorded. Three cooking methods were utilized: grilling, roasting, and oven braising. Cooking assignments are shown on Table 4. Cooking data were recorded individually for each sample.

3.4.1. Grilling – ribeye steaks. A Salton two-sided electric grill, model GRP99, was pre-heated for approximately 10 min, and the grill surface was measured with an infared thermometer to verify that surface temperature was approximately 195°C. One or two steaks were placed on grill surface and the cooking start time of each was recorded individually. Type J Digi-Sense thermocouple thermometers and probes were used to periodically monitor individual temperatures during the cooking process. Once an internal temperature of 70°C was obtained, steaks were removed from the grill surface and final internal temperature and cooked weight (to the nearest 0.1 g) were recorded immediately. Cuts were placed on a tray and allowed to chill uncovered under

Table 4
Retail cuts with cooking method utilized for this study

Retail cut name	UPC[a]	Cooking method
Bone-in lip-on ribeye steak	1197	Grilled
Bone-in lip-on ribeye roast	1193	Roasted
Boneless lip-on ribeye steak	1203	Grilled
Boneless lip-on ribeye roast	1194	Roasted
Back ribs	1182	Braised
Inside skirt	1607	Grilled
Outside skirt	1612	Grilled
Boneless lip-off ribeye steak	1209	Grilled

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

refrigeration (2° to 4°C) for at least 12 h before dissection. Individual steak identity was maintained throughout the entire process.

3.4.2. Grilling – inside and outside skirts. As with the grilling of ribeye steaks, a two-sided electric grill was pre-heated to obtain a surface temperature of 195°C. Each skirt portion was cooked individually to allow for even and efficient cooking due to uneven thickness of the sample. Skirt steaks were flipped mid-way through the cooking process in order to assure contact of entire steak with grill surface. Type J Digi-Sense thermocouple thermometers and probes were used to periodically measure the temperature of the skirt steak. To avoid inaccurate readings due to residual heat from the grill, tongs were used to measure temperature of the skirt steak away from the grill surface. Once an internal temperature of 80°C was obtained, skirt steaks were removed from the heat source and a final internal temperature and cooked weight (to the nearest 0.1 g) were recorded immediately for each individual piece. Cuts were placed on a tray and allowed to chill uncovered under refrigeration (2° to 4°C) for at least 12 h before dissection.

3.4.3. Roasting. Each individual ribeye roast (bone-in and boneless) was placed in a non-stick, anodized aluminum roasting pan with rack. A type J Digi-Sense thermocouple thermometer was inserted into the centermost portion of the roast in order to monitor temperature throughout the cooking process. A non-commercial oven was pre-heated to 160°C. Upon attainment of this temperature, one roasting pan was placed on the center rack of the oven. Temperature was monitored throughout and roasts were removed once an internal temperature of 60°C was obtained. Upon removal, individual

temperature and time of removal were recorded. The roasts were removed from the roasting pan and placed on a wire rack at room temperature. Temperature was monitored continuously until the peak temperature was reached. Peak temperature (highest temperature reached) was recorded for each individual roast. After 30 min of rest at room temperature, weight of the roast was measured and recorded to the nearest 0.1 g. Samples were then allowed to chill uncovered under refrigeration (2° to 4°C) for at least 12 h before dissection. Individual identify was maintained throughout cooking process.

3.4.4. Oven braising. Each set of back ribs were separated into individual ribs and placed as a single layer in a Dutch oven with lid. Double-distilled water was added to the pan until all ribs were completely covered. The added water volume was recorded. A non-commercial oven was pre-heated to 120°C. Upon attainment of this temperature, one pan was placed on the center rack of the oven. The ribs cooked for 2 ½ h. After removal, time of removal was recorded. The ribs were removed from the pan and allowed to rest on a wire rack for 30 min at room temperature. The juices were strained, and then the total volume was recorded. After 30 min, weight of all the ribs was measured and recorded to the nearest 0.1 g. Samples were then allowed to chill uncovered under refrigeration (2° to 4°C) for at least 12 h before dissection.

3.4.5. Cooking yield and fat retention. Cooking yield was determined for each cut by the following equation:

$$Cooking\ yield\ = \frac{cooked\ weight}{raw\ weight} \times 100$$

In addition, percentage fat retention was measured by the following equation that was used by several previous studies (Jones et al., 1992c, Wahrmund-Wyle et al., 2000b, West, 2009).

$$Percentage\ fat\ retention\ = \frac{\%\ fat\ in\ the\ cooked\ lean}{\%\ fat\ in\ the\ raw\ lean} \times cooking\ yield$$

3.5. Retail cut dissection

Samples were tempered in a single layer at 0° to 4°C refrigeration for 24 to 48 h while cooked samples were tempered as a single layer at 0° to 4°C refrigeration for 12 to 24 h. Due to the sensitivity of nutrients, all dissection procedures were completed with powder-free gloves. Before dissection, a 2.54 cm lip was formed by reducing the lip ventral to the *M. longissimus thoracis* for any raw cuts with lips. The weight of the lip was recorded to the nearest 0.1 g. Samples were dissected individually and individual weights recorded for initial cut weight, separable lean, refuse, external fat, and seam fat. Lip fat and lip lean weights were recorded for necessary cuts. The lip of the respective cut was defined as the portion of the cut extended beyond the ventral curvature of the *M. longissimus thoracis*. After measuring and recording weights of lip components, lip lean was added to separable lean component while lip fat was added to seam fat component for the respective cut. Regarding dissection of back ribs, fat located on the internal side (diaphragm side) of the rib was considered external while any fat lying between the rib bone and the ribeye roll was considered seam fat. For dissection of inside skirts and outside skirts, all separable fat was considered external. At the conclusion of dissection of those cuts with multiple individual pieces, separable lean for all pieces was combined.

Dissected lean was placed in sealed plastic bags and stored in 0° to 4°C refrigeration for same day homogenization. Dissected seam and external fat was cubed, placed into individual sealed plastic bags and frozen at -80°C for later homogenization. Seam fat (raw and cooked) and external fat (raw and cooked) for each cut remained separate.

3.6. Retail cut homogenization

Due to the sensitivity of B vitamins and possibly other nutrients to light, homogenization and aliquoting procedures were completed in the absence of direct light. Additionally, powder-free gloves were worn to prevent sample contamination. All lean samples were homogenized the same day they were dissected. Prior to homogenization, each individual cut was combined with the other samples from the respective sample number. Following dissection, samples were removed from refrigeration one at a time, cubed into 2.5 cm^3 or less pieces, and submerged in liquid nitrogen in a 1.89 l insulated foam nitrogen bucket. At this time, a homogenization start time was recorded. Using a stainless steel long handled spoon, the samples were stirred to incorporate the nitrogen and ensure that all pieces were completely frozen. The frozen samples were transferred into a 6.62 l Robot Coupe BLIXER 6V (Robot Coupe USA Inc., Ridgeland, MS) and blended/powdered until appearing finely powdered and homogenized. Each sample was blended for approximately 10 s on low speed (1500 rpm) and 30 s on high speed (3500 rpm), after which a small amount of liquid nitrogen was added. When the sample was completely homogenized, an end time and weight were recorded. The following aliquots

were used: 60 g for proximate analysis, 100 g for proximate backup, 450 g for composite, and any additional sample for back up. All aliquots were placed in pre-labeled whirl-pak bags, double bagged and then stored at -80°C for further analysis and compositing. For homogenization of fat samples, the fat from all the cuts in each fat group (raw external fat, raw seam fat, cooked external fat and cooked seam fat) was mixed with a mixer for approximately 5 min. Homogenates were placed in prelabeled plastic bags, double bagged, and then stored at -80°C for further analysis and compositing.

3.7. Proximate analysis

Proximate analyses of the individual animals per cut were performed on the derived aliquots.

*3.7.1. Moisture***.** Moisture analysis was performed using the AOAC oven-drying method 950.46 (Association of Official Analytical Chemists, 1990). A five +/- 0.05 g sample was weighed out into pre-dried, pre-weighed, pre-labeled crucibles or tins and immediately allowed to dry for 16 to 18 h at 100 to 103°C in a Fisher Scientific isotemp oven, model 650G (Fisher Scientific, Dubuque, IA). The samples were removed with tongs, cooled in a Nalgene desiccator, and weighed. All analysis was run in triplicate. Percent moisture (% MC) was calculated using the formula:

$$Percent\ Moisture\ = \frac{wet\ weight - dry\ weight}{wet\ weight} \times 100$$

3.7.2. Ash. Ash was determined by combustion in a muffle furnace using the AOAC ash oven method (Association of Official Analytical Chemists, 1990). After the moisture analysis, the dried samples were placed in a box furnace for 10.5 h at 600°C, then held at 100°C. The samples were removed, cooled in a Nalgene desiccators, and weighed. All analyses were run in triplicate. Percent ash was calculated using the formula:

$$Percent\ ash = \frac{ash\ weight}{wet\ weight} \times 100$$

3.7.3. Protein. Protein analysis was performed by combustion. Using a rapid N cube (Elementar Analysensysteme GmbH, Hanau, Germany) nitrogen analyzer, percent protein was determined. Standard blank and calibration procedures were performed as in the operators' instruction manual. Aspartic acid was used for calibration during analysis. Approximately 250 mg of each sample was weighed into foil weigh boats and a pellet was formed. Samples were placed in carousel and the nitrogen analysis was run. All analyses were run in triplicate.

3.7.4. Fat. Total lipid was extracted using a modified Folch, Lees, and Stanley (1957) method. Approximately 0.5 g of sample was weighed into a glass test tube. Fifteen milliliters of Chloroform:Methanol were added and then shaken for ten minutes. The homogenate was filtered into a second glass test tube and the volume was increased to twenty milliliters with additional Chloroform:Methanol rinsing. Eight milliliters of 0.74% KCL were added and vortexed for thirty seconds. The mixture was poured into a fifty milliliter graduated cylinder and refrigerated for at least twelve hours. The KCL layer was then suctioned off after recording the total volume of Chloroform:Methanol.

Ten milliliters of the Chloroform:Methanol layer were poured into a glass scintillation vial and dried in a nitrogen gas evaporator. The vials were put in the oven for ten minutes to remove any additional moisture. Analyses were run in triplicate. Percentage fat was calculated using the formula:

$$Percent\ fat = \frac{(total\ volume\ of\ Chloroform{:}\ Methanol\ \div 10)\ \times\ final\ lipid\ weight}{sample\ weight} \times 100$$

3.7.5. Quality Control. Quality control (QC) throughout proximate analysis was performed in order to ensure precise and accurate data. Lab validation was performed using beef and chicken baby food standards from the same lot of production from Beech Nut (Canajoharie, NY) obtained from the FALCC (Virginia Polytechnic Institute and State University, Blacksburg, Virginia). Throughout analyses, these same control materials were run with each analysis group to ensure that values were within the acceptable range established by the FALCC. Chemical analyses were considered valid by USDA NDL when the standard reference material was within the standard error of the certified value. Furthermore, a blind duplicate sample was run in each analysis group. If the variation of the study sample and its respective blind duplicate was greater than 5%, the data were considered invalid and reanalyzed. Each sample was run in triplicate in order to calculate a variation per sample and ensure that all variations were below 10% before accepting the sample's analysis value. No variations greater than 10% in this study.

3.8. Statistical analysis

Percentage values were computed using data analysis functions in Microsoft Excel (Microsoft Corporation, Redmond, Washington). Mean and standard deviations were computed by using PROC Means, and mean separation by USDA quality grade for each retail cut was conducted for significance between treatments using PROC GLM with Pdiff option (SAS Institute, Cary, North Carolina).

CHAPTER IV

RESULTS AND DISSCUSSION

4.1. Cooking yields of retail cuts

Cooking yields of retail cuts from the beef rib and plate are shown in Table 5. Grilled ribeye steaks, regardless of type, had the highest cooking yield followed by roasted ribeye roasts and grilled inside skirts. Outside skirts had the lowest cooking yield. The large differences in cooking yield seen in cuts that were grilled could be due to the different endpoint temperatures. All ribeye steaks were grilled to 70˚C, and all skirt steaks were grilled to 80˚C. By averaging all the cooking yields within each of the three cooking methods, grilling had the highest cooking yield followed by roasting and braising. Previous studies by Jones et al. (1992b) and Wahrmund-Wyle et al. (2000a) also found braising to produce the lowest cooking yields. Bone-in cuts also had higher cooking yields when compared to their boneless counterparts regardless of cooking method.

4.2. Separable tissue components of raw and cooked retail cuts

Retail cuts in this study were dissected into four separable components, separable lean, seam fat, external fat, and refuse (bone and heavy connective tissue considered inedible) with the exception of inside and outside skirts. All fat from these two cuts was considered external fat. Tables 6 and 7 report means and standard deviations for the separable components of raw and cooked retail cuts from the beef rib and plate,

Table 5
Cooking yields of retail cuts from the beef rib and plate

Retail cut name	UPC[a]	Cooking method	Cooking yield (%)[b]
		Grilling	
Bone-in lip-on ribeye steak	1197		88.72
Boneless lip-on ribeye steak	1203		85.04
Boneless lip-off ribeye steak	1209		83.83
Inside Skirt	1607		75.36
Outside Skirt	1612		70.39
		Roasting	
Bone-in lip-on ribeye roast	1193		76.00
Boneless lip-on ribeye roast	1194		74.74
		Braising	
Back ribs	1182		74.16

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]Cooking yield = (cooked weight / raw weight) × 100

Table 6
Means and standard deviations (SD) for percentage separable components of raw retail cuts from the beef rib and plate

			Lean (%)		Seam fat (%)		External fat (%)		Refuse[b] (%)	
Retail cut name	UPC[a]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bone-in lip-on ribeye steak	1197	81	64.68	5.90	15.09	4.91	2.69	1.52	16.25	6.44
Bone-in lip-on ribeye roast	1193	10	61.75	3.77	18.19	5.01	3.84	1.34	15.16	2.59
Boneless lip-on ribeye steak	1203	35	74.52	5.40	16.58	5.78	3.72	1.98	3.90	2.53
Boneless lip-on ribeye roast	1194	10	70.45	6.44	21.13	6.67	4.22	1.68	3.27	1.85
Back ribs	1182	10	36.62	4.41	1.15	1.07	5.31	1.62	56.31	3.40
Inside skirt[c]	1607	80	90.11	4.95	0.00	0.00	8.05	5.03	0.94	1.70
Outside skirt[c]	1612	80	87.96	5.57	0.00	0.00	9.86	5.73	0.96	1.43
Boneless lip-off ribeye steak	1209	42	78.55	5.95	12.80	5.94	3.68	2.02	3.77	2.51

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]Bone and connective tissue
[c]All fat collected from inside and outside skirts was recorded as external fat.

Table 7
Means and standard deviations (SD) for percentage separable components of cooked retail cuts from the beef rib and plate

			Lean (%)		Seam fat (%)		External fat (%)		Refuse[b] (%)	
Retail cut name	UPC[a]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bone-in lip-on ribeye steak	1197	80	59.70	7.04	16.49	5.10	2.94	1.80	19.68	7.93
Bone-in lip-on ribeye roast	1193	10	66.24	3.01	14.62	4.63	2.20	1.35	15.99	2.90
Boneless lip-on ribeye steak	1203	38	72.07	6.13	18.17	6.39	3.43	1.45	5.03	2.40
Boneless lip-on ribeye roast	1194	10	73.67	4.86	20.33	5.61	1.90	1.11	3.12	2.04
Back ribs	1182	10	30.07	2.64	1.43	0.89	4.67	1.72	63.19	3.52
Inside skirt[c]	1607	61	94.10	2.49	0.00	0.00	4.35	2.14	0.92	1.30
Outside skirt[c]	1612	41	93.25	4.33	0.00	0.00	5.73	4.16	0.36	0.72
Boneless lip-off ribeye steak	1209	46	75.99	6.22	13.26	6.16	4.16	2.64	5.30	2.52

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]Bone and connective tissue
[c]All fat collected from inside and outside skirts was recorded as external fat.

respectively. Single muscle cuts, such as inside and outside skirts, had the highest numerical percentage of separable lean. This was expected as cuts with multiple muscles have more seam fat to remove between muscles during dissection. Back ribs had the lowest numerical percentage of separable lean. This is also expected since bone makes up most of this cut's composition. This trend continued with all bone-in cuts having a lower percentage of separable lean as compared to their boneless counterparts. In addition, raw ribeye steaks had a higher percentage of separable lean compared to raw ribeye roasts. However, this reverses when the cuts are cooked before dissection. Cooked ribeye roasts had a higher percentage of separable lean compared to cooked ribeye steaks. The final trend that existed showed that cuts without a lip had a higher percentage of separable lean. This was also expected since the lip is mostly made up of seam fat with a minimal amount of lean.

4.3. Proximate analysis of the separable lean

Percent total chemical fat, moisture, protein, and ash analyses were conducted on the separable lean component obtained from the dissection of each retail cut except raw bone-in lip-on ribeye steaks and raw boneless lip-on ribeye roasts. Means and standard deviations for the percentage of each component for raw and cooked retail cuts from the beef rib and plate are reported in Tables 8 and 9, respectively. Boneless lip-on and lip-off ribeye steaks contained the lowest percentages of total chemical fat on both a raw and cooked basis, while back ribs and outside skirts presented the highest percentages of total chemical fat. As the percentage of fat increased, the percentage of moisture

Table 8
Means and standard deviations (SD) for percentage total chemical fat, moisture, protein, and ash (separable lean only) for raw retail cuts from the beef rib and plate

			Total fat (%)		Moisture (%)		Protein (%)		Ash (%)	
Retail cut name	UPC[a]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bone-in lip-on ribeye roast	1193	10	11.16	2.13	67.72	1.91	20.72	0.58	1.01	0.04
Boneless lip-on ribeye steak	1203	10	7.62	2.19	70.18	1.61	21.92	0.85	1.06	0.05
Back ribs	1182	10	19.92	4.73	60.47	3.82	18.57	1.20	0.87	0.09
Inside skirt	1607	20	10.06	2.82	68.23	2.11	21.08	1.01	1.00	0.06
Outside skirt	1612	20	15.25	2.71	65.48	2.36	18.55	0.87	0.98	0.05
Boneless lip-off ribeye steak	1209	10	7.49	2.39	70.01	1.45	21.93	0.82	1.06	0.05

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

Table 9
Means and standard deviations (SD) for percentage total chemical fat, moisture, protein, and ash (separable lean only) for cooked retail cuts from the beef rib and plate

			Total fat (%)		Moisture (%)		Protein (%)		Ash (%)	
Retail cut name	UPC[a]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bone-in lip-on ribeye steak	1197	10	12.91	2.71	60.84	1.75	25.92	1.35	1.09	0.05
Bone-in lip-on ribeye roast	1193	10	16.46	2.72	57.07	2.02	26.34	0.98	1.03	0.07
Boneless lip-on ribeye steak	1203	10	10.28	3.12	62.41	2.02	27.20	0.99	1.08	0.07
Boneless lip-on ribeye roast	1194	10	13.02	2.22	58.31	2.04	27.67	1.39	1.10	0.07
Back ribs	1182	10	18.53	1.61	53.76	1.32	28.35	0.57	0.68	0.10
Inside skirt	1607	20	14.35	2.82	57.27	1.88	27.86	1.53	1.02	0.07
Outside skirt	1612	20	20.29	4.06	53.02	2.60	25.92	1.56	1.30	0.32
Boneless lip-off ribeye steak	1209	10	9.85	2.78	62.40	2.12	27.48	1.38	1.13	0.06

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

decreased which kept consistent with previous studies, such as Jones et al. (1992b), Wahrmund-Wyle et al. (2000b), Mason et al. (2009), and West (2009). In addition, bone-in cuts revealed a higher percentage of total chemical fat when compared to their boneless counterparts. However, Mason et al. (2009) found bone-in ribeye steaks to have a lower percentage of total chemical fat than boneless ribeye steaks.

Tables 10 and 11 present the least squares means of total chemical fat of the separable lean for raw and cooked retail cuts from the beef rib and plate stratified by USDA quality grade. Almost all of the retail cuts in this study showed that there is a difference between USDA quality grades. Most cuts revealed the expected difference between USDA Choice and USDA Select with upper and lower USDA Choice being the same; however, some cuts showed that upper and lower USDA Choice were the same as well as lower USDA Choice and USDA Select. Since there are differences between quality grade, it suggests that the USDA National Nutrient Database should continue to report nutrients in three different grade categories: USDA Choice, USDA Select, and all grades.

4.4. Fat retention of the separable lean

Table 12 presents the percentage of chemical fat retention of the separable lean in retail cuts from the beef rib and plate. Fat retentions less than 100% are usually single muscle retail cuts that have no external fat or seam fat. It is thought that during the cooking process the fat liquefies and is absorbed by the lean to increase the fat retention (Coleman, Rhee, & Cross, 1988). This would explain why all ribeye steaks and roasts

Table 10
Least squares means of total chemical fat percentage of separable lean of raw beef retail cuts from the rib and plate, stratified by USDA (1997) quality grade

		Upper USDA Choice		Lower USDA Choice		USDA Select	
Retail cut name	*n*	Total fat (%)	SEM[a]	Total fat (%)	SEM[a]	Total fat (%)	SEM[a]
Bone-in lip-on ribeye roast	10	13.42[b]	0.68	11.20[c]	0.59	8.87[c]	0.68
Boneless lip-on ribeye steak	10	9.28[b]	0.87	8.19[b]	0.76	5.21[c]	0.87
Back ribs	10	22.38[b]	1.98	22.02[b]	1.72	14.66[c]	1.98
Inside skirt	20	12.18[b]	0.90	10.42[b]	0.78	7.47[c]	0.90
Outside skirt	20	16.78[b]	1.07	14.95[b]	0.93	14.12[b]	1.07
Boneless lip-off ribeye steak	10	9.55[b]	1.07	7.62[b,c]	0.92	5.27[c]	1.07

[a]Standard error of the least squares means
[b-c]Means within the same row lacking a common letter differ ($P < 0.05$)

Table 11
Least squares means of total chemical fat percentage of separable lean of cooked beef retail cuts from the rib and plate, stratified by USDA (1997) quality grade

		Upper USDA Choice		Lower USDA Choice		USDA Select	
Retail cut name	*n*	Total fat (%)	SEM[a]	Total fat (%)	SEM[a]	Total fat (%)	SEM[a]
Bone-in lip-on ribeye steak	10	15.77[b]	1.19	12.06[c]	1.03	11.17[c]	1.19
Bone-in lip-on ribeye roast	10	19.28[b]	1.20	15.76[b,c]	1.04	14.57[c]	1.20
Boneless lip-on ribeye steak	10	11.79[b]	1.63	11.16[b]	1.41	7.60[b]	1.63
Boneless lip-on ribeye roast	10	14.95[b]	0.94	13.21[b,c]	0.81	10.83[c]	0.94
Back ribs	10	18.95[b]	0.96	18.95[b]	0.83	17.56[b]	0.96
Inside skirt	20	15.88[b]	1.08	14.49[b,c]	0.94	12.65[c]	1.08
Outside skirt	20	24.01[b]	1.38	18.58[c]	1.20	18.85[c]	1.38
Boneless lip-off ribeye steak	10	11.17[b]	1.35	10.89[b]	1.17	7.16[b]	1.35

[a]Standard error of the least squares means
[b-c]Means within the same row lacking a common letter differ ($P < 0.05$)

Table 12
Percentage chemical fat retention for the separable lean from cooked retail cuts from the beef rib and plate

Retail cut name	UPC[a]	Percentage fat retention[b]
Bone-in lip-on ribeye roast	1193	112.09
Boneless lip-on ribeye steak	1203	114.73
Back ribs	1182	68.99
Inside skirt	1607	107.50
Outside skirt	1612	93.65
Boneless lip-off ribeye steak	1209	110.24

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]Percentage fat retention = [(percentage total fat of cooked retail cut) / (percentage total fat of raw retail cut)] × cooking yield percentage

had fat retention levels greater than 100% as seam fat is present between the multiple muscles.

4.5. Comparisons between data found in the National Nutrient Database, 2005 National Beef Market Basket Survey and this study

The major reason for conducting this study was to update data found in the National Nutrient Database. One of the major problems with the database was trying to match nutrient profiles from the database with retail cuts that are currently being sold to consumers. Tables 13 and 14 present comparisons between the National Nutrient Database, Mason et al. (2009), and this study. It is very apparent from all of the blank data points that there must be an updating of the database as several of the cuts from this study and Mason et al. (2009) are not even present in the current SR. With the values that are present, raw boneless ribeye steaks revealed a reduction in percentage of total chemical fat. The remaining cuts saw increases in percentage of total chemical fat compared to Mason et al. (2009). Some of the differences in fat values could be due to the methods of fat extraction used. Mason et al. (2009) used a modified ether extraction technique while this study used a modified Folch (Folch et al., 1957) method.

Table 13
Comparison of USDA National Nutrient Database with information from the 2005 National Beef Market Basket Survey and the current study for total chemical fat of the separable lean in raw retail cuts

		TAMU data, 2010	Market Basket[b]	National Database[c]	Difference[d] (%)	
		Total chemical fat (%)	Total chemical fat (%)	Total chemical fat (%)	Market Basket	National Database
Retail cut name	UPC[a]	Mean	Mean	Mean		
Bone-in lip-on ribeye roast	1193	11.16	7.75		44.00	
Boneless lip-on ribeye steak	1203	7.62	8.02		-4.99	
Back ribs	1182	19.92	11.67		70.69	
Inside skirt	1607	10.06		8.24		22.09
Outside skirt	1612	15.25		8.95		70.39
Boneless lip-off ribeye steak	1209	7.49	7.97		-6.02	

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]2005-National Beef Market Basket Survey (Mason et al., 2009)
[c]USDA, National Database
[d]Difference, % = [(TAMU data, 2010 – Market Basket[b]) / Market Basket[b]] × 100; % = [(TAMU data, 2010 – National Database[c]) / National Database[c]] × 100

Table 14
Comparison of USDA National Nutrient Database with the current study for total chemical fat of the separable lean in cooked retail cuts

		TAMU data, 2010	National Database[b]	
		Total chemical fat (%)	Total chemical fat (%)	Difference[c] (%)
Retail cut name	UPC[a]	Mean	Mean	
Inside skirt[d]	1607	14.35	10.06	42.64
Outside skirt[d]	1612	20.29	14.37	41.20

[a]Universal Product Code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]USDA, National Database
[c]Difference, % = [(TAMU data, 2010 – National Database[b]) / National Database[b]] × 100
[d]Data collected from the National Database is based on a broiled cookery instead of a grilled method

CHAPTER V

CONCLUSIONS

This study helped fulfill the need found from the Mason et al. (2009) study to complete nutrient profiles for the USDA National Nutrient Database SR on cuts that are actually sold in the marketplace today. Of the eight cuts used in this study, only two were previously listed in the database. However, a different cooking method was utilized in deriving the current nutrient profiles of the two cuts. By updating the database with retail cuts that can be purchased in the current marketplace, professionals and consumers alike will be able to make better and more educated decisions when it comes to recommending and purchasing beef cuts from the retail case. Additional revisions of the database are still needed for cuts from the beef loin and round. In addition, surveys, such as the National Beef Market Basket and National Beef Tenderness, should continue to be updated every five to ten years to keep up with the changing consumer and marketplace trends. These surveys provide a great deal of guidance as the next steps needed to keep the nutritional information updated for the beef industry.

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APPENDIX A

Beef Nutrient Database Improvement Study
SOP 1.2

PACKING PLANT COLLECTION PROTOCOL

1. Purpose:

1.1. To describe the procedure for identifying carcasses and collecting cuts for the Beef Nutrient Database Improvement Study.

2. Materials

2.1. Identification tags, multiple per carcass (See sample tag A), and tagging guns
2.2. Data Collection Sheets (2.1.1A-5B to 2.1.30A-36B)
2.3. Clipboards, Pens, Markers
2.4. Fat Depth Probe
2.5. Marbling Cards
2.6. Ribeye Dot Grid
2.7. Refrigerated Truck
2.8. Cooler (0-4°C)

3. Packer Letter

3.1. A letter (see attached *Letter to Packer.NDI.P2*) has been prepared to provide to the packer in order to gain entry to the packing plant for the purpose of carcass collection. This letter has been signed by Shalene McNeill and is on NCBA letterhead.

4. Sampling Plan

i. Plant – Animal Assignments – See Table A-1

Each animal number represents a set quality grade, yield grade, gender and genetic combination that has been determined in order to represent at least 85% of the beef carcasses in the U.S. if any selection criteria needs to be altered for a specific animal due to limiting factors at a plant location, the study statistician must be contacted immediately to assure that the sampling plan can maintain balance and strength.

NOTE: Side (left/right) of the carcass has been randomly assigned to cooked or raw treatment. (Refer to Table A-1)

ii. University Plant Assignments

Specific plant location may be changed by the university if the original plant selected it difficult to work with or does not have the appropriate cattle necessary to fill the sampling matrix. If it is necessary to select product from a different plant than those that are specified the study statistician must be notified.

1. Colorado State University
   - Greeley
   - Kansas (Dodge City)
2. Texas A&M University
   - Green Bay
   - Tolleson
3. Texas Tech University
   - Plainview
   - Nebraska (Omaha)

iii. Larry Douglass (study statistician) should be informed by each university of plant collection dates conducting in order to be on call for possible changes in the sampling plan.

5. Procedure

i. Guidelines for carcass selection

NOTE#1: Two carcasses (A & B) will be selected to fill each of the 36 cells (72 carcasses total)

NOTE#2: Cuts to be procured as follows:

- 109E Beef Rib, Ribeye Roll, Lip-On, Bone In (Export Style)
- 121E (outside) and 121D (inside) Beef Plate, Skirt Steak

ii. All standard carcass data will be collected on the respective NDI Data Form (2.1.1A-5B to 2.1.30A-36B)

iii. Following the data collection all data shall be entered into the official tracking spreadsheet (TI- Packing Plant. NDI.P2).

1. Proper quality control measures in reviewing the data must occur prior to submitting the data to the study tracker
2. Data entry **must be consistent** (ie: case sensitive, cut names, etc…) within and across all data files

iv. Data Point to be Collected (See Table A-2 for List of data Points)

1. USDA Graders will categorize carcasses into the official grade categories (Ch, Se, YG2, YG3)
2. University personnel will make specific quality and yield grade measurements using guided instrumentation
   - If university grade assessments disagree with USDA graders then the carcass shall not be selected into the study.

- Call and record marbling on **both** sides (left and right sides) of the carcass
    i. Marbling scores shall not cross the grade line
        1. Example: if the right side of a carcass has Slight 90 marbling and its left side has Small 10 marbling then this carcass can not be selected into the study.
    ii. Aim to select representative marbling scores within marbling categories
        1. Categories of Choice marbling by % of Choice in market
            a. 8.8% Moderate
            b. 26.9% Modest
            c. 64.2% Small
        2. Categories of Select marbling by % Select in market
            a. 40% Slight +
            b. 60% Slight –
- Numeric Scales to be used in the data entry spreadsheet so that the data is ready for analysis
    i. Marbling Scale: Marbling score should be assessed to the <u>nearest 10</u>.
        - Slight 0 - 99 = 300 - 399
        - Small 0 - 99 = 400 - 499
        - Modest 0 - 99 = 500 - 599
        - Moderate 0-99 = 600 – 699

    v. Skeletal / Lean Maturity Scale: Assess to the nearest 10
        - A 0 – A 90 = 0 – 90

    vi. Overall Quality Grade Scale:
        - Low Select = 1
        - High Select = 2
        - Low Choice = 3
        - Ave. Choice = 4
        - High Choice = 5

    vii. Percentage KPH: enter actual percentage, not the adjustment factor
        - 3.5% = 0 adjustment. >3.5%= positive adjustment; <3.5 = negative adjustment

          4.5 = +.2
          4.0 = +.1
          3.5 = 0

3.0 = -.1
2.5 = -.2
3.0 = -.3
2.5 = -.4
2.0 = -.5
1.5 = -.6
1.0 = -.7
0.5 = -.8

2. Duplicate carcasses (A&B) shall be selected to be as close in marbling scores as possible (not to cross the grade line). All other characteristics should fall into the outlined criteria.
    - It is acceptable for duplicate Upper Choice carcasses cross the Modest/Moderate marbling score line
3. University personnel will be responsible for identifying dairy carcasses

viii. All animals selected shall be A maturity only

ix. Carcass weights should fit the following weight ranges:
    1. 700 – 900 lb. for steers and dairy carcasses
    2. 650 – 850 lb for heifer carcasses
    If absolutely no other carcasses are available to be selected within a 2 day sampling period that will fit the exact sampling requirements of a particular cell, a carcass can be selected to fall within (±10) of the set weight range.

x. Carcasses selected for this study shall have hump heights less than 4" measured from the thoracic vertebrae

xi. Carcasses selected for this study shall be free of major defects
    1. Bruises, dark cutting, blood splash, callous ribeyes, yellow fat, miss split, etc…

b. Identification of cuts

i. All cuts will be labeled with proper identification tags
    1. Refer to Sample Tag – A

PACKING PLANT TAG ID'S

1. Project # (28910-P2)
2. Date of Carcass Collection
3. University (AM, CS, TT)
4. Carcass A or B
5. Animal ID # (1-36)
6. Side of Carcass(R/L)

7. Cooked or Raw
(Randomly assigned to left or right side of the carcass as shown in Table A-1)

SAMPLE TAG - A

28910-P2	8/20/09
AM-B-10-R	
Cooked	

c. Transportation of cuts from packing plant to the University

i. Each university will make arrangements for proper transportation of selected cuts to their respective meat lab.
ii. Product must be transported in refrigerated temperature.
iii. Using the official study sample receiving form, record the temperature of two cuts (from two different boxes) when received at the university.
- Re-vacuum package the cuts in which the packaging was disturbed to take temperatures.

d. Storage of cuts prior to fabrication

i. All cuts shall be stored in a cooler at (0°- 4° C)
ii. Proper daily temperature logs shall be maintained by each university to verify their cooler maintained the proper temperature.
iii. Fabrication to retail cuts should occur between 14-21 days postmortem

e. Tracking

i. NDI electronic Tracking Spreadsheet (1-Packing Plant. NDI.P2) shall be completed and forwarded to the Project Tracking Manager (PTM) according to Tracking Protocol found in the Master Study Protocol.
iii. Naming Files: University code.study #, packplant.packplantname(mm-dd).xls: TTU.28910-P2.packplant.Plainview(mm-dd-yy).xls.

TABLE A-1. PLANT – ANIMAL ASSIGNMENT
NOTE: Two carcasses (A & B) will be selected to fill each of the 36 cells (72 carcasses total)

Plant	Animal #	QG	YG	Gender	Genetics	Raw	Cooked
Greenbay	1	U	2	S	D	**L**	**R**
Greenbay	2	U	3	H	N	**R**	**L**
Greenbay	3	L	2	H	N	**L**	**R**
Greenbay	4	L	3	S	D	**R**	**L**
Greenbay	5	S	2	S	N	**R**	**L**
Greely	6	U	2	S	N	**L**	**R**
Greely	7	U	3	S	N	**R**	**L**
Greely	8	L	2	S	N	**L**	**R**
Greely	9	L	3	H	N	**R**	**L**
Greely	10	S	2	H	N	**L**	**R**
Greely	11	S	3	S	N	**R**	**L**
Dodge City	12	U	2	H	N	**L**	**R**
Dodge City	13	U	3	S	N	**R**	**L**
Dodge City	14	L	2	S	N	**R**	**L**
Dodge City	15	L	3	S	N	**L**	**R**
Dodge City	16	S	2	S	N	**L**	**R**
Dodge City	17	S	3	H	N	**R**	**L**
Dodge City	18	S	3	S	N	**L**	**R**
Tolleson	19	U	3	S	N	**L**	**R**
Tolleson	20	L	2	S	D	**R**	**L**
Tolleson	21	L	3	H	N	**L**	**R**
Tolleson	22	S	2	H	N	**R**	**L**
Tolleson	23	S	3	S	D	**L**	**R**
Plainview	24	U	3	H	N	**L**	**R**
Plainview	25	U	2	S	N	**R**	**L**
Plainview	26	L	2	H	N	**L**	**R**
Plainview	27	L	3	S	N	**R**	**L**
Plainview	28	S	2	S	N	**L**	**R**
Plainview	29	S	3	S	N	**R**	**L**
Omaha	30	U	2	S	N	**L**	**R**
Omaha	31	U	2	H	N	**R**	**L**
Omaha	32	U	3	S	N	**R**	**L**
Omaha	33	L	2	S	N	**L**	**R**
Omaha	34	L	3	S	N	**R**	**L**
Omaha	35	S	2	S	N	**R**	**L**
Omaha	36	S	3	H	N	**L**	**R**

TABLE A-2 - Packing Plant Data Points to Collect *(T1 – PackingPlant.NDI.P2)*

Data Point	Description of Data Point
1	Study #
2	Plant # Name
3	University (AM, CS,TT)
4	Carcass Collection Date (mm/dd/yy)
5	Sequence #
6	Carcass Kill Date (mm/dd/yy)
7	Shipped from plant (mm/dd/yy)
8	Arrived at Univ (mm/dd/yy)
9	Animal ID (1-36; a/b)
10	Yield Grade (2/3)
11	QG (U/L/S)
12	Gender (S/H)
13	Genetics (N/D)
14	PYG
15	Adj. PYG
16	HCW (lbs)
17	REA
18	KPH %[1]
19	Actual YG (nearest 0.1)
20	Lean Maturity[2]
21	Skeletal Maturity[2]
22	Marbling Score (R) [3]
23	Marbling Score (L) [3]
24	Actual QG [4]

[1] Enter the percentage KPH not the adjustment factor

[2] A0 – A90 = 0 – 90

[3] Slight 0 - 90 = 300 - 390, Small 0 - 90 = 400 - 490, Modest 0 - 90 = 500 - 590, Moderate 0-90 = 600 – 690

[4] Low Select = 1; High Select = 2; Low Choice = 3; Ave. Choice = 4; High Choice = 5

Beef Nutrient Database Improvement Study
SOP 2.2 A

RIBEYE FABRICATION PROTOCOL

1. Purpose:

1.1. To describe the procedure for fabricating beef ribs for the cuts needed for this study. Product will be vacuum packaged and stored without exposure to light at 0-4°C until day 14 postmortem. Fabrication to retail portions shall occur between 14-21 days. Retail cuts shall be properly identified, packaged and stored without exposure to light at 0-4°C until day 21 postmortem, and then cuts will be transferred to -18°C storage.

2. Materials

2.1. Carcass cooler (0°-4°C)
2.2. Daily Temperature Recorder/Logger
2.3. Cryovac Machine and bags
2.4. Post fabrication cuts to be frozen and stored below -18°C

3. Fabrication to retail cut weights

3.1. Scale considerations
- **3.1.1.** All scales should be calibrated each day
- **3.1.2.** Scale should be on level surface.
- **3.1.3.** **Take weight to the nearest 0.1 g for retail cut weights**
- **3.1.4.** Zero before each weight
- **3.1.5.** Wipe residue from weigh pan after each weight

3.2. Net weights to be recorded on the Fab to Retail Cut spread sheet

Retail Cut	**Cooked/ Raw**
• Beef, Ribeye Bone-in Lip On Roast 1/8”	Cooked/Raw
• Beef, Ribeye Bone-in Lip On Steak 1/8”	Cooked/Raw
• Beef, Ribeye Boneless Lip Off Steak 1/8”	Cooked/Raw
• Beef, Ribeye Boneless Lip On Roast 1/8”	Cooked/Raw
• Beef, Ribeye Boneless Lip On Steak 1/8”	Cooked/Raw
• Beef, Rib Back Ribs 0”	Cooked/Raw

4. Data Collection

4.1.1. All standard carcass data will be collected on the respective NDI Data Form (2.2. A)

4.1.2. Following the data collection all data shall be entered into the official standardized data reporting spreadsheet (T3- Fab to Retail. NDI.P2).

4.1.2.1. Proper quality control measures in reviewing the data must occur prior to submitting the data to the study tracker (SOP 12.2)

4.1.2.2. Data entry **must be consistent** (ie: case sensitive, cut names, etc…) within and across all data files

4.1.3. Data Point to be Collected (See Table A-3 for List of data Points)

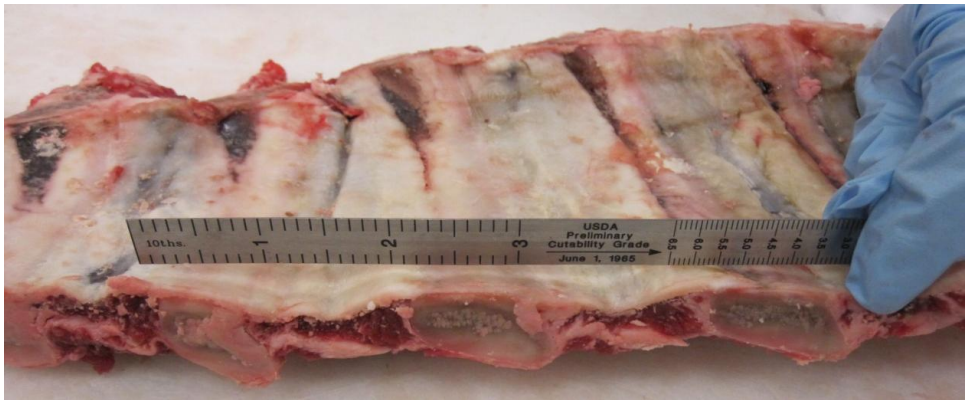
5. Fabrication Procedure

5.1. Carcass A=Bone-In Retail Cuts

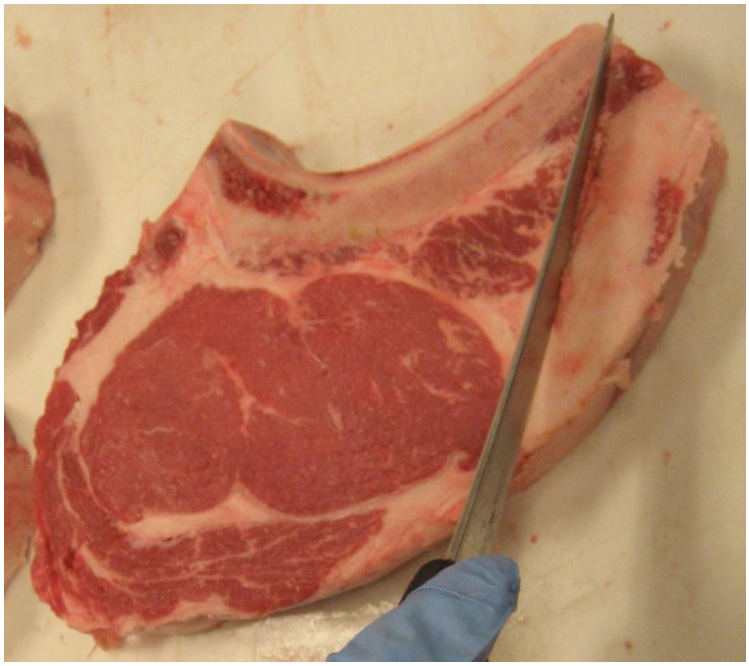
Refer to Table A-3 Plant Animal Assignment and Compositing for Rib Randomization by section.

5.1.1. Bone-In Ribs shall have a 2" lip

5.1.2. Roasts will be removed in a three rib section. Therefore, small end roasts will be removed at ribs 6, 7, and 8. Middle roasts will be removed at ribs 8, 9, and 10. Large end roasts will be removed at ribs 10, 11, and 12.



5.1.3. All bone-in steaks should have the lip on with the fat trimmed at an angle as shown below.



5.2. Carcass B=Boneless Retail Cuts

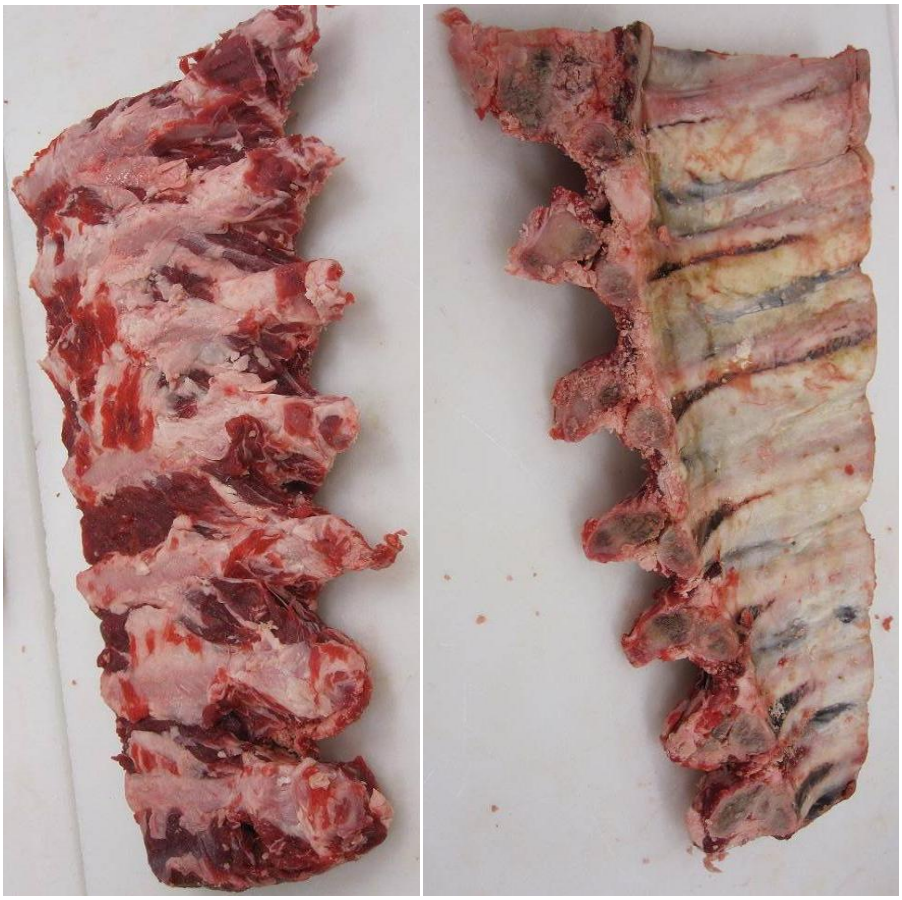
Refer to Table A-3 Plant Animal Assignment and Compositing for Rib Randomization by section.

5.2.1. Boneless Ribs shall have a 1 inch lip

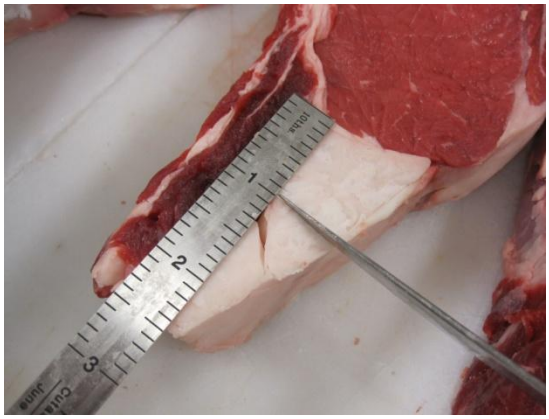
5.2.2. Roasts will be removed in a three rib section. Therefore, small end roasts will be removed at ribs 6, 7, and 8. Middle roasts will be removed at ribs 8, 9, and 10. Large end roasts will be removed at ribs 10, 11, and 12. A mark would need to be made to indicate the proper location to remove the roast from after the back ribs had been removed.

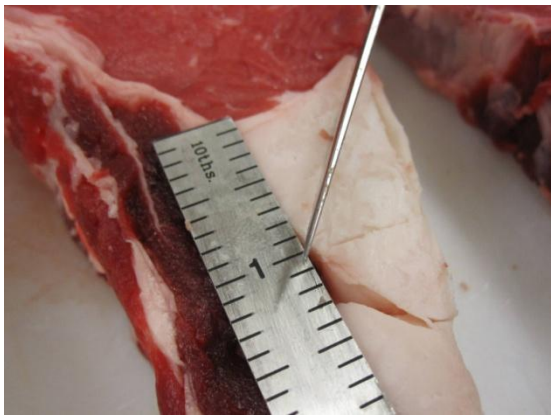
5.2.3. Remove the back ribs. The back ribs will be removed by leaving a portion of the finger meat attached to the ribeye roll. Below a picture indicates the amount of finger meat that should be left on the ribeye roll.

FINISHED BACK RIBS

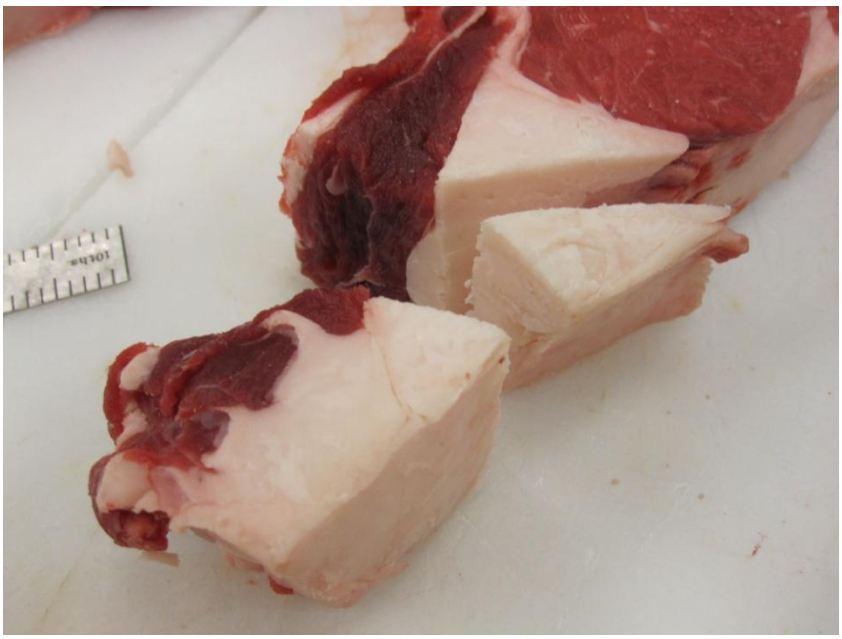


5.2.4. All boneless steaks will fall into two categories. Odd numbered steaks (1, 3, 5) from each section will be lip off steaks, where the whole lip is removed. Even numbered steaks (2, 4, 6) will be lip on steaks and will have a 1 inch lip remaining. Below are pictures to guide in the process of cutting the 1 inch lips.





FINISHED TRIMMED TAIL



5.3. Blade End (Small end) Roast Collection

5.3.1. Remove the Small end roasts at ribs 6, 7, and 8.

5.3.2. The remaining rib will be cut into 1 in. steaks. Odd numbered steaks (1, 3, 5) from each section will be lip off steaks, where the whole lip is removed. Even numbered steaks (2, 4, 6) will be lip on steaks and will have a 1 inch lip remaining. The steaks will be individually identified

and will be numbered from where the roast was removed to the large end. An example of the numbering follows. Dairy ribeye rolls are expected to have approximately 4 steaks per section; while other types of cattle may have fewer steaks per section.

Small End Roast	1 Middle	2 Middle	3 Middle	4 Middle	1 Large	2 Large	3 Large	4 Large

5.4. Middle Roast Collection

5.4.1. Remove Middle roasts at ribs 8, 9, and 10.

5.4.2. The remaining rib will be cut into 1 in. steaks. Odd numbered steaks (1, 3, 5) from each section will be lip off steaks, where the whole lip is removed. Even numbered steaks (2, 4, 6) will be lip on steaks and will have a 1 inch lip remaining. The steaks will be individually identified and will be numbered starting on the small end and working forward to where the roast was removed and continuing to the large end. An example of the numbering follows.

1 Small	2 Small	3 Small	4 Small	Middle Roast	1 Large	2 Large	3 Large	4 Large

5.5. Ribeye Face (Large End) Roast Collection

5.5.1. Remove Large end roasts at ribs 10, 11, and 12.

5.5.2. The remaining rib will be cut into 1 in steaks. Odd numbered steaks (1, 3, 5) from each section will be lip off steaks, where the whole lip is removed. Even numbered steaks (2, 4, 6) will be lip on steaks and will have a 1 inch lip remaining. The steaks will be individually identified

and will be numbered from the small end to where the roast was removed. An example of the numbering follows.

1 Small	2 Small	3 Small	4 Small	1 Middle	2 Middle	3 Middle	4 Middle	Large End Roast

6. Storage and identification

6.1 Following the fabrication all cuts should be tagged and vacuum packaged, with no administration of heat shrinking, Cuts should be stored without exposure to light until day 21 postmortem between 0-4°C. After day 21 postmortem, cuts shall be stored below -18°C. Transmission properties of the bags used shall be recorded. Proper daily temperature logs shall be maintained by each university to verify cooler maintained proper temperature during storage.

ID TAGS FOR RETAIL CUTS

1. Project # (28910-P2)
2. Date of carcass collection
3. University (AM, CS, TT)
4. Carcass A or B
5. Animal # (1-36)
6. Side of carcass (R/L)
7. Steak Identification
8. Retail Cut name
9. Cooked/ Raw
10. If cooked, cooking method (grilled, roasted, braised)

SAMPLE TAG - B

28910-P2 **9/14/09**

AM-B-10-R-1 Middle
Ribeye Steak
Cooked-Grilled

Table A-3. Plant Animal Dissection Assignments and Compositing for Ribeye Randomization

Univ	Plant	Animal #	QG	YG	Gender	Genetics	Raw	Cooked	Roast	Large End	Middle	Small End
TAM	Greenbay	1	U	2	S	D	L	R	SE	Steak	Steak	Roast
TAM	Greenbay	2	U	3	H	N	R	L	SE	Steak	Steak	Roast
TAM	Greenbay	3	L	2	H	N	L	R	M	Steak	Roast	Steak
TAM	Greenbay	4	L	3	S	D	R	L	LE	Roast	Steak	Steak
TAM	Greenbay	5	S	2	S	N	R	L	M	Steak	Roast	Steak
CSU	Greeley	6	U	2	S	N	L	R	M	Steak	Roast	Steak
CSU	Greeley	7	U	3	S	N	R	L	LE	Roast	Steak	Steak
CSU	Greeley	8	L	2	S	N	L	R	SE	Steak	Steak	Roast
CSU	Greeley	9	L	3	H	N	R	L	SE	Steak	Steak	Roast
CSU	Greeley	10	S	2	H	N	L	R	LE	Roast	Steak	Steak
CSU	Greeley	11	S	3	S	N	R	L	SE	Steak	Steak	Roast
CSU	Dodge City	12	U	2	H	N	L	R	LE	Roast	Steak	Steak
CSU	Dodge City	13	U	3	S	N	R	L	M	Steak	Roast	Steak
CSU	Dodge City	14	L	2	S	N	R	L	LE	Roast	Steak	Steak
CSU	Dodge City	15	L	3	S	N	L	R	M	Steak	Roast	Steak
CSU	Dodge City	16	S	2	S	N	L	R	SE	Steak	Steak	Roast
CSU	Dodge City	17	S	3	H	N	R	L	SE	Steak	Steak	Roast
CSU	Dodge City	18	S	3	S	N	L	R	M	Steak	Roast	Steak
TAM	Corpus Christi	19	U	3	S	N	L	R	LE	Roast	Steak	Steak
TAM	Tolleson	20	L	2	S	D	R	L	SE	Steak	Steak	Roast
TAM	Corpus Christi	21	L	3	H	N	L	R	SE	Steak	Steak	Roast
TAM	Corpus Christi	22	S	2	H	N	R	L	SE	Steak	Steak	Roast
TAM	Tolleson	23	S	3	S	D	L	R	M	Steak	Roast	Steak
TTU	Plainview	24	U	3	H	N	L	R	SE	Steak	Steak	Roast
TTU	Plainview	25	U	2	S	N	R	L	LE	Roast	Steak	Steak
TTU	Plainview	26	L	2	H	N	L	R	LE	Roast	Steak	Steak
TTU	Plainview	27	L	3	S	N	R	L	M	Steak	Roast	Steak
TTU	Plainview	28	S	2	S	N	L	R	M	Steak	Roast	Steak
TTU	Plainview	29	S	3	S	N	R	L	LE	Roast	Steak	Steak
TTU	Omaha	30	U	2	S	N	L	R	M	Steak	Roast	Steak
TTU	Omaha	31	U	2	H	N	R	L	SE	Steak	Steak	Roast
TTU	Omaha	32	U	3	S	N	R	L	M	Steak	Roast	Steak
TTU	Omaha	33	L	2	S	N	L	R	M	Steak	Roast	Steak
TTU	Omaha	34	L	3	S	N	R	L	LE	Roast	Steak	Steak
TTU	Omaha	35	S	2	S	N	R	L	LE	Roast	Steak	Steak
TTU	Omaha	36	S	3	H	N	L	R	LE	Roast	Steak	Steak

Beef Nutrient Database Improvement Study
SOP 2.2 B

SKIRT FABRICATION PROTOCOL

1. Purpose:

1.1. To describe the procedure for fabricating the skirt for this study. Skirts will be vacuum packaged and stored without exposure to light at 0-4°C until day 14 postmortem. Fabrication of skirts to retail portions shall occur between 14-21 days. Retail cuts shall be properly identified, packaged and stored without exposure to light at 0-4°C until day 21 postmortem, and then cuts will be transferred to -18°C storage.

NOTE: All products available from each skirt shall be cut, prepared and packaged to be used as study samples.

2. Materials

2.1. Carcass cooler (0°-4°C)
2.2. Daily Temperature Recorder/Logger
2.3. Cryovac Machine and bags
2.4. Post fabrication cuts to be frozen and stored below -18°C

3. Fabrication to retail cut weights

3.1. Scale considerations
- **3.1.1.** All scales should be calibrated each day
- **3.1.2.** Scale should be on level surface.
- **3.1.3.** **Take weight to the nearest 0.1 g for retail cut weights**
- **3.1.4.** Zero before each weight
- **3.1.5.** Wipe residue from weigh pan after each weight

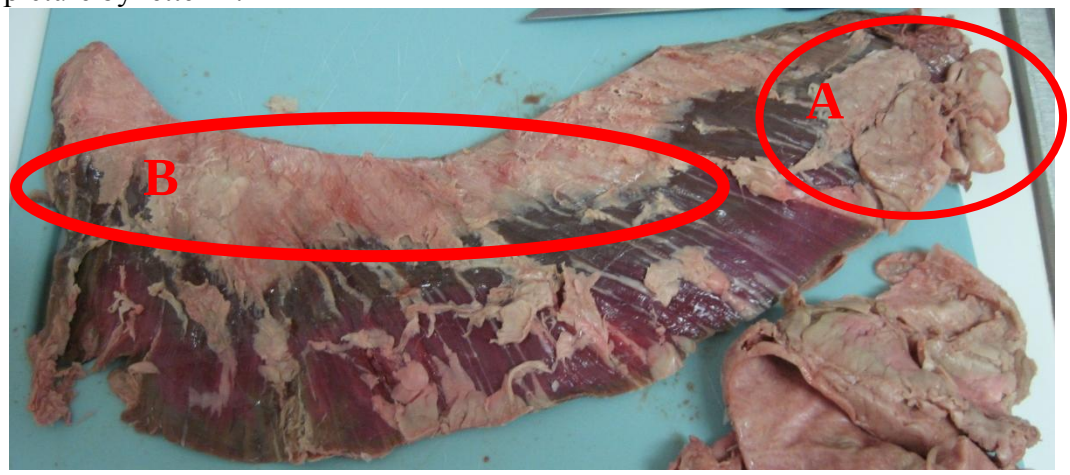
3.2. Net weights to be recorded on the Fab to Retail Cut spread sheet.

Retail Cut	Cooked/ Raw
• Beef Plate, Inside Skirt 0”	Cooked/Raw
• Beef Plate, Outside Skirt 0”	Cooked/Raw

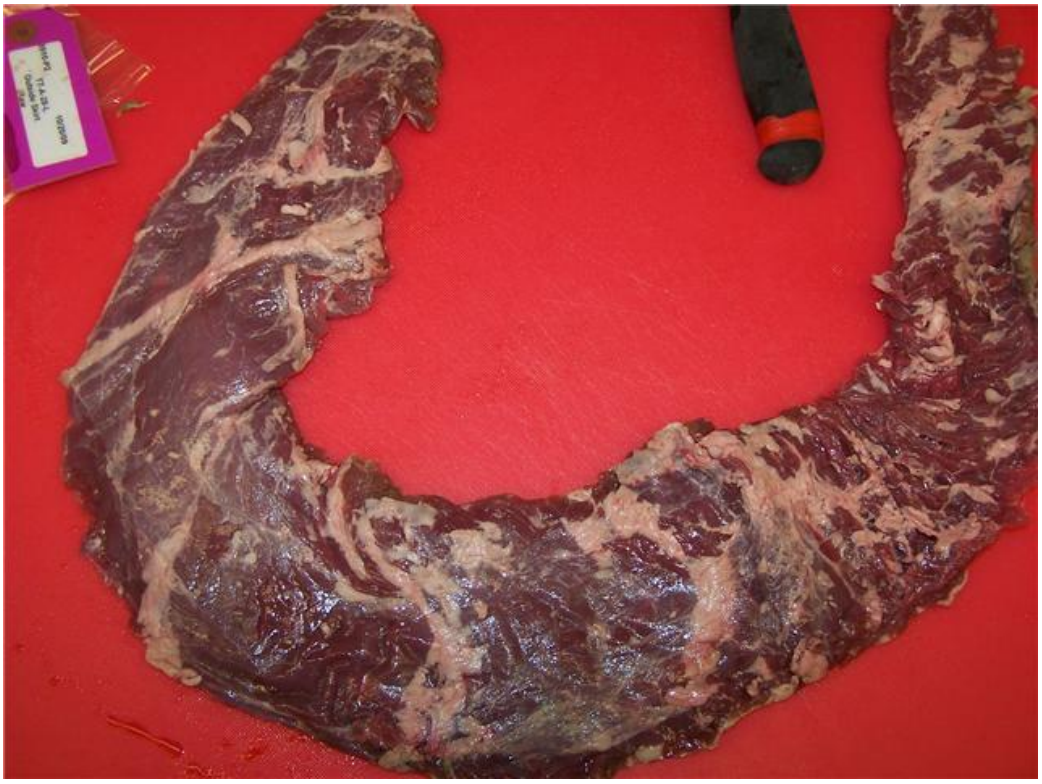
4. Fabrication Procedure

4.1. Remove membrane from either side of the product.

4.2. Any large clumps of fat should be removed from the outer edges of the skirt as illustrated in the picture by letter A. The final product should be trimmed practically free of fat as indicated in the final product picture.
4.3. Remove connective tissue so that lean is showing along the edge as illustrated in the picture by letter B.



FINAL PRODUCT: OUTSIDE SKIRT



FINAL PRODUCT: OUTSIDE SKIRT

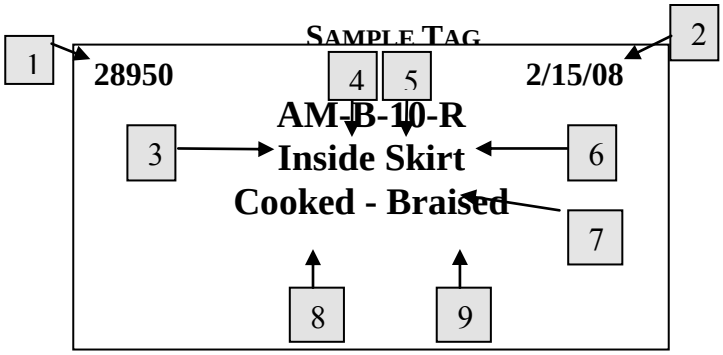
5. **Storage and Identification**

5.1. All cuts should be tagged and vacuum packaged, with no administration of heat shrinking, Cuts should be stored without exposure to light until day 21 postmortem between 0-4°C. After day 21 postmortem, cuts shall be stored below -18°C. Transmission properties of the bags used shall be recorded. Proper daily temperature logs shall be maintained by each university to verify cooler maintained proper temperature during storage.

5.2. The skirts will be reduced to smaller portions at the time of cooking in order to fit on the grill.

ID TAGS FOR RETAIL CUTS

1. Project # (28950)
2. Date of carcass collection
3. University (AM, CS, TT)
4. Carcass A or B
5. Animal # (1-36)
6. Side of carcass (R/L)
7. Retail Cut name
8. Cooked/ Raw
9. If cooked, cooking method (grilled, roasted, braised)



Beef Nutrient Database Improvement Study
SOP 3.2

GRILLING PROTOCOL – DIRECT COOKING

1. Purpose

1.1. To describe the procedure for preparing and grilling beef retail cuts from the **rib and plate**

Note: This protocol was tested by the NDI Research Team on 1/28/10 at the HEB Facility in San Antonio, TX.

2. Safety

2.1. Be careful when handling hot surfaces.

3. Materials

3.1. Electric grill - Salton two-sided electric with removable grill plates, Grill Model No. GRP99, Salton, Inc., Lake Forest, IL

3.2. Thermometers/thermocouples

- **3.2.1.** Type J or K Thermocouple – Calibrate prior to use
- **3.2.2.** Type J or K insulated wire
  - **3.2.2.1.** The thermocouple type and wire type must be the same (ie: if Type J wire is used the appropriate Type J Thermocouple Thermometer must be used)
- **3.2.3.** Infrared Thermometer – Grill surface heat detection

3.3. Digital Scale

- **3.3.1.** Calibrate daily
- **3.3.2.** Record to the nearest 0.1 g

3.4. Beef Samples (Frozen, -20°C)

- **3.4.1.** Beef, ribeye, bone-in lip-on steak
- **3.4.2.** Beef, ribeye, bnls lip ON steak
- **3.4.3.** Beef, ribeye, bnls lip OFF steak
- **3.4.4.** Beef, plate, inside skirt steak
  - **3.4.4.1.** If the skirt steak is longer than the length of the electric grill the skirt steak is to be cut into equal segments to fit the width of the grill.
- **3.4.5.** Beef, plate, outside skirt steaks
  - **3.4.5.1.** If the skirt steak is longer than the length of the electric grill the skirt steak is to be cut into equal segments to fit the width of the grill.

3.5. Stainless steel tongs

3.6. Data Entry Form for Grilling

- **3.6.1.** *Data4-Cooking.**CSU**.NDI.P2 2-5-10*
- **3.6.2.** *Data4-Cooking.**TAMU**.NDI.P2 2-5-10*

3.6.3. *Data4-Cooking.**TTU**.NDI.P2 2-5-10*

3.6.3.1. Table A-4 outlines the specific data points to be collected on the Data 4 form.

3.7. Identification tags – Polyester Paper (Xerox Item No. 3R12363)

4. Beef Preparation before Cooking

4.1. Temper frozen raw samples in original package as a single layer in refrigeration (0-4°C) for 24-48 h based on the appropriate size and weight of the cut; record tempering start and stop date and time, cooler location and temperature of cooler.

4.2. Remove the product from its packaging and purge and blot with a paper towel.

4.3. Record initial internal temperature (*Internal Temp*) of each individual steak or skirt segment (should not exceed 5°C for thawed product).

4.4. Record raw weight of product to the nearest 0.1 g

4.4.1. All steaks or skirt segments for an individual sample number should be weighed individually.

4.5. For each ribeye steak, apply the thermocouple in the geometric center, or thickest portion of the meat piece.

4.5.1. Probe positioning should not affect product's contact with the cooking surface.

4.6. For skirt steaks a thermocouple will not be placed during cooking as the steak is too thin. Instead use a thermocouple to periodically check internal temperature of samples throughout the cooking process by using tongs to hold the steak off of the grill grate to avoid inaccurate temperature readings.

5. Pre-heating

5.1. Turn on grill using manufacturer's instructions.

5.2. Close grill lid and allow grill to preheat for approximately 10 minutes (all grills must be calibrated and allowed to pre-heat based on each individual grill's warm-up time).

5.3. Allow grill temperature to equalize. Check and record surface temperature of the grill plates using the infrared thermometer – grill surfaces should be approximately 195°C before cooking begins.

6. Grilling

6.1. Arrange beef sample(s) evenly spaced in center of cooking grate, with proper identification.

6.1.1. **Cook each skirt piece individually** so that only one piece is on the grill at one time. This will allow for more even and efficient cooking due to the uneven thickness of the skirt steaks.

6.2. Cook with grill lid closed so that the grill plates are in contact with the meat.

6.2.1. If the grill grates are not in contact with the meat, reposition the steak so that contact can be made before proceeding.

6.2.2. Skirt Steaks will need to be flipped over mid-way through cooking in

order to assure the entire steak surface makes contact with the grill grate.

6.3. Final Internal Temperatures

6.3.1. Cook each ribeye steak segment to an internal temperature of 70°C.

6.3.1.1. Monitor temperature midway through cooking to determine when the final temp is achieved.

6.3.2. Cook each skirt steak segment to an internal temperature of 80°C.

6.3.2.1. Monitor temperature midway through cooking.

6.3.2.1.1. Use tongs to hold the meat off the grill while taking the temperature of the product to avoid inaccurate reading caused by residual heat from the grill plate.

6.3.2.1.2. Flip steak over before closing the lid. This will allow for the entire steak to make contact with the grill and to be cooked appropriately. .

6.4. Remove from grill and immediately place on a wire rack at room temperature.

6.4.1. Use tongs or spatula to remove test samples from grill. Do not use fork.

6.5. Record the time (*Removal Time*) and final internal product temperature (*Final Temp*) when removed from heat.

6.6. Record cooked weight of product to the nearest 0.1 g at the time it is removed from the grill.

7. Allow beef samples(s) to chill **uncovered on a wire rack** under refrigeration (2-4° C) for at least 12 h before dissection.

7.1. Assure all ID tags are secure in order to maintain product identification.

Table A-4- Data Points to Record for Grilling *(Data4-Cooking.NDI.P210.5.09 (TH)*

Data Point	Description of Data Point
1	Study # (28910-P2)
2	Univ (AM, CS,TT)
3	Animal(1-36; a/b)
4	Side (R/L)
5	ID Code[1]
6	Date Placed in Cooler (mm/dd/yy)
7	Time Placed in Cooler (Military Time)
8	Date of Cooking (mm/dd/yy)
9	Time of cooking (Military Time)
10	Raw Temp (Internal Temp of Individual Steaks prior to Cooking) (°C)
11	Raw Weight (Individual Retail Cut Weight- 0.1 g)[2]
12	Grill Surface Temp (°C)
13	Removal Time (time product removed from heat (Military Time))
14	Final Temp (Internal temperature of each Steak @ Removal Time(°C)
15	Cooked Weight (0.1 g) (Individual Cut weight @ Removal Time)

[1] See ID Code list

[2] Remove each steak from its package and its purge and blot with a paper towel

Beef Nutrient Database Improvement Study
SOP 4.2

OVEN BRAISING PROTOCOL

1. Purpose

1.1. To describe the procedure for preparing and oven braising retail cuts from the **beef rib and plate**

Note: This protocol was tested by the NDI Research Team on 1/28/10 at the HEB Facility in San Antonio, TX. Further revisions to this protocol were discussed and approved on the 2/3/10 NDI Team Call.

2. Safety

2.1. Be careful when handling hot surfaces.

3. Materials

3.1. Calphalon Everyday Nonstick 8½ or 6-Quart Dutch Oven (anodized aluminum).
3.2. Thermometers/thermocouples
3.3. Oven thermometer
3.4. Digital Scale
  3.4.1. Calibrate daily
  3.4.2. Record to the nearest 0.1 g
3.5. Beef Samples (Frozen, -20°C)
  3.5.1. Beef, rib back ribs
3.6. Stainless steel tongs
3.7. Data entry form for oven braising
  3.7.1. *Data4-Cooking.**CSU**.NDI.P2 2-5-10*
  3.7.2. *Data4-Cooking.**TAMU**.NDI.P2 2-5-10*
  3.7.3. *Data4-Cooking.**TTU**.NDI.P2 2-5-10*
3.8. Table A-5 outlines the specific data point to be collected on the Data 4 form.
3.9. Identification tags – Polyester Paper (Xerox Item No. 3R12363)
3.10. Stainless steel colander (Williams-Sonoma Stainless Steel Colander, 5 1/2-Qt. Item #:7869894 - http://www.williams-sonoma.com or http://www.williams-sonoma.com/products/stainless-steel-colander/?pkey=k55-7869894&catalogId=55&sku=7869894)
3.11. 250-mL graduated cylinder

4. Beef preparation before cooking

4.1. Temper frozen raw samples in its original packaging as a single layer in

refrigeration (0-4°C) for 24-48 h based on the appropriate size and weight of the cut; record tempering start and stop date and time.

4.1.1. Internal temperature of product should not exceed 5°C (for thawed product).

4.2. Remove rib from its packaging and purge and blot with a paper towel

4.3. Cut the rib so that each rib is separated

4.4. Weigh all ribs from a single rib and record raw weight of product to the nearest 0.1 g

5. Oven Braising

5.1. Do not brown Beef Back Ribs.

5.2. Place all Beef Back Ribs from a single rib in the Dutch oven.

5.2.1. Calphalon Everyday Nonstick 8½ or 6-Quart Dutch oven may be used. Select the oven that best fits the size of the sample and record the size of oven that was used.

5.3. Add distilled, deionized water until the water covers the meat. (Record the volume (mL) of water added.)

5.4. Cover pan with proper lid.

5.5. Place Dutch oven in a preheated 120°C* (250°F) oven.

5.5.1. Record preheated oven temperature on data sheet (°C).

5.5.2. Record the time at which the Dutch oven was placed in the preheated oven.

5.6. Simmer* and cook beef samples for 2 hours and 30 minutes and remove from the pot from the oven

5.6.1. Record the time when removed from the heat

5.6.1.1. Due to the high volume of bone in this cut it is extremely difficult to measure an accurate internal product temperature. Therefore, the NDI research team decided to standardize this cooking method by length of time cooked rather than an end point temperature.

5.6.1.2. This protocol was approved by Julie Howe on February 1, 2010, on behalf of the USDA NDL.

5.7. Using the stainless steel tongs, remove ribs from Dutch oven immediately after removing from the oven, and place them in the stainless steel colander.

5.8. Pour the cooking liquid in the Dutch oven through the stainless steel colander into the graduated cylinder

5.8.1. Measure and record the volume of cooking liquid remaining in the pan in mL.

5.9. Using the stainless steel tongs move the ribs and all the loose fat/lean pieces remaining from the colander to a wire rack to rest.

5.10. Record the weight of the entire cooked sample recovered from the colander to the nearest 0.1 g, 30 minutes after the product is removed from the oven,

6. Post-cooking (Stand-time)

6.1. Place the entire Rib sample (each rib and any loose tissue recovered from the colander) on a tray and chill uncovered in refrigeration (2-4° C) for at least 12 hours before dissection.

6.1.1. Assure all ID tags are secure in order to maintain product identification

*Labensky, S. R., A. M. Hause. 2006. On cooking: A textbook of culinary fundamentals. 4th ed. Pearson Education, Inc., Upper Saddle River, NJ.

Table A-5- Data Points to Record for Oven Braising *(Data4-Cooking.NDI.P2 10.5.09 (TH)*

Data Point	Description of Data Point
1	Study # (28910-P2)
2	Univ (AM, CS,TT)
3	Animal(1-36; a/b)
4	Side (R/L)
5	ID Code[1]
6	Cooler Location
7	Date Placed in Cooler (mm/dd/yy)
8	Time Placed in Cooler (Military Time)
9	Date of Cooking (mm/dd/yy)
10	Raw, Retail Cut Weight[2]
11	Raw internal product Temperature (°C)
12	Pot Size (indicate size of Dutch Oven 8 ½ or 6 Qt)
13	Added Water (ml)[3]
14	Pre-heated Oven Temp (°C)
15	Start Time of cooking (Military Time)
16	Post-cooking liquid volume (ml)[3]
17	Time removed from heat (Military Time)
18	Cooked Weight after (30 minutes after removed from oven)

[1]See ID Code list

[2] Remove cut from its package and its purge and blot with a paper towel, weigh all ribs that makeup the sample together and record the weight to the nearest 0.1 g

[3]Measure all volumes to the nearest 0.1 ml

Beef Nutrient Database Improvement Study
SOP 5.2

ROASTING PROTOCOL

1. Purpose

1.1. To describe the procedure for preparing and roasting retail cuts from the **beef rib and plate**

Note: This protocol was tested by the NDI Research Team on 1/28/10 at the HEB Facility in San Antonio, TX.

Safety

1.2. Be careful when handling hot surfaces.

2. Materials

2.1. Calphalon Non-stick Roasting Pan with its rack (anodized aluminum – 16 x13 x 4 in.)
2.2. Thermometers/thermocouples
- **2.2.1.** Type J or K Thermocouple – Calibrate prior to use
- **2.2.2.** Type J or K insulated wire
  - 2.2.2.1. The thermocouple type and wire type must be the same (ie: if Type J wire is used the appropriate Type J Thermocouple Thermometer must be used)

2.3. Digital Scale
- **2.3.1.** Calibrate daily
- **2.3.2.** Record to the nearest 0.1 g

2.4. Beef Samples (Frozen, -20°C)
2.5. Beef ribeye bone-in lip-on roast and Beef ribeye bnls lip-on roast
2.6. Stainless steel tongs or 2 – stainless steel spatulas for removing the hot roast from the roasting pan
2.7. wire racks to rest the cooked product on
2.8. Data Collection Form for Roasting
- **2.8.1.** *Data4-Cooking.**CSU**.NDI.P2 2-5-10*
- **2.8.2.** *Data4-Cooking.**TAMU**.NDI.P2 2-5-10*
- **2.8.3.** *Data4-Cooking.**TTU**.NDI.P2 2-5-10*
  - 2.8.3.1. Table A-6 outlines the specific data points to be collected on the Data 4 form.

2.9. Identification tags – Polyester Paper (Xerox Item No. 3R12363)

3. Beef Preparation before Cooking

3.1. Temper frozen raw samples in original package as a single layer under refrigeration (0-4°C) for 24-48 h based on the appropriate size and weight of the cut; record tempering start and stop date and time.

3.1.1. Record Internal temperature of product (*Beginning Temp*) should not exceed 5°C (41°F) (for thawed product).

3.2. Remove roast from its package and purge and blot with a paper towel.

3.3. Record raw weight and initial internal temperature of product.

3.4. Apply the thermocouple in the geometric center, or thickest portion, of the roast within the roasting pan. Probe positioning should not affect product's contact with the cooking surface and may not be possible with small or thin beef cuts. In this case, use a thermocouple to periodically check internal temperature of samples throughout the cooking process.

4. Pre-heating Oven

4.1. Position oven rack so that beef sample will be in the center of the oven.

4.2. Preheat oven 10 minutes at 160°C (325°F). Assess temperature. Adjust heat level if necessary. Continue to preheat an additional 5 minutes or until desired temperature is reached.

4.2.1. Record actual oven temperature from a calibrated oven thermometer before roasting begins.

5. Cooking

5.1. Position beef sample in the center of the rack in the roasting pan bone/boned side down.

5.2. Do NOT add oil or water. Do NOT cover.

5.3. Position roasting pan with beef sample on oven rack in center of oven.

5.3.1. Two roasts may be placed in the oven at the same time if the oven rack will accommodate two roasting pans.

5.4. Roast to internal temperature of 60°C (140°F). Observe cook temperature and cook time as needed throughout cooking.

5.5. Remove roasting pan from the oven.

5.5.1. Record the time removed (*Removal Time*) and internal product temperature (*Removal Temp.*) when removed from the oven.

5.5.2. Carefully remove the roast and the rack that it was cooked on from the pan and place at room temperature. Continue to monitor temperature until the peak internal temperature (*Peak Temp*) is reached.

5.5.2.1. The roast may remain on its original rack as long as it is removed from the roasting pan. Or, the roast can be place on a different wire rack.

5.6. Record peak internal temperature of the roast and the time this temperature was achieved.

5.6.1.1.The point right before the temperature declines (highest temperature reached) is the peak final internal temperature of the cooked sample.

5.7. Record cooked weight (*Cooked Weight*) of product to the nearest 0.1 g, 30 minutes after the product is removed from the oven.

6. Post-cooking (Stand-time)

6.1. Allow beef samples to chill uncovered under refrigeration (2-4° C) for at least 12 hr before dissection.

6.1.1. Assure all ID tags are secure in order to maintain product identification.

Table A-6- Data Points to Record for Roasting *(Data4-Cooking.NDI.P2 10.5.09 (TH) Roasting)*

Data Point	Description of Data Point
1	Study # (28950-P2)
2	Univ (AM, CS,TT)
3	Animal ID (1-36)
4	Side (R/L)
5	Retail ID Code[1]
6	Roast Position
7	Date Placed in Cooler (mm/dd/yy)
8	Time Placed in Cooler (Military Time)
9	Date of Cooking (mm/dd/yy)
10	Time of Cooking (Military Time)
11	Raw, Retail Cut Weight (0.1 g) [2]
12	Internal Product Temp prior to Cooking (°C)
13	Pre-heated Oven Temp (°C)
14	Internal Temp when removed from Heat(°C)
15	Time Removed from Heat (Military Time)
16	Final Peak Internal Temp(°C)
17	Cooked weight (0.1 g) at 30 minutes post cooking

[1]See ID Code list

[2] Remove each steak from its package and its purge and blot with a paper towel

Beef Nutrient Database Improvement Study
SOP 6.2

DISSECTION OF RAW AND COOKED RETAIL CUTS

1. Purpose

1.1. To describe the procedure for dissection of raw and cooked beef retail cuts from the **rib and plate**

2. Safety

2.1. Be careful when handling sharp instruments.
2.2. Be careful when handling raw product; wash hands thoroughly after dissecting raw product.

3. Materials

3.1. Digital Scale
- **3.1.1.** Calibrate daily
- **3.1.2.** Weigh to the nearest 0.1 g

3.2. Cutting board
3.3. Non-latex, non-powdered, disposable examination gloves
3.4. Disposable scalpels – Fisher Catalog # S17800
3.5. Data Collection Form (Data6-Dissection.NDI.P2) – See Table A-7
3.6. Data Reporting Spreadsheet (T6-Dissection.NDI.P2)
3.7. Weigh Boats
3.8. Beef Samples - Raw (Chilled, 0 ± 4 °C)
- **3.8.1.** Beef Ribeye Bone-in Lip On Steak (U.P.C. 1197/2012)
- **3.8.2.** Beef Ribeye Bone-in Lip On Roast (U.P.C. 1193/2008)
- **3.8.3.** Beef Ribeye Bnls Lip On Steak (U.P.C. 1203/2018)
- **3.8.4.** Beef Ribeye Bnls Lip Off Steak (U.P.C. 1203/2018)
- **3.8.5.** Beef Ribeye Bnls Lip On Roast (U.P.C. 1194/2009)
- **3.8.6.** Beef Rib Back Ribs (U.P.C. 1182/1997)
- **3.8.7.** Beef Plate, Inside Skirt Steak (U.P.C. 1613/2428)
- **3.8.8.** Beef Plate, Outside Skirt Steak (U.P.C. 1607/2422)

3.8. Beef Samples - Cooked (Chilled, 0 ± 4 ºC)
- **3.8.1.** Beef Ribeye Bone-in Lip On Steak (U.P.C. 1197/2012)- grilled
- **3.8.2**. Beef Ribeye Bone-in Lip On Roast (U.P.C. 1193/2008)- roasted
- **3.8.3.** Beef Ribeye Bnls Lip On Steak (U.P.C. 1203/2018)- grilled
- **3.8.4.** Beef Ribeye Bnls Lip Off Steak (U.P.C. 1203/2018)-grilled
- **3.8.5.** Beef Ribeye Bnls Lip On Roast (U.P.C. 1194/2009)- roasted
- **3.8.6.** Beef Rib Back Ribs (U.P.C. 1182/1997)- braised
- **3.8.7.** Beef Plate, Inside Skirt Steak (U.P.C. 1613/2428)- grilled

3.8.8. Beef Plate, Outside Skirt Steak (U.P.C. 1607/2422)- grilled

3.9. Fat Samples-Raw

3.9.3. External Fat

3.9.4. Seam Fat

3.10. Fat Samples-Cooked

3.10.3. External Fat

3.10.4. Seam Fat

3.11. Identification tags – Polyester Paper (Xerox Item No. 3R12363)-*recommended*

4. Meat Preparation Before Dissection

4.1. Temper frozen raw samples as a single layer in refrigeration (0-4°C) for at least 24 hr based on the size and weight of the cut.

4.1.1. Record tempering date, start time (military) and location.

4.2. Temper cooked samples as a single layer in refrigeration (0-4°C) for 12h post cooking.

4.2.1. Record tempering date, start time (military) and location.

4.3. Record internal temperature of product. Should not exceed 5°C (for raw product).

4.4. Remove cut from vacuum package and blot surface to remove excessive surface moisture.

4.5. Weigh intact cuts of a single sample individually. (i.e. Obtain and record weights for ***each individual*** steaks comprising sample 24B-Right.)

4.6. Record location of the individual steak.

5. Dissection

5.1. DISSECTION COMPONENT DEFINITIONS (Jones et al., 1992).SEE ILLUSTRATIONS 1-4.
DEMONSTRATION VIDEOS OF DISSECTION CAN BE FOUND ON HUDDLE

5.1.1. Refuse (waste): Includes all bone and heavy connective tissue

5.1.1.1.Heavy Connective tissue: connective tissue perceived by trained dissectors as inedible and would eventually be trimmed from a retail cut before being consumed.

5.1.1.1.1. For backrib dissection, refuse includes all bone and connective tissue. *Any membrane covering the external fat (diaphragm side) shall be removed and included in refuse.*

5.1.1.1.1.1.Please note that membrane may not be present if removed at plant or at fabrication.

5.1.2. Lean: to include all muscle, intramuscular fat and any "light" connective tissue considered edible.

5.1.2.1.Lip lean from Ribeye BNLS Lip-On Steaks (23-RSBNLS) will be included in this category.

5.1.2.2. After weights of lean from the lip have been measured for Ribeye BI Lip-On Steaks (21-RSBI), Ribeye BI Lip-On Roasts (22-RRBI), and

Ribeye BNLS Lip-On Roasts (24-RRBNLS), lip lean will be combined with lean of whole cut.

5.1.2.3. Lean from Backrib: Separable lean from the backrib includes lean scraped from the bone and any included feathering/intramuscular fat.

5.1.3. Lip Lean: to include all lean from the lip, defined as the portion past the curvature of the natural seam,

5.1.3.1. Lip Lean Obtained From: Ribeye Bone-In Lip On Steaks (21- RSBI), Ribeye Bone-In Lip On Roasts (22-RRBI) and Ribeye Boneless Lip On Roasts (24-RRBNLS).

5.1.3.1.1. Combine with Separable lean after measuring and recording weight.

5.1.4. Lip Fat: to include all fat from the lip, defined as the portion past the curvature of the natural seam,

5.1.4.1. Lip Fat Obtained From: Ribeye Bone-In Lip On Steaks (21-RSBI), Ribeye Bone-In Lip On Roasts (22-RRBI) and Ribeye Boneless Lip On Roasts (24-RRBNLS).

5.1.4.1.1. Combine with Seam fat after measuring and recording weight.

5.1.5. External Fat: Includes adipose tissue located on the outer surface of the cut, above the bridge of the muscles.

5.1.5.1. External fat for the backrib includes all fat located on the internal side of the rib (diaphragm side).

5.1.5.2. *All fat from skirt dissection is considered external.*

5.1.6. Seam fat: Includes the fat deposited between muscles in a cut and may extend to the outer portion of the cut as a result of fabrication.

5.1.6.1. Lip fat for Ribeye BNLS Lip On Steaks (23-RSBNLS) will be included in this category.

5.1.6.2. Seam fat for the backribs includes any fat that lies between the rib bone and the rib eye roll that was removed at fabrication.

5.1.6.3. *After weights of fat from the lip have been measured for Ribeye BI Lip-On Steaks, Ribeye BI Lip-On Roasts, and Ribeye BNLS Lip-On Roasts, lip fat will be combined with seam fat of whole cut.*

5.1.6.4. *There is no seam fat in the inside or outside skirt.*

5.2. DISSECTION OF THE RETAIL CUT

5.2.1. Record the date of dissection

5.2.2. Record the start time of dissection for each cut in military time.

5.2.3. Blot surface of cut prior to recording initial weight.

5.2.4. Dissect and weigh one sample at a time so that samples will not be mixed.

5.2.5. Wear latex gloves (no powder)

5.2.6. Record the initial product weight and internal temperature of the single sample. Defined as the weight of *individual* cut making up a sample.

5.2.6.1. Raw samples – Post 24-48 h tempering of the frozen raw retail cuts, record the product weight of the single sample. Defined as the weight of *individual* cut making up a sample.

5.2.6.2. Cooked samples – Post 12-24 h tempering of the cooked retail product, record initial cooked product weight prior to dissection. Defined as the weight of *individual* cut making up a sample.

5.2.7. Using the boning knife or a scalpel, separate any connective tissue and seam fat, and external fat from the lean of the meat sample.

5.2.8. Weigh each component of the dissected retail cut and record on data sheet.

5.2.9. Place dissected lean components in Ziploc® bags with proper identification and hold in cooler (0°- 4° C) for same-day homogenization.

5.2.10. Homogenization of the separable lean shall occur the same day as dissection

5.2.11. Dissected fat shall be separated and homogenized as follows:

5.2.11.1.1. Seam fat – Raw & Cooked

5.2.11.1.2. External fat – Raw & Cooked

*NOTE: There should be a composited 500g sample of both the raw and cooked fat that will be sent to Texas Tech University.

5.3. WEIGH DISSECTED SAMPLES

5.3.1. Scale considerations

5.3.1.1. All scales should be calibrated each day

5.3.1.2. Scale should be on level surface.

5.3.1.3. Take weight to the nearest 0.1 gram.

5.3.1.4. Zero scale before each weight.

5.3.1.5. Blot surface of cut before measuring weight.

5.3.1.6. Record weight in appropriate space on approved NDI data sheet

5.3.1.7. Wipe residue from weigh pan after each weight

5.3.2. Yield tolerance must be recorded at time of dissection and meet tolerance levels below.

5.3.2.1. 97.0 – 101.0 % recovery tolerance

5.3.2.2. Corrective Action when Yield tolerance is not met.

5.3.2.2.1. If yield tolerance is not met, re-calibrate scales

5.3.2.2.2. Assure that all separable components have been removed from the cutting board and instruments and re-weigh components.

5.3.2.2.2.1. If tolerance is then within range, record new data.

5.3.2.2.2.2. For Ribeye Steaks, if yield tolerance is still not met, replace cut with extra steak from cut, if available.

5.3.2.2.2.2.1. If no extra steak is available, contact Project Director.

5.4. IDENTIFICATION OF CUTS

5.4.1. All cuts will be labeled with proper identification tags.

5.4.1.1. Refer to Sample Tag - C

6. Data Collection and Reporting

6.1. Dissection data shall be collected on the official NDI data collection form "Data6-Dissection.NDI.P2.

6.2. Following dissection the data collected on Data Form 6 shall be entered in the official NDI dissection spreadsheet and submitted to the project tracking manager (PTM) following university QC check.

ID TAGS FOR DISSECTED AND HOMOGENIZED RETAIL CUTS **SAMPLE TAG - C**

1. Project # (28950-P2)
2. Date carcass collection
3. University (AM, CS, TT)
4. Animal # (1-36)
5. Carcass A or B
6. Side of carcass (R/L)
7. Cut ID Code
8. Cooked (C) / Raw (R)
9. If cooked, cooking method (G-grilled, R-roasted, B-braised)
10. Purpose (proximate, back up, composite)

28950-P2 **2/15/08**

AM-10-B-R-22RRBI-C-R

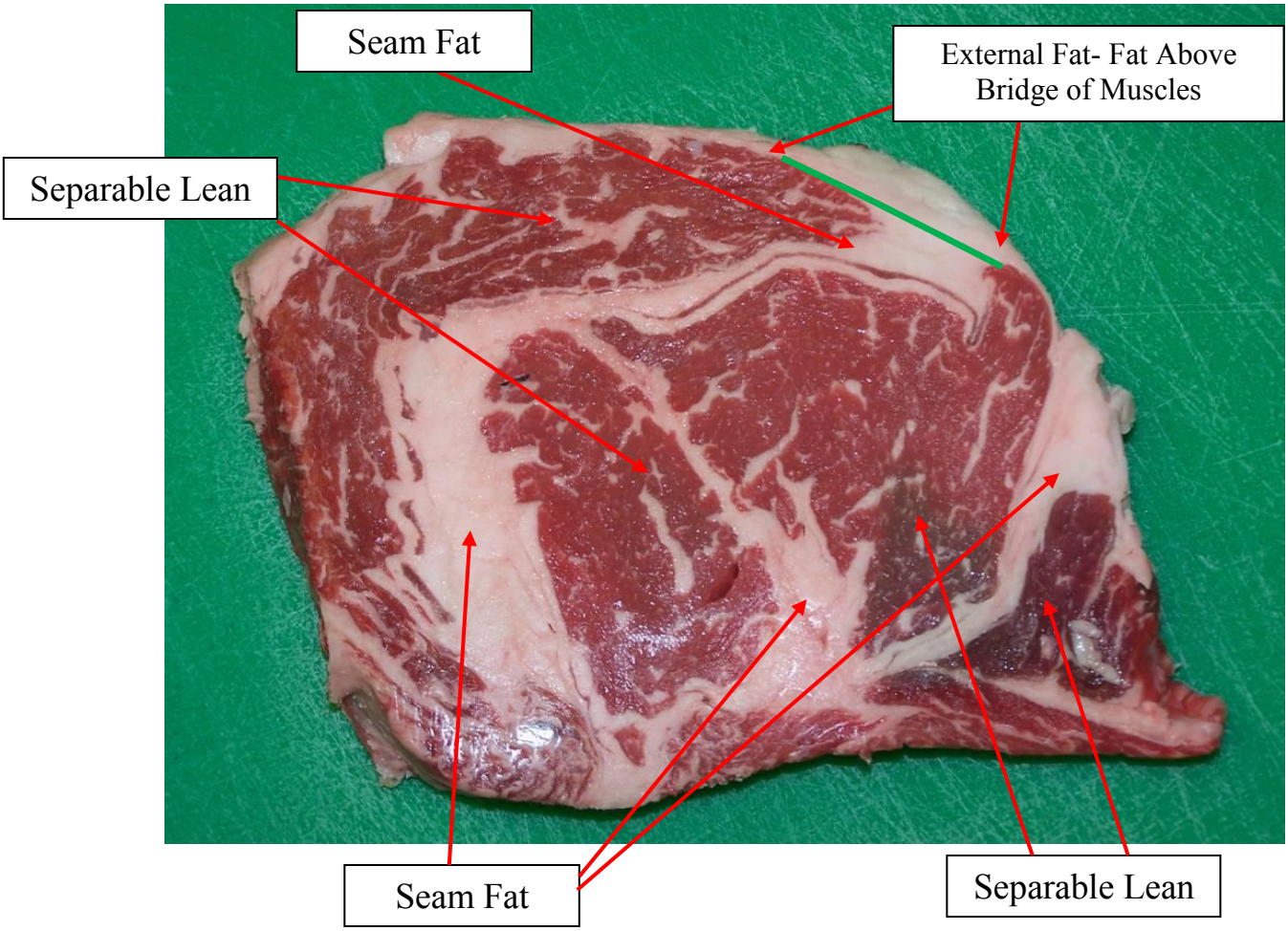
PROX

Table A-7 – Dissection data points for raw and cooked cuts (Data6-Dissection.NDI.P2)

Data Point	Description of Data Point
1	Study # (28950-P2)
2	Univ (AM, CS,TT)
3	Animal(1-36; a/b)
4	Side (R/L)
5	Carcass Collection Date (mm/dd/yy)
6	ID Code[1]
7	Cut
8	Location (S/M/L)
9	Cook Method (Braise,Grill,Roast)/Raw
10	Cooler Location
11	Cooler Temp[2]
12	Date Placed in Cooler (mm/dd/yy)
13	Time Placed in Cooler (Military Time)
14	Date of Dissection (mm/dd/yy)
15	Time of dissection (Military Time)
16	Internal Temp at Dissection[2]
17	Raw, Retail Cut Weight[3] or Tempered Cooked Cut Weight[4]
18	Lean[4]
19	Seam Fat[4]
20	External Fat[4]
21	Refuse[4]
22	Yield of Dissection Weights[5]

[1]See ID Code list
[2]Record temperature in ^{o}C
[3] Remove cut from its package and its purge; weigh cut to the nearest 0.1g
[4] Record weights to the nearest 0.1 kg
[5] Yield of Dissection Weights = (Sum of Lean, Seam Fat, External Fat, Refuse)/Intact cut weight

Illustration 1- Boneless Lip-On Ribeye Steak



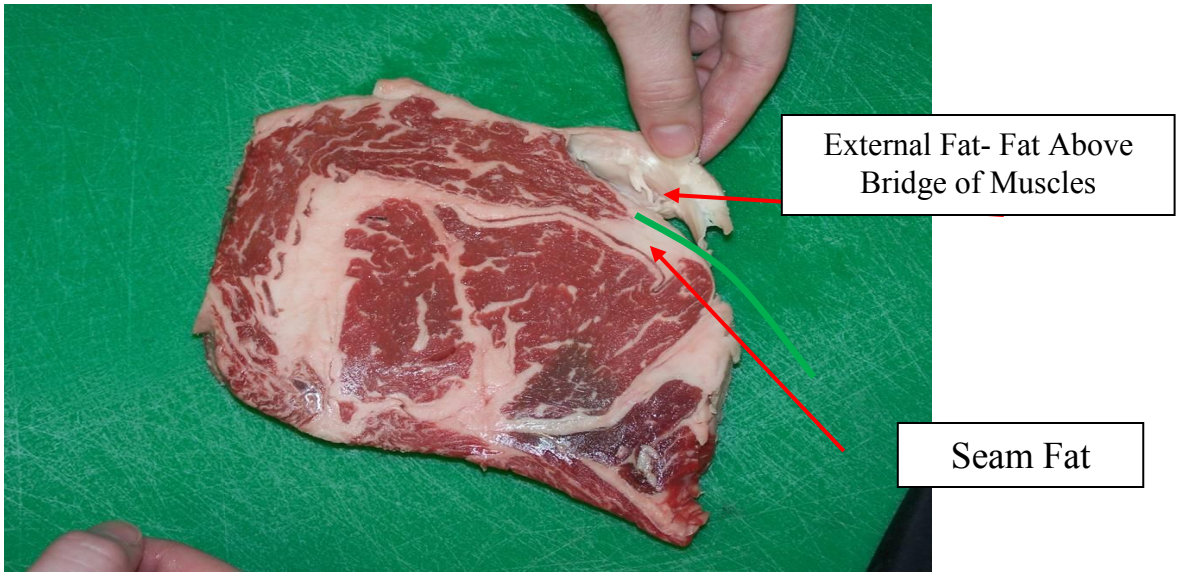
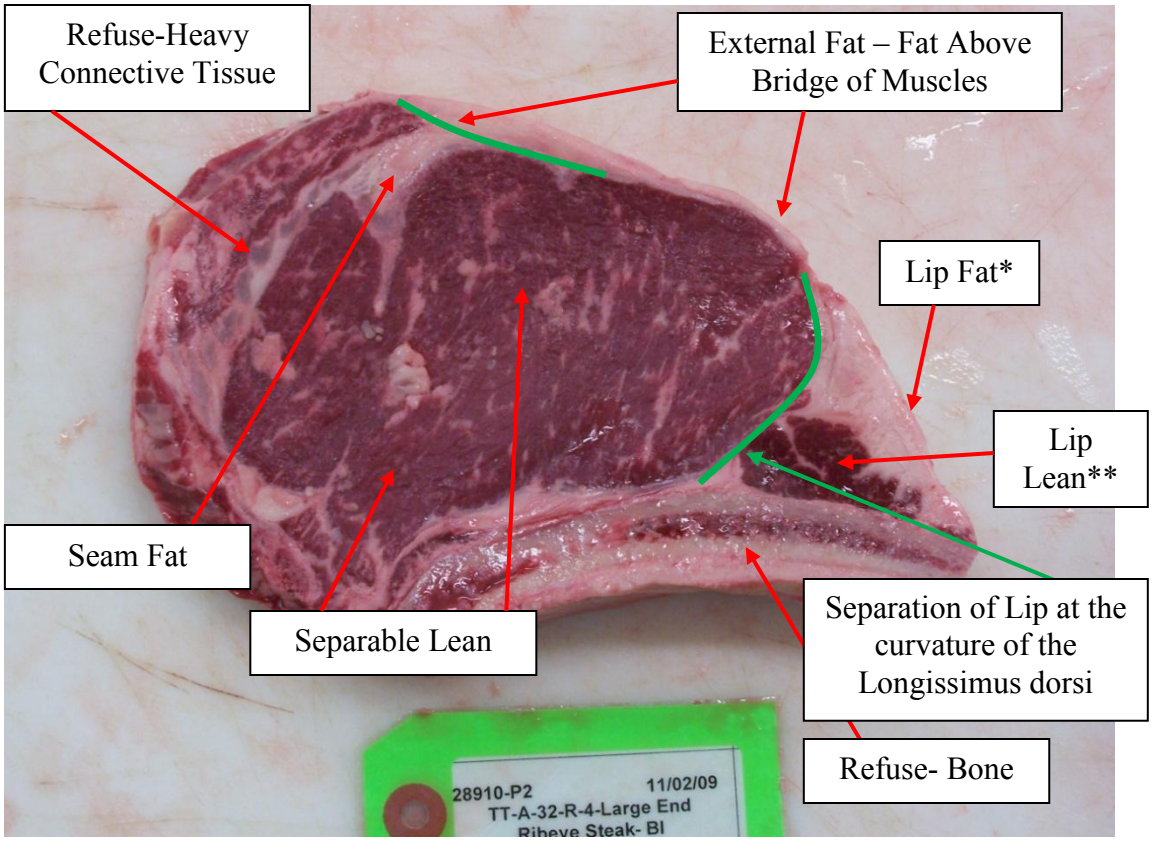


Illustration 2- Bone-In Lip-On Ribeye Steak (Large End)



***Lip Fat will be weighed and recorded separately then combined with Seam Fat for a Total Seam Fat Weight.**
****Lip Lean will be weighed and recorded separately, then combined with Separable Lean for a Total Separable Lean Fat Weight.**

Illustration 3- Outside Skirt Dissection

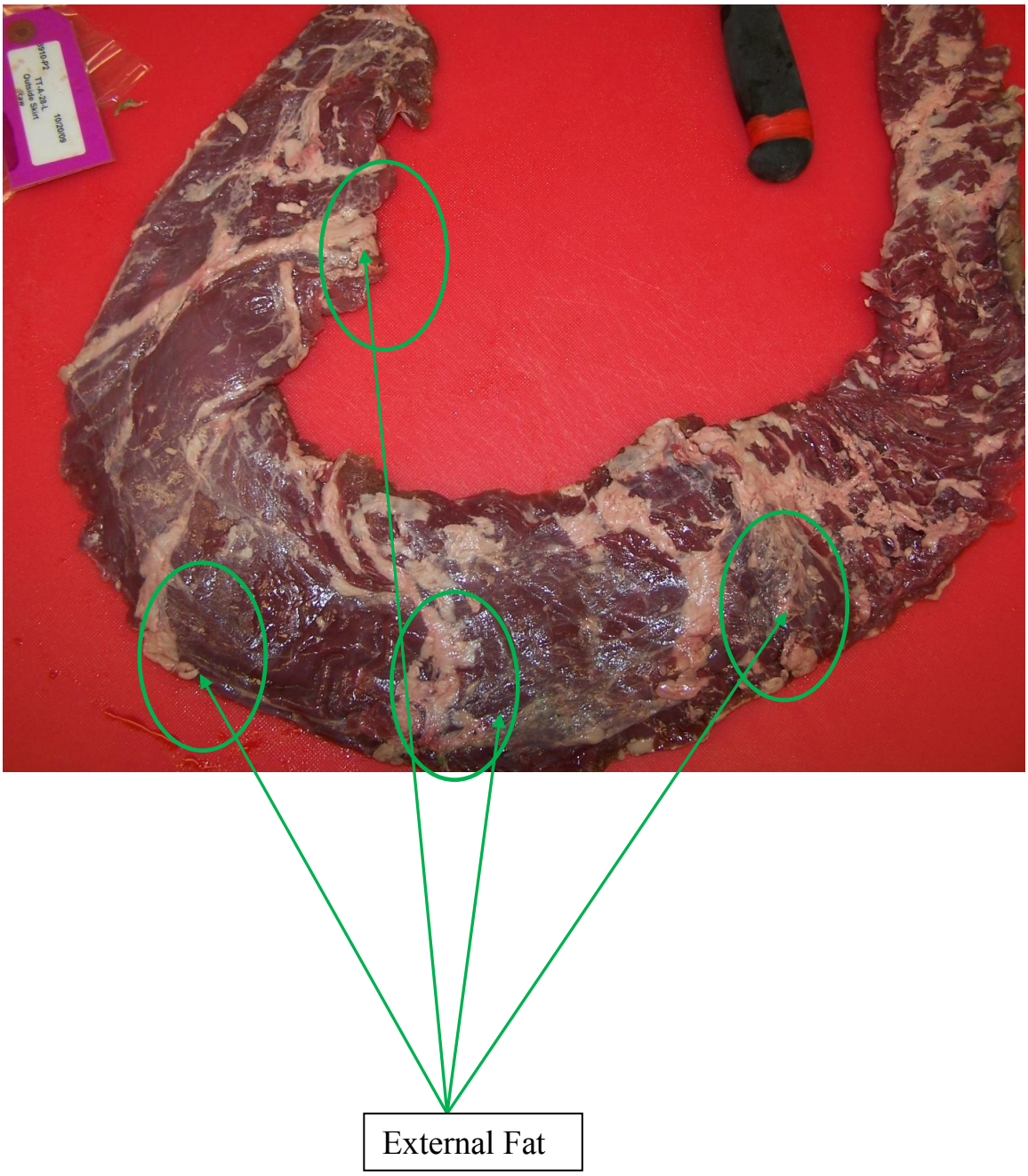
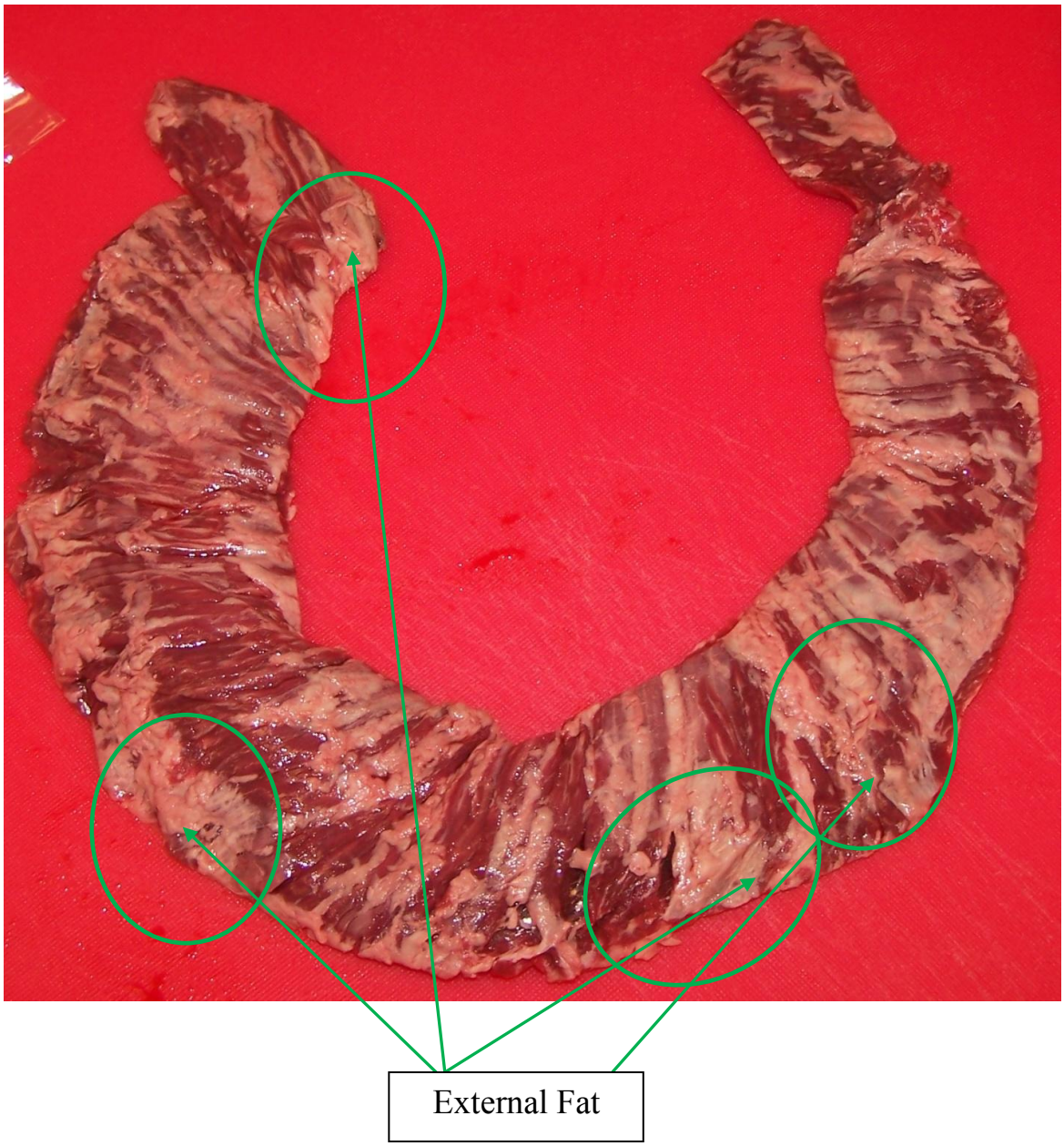
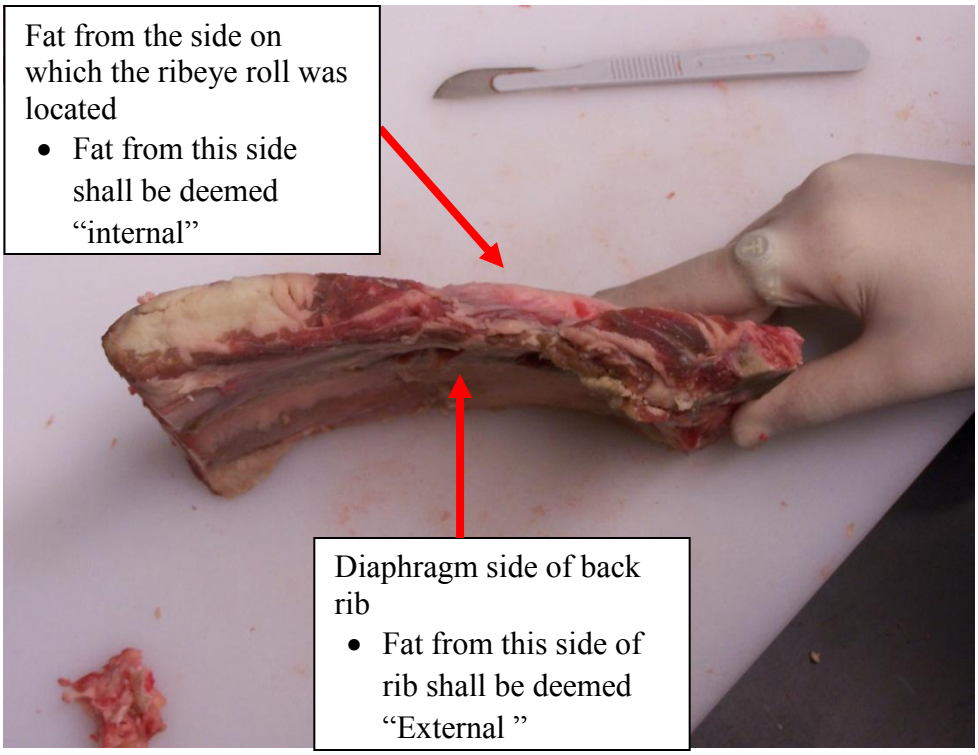


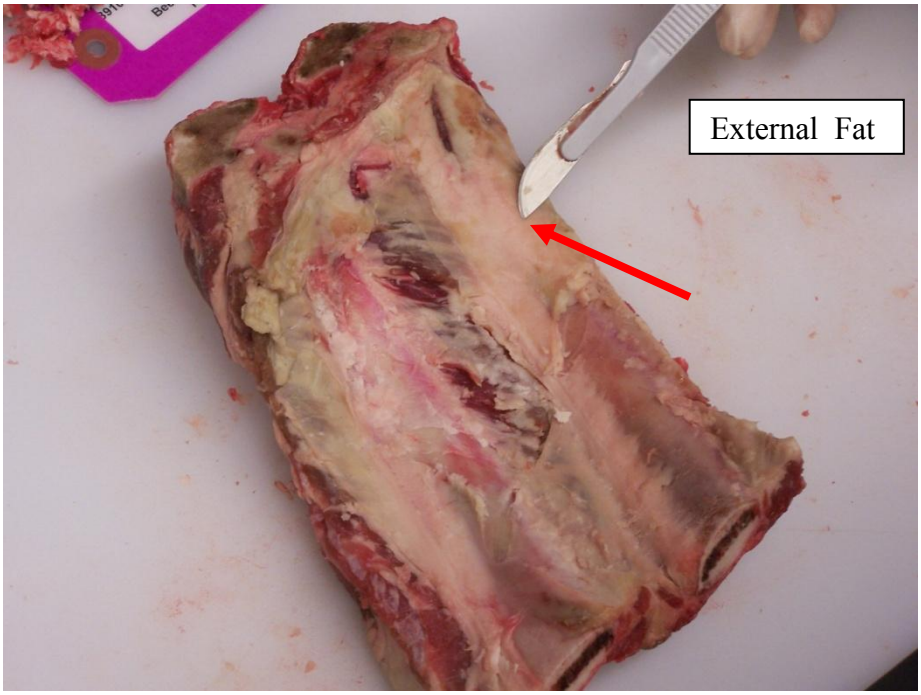
Illustration 4: Inside Skirt Dissection

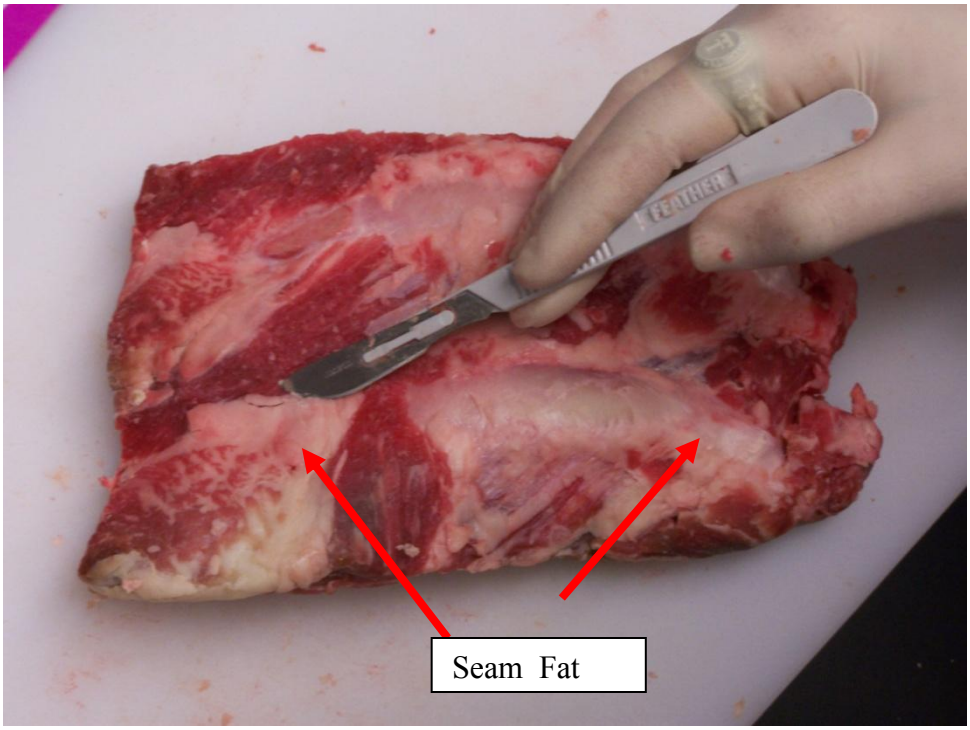


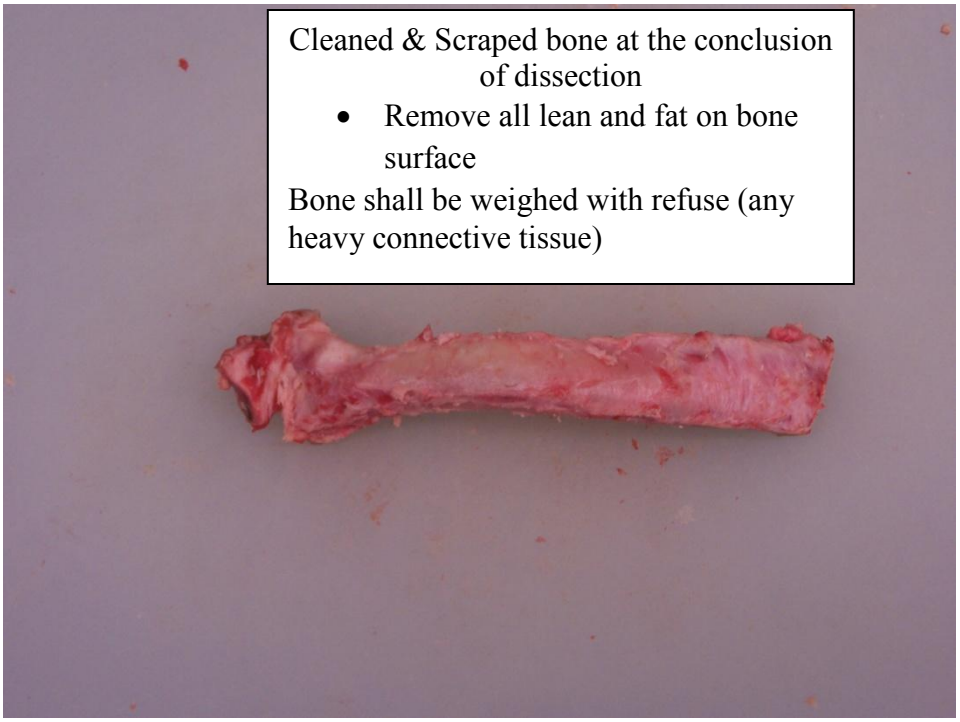
Beef Nutrient Database Improvement Study

RAW BACKRIB DISSECTION ILLUSTRATIONS






Seam Fat


Cleaned & Scraped bone at the conclusion of dissection
Remove all lean and fat on bone surface
Bone shall be weighed with refuse (any heavy connective tissue)

Beef Nutrient Database Improvement Study
SOP 7.2

HOMOGENIZATION OF BEEF RETAIL CUT SAMPLES

NOTE: All homogenization must be done in the absence of direct light.

1. Purpose

To describe the procedure for preparing and homogenizing raw and cooked beef samples.

2. Safety

2.1 Be careful when handling the Robot-Coupe 7 blade-it is very sharp.
2.2 Cryogenic gloves, lab coat and safety goggles must be worn when handling liquid nitrogen.

3. Materials

NOTE: All utensils and equipment used in homogenization must be thoroughly cleaned and dried between each sample to assure there is no cross-contamination of materials that would affect nutrient analysis.

3.1 Robot Coupe Blixer 7 BX 6V batch processor (M1-45-3) or other approved blending/homogenizing device
3.2 Dissected and cubed beef samples to be homogenized
3.3 Freezer (-80 ± 5° C ULTRA LOW TEMP)
3.4 Digital thermometer (Fisher Cat #15-078J) or equivalent
3.5 18 oz Whil-pak bag – primary and secondary sample bag (Fisher Cat # B00736) or equivalent
3.6 Gallon size freezer Ziplock bags
3.7 11-13/16" Ellipso-Spoon J spatula (Fisher Cat #14-375-57), or equivalent
3.8 Permanent, cryogenic marker (Fisher Cat #13-382-52), or equivalent
3.9 Teri Wipers (Fisher Cat #15-235-61), or equivalent
3.10 Powder-free nitrile gloves (Fisher Cat #18-999-4099), or equivalent
3.11 Ice bucket (Insulated bucket capable of withstanding liquid N), at least ~2 quarts size
3.12 One (1) medium (7-quart) stainless steel bowl
3.13 Cryogenic labels preprinted with sample numbers (Avery #5520), or equivalent
3.14 Large siliconized Rubbermaid spatula or equivalent
3.15 Analytical balance (M1-39-9 or M1-42-3, Fisher #01-913-317), or equivalent
3.16 Liquid nitrogen

3.17 Large stainless steel spoon
3.18 Safety goggles
3.19 Lab coat
3.20 Cryogenic gloves
3.21 Data sheet
3.22 Protocol

4. Procedure

4.1 Prepare for homogenization

Note: It is extremely important to protect the samples from contamination. Do not touch utensils or equipment that comes in contact with the sample. Wear clean, powder-free nitrile gloves when working with utensils, equipment and samples.

Note: All homogenization must be done in the absence of direct light to prevent nutrient loss.

4.1.1 Adhere a pre-printed label on the outside, at the bottom of all the 18 oz whirl-pack bags needed.

4.1.2 Prepare the station for homogenization. Set out labeled bags and homogenization utensils.

4.2 Homogenize the sample

Note: Wear powder-free gloves throughout the homogenization procedure.

Note: Always use the same balance throughout the entire procedure.

4.2.1 Raw Lean Samples

4.2.1.1 Remove the samples to be homogenized from the –18°C freezer. Allow the samples to thaw in the refrigerator (0°C to 4°C) for 24-48 h. When samples are thawed, the retail cut shall be dissected according to SOP 6.2 (Dissection) into separable lean and separable fat. Once dissection is complete, proceed to the homogenization procedure.

4.2.2 Cooked Lean Samples

4.2.2.1 Remove the samples to be cooked from the –18°C freezer. Allow the samples to thaw in the refrigerator (0°C to 4°C) for 24-48 h. When samples are thawed, the retail cut shall be cooked according to study protocol. Cooked samples will be tempered for 24 h (0°C to 4°C) prior to dissection

into separable lean and separable fat. Once dissection is complete, proceed to the homogenization procedure.

4.2.3 Fat Samples

4.2.3.1 Fat samples will be homogenized by each university per cut and type Dissected fat samples should be separated into three groups as follows and sent to TTU for compositing for the entire rib and plate (fat data will not be analyzed on a cut by cut basis). **Keep the 4 fat groups from each cut separate.**

-external fat, raw
-external fat, cooked
-seam fat, raw
-seam fat, cooked

Note: The total time necessary to complete steps 4.2.4 through 5.1 must not exceed two hours. If the time limit is exceeded, notify a supervisor and record the deviation on the homogenizing lab form

4.2.4 Following completion of dissection of cooked and raw samples, reserve samples in refrigeration (0°C to 4°C)

4.2.5 Prior to homogenization, place Robot Coupe 7 bowl in -80 freezer.

4.2.6 Record starting time on form.

4.2.5 Fill ice bucket with liquid nitrogen to fill line.

4.2.6 Carefully transfer sample to the ice bucket while stirring with stainless steel sppon. to avoid pieces freezing to the bottom and sides of the bucket. Using the stainless steel spoon, check that all of the pieces are completely frozen. If they are not, add more liquid nitrogen in increments until the composite is completely frozen. Drain the liquid nitrogen into another bucket.

4.2.7 Transfer the frozen sample from the ice bucket into the Robot Coupe 7 bowl. (store bowl in -80 freezer until needed)

Note: Do not place more than 2500 grams of beef into the Robot Coupe 7 bowl.

4.2.8 Set the speed setting on the Robot Coupe 7 to 1500 rpm. Blend the composite for 10 seconds by turning on the power switch.

4.2.9 Turn off, then turn switch to 3500 rpm.

4.2.10 Blend the sample for 30 seconds at 3500 rpm by turning on the power switch of the Robot Coupe 7.

4.2.11 Remove the Robot Coupe 7 lid and scrape any material adhering to the lid back into the Robot Coupe 7 bowl using the large siliconized Rubbermaid 7 spatula. Scrape the residue off the spatula on the inside of the Robot Coupe 7 bowl.

4.2.12 Repeat steps 4.2.12 through 4.2.13. If the contents of the Robot Coupe 7 bowl appear to be homogeneous, proceed to step 4.2.15. Contents should be in fine powdered form free of chunks, etc. If not, repeat steps 4.2.12 through 4.2.13. If needed, store homogenized samples in -80 freezer before aliquoting.

4.2.13 Transfer the contents of the Robot Coupe 7 bowl to a clean medium stainless steel bowl using the large stainless steel spoon. Immediately place the bowl into a bucket with liquid nitrogen.

4.2.14 Using the stainless steel spoon, stir the sample in the following manner; start at the outer edge of the bowl and work toward the center and then back out again in a smooth motion. Repeat the stirring pattern for 30 seconds.

4.3 Aliquot into sample bags for proximate analysis and for compositing.

4.3.1 Using the Ellipso-Spoon J spatula, fill an 18 oz Whirl-pak bag with the required amount for sampling – Record proximate and back-up weights (tare scale for bags or weigh bags and subtract bag weight)
4.3.1.1 Proximate analysis = 60 grams
4.3.1.2 Proximate Back-up sample = 100 grams

4.3.2 Make sure there is no sample residue on the opening or on the outside of the bags. Clean the bags with a Teri Wiper 7 if necessary.

4.3.3 Fold each sample bag and seal. Be sure to press out all air.

4.3.4 Place sample bag inside 18oz Whirl-pak bag, fold and seal. Store in -80°C freezer until ready for proximate analysis.

4.3.5 Aliquot 450 grams from the remainder (for each animal) into a Freezer Ziplock Bag that is properly labeled with the sample

identification; remove all air and seal securely. This sample is for compositing and will be referred to as “For Composite”.

4.3.6 Record “For Composite” sample weight (tare scale for bags or weigh bags and subtract bag weight).

4.3.7 Place “For Composite” sample inside another Ziplock Bag and seal. The “For Composite” sample will be shipped to Texas Tech University for compositing.
4.3.7.1 See NDI Shipping SOP#9

4.3.8 Aliquot another 450g from the remainder that is left after the sample “For Composite”. This remainder that is left should be double Ziploc bagged and stored in the -80°C freezer. This remainder, referred to as “Backup/ Archive” may only be used for compositing and will be shipped to TTU separately, *if necessary*, (to account for possible shipping errors) from the “For Composite” sample.
4.3.8.1 See NDI Shipping SOP #9

4.3.9 Record weight of the remainder of sample- referred to as ““Backup Archive” (tare scale for bags or weigh bags and subtract bag weight).

4.3.10 Record end time of homogenization of a single animal on the data sheet upon storage.

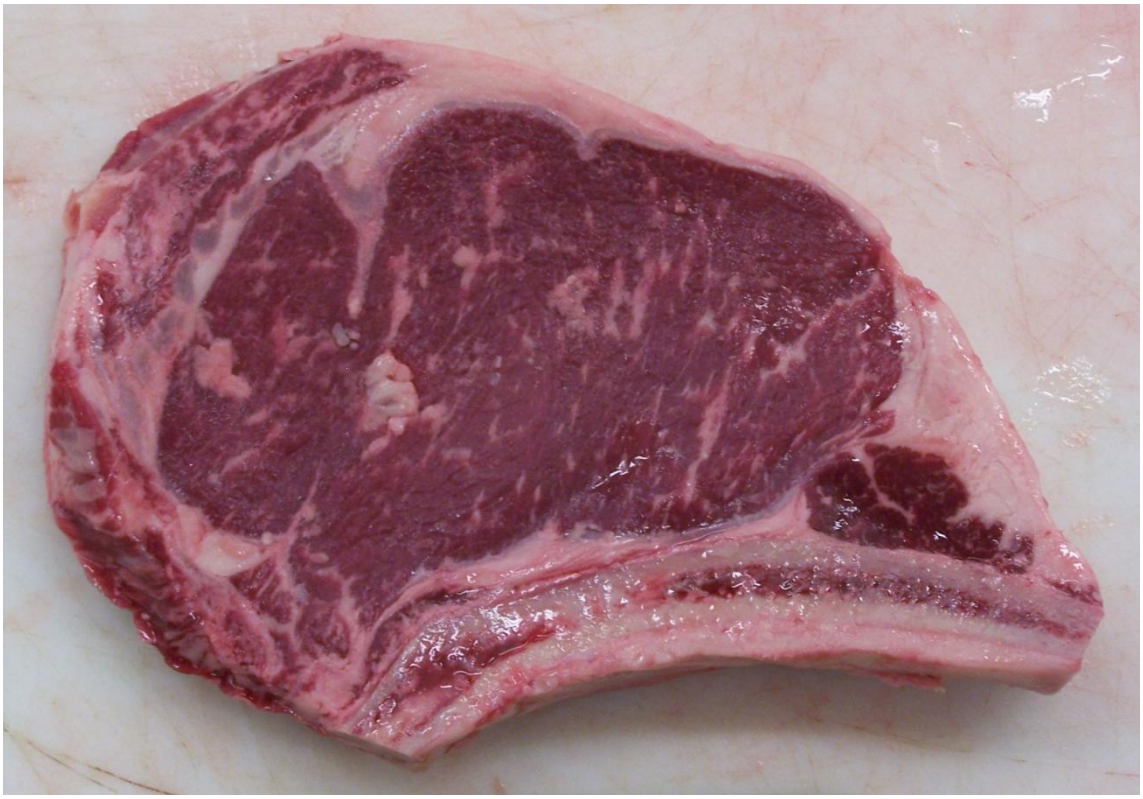
5. Storage

5.1 Make sure each bag is tightly sealed. Store the samples kept for proximates, backups, and archives in the - 80°C ± 5°C ultra-cold freezer until needed for proximate analysis. Record end time on form.

5.2 Complete Form.

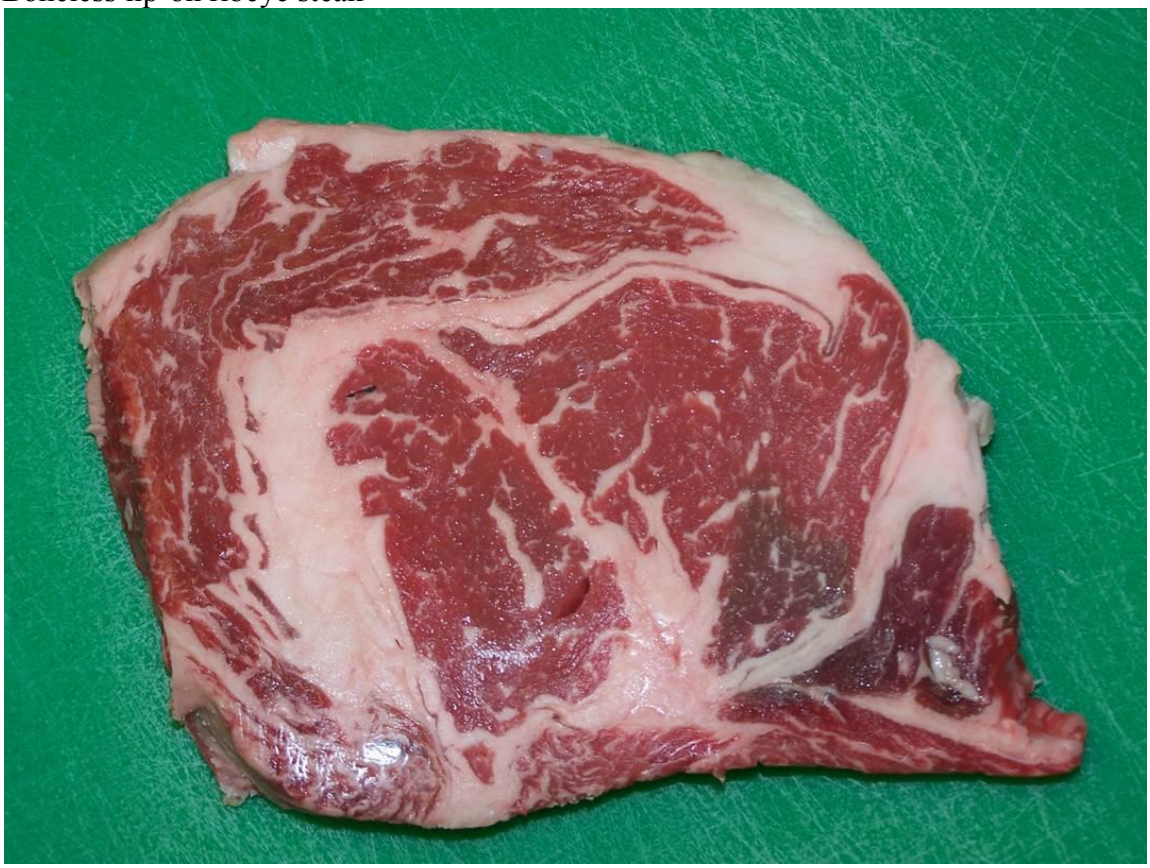
APPENDIX B

Bone-in lip-on ribeye steak



Bone-in lip-on ribeye roast

Boneless lip-on ribeye steak

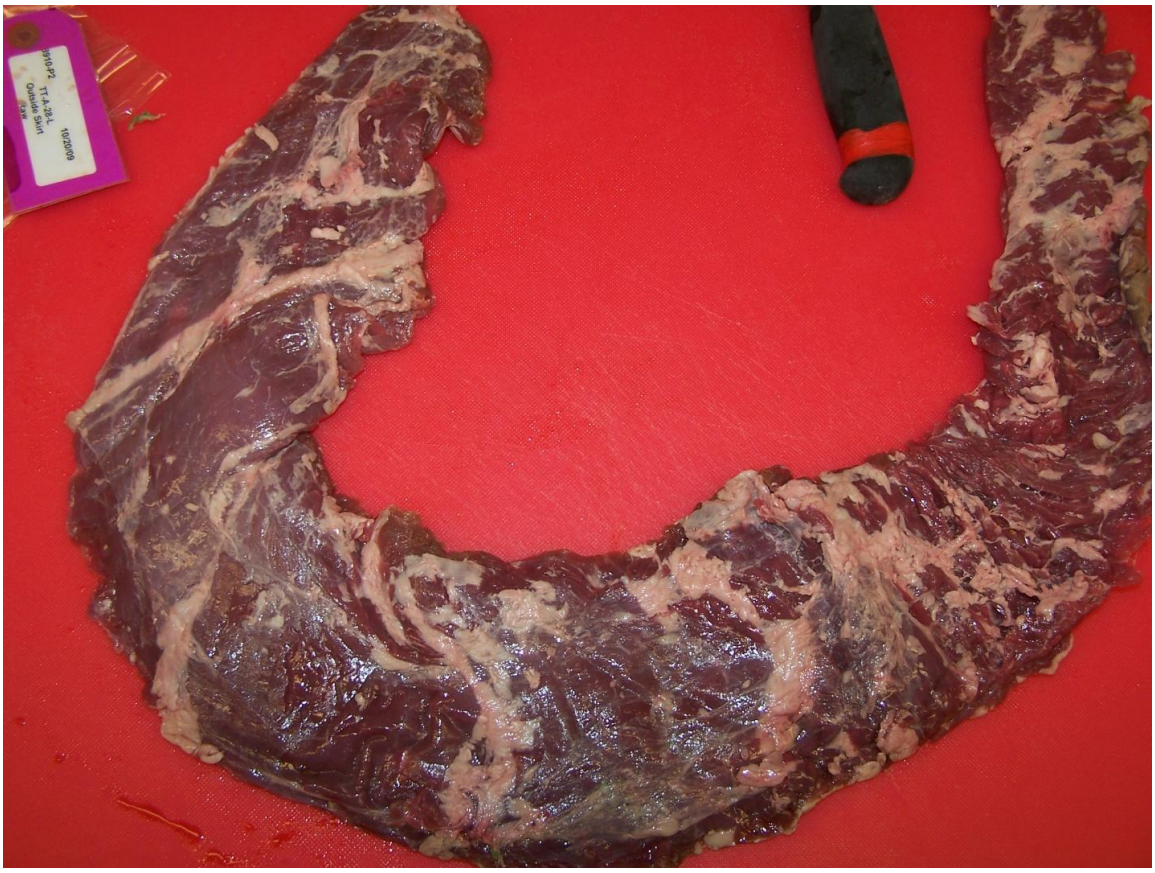


Boneless lip-on ribeye roast

Back ribs

Inside Skirt

Outside Skirt



Boneless lip-off ribeye steak

VITA

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