BENCHMARKING U.S. BEEF RETAIL CUT COMPOSITION

A Thesis

by

CARRIE LYNN ADAMS

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

August 2006

Major Subject: Animal Science

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Approved by:

Chair of Committee,	Jeffrey W. Savell
Committee Members,	Davey B. Griffin
	Kerri B. Harris
	Ben Welch
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ABSTRACT

Benchmarking U.S. Beef Retail Cut Composition. (August 2006)

Carrie Lynn Adams, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Jeffrey W. Savell

An assortment of 1,551 retail cuts were purchased from eleven cities across the United States to study their physical and chemical composition. Information with regard to external fat thickness, package weight, price per kilogram, and total package price were collected at the retail store. Cuts were purchased and later dissected into four different separable components, separable lean, external fat (carcass and cut), seam (intermuscular) fat, and bone and heavy connective tissue. Chemical fat analyses were conducted on the separable lean component of each dissected cut.

Dissection data showed that cuts originating from the round had the highest means for separable lean percentages, resulting in the lowest means for separable fat percentages. Cuts from the rib were found to have the highest separable fat percentage means, thus the lowest separable lean percentage means.

Chemical fat data mirrored dissection data, with round cuts having the lowest means for percent extractable fat for the separable lean (only) and rib cuts producing the highest means. In general, ground beef packages had a lower percentage of extractable fat than the fat percentage that was declared on the retail package label.

This study was designed to acquire data on cuts presently available at the retail level and compare their composition to data presented in the National Nutrient Database

for Standard Reference. It must be noted that separable fat percentages are not available for many of cuts sampled for this survey. Additionally, data reported in the Nutrient Database encompasses only retail cuts trimmed to 1.25 cm, 0.6 cm, 0.3 cm, and 0.0 cm. Cuts from this study consistently had fat thickness measurements between 0.0 cm and 0.3 cm; thus, there is no nutritional information in the Nutrient Database for beef cuts trimmed to these levels.

DEDICATION

I dedicate this work to the three people closest to me. To my Mom and Billy, thank you so much for all of your love, support, and encouragement. You have never hesitated to sacrifice anything for my happiness, and I cannot tell you how much I appreciate your unselfishness. To Kelton, thank you for always believing in me, picking me up when I fall, and loving me without end. I love each of you very much.

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I would be remiss without thanking my fellow graduate students and all of the student workers who helped me complete this project. There is no possible way that I could have done any part of this study without their constant support and encouragement. To Kristin Voges, Eric Metteauer, Lyda Garcia, Robby Smith, Jason Bagley, LeeAnn Sitka, J.D. Nicholson, Diana Huerta, Brad Kim, Keri Bagley, Megan Laster, Megan Maenius, Katie Leigh, Stephanie Bradley, and Kyle Baker, words are not enough to express my sincere appreciation for all of your help. I could not have

physically or mentally made it through this project without each of you. I am a smarter student, a stronger worker, and a better person because I worked and shared many hours with each of you. Thank you from the bottom of my heart.

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CHAPTER I

INTRODUCTION

Throughout the 1990's, several studies established trends in retail fat trim levels and determined corresponding separable fat and lean analyses in order to have the most current nutrient data available on beef cuts presented at the retail level. The first National Beef Market Basket Survey (Savell, Harris, Cross, Hale, & Beasley, 1991) was conducted in 1987-1988, and at the time, USDA's National Nutrient Data Bank (NNDB) and Agriculture Handbook 8-13 (AH 8-13) information was based upon a retail external fat trim level of 1.27 cm. Savell et al. (1991) found an overall mean fat trim level of 0.31 cm for all beef retail cuts, and an overall mean fat thickness for steaks and roasts, from the major primals, to be 0.38 cm. Additionally, 42% of beef retail cuts were trimmed of all external fat. As a result, this study found that beef steaks and roasts had 27.4% less separable fat, and ground beef had approximately 10% less fat than information shown in AH 8-13 at the time. To better justify updating the NNDB and AH 8-13, subsequent studies (Jones, Savell, & Cross, 1992 a,b,c) looked at the effects of external fat trim on the composition of beef retail cuts. More specifically, fat, lean, bone, and connective tissue components, fat and moisture content of separable lean, as well as cooking yield and fat retention of the separable lean were determined. These data mirrored what was found in the National Market Basket Survey and were ultimately used to update the AH 8-13. Because Brooks et al. (2000) found that fat thickness on beef retail cuts have continued to decrease, Wahrmund-Wyle, Harris, and Savell (2000 a,b) calculated

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This thesis follows the style of *Meat Science*.

cooking yields and determined percentages of dissectable components (lean, fat, and waste) of beef retail cuts with 0.0 cm, 0.3 cm, and 0.6 cm of external fat trim. These data also were used to update the National Nutrient Database for Standard Reference (replaced NNDB and AH 8-13 and from this point forward referred to as National Database).

Maintaining representative nutrient information on retail cuts is a never-ending task. Not only are fat thickness levels continuing to change at the retail level, but industry efforts to better merchandize single muscle cuts have caused a materialization of new retail cuts that currently are not represented in the National Database. As a consequence of innovative fabrication styles and new cut representation, retail cases must be surveyed to update cut representation and possibly even nutrient information in the National Database.

It has been almost two decades since the last U.S. survey was conducted. The objectives of this study were: 1) to gain knowledge of the present state of the composition of retail raw beef throughout the United States; 2) to compare data acquired through this research with that shown in the National Database and other previous research, in order to assess appropriate revisions.

CHAPTER II

REVIEW OF LITERATURE

Since the beginning of the diet and health craze of the 1980's, the contribution of beef to the diet has been a controversial and perplexing subject to many Americans. Health professionals have often labeled beef as fat and unhealthy, especially when compared to other meat choices. Consumers have been discouraged to eat red meat, especially beef, by health professionals who believe diets high in saturated fat contribute negatively to risk factors associated with coronary heart disease. However, for many years, there have been nutritional information sources that have misled both nutritionists and the consuming public about beef's role in the diet as a source of dietary fat.

Beef carcass and cut composition has been a long-standing research area for meat scientists. Studies conducted to predict the estimated yields of retail cuts from beef carcasses date back to as early as the 1960's (Murphey, Hallet, Tyler, and Pierce, 1960). The compilation of basic food composition data and the development of composition tables for the United States Department of Agriculture began even earlier, approximately 115 years ago. These data were first evaluated by W.O. Atwater in the 1890's. The first publication in a long series of food composition tables issued by the Department was in 1896, the USDA Bulletin No. 28, "The Chemical Composition of American Food Materials," by W.O. Atwater and C.D. Woods (USDA, 1963). This initial publication was revised in 1899 and again in 1906. Nearly thirty years later, in 1926, U.S. Department of Agriculture Circular 389, "Proximate Composition of Beef" was issued by the USDA. This report related carcass composition to relative fatness based upon the meat grades that were in effect at the time and wholesale cuts were then related to carcass

composition (Pecot, Jaeger, and Watt, 1965, as cited by Wahrmund, 1999). A high correlation was found between fat in each individual cut and carcass fat. Several more Department Circulars were published in the next few years relating to food proximate composition, but the next one involving beef products was not released until 1940, which was the U.S. Department of Agriculture Circular 549, "Proximate Composition of American Food Materials" by Chatfield and Adams (USDA, 1963). This was the first of three publications that are considered to be major contributors in this field and one of the first publications believed to have overestimated the percent fat and total calories for products because there was no adjustment for trimming (Pecot et al., 1965, as cited by Wahrmund, 1999). Two of the other major publications relating to food composition were the Miscellaneous Publication 572, "Tables of Food Composition in Terms of Eleven Nutrients," 1945 and Handbook No. 8, "Composition of Foods- raw, processed, prepared," 1950 (USDA, 1963). Since the mid 1900's, continued research in beef composition by universities, agriculture experiment stations, government laboratories, as well as industry, has helped USDA to continue to update and revise nutrient information, resulting in four different versions of the Agriculture Handbook No. 8, "Composition of Foods: Beef Products; Raw, Processed, Prepared" (commonly referred to today as Agriculture Handbook 8-13). As previously mentioned, the first version of the Agriculture Handbook was released in 1950, with revisions made and published in 1963, 1986, and 1990. Data published in the 1963 Handbook 8-13 were based on fat trim levels of 1.27 cm or less, which was believed to have accurately represented market practice at the time. Additionally, chemical composition data were reported for the total of both the lean and fat present in the carcass. Moreover, the final values reported for meat cuts were

believed to be directly related to the average composition of each grade of carcass, based on the grades of that time. Data released in the 1987 Agriculture Handbook 8-13 represented cuts trimmed to the same fat thickness level (1.27 cm) as those reported in the 1963 version. The Agriculture Handbook 8-13 published in 1990 used much of the data generated from Savell et al. (1991) and Jones et al. (1992 a,b,c) to provide information on beef retail cuts trimmed to 0.63 cm of external fat.

Since 1992, beef retail cut composition and nutrient information have been maintained by the United States Department of Agriculture's National Nutrient Data Laboratory through the use of a Nutrient Database for Standard Reference. Today, the National Nutrient Database for Standard Reference maintains data on cuts with various fat thickness levels, including some data for cuts with no external fat thickness. This Nutrient Database must be kept up to date in order to facilitate consumer dietary awareness as well as accurately represent the retail cut assortment presently available to the public. Much of the stereotype that beef has as an unhealthy food choice is believed to have originated from past food consumption surveys like the USDA's National Food Consumption Survey and the U.S. Department of Health and Human Services' National Health and Nutrition Examination Survey, both of which are conducted every ten years. Data and information collected from these two studies are used to determine the contribution of beef to the total consumption of fat. For these two surveys, both the technique used for coding interviewee answers and the data bank (Agriculture Handbook 8-13) used to calculate fat content of retail cuts compounded the negative estimations for beef's contribution to overall fat intake. In previous years when these studies were

conducted, data shown in Agriculture Handbook 8-13 was based on retail cuts with more external fat than those cuts found in the retail meat case at that time.

Several key findings in the beef industry during the late 1980's instigated major changes in the way beef retail cuts have been merchandized and as a consequence made data presented in Agricultural Handbook 8-13 (USDA, 1986) obsolete. The National Consumer Retail Beef Study (Cross, Savell, and Francis, 1986; Savell et al., 1989) showed that consumers preferred beef retail cuts that were trimmed to have little or no subcutaneous fat. These findings led retailers to reduce fat trim specifications to no more than 0.64 cm to meet consumer demands (Cross et al., 1986). These results also prompted the need for more research to better define the fatness of beef cuts at the retail level and determine to what extent retailers were trimming external fat to meet consumer demands. As previously mentioned, The National Beef Market Basket Survey (Savell et al., 1991) found cuts to be even leaner than was expected. Results from this study led to the work by Jones et al. (1992 a,b,c) that analyzed the physical and chemical composition of beef retail cuts, raw and cooked, trimmed to 0.0 cm and 0.6 cm of external fat. Not only did these data validate the previous reports of leaner beef retail cut composition, but it also was used to update the Agriculture Handbook 8-13 at the time. Regression equations reported in the study could be used to predict the composition of beef retail cuts trimmed to 0.0 cm and 0.6 cm external fat regardless of the changes expected in the U.S. beef carcass population throughout time. Data derived from The National Beef Market Basket Survey (Savell et al., 1991), along with data from the Agriculture Handbook 8-13, were instrumental in another study conducted to produce a statistical program to determine nutritive values for raw and cooked beef retail cuts trimmed to 0.3

cm (Morris, Harris, Harris, Douglass, and Savell, 1994, as cited by Wahrmund, 1999). An adjusted nutritive value could be computed based on the reduction of the amount of fat and changes in nutrients due to trimming the external fat thickness of cuts from 0.6 cm to 0.3 cm. Results from this study also were used to supplement data reported in the National Nutrient Data Bank at the time. Wahrmund-Wyle et al. (2000 a,b) studied the physical and chemical composition of the separable lean for cuts trimmed to an external fat trim level of 0.6 cm, cooked; 0.3 cm, cooked; 0.3 cm, raw; and 0.0 cm, cooked. USDA's nutritional information sources were devoid of this type of information on the separable lean tissue only. Results for chemical fat content from this study for most cuts were lower than what was reported by USDA.

It is apparent that continual work must be done to most accurately represent the ever-changing face of beef retail cut composition. Data presented in the National Nutrient Database are the foundation for a majority of the public and private work in the human nutrition field. Because this information directly impacts nutritional activities within this country, it must be the most accurate and current data available. The federal government not only uses these numbers for various disease and disease treatment research studies, but for dietary guidance and the planning of national nutritional policies as well. With continued nutrition research and the resurgence of low carbohydrate diets, beef has risen in the ranks of healthful food options. However, even more can be done to heighten the public perception and image of beef as a healthful food source.

CHAPTER III

MATERIALS AND METHODS

3.1. Product selection

Eleven cities were selected to allow sampling in various geographical regions of the United States with known differences in market preference. Cities sampled included: New York, NY; Philadelphia, PA; Atlanta, GA; Chicago, IL; Kansas City, MO; Houston, TX; Denver, CO; Los Angeles, CA; San Francisco, CA; Seattle, WA; and Tampa, FL. Cities were chosen to allow for comparison to the previous market basket survey and to provide additional opportunities for data collection. Two retail chains per city were selected with the chains representing at least one third of the total volume of supermarket sales in that city. Four stores per chain were chosen, so that a total of eight supermarket stores per metropolitan area were sampled. Sampling occurred throughout the months of January to March 2006.

At the store level, external fat thickness, when present, was measured on all steaks and roasts at three different locations on the cut using a ruler. These measurements were used to calculate an average external fat thickness measurement for each cut. Those cuts that were free of external fat were noted as such. Additional information that appeared on the meat label or package also was recorded such as: package weight, price per kilogram, total package price, grade, brand, package date, sell by date, and any special claims with regards to aging and/or tenderness or declared fat/lean (i.e., percent of fat and lean in ground beef). After all measurements and data were collected at the store, an assortment of twenty-one retail cuts, representing various locations across the carcass, were purchased from each store and shipped to the Rosenthal Meat Science and Technology

Center at Texas A&M University for cut dissection and chemical fat determination. Cuts from the following primals or sections were selected for dissection studies: chuck blade section, chuck arm section, rib, loin, round, ground beef, and miscellaneous (stew meat, stir-fry, or skirt steak). Cuts were shipped the same day for overnight delivery in either plastic coolers or insulated boxes.

3.2. Retail cut dissection

Upon arrival, retail cuts were identified according to the Uniform Retail Meat Identity Standards (URMIS) with both the official URMIS name and UPC code (Industry-Wide Cooperative Meat Identification Standards Committee, 2003). Cuts were removed from the package, photographed, and then dissected into separable lean, external fat (which may have included subcutaneous or intermuscular fat, depending on where the cut was fabricated from the carcass), seam (intermuscular) fat, and bone and heavy connective tissue (waste). Heavy connective tissue within muscles (e.g., Top Blade Steaks) was not removed; however, heavy connective tissue between muscles was removed. Initial cut weight and post-dissection weights of all components were taken to ascertain the percentages of each dissected component for that cut. Dissection data were used later to determine the fatness of retail cuts. For those packages containing multiple steaks, each steak was weighed and treated independently during dissection, but separable lean was combined for powdering. Subcutaneous fat and seam fat were collected from all cuts, separated and grouped according to primal and at the end of each processing day were powdered to conduct chemical fat analysis (data not reported here).

3.3. Sample preparation

Separable lean from all steaks and roasts from each package were powdered to make a homogenous sample for chemical fat analysis. Powdering occurred immediately after dissection and weighing. Separable lean from each cut was submerged in liquid nitrogen and then placed in stainless steel blending cups to powder. Two Whirl-pak bags per retail cut were filled with the resulting powdered sample and stored at -10°C until used for chemical fat analysis.

Ground beef samples, stew meat, cubed meat, stir-fry, or any other cuts that had no visible external or seam fat to remove were immediately weighed and powdered, skipping the dissection step completely. As stated earlier, for those packages containing multiple steaks, each steak was weighed and treated independently during dissection; however, the entire package was combined as a composite for powdering. Cuts that were very large (e.g., whole briskets) were dissected into separable components with all appropriate weights taken and then the separable lean was sent through a small table-top grinder for homogenization. Smaller grab samples were taken from each quadrant of this homogenized separable lean for powdering.

3.4. Chemical fat analysis

Chemical fat of the separable lean from each cut package, as well as ground beef samples, were measured using a modified version of the oven-dry ether extraction method described by AOAC (2000). Of the powdered sample, three to four grams were put in a dried, preweighed thimble. Thimbles were originally dried for twelve hours at 100°C. Once thimbles were stuffed with the appropriate amount per sample, they were dried in an oven at 100°C for 18 hours, removed and cooled in a desiccator for 30 to 45

min. Thimbles were reweighed to determine percent moisture. Fourteen to sixteen thimbles were placed in a soxhlet, the flasks underneath filled to 1000 ml with ether and boiling chips added as well. Extraction was carried out over an eighteen-hour period. Upon removing thimbles, excess ether remaining in the soxhlet was poured into flasks and thimbles arranged in a single layer under a hood to allow ether to evaporate completely (approximately 45 min). Thimbles then were oven dried again at 100°C for 12 hours and then reweighed for percent fat determination.

3.5. Statistical analysis

Means, standard deviations, and percentage values were computed using data analysis functions in Microsoft Excel (Microsoft Corporation, Redmond, Washington). Least square means were separated using PROC GLM with pdiff option (SAS Institute, Cary, North Carolina).

CHAPTER IV

RESULTS AND DISCUSSION

4.1. Store data

External fat thickness measurements, package weight, price per kilogram, and total package price information are reported in Tables 1 through 7. When comparing cuts originating from one of the four main primals, cuts from the round had significantly less (P <0.05) external fat than cuts from the rib and loin. The overall average external fat thickness for round cuts in this study was 0.10 cm. Cuts from the rib and loin had the most external fat, 0.26 cm and 0.27 cm, respectively. It is economically advantageous for retailers to sell beef steaks from the rib and loin with more external fat because of the value difference between fat left on a steak and that fat that is trimmed off.

For a majority of the retail cuts represented in the National Database, nutrient information is available for cuts with external fat thickness measurements of 1.27 cm, 0.6 cm, 0.3 cm, and 0.0 cm (USDA, 2006). However, much of the data in this study shows that, on average, many of the beef cuts at the retail level would have external fat thickness measurements that would lie between 0.3 cm and 0.0 cm. As a result of this, nutritional information for these products cannot be accurately derived from the data shown in the National Database.

Cuts from the chuck and round had significantly (P <0.05) heavier package weights, than cuts from the rib and loin, miscellaneous cuts, and ground beef packages. The influx of "family packages" or "value packages" in retail cases may explain this difference. Additionally, the high number of roast cuts sampled within these two primals would greatly influence means for package weight. Moreover, the presence of bone in

Table 1
Means and standard deviations (SD) for external fat thickness, package weight, price per kilogram, and total package price for retail cuts from the beef chuck

URMIS[a] approved name	UPC[a]	*n*	External fat thickness, cm	SD	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
Beef Chuck										
Arm pot roast	1048	3	0.25	0.36	1.42	0.48	7.77	0.89	23.95	6.53
Arm pot roast bnls	1049	3	0.13	0.18	0.90	0.39	10.41	6.26	18.72	7.78
Shoulder pot roast bnls	1132	27	0.38	0.28	0.96	0.31	8.22	1.52	17.51	6.84
Arm steak bnls	1056	1	0.00		0.56		6.59		8.11	
Short ribs	1124	23	0.15	0.31	0.69	0.22	7.89	1.18	11.73	3.77
Short ribs bnls	1127	6	0.00	0.00	0.52	0.17	9.53	2.28	10.28	1.68
Shoulder steak bnls	1133	37	0.24	0.19	0.60	0.30	9.55	1.14	12.57	6.31
Flanken style ribs	1107	9	0.01	0.04	0.54	0.14	10.24	1.13	11.97	2.67
Flanken style ribs bnls	1110	1	0.00		0.58		8.80		11.18	
Neck pot roast bnls	1121	6	0.11	0.10	1.15	0.33	7.62	1.74	19.38	7.74
Pot roast bnls	1080	21	0.08	0.12	1.25	0.40	8.73	2.42	24.14	12.41
7-bone pot roast	1033	4	0.25	0.23	1.37	0.26	6.70	0.42	20.29	4.63
7-bone steak	1035	6	0.33	0.25	0.92	0.19	6.85	1.22	13.43	1.06
Blade roast	1064	4	0.54	0.78	1.43	0.43	6.04	1.16	19.25	7.06
Blade steak	1066	5	0.38	0.18	0.95	0.08	5.89	2.05	12.17	3.81
Blade steak bnls	1073	24	0.08	0.12	0.62	0.29	8.65	1.70	11.14	3.33
Top blade steak BI	1138	2	0.00	0.00	0.56	0.15	8.69	0.16	10.69	2.69
Under blade pot roast	1150	1	0.00		2.27		9.24		46.19	
Under blade steak	1152	3	0.13	0.18	0.57	0.02	7.40	3.57	9.19	4.32
Under blade pot roast bnls	1151	20	0.10	0.14	1.12	0.26	8.39	1.14	20.82	5.93
Under blade steak bnls	1158	18	0.08	0.15	0.48	0.11	9.09	1.41	9.48	1.96
Mock tender roast	1115	3	0.06	0.09	1.20	0.05	8.50	1.78	22.36	3.97
Mock tender steak	1116	20	0.01	0.04	0.47	0.11	9.78	1.71	10.30	3.44
Top blade roast bnls	1137	14	0.02	0.07	0.95	0.21	8.91	1.49	18.68	5.18
Top blade steak bnls	1144	28	0.02	0.06	0.51	0.24	10.05	0.80	11.40	5.40
Top blade steak (flat iron)	1166	7	0.00	0.00	0.64	0.18	11.32	1.05	15.74	3.73
Eye steak bnls	1102	32	0.10	0.13	0.50	0.16	10.34	1.21	11.40	3.77
Chuck average		**328**	**0.13**	**0.01**	**0.74**	**0.02**	**8.93**	**0.23**	**14.10**	**0.48**

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

Table 2

Means and standard deviations (SD) for external fat thickness, package weight, price per kilogram, and total package price for retail cuts from the beef rib

URMIS[a] approved name	UPC[a]	*n*	External fat thickness, cm	SD	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
Beef Rib										
Roast large end	1218	4	0.42	0.07	1.37	0.49	19.89	3.21	16.65	27.67
Steak large end	1222	4	0.34	0.15	0.43	0.15	23.79	2.92	22.78	9.64
Back ribs	1182	34	0.00	0.00	0.82	0.36	4.49	1.64	9.13	5.03
Roast small end	1235	4	0.16	0.19	1.49	0.45	19.00	2.44	61.87	20.11
Roast small end bnls	1238	1	0.25		0.84		17.62		32.59	
Steak small end	1239	4	0.16	0.12	0.32	0.07	17.56	3.08	12.19	2.45
Steak small end bnls	1245	7	0.27	0.19	0.32	0.06	21.14	2.18	14.95	2.21
Ribeye steak	1209	46	0.25	0.21	0.38	0.14	22.99	3.86	19.38	7.34
Ribeye roast	1192	1	0.25		0.99		19.38		42.45	
Short ribs	1259	3	0.25	0.00	0.84	0.17	8.80	2.21	16.60	6.26
Short ribs bnls	1265	1	0.00		0.55		5.49		6.70	
Ribeye rst lip on BI	1193	5	0.33	0.19	1.64	0.58	20.29	2.00	73.07	25.49
Ribeye stk lip on BI	1197	44	0.35	0.22	0.43	0.10	21.32	2.90	20.18	4.85
Ribeye stk lip on bnls	1203	39	0.33	0.26	0.40	0.17	23.94	4.59	20.35	5.91
Rib average		**197**	**0.26**	**0.01**	**0.57**	**0.03**	**18.99**	**0.31**	**21.23**	**0.64**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 3

Means and standard deviations (SD) for external fat thickness, package weight, price per kilogram, and total package price for retail cuts from the beef loin

URMIS[a] approved name	UPC[a]	*n*	External fat thickness, cm	SD	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
Beef Loin										
Top loin steak	1398	21	0.45	0.17	0.38	0.12	19.28	3.70	15.96	5.69
Top loin steak bnls	1404	52	0.40	0.23	0.40	0.13	21.67	4.60	18.74	6.46
Tenderloin steak	1388	33	0.13	0.27	0.37	0.13	29.86	6.33	23.88	7.89
T-bone steak	1369	43	0.37	0.24	0.47	0.18	19.92	4.43	20.61	8.75
Porterhouse steak	1330	21	0.37	0.21	0.52	0.08	19.74	3.94	22.89	6.39
Sirloin steak	1358	1	0.76		0.57		13.21		16.52	
Shell sirloin steak	1346	1	0.00		0.45		13.21		13.21	
Ball tip roast	1307	4	0.00	0.00	0.82	0.19	10.71	0.54	19.18	3.20
Ball tip steak	1308	13	0.03	0.08	0.46	0.07	10.71	1.17	10.91	2.07
Flap meat steak	1326	1	0.00		0.39		10.12		8.60	
Tri tip roast	1429	12	0.07	0.16	1.00	0.36	13.17	2.47	28.55	10.69
Tri tip steak	1430	16	0.13	0.18	0.56	0.19	14.26	1.48	17.38	5.40
Top sirloin rst bnls cap off	1419	1	0.51		0.38		14.31		11.88	
Top sirloin steak bnls	1422	23	0.22	0.17	0.55	0.13	13.83	2.20	16.71	5.20
Top sirloin stk bnls cap off	1426	22	0.16	0.20	0.47	0.16	14.37	2.60	14.46	4.81
Top sirloin cap steak bnls	1421	4	0.04	0.07	0.59	0.19	13.76	1.10	18.08	7.19
Loin average		**268**	**0.27**	**0.01**	**0.48**	**0.02**	**19.02**	**0.27**	**19.14**	**0.55**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 4
Means and standard deviations (SD) external fat thickness, package weight, price per kilogram, and total package price for retail cuts from the beef round

URMIS[a] approved name	UPC[a]	*n*	External fat thickness, cm	SD	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
Beef Round										
Steak	1494	1	0.38		1.06		6.15		14.33	
Steak bnls	1501	15	0.44	0.20	0.66	0.20	9.55	0.97	13.93	4.12
Top round roast	1455	6	0.00	0.00	1.25	0.29	8.76	2.58	23.09	5.48
Top round roast cap off	1454	7	0.04	0.10	0.95	0.19	10.40	1.35	21.38	2.67
Top round steak, 1st cut	1556	6	0.00	0.00	0.63	0.14	10.05	3.11	13.58	4.25
Top round steak	1553	36	0.08	0.14	0.42	0.17	11.27	2.18	10.34	4.54
Bottom round rump roast	1519	20	0.10	0.16	1.34	0.35	9.00	1.40	26.60	8.12
Bottom round roast	1464	23	0.14	0.18	1.14	0.35	7.99	1.79	20.00	7.04
Bottom round steak	1466	28	0.17	0.19	0.42	0.17	10.07	1.91	9.05	3.89
Eye round roast	1480	24	0.07	0.11	1.11	0.40	10.13	1.78	25.05	10.70
Eye round steak	1481	28	0.10	0.16	0.39	0.19	11.55	1.60	9.73	4.24
Bottom round rst (triangle)	1463	2	0.32	0.09	1.30	0.29	6.04	0.78	17.12	1.56
Tip roast	1525	5	0.00	0.00	1.26	0.59	9.45	0.60	26.49	13.39
Tip steak	1527	10	0.04	0.09	0.43	0.16	10.69	1.46	10.15	4.53
Tip roast cap off	1526	2	0.00	0.00	1.27	0.13	8.57	1.89	23.76	2.81
Tip steak cap off	1535	17	0.01	0.03	0.56	0.30	11.05	1.72	13.83	8.46
Sirloin tip center steak	1550	7	0.00	0.00	0.39	0.12	11.35	0.46	9.84	2.94
Sirloin tip center roast	1549	4	0.00	0.00	1.47	0.24	9.78	0.22	31.84	5.77
Sirloin tip side steak	1543	8	0.00	0.00	0.37	0.14	11.53	0.74	9.31	3.51
Cubed steak	1577	32	0.01	0.05	0.32	0.11	9.61	1.32	6.91	2.61
Round average		**281**	**0.10**	**0.01**	**0.69**	**0.02**	**10.12**	**0.26**	**14.71**	**0.54**

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

Table 5

Means and standard deviations (SD) for external fat thickness, package weight, price per kilogram, and total package price for miscellaneous beef retail cuts

URMIS[a] approved name	UPC[a]	*n*	External fat thickness, cm	SD	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
Beef shank cross cuts	1636	39	0.19	0.23	0.48	0.14	6.43	0.77	6.75	2.29
Beef Brisket										
Whole bnls	1615	3	0.38	0.54	4.41	0.94	4.53	0.25	43.77	7.36
Point half bnls	1628	1	0.00		1.93		6.59		28.02	
Flat half bnls	1623	14	0.16	0.24	1.13	0.61	10.12	2.15	24.15	10.86
Middle cut bnls	1626	2	0.00	0.00	0.98	0.04	8.80	0.00	18.96	0.81
Flat cut bnls	1622	14	0.15	0.22	0.83	0.20	9.95	1.35	18.38	5.39
Point off bnls	1629	5	0.43	0.35	1.66	0.55	7.92	2.39	27.17	7.28
Edge cut bnls	1624	1	0.00		0.76		7.01		11.71	
Beef flank steak	1581	38	0.00	0.00	0.62	0.20	14.65	2.80	20.19	7.55
Beef Plate										
Skirt steak bnls	1607	23	0.03	0.09	0.43	0.15	12.20	2.38	11.14	3.24
Skirt steak rolls bnls	1611	5	0.08	0.07	0.35	0.06	14.31	0.00	11.13	1.94
Short ribs	1599	7	0.19	0.13	0.68	0.20	7.41	1.71	10.94	3.55
Spareribs	1598	1	0.00		0.45		4.39		4.39	
Short ribs bnls	1605	7	0.04	0.10	0.54	0.24	9.29	1.54	10.96	4.72
Short ribs flanken style	1603	9	0.24	0.30	0.54	0.15	7.92	1.93	9.37	3.29
Beef for stew	1727	43	0.00	0.00	0.47	0.14	8.05	1.01	8.30	2.69
Beef for stirfry		30	0.00	0.00	0.41	0.36	11.40	2.36	10.00	7.83
Miscellaneous average		**242**	**0.07**	**0.01**	**0.64**	**0.03**	**10.17**	**0.29**	**13.40**	**0.61**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 6

Means and standard deviations (SD) for external fat thickness, package weight, price per kilogram, and total package price for retail ground beef

Declared fat percentage	*n*	Package weight, kg	SD	US$/ kg	SD	Total package price, US$	SD
73/27	10	0.47	0.03	5.33	1.21	5.61	1.51
75/25	3	0.51	0.10	4.61	0.38	5.10	0.66
78/22	4	0.52	0.08	7.70	0.00	8.75	1.36
80/20	49	0.59	0.20	6.99	2.12	8.86	3.15
81/19	3	0.55	0.11	6.87	0.66	8.44	2.31
85/15	50	0.55	0.16	8.27	1.73	9.85	2.53
90/10	35	0.53	0.11	8.69	0.90	10.10	2.21
91/9	2	0.45	0.00	8.69	0.16	8.69	0.16
92/8	4	0.46	0.00	9.29	0.73	9.34	0.69
93/7	40	0.54	0.16	9.43	1.26	11.15	2.68
95/5	7	0.56	0.04	9.18	0.35	11.23	0.62
96/4	28	0.51	0.05	10.89	1.58	12.30	2.23
Ground beef average	**235**	**0.54**	**0.02**	**8.40**	**0.28**	**9.85**	**0.59**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 7

Least square means ± SEM[a] for external fat thickness, package weight, price per kilogram, and total package price for retail cuts from the chuck, rib, loin, and round primals, other miscellaneous beef cuts, and ground beef

	Chuck	Rib	Loin	Round	Miscellaneous	Ground beef	P > F
Ext. fat, cm	0.13 ± 0.01bc	0.26 ± 0.01a	0.27 ± 0.01a	0.10 ± 0.01bcd	0.07 ± 0.01bcd	0.00 ± 0.01bcde	<0.0001
Pkg weight, kg	0.74 ± 0.02a	0.57 ± 0.03bc	0.48 ± 0.02bcde	0.69 ± 0.02a	0.64 ± 0.03b	0.54 ± 0.02bcd	<0.0001
US$/kg	8.93 ± 0.23 bcde	18.99 ± 0.31a	19.02 ± 0.27a	10.12 ± 0.26bc	10.17 ± 0.29bc	8.40 ± 0.28bcde	<0.0001
Ttl pkg price, US$	14.10 ± 0.48bc	21.23 ± 0.64a	19.14 ± 0.55b	14.71 ± 0.54bc	13.40 ± 0.61bc	9.85 ± 0.59bcde	<0.0001

[a]SEM is the standard error of the least square means

Means within the same row lacking a common letter differ ($P<0.05$)

various chuck cuts could have contributed to this increase in weight. Package weight plays an important role in consumer buying behavior at the retail level because of its influence on total package price.

It is not surprising that the two primals representing the middle meats (rib and loin) had the highest price per kilogram and the highest total package price. Retail cuts from the rib and loin primals are recognized as representing approximately 13% of the saleable product from a beef carcass, while they are believed to constitute approximately 35% of the value. As expected, ground beef package value is dependent upon the lean to fat ratio of the product, thus the higher the lean content, the higher the price per kilogram.

4.2. Separable tissue components

Retail cuts in this study were dissected into four basic separable components, separable lean, external fat, seam fat, and bone and heavy connective tissue. Data in Tables 8-13 show means and standard deviations for each of the separable components, as well as total separable fat for individual cuts. Table 12 shows least square means and standard errors for each primal and the miscellaneous beef retail cut category. Cuts from the round (Table 10) had the highest ($P<0.05$) percentage of separable lean compared to all other primals and categories. Cuts from the rib (Table 8) had the numerically lowest percentage. As would be expected, the percentage of total separable fat decreased when the percentage of separable lean increased. Because of this, round cuts also had the lowest numeric percentage of external and seam fat, resulting in the lowest percentage of total separable fat. This is partially because most round cuts are single muscle cuts, which diminishes the amount of seam fat. Cuts from the rib were on the opposite end of the spectrum, having the lowest ($P<0.05$) percentage of separable lean and highest

Table 8
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef chuck

			Lean, %		External fat, %		Seam fat, %		Total fat, %		Bone and connective tissue, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef Chuck												
Arm pot roast	1048	3	73.34	7.12	3.88	3.51	7.43	0.87	11.31	3.30	15.59	4.82
Arm pot roast bnls	1049	3	85.42	11.11	4.17	7.22	9.56	2.41	13.73	9.63	0.85	1.47
Shoulder pot roast bnls	1132	27	88.97	5.37	5.59	3.14	3.17	3.33	8.76	4.32	2.27	3.02
Arm steak bnls	1056	1	94.59		0.70		3.14		3.84		1.57	
Short ribs	1124	32	55.90	14.84	7.77	6.03	5.73	4.92	13.50	6.79	30.59	11.98
Short ribs bnls	1127	8	94.30	5.89	4.25	4.70	1.21	2.14	5.46	6.10	0.24	0.68
Shoulder steak bnls	1133	66	93.58	4.14	3.62	2.93	1.22	1.76	4.84	3.75	1.53	2.24
Flanken style ribs	1107	9	60.10	5.53	5.46	3.60	4.62	3.15	10.08	4.39	29.82	5.08
Flanken style ribs bnls	1110	1	86.61		5.29		6.45		11.74		1.65	
Neck pot roast bnls	1121	6	86.15	3.85	4.93	4.71	5.41	2.04	10.34	3.54	3.51	2.66
Pot roast bnls	1080	22	86.35	3.53	2.62	2.13	9.26	3.54	11.88	3.75	1.71	2.14
7-bone pot roast	1033	4	65.00	5.90	3.47	2.27	9.49	0.90	12.96	2.28	22.04	4.27
7-bone steak	1035	6	65.03	3.47	3.70	1.72	12.44	4.15	16.14	4.50	18.84	1.92
Blade roast	1064	4	60.95	1.24	4.33	3.52	10.59	4.24	14.92	3.46	24.13	3.70
Blade steak	1066	5	63.77	2.15	2.54	1.09	16.49	3.59	19.03	4.05	17.20	3.43
Blade steak bnls	1073	27	88.50	3.48	1.53	1.85	8.94	4.21	10.47	3.77	1.04	1.19
Top blade steak BI	1138	4	69.50	16.35	13.66	22.11	1.81	2.78	15.47	20.75	15.03	4.81
Under blade pot roast	1150	1	86.21		0.00		9.29		9.29		4.50	
Under blade steak	1152	5	82.30	6.86	1.85	1.70	8.54	3.72	10.39	4.21	7.32	9.10
Under blade pot roast bnls	1151	21	81.72	4.82	2.26	2.64	13.96	4.11	16.22	4.27	2.06	1.66
Under blade steak bnls	1158	23	86.19	5.83	1.61	1.56	10.21	5.54	11.82	6.16	1.81	2.76
Mock tender roast	1115	3	97.40	0.28	0.66	0.73	0.49	0.44	1.15	0.29	1.45	0.11
Mock tender steak	1116	62	97.54	3.33	1.09	2.27	0.06	0.29	1.14	2.26	1.28	2.57
Top blade roast bnls	1137	15	94.29	5.75	2.17	4.46	0.17	0.45	2.34	4.40	3.37	3.51
Top blade steak bnls	1144	110	97.85	4.03	0.29	0.84	0.33	1.82	0.62	1.96	1.54	3.43
Top blade steak (flat iron)	1166	7	97.87	2.44	0.92	1.17	0.00	0.00	0.92	1.17	1.21	2.02
Eye steak bnls	1102	66	83.20	6.90	4.33	3.40	9.94	4.74	14.27	5.32	2.53	4.19
Chuck average		**541**	**86.81**	**0.56**	**2.92**	**0.19**	**4.67**	**0.18**	**7.56**	**0.27**	**5.59**	**0.45**

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

Table 9
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef rib

			Lean, %		External fat, %		Seam fat, %		Total fat, %		Bone and connective tissue, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef Rib												
Roast large end	1218	3	67.97	2.24	7.14	3.13	9.68	1.05	16.82	2.87	15.21	0.65
Steak large end	1222	3	72.20	10.46	10.23	4.90	12.37	4.78	22.60	9.43	5.20	3.11
Back ribs	1182	34	34.45	6.20	9.27	5.36	10.22	5.86	19.49	7.23	46.06	7.98
Roast small end	1235	4	68.57	3.53	7.94	3.63	8.88	4.19	16.82	2.34	14.60	3.71
Roast small end bnls	1238	1	68.82		5.69		11.82		17.51		13.68	
Steak small end	1239	5	71.93	6.73	7.97	4.66	8.35	2.61	16.32	2.49	11.75	8.23
Steak small end bnls	1245	8	78.02	5.74	8.12	2.93	8.04	3.50	16.16	3.56	5.81	3.67
Ribeye steak	1209	62	80.56	6.09	6.85	4.86	10.54	5.38	17.39	6.68	2.04	2.15
Ribeye roast	1192	1	61.99		3.78		22.97		26.75		11.25	
Short ribs	1259	3	54.48	7.46	5.81	6.33	9.60	5.00	15.41	5.19	30.10	3.50
Short ribs bnls	1265	1	85.74		14.26		0.00		14.26		0.00	
Ribeye rst lip on BI	1193	7	69.45	4.69	8.68	2.64	10.43	3.72	19.11	3.65	11.44	1.66
Ribeye stk lip on BI	1197	47	68.58	7.75	6.75	3.79	10.57	4.55	17.32	4.89	14.10	6.85
Ribeye stk lip on bnls	1203	49	79.10	4.55	6.69	3.58	11.36	4.76	18.05	5.40	2.85	2.97
Rib average		**228**	**69.34**	**0.89**	**7.35**	**0.31**	**10.52**	**0.28**	**17.87**	**0.42**	**12.79**	**0.71**

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

Table 10
Means and standard deviations (SD) for percentage separable components of retail cuts from the beef loin

			Lean, %		External fat, %		Seam fat, %		Total fat, %		Bone and connective tissue, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef Loin												
Top loin steak	1398	24	68.06	7.15	7.07	3.86	5.02	4.82	12.09	5.59	19.88	7.11
Top loin steak bnls	1404	80	83.29	5.38	10.08	6.85	3.35	3.62	13.43	7.30	3.77	3.66
Tenderloin steak	1388	66	92.33	6.66	3.20	2.69	2.01	3.47	5.21	4.70	2.46	5.07
T-bone steak	1369	49	66.56	7.30	6.56	3.18	5.55	5.28	12.11	5.89	21.74	6.61
Porterhouse steak	1330	21	69.93	4.64	6.61	4.26	6.36	4.37	12.97	4.26	17.10	3.92
Sirloin steak	1358	1	78.32		5.08		8.40		13.48		9.18	
Shell sirloin steak	1346	1	75.69		1.75		10.53		12.28		12.03	
Ball tip roast	1307	6	92.61	3.85	4.82	3.42	1.13	1.68	5.95	3.61	1.72	3.45
Ball tip steak	1308	22	95.83	3.30	2.29	2.85	1.30	1.79	3.59	3.10	0.58	1.37
Flap meat steak	1326	1	90.19		6.70		0.96		7.66		2.15	
Tri tip roast	1429	12	88.37	9.32	10.87	8.66	0.38	1.08	11.25	9.02	0.38	0.68
Tri tip steak	1430	26	92.29	6.31	6.58	5.81	0.40	1.51	6.98	6.98	0.73	1.95
Top sirloin rst bnls cap off	1419	1	90.43		8.56		0.00		8.56		1.01	
Top sirloin steak bnls	1422	26	90.70	4.12	4.74	3.29	3.27	2.99	8.01	3.90	1.29	1.83
Top sirloin stk bnls cap off	1426	33	94.15	3.77	3.12	2.79	1.54	2.13	4.66	3.04	1.19	1.86
Top sirloin cap steak bnls	1421	13	95.81	4.94	3.31	4.78	0.00	0.00	3.31	4.78	0.71	0.93
Loin average		**382**	**84.53**	**0.69**	**6.07**	**0.24**	**2.97**	**0.22**	**9.04**	**0.33**	**6.59**	**0.55**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 11

Means and standard deviations (SD) for percentage separable components of retail cuts from the beef round

Approved URMIS[a] name	UPC[b]	*n*	Lean, %		External fat, %		Seam fat, %		Total fat, %		Bone and connective tissue, %	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef Round												
Steak	1494	1	86.07		6.21		4.08		10.29		3.64	
Steak bnls	1501	15	89.55	3.44	4.95	2.25	4.51	2.32	9.46	3.90	1.00	0.95
Top round roast	1455	6	91.61	3.45	2.41	2.16	4.19	2.85	6.60	2.62	1.79	1.98
Top round roast cap off	1454	7	98.34	1.50	1.34	1.15	0.32	0.84	1.66	1.50	0.00	0.00
Top round steak, 1st cut	1556	6	91.25	18.05	8.43	18.21	0.30	0.75	8.73	18.06	0.02	0.05
Top round steak	1553	40	97.43	3.09	1.60	2.22	0.91	1.71	2.51	3.08	0.07	0.42
Bottom round rump roast	1519	20	93.77	3.84	5.23	3.53	0.52	0.85	5.75	4.02	0.48	1.29
Bottom round roast	1464	22	91.81	4.25	5.91	3.37	1.17	1.68	7.08	4.35	1.11	1.31
Bottom round steak	1466	55	95.57	3.52	3.28	3.48	0.58	1.27	3.86	3.40	0.58	1.29
Eye round roast	1480	24	95.46	3.67	3.88	2.94	0.39	1.00	4.27	3.74	0.27	0.58
Eye round steak	1481	79	98.01	2.31	1.71	2.24	0.02	0.11	1.73	2.23	0.27	0.83
Bottom round rst (triangle)	1463	2	93.59	0.87	6.41	0.87	0.00	0.00	6.41	0.87	0.00	0.00
Tip roast	1525	5	93.95	2.63	1.09	0.65	3.35	1.94	4.44	2.28	1.62	1.54
Tip steak	1527	16	95.88	3.96	1.74	2.64	1.58	2.17	3.32	3.23	0.79	1.50
Tip roast cap off	1526	2	97.86	3.03	0.52	0.73	1.62	2.30	2.14	3.03	0.00	0.00
Tip steak cap off	1535	39	98.94	1.95	0.41	0.75	0.16	0.53	0.57	1.02	0.50	1.42
Sirloin tip center steak	1550	10	98.58	1.49	0.99	0.91	0.00	0.00	0.99	0.91	0.43	1.26
Sirloin tip center roast	1549	4	94.31	2.84	2.98	2.18	1.18	1.46	4.16	3.51	1.53	3.06
Sirloin tip side steak	1543	16	99.38	1.32	0.35	0.64	0.21	0.82	0.56	1.33	0.07	0.28
Cubed steak	1577	53	99.63	1.18	0.15	0.41	0.22	1.14	0.37	1.18	0.00	0.00
Round average		**422**	**96.63**	**0.65**	**2.27**	**0.22**	**0.68**	**0.21**	**2.96**	**0.31**	**0.42**	**0.52**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 12
Means and standard deviations (SD) for percentage separable components of miscellaneous beef retail cuts

			Lean, %		External fat, %		Seam fat, %		Total fat, %		Bone and connective tissue, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beef shank cross cuts	1636	58	58.66	14.79	3.77	5.32	2.99	3.16	6.76	6.48	34.65	12.31
Beef Brisket												
Whole bnls	1615	3	71.83	14.95	15.50	6.87	12.67	11.72	28.17	14.95	0.00	0.00
Point half bnls	1628	1	87.26		12.74		0.00		12.74		0.00	
Flat half bnls	1623	14	86.15	5.33	12.68	5.49	1.17	3.16	13.85	5.33	0.00	0.00
Middle cut bnls	1626	2	77.47	3.29	18.37	1.69	4.16	4.99	22.53	3.29	0.00	0.00
Flat cut bnls	1622	18	91.88	7.14	7.04	7.12	0.45	1.12	7.49	7.25	0.63	1.92
Point off bnls	1629	5	89.65	3.37	9.94	3.54	0.42	0.94	10.36	3.37	0.00	0.00
Edge cut bnls	1624	1	78.05		5.91		16.04		21.95		0.00	
Beef flank steak	1581	38	98.20	1.65	1.46	1.55	0.16	0.67	1.62	1.54	0.18	0.46
Beef Plate												
Skirt steak bnls	1607	25	89.91	12.13	6.81	9.27	0.60	2.48	7.41	9.14	2.71	9.79
Skirt steak rolls bnls	1611	10	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Short ribs	1599	7	47.49	9.99	8.69	6.04	10.52	6.56	19.21	8.32	33.29	6.82
Spareribs	1598	1	37.86		8.95		5.61		14.56		47.57	
Short ribs bnls	1605	8	90.62	6.12	4.06	4.77	2.07	3.70	6.13	6.16	3.25	4.09
Short ribs flanken style	1603	10	62.07	6.33	3.36	3.61	8.25	7.24	11.61	6.07	26.32	4.04
Beef for stew	1727	43	96.45	13.90	1.11	3.05	0.24	1.09	1.35	3.28	0.11	0.39
Beef for stirfry		30	99.98	0.13	0.02	0.13	0.00	0.00	0.02	0.13	0.00	0.00
Miscellaneous average		**216**	**86.18**	**0.85**	**3.82**	**0.29**	**1.18**	**0.27**	**5.00**	**0.41**	**8.47**	**0.68**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 13
Least square means ± SEM[a] for separable components of retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts

Percentage	Chuck	Rib	Loin	Round	Misc	P > F
Lean	86.81 ± 0.56b	69.34 ± 0.89bcde	84.53 ± 0.69bc	96.63 ± 0.65a	86.18 ± 0.85b	<0.0001
Ext fat	2.92 ± 0.19bcd	7.35 ± 0.31a	6.07 ± 0.24b	2.27 ± 0.22bcde	3.82 ± 0.29bc	<0.0001
Seam fat	4.67 ± 0.18b	10.52 ± 0.28a	2.97 ± 0.22bc	0.68 ± 0.21bcd	1.18 ± 0.27bcd	<0.0001
Total fat	7.56 ± 0.27bc	17.87 ± 0.42a	9.04 ± 0.33b	2.96 ± 0.31bcde	5.00 ± 0.41bcd	<0.0001
Perinephric	0.00 ± 0.04b	0.00 ± 0.06b	0.26 ± 0.05a	0.00 ± 0.05b	0.00 ± 0.06b	0.0002
Bone and conn.	5.59 ± 0.45bc	12.79 ± 0.71a	6.59 ± 0.55bc	0.42 ± 0.52bcd	8.47 ± 0.68b	<0.0001

[a]SEM is the standard error for least square means.
Means within the same row lacking a common letter (a-e) differ $P<0.05$.

($P<0.05$) percentage of total separable fat. Specifically, back ribs produced a much lower numeric percentage (34.45%) for separable lean causing the overall lean percentage mean for rib cuts to be lower than its counterparts. Savell et al. (1991) stated that it is expected that cuts from the rib and chuck to have higher percentages of seam fat than cuts from other primals because many of these are multiple muscle cuts. Results from this study support Savell et al. (1991) finding the rib and chuck cuts to have the highest percentages of seam fat. Seam fat presents a problem because it is not easy to remove from retail cuts given that trimming seam fat would disrupt the integrity of the cut and decrease consumer appeal. Unlike seam fat, external fat can be removed relatively easily from retail cuts, and after the release of the National Consumer Retail Beef Study (Cross et al., 1986; Savell et al., 1989), retailers made tremendous efforts to decrease the amount of external fat on cuts in the retail case. Innovative fabrication styles are being used more in industry today, and these account for some of the decrease in fat trim levels at retail; however, retailer product specifications have specific external fat thickness requirements for incoming product and may also have contributed to this decrease. Cobiac, Droulez, Leppard, and Lewis (2003) conducted a survey in Australia of retail outlets similar to the present study and the National Beef Market Basket Survey (Savell et al., 1991). Cobiac et al. (2003) stated that there was a wide variation in the percentage of total separable fat in the retail beef cut section. This variation could lead to difficulty in providing accurate nutrient composition data for beef retail cuts. The relationship is clear between total separable fat and external fat thickness, and it would make the task of providing accurate nutrient composition data easier by continuing to decrease the variability of fat trim levels on a national level.

In general, boneless, closely-trimmed cuts tended to produce a higher percentage of separable lean than others. Additionally, steaks produced a higher percentage of separable lean than roast counterparts because of increased trimming during fabrication. With this said, these types of boneless, closely-trimmed cuts have a higher edible portion and are more appealing to today's diet and health conscious consumer.

4.3. Extractable fat and moisture of separable lean

Chemical fat and moisture analyses were conducted on the separable lean component obtained from the dissection of each retail cut. Means and standard deviations for the percentages of extractable fat and moisture are presented in Tables 14 to 20. These data follow the same trend reported in the separable component results section with cuts from the round having the lowest numeric percentage of extractable fat and rib cuts generating the highest ($P<0.05$) percentage, 9.04. Mean extractable fat percentages for nine of the twelve ground beef classifications were lower than what was declared on the package label for fat percentage. These results agree with findings from the National Beef Market Basket Survey (Savell et al., 1991). Mean percentages for extractable moisture tended to decrease as the percentage of extractable fat increased. These findings are similar to those reported by Jones et al. (1992b) and Wahrmund (1999). Similar to data reported in Savell et al. (1991), short rib and flanken style rib cuts tended to contribute more to the mean extractable fat percentage than other cuts within their respective primals. In this study, back rib cuts followed the same trend as the short rib and flanken style rib cuts, but were not reported in Savell et al. (1991) for comparison.

Table 14
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef chuck

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat, %		Moisture, %	
			Mean	SD	Mean	SD
Beef Chuck						
Arm pot roast	1048	3	3.35	0.74	75.47	0.78
Arm pot roast bnls	1049	3	4.64	1.85	74.13	1.35
Shoulder pot roast bnls	1132	27	3.96	1.22	74.32	1.34
Arm steak bnls	1056	1	3.10		74.95	
Short ribs	1124	23	10.22	4.56	70.28	3.65
Short ribs bnls	1127	6	8.40	4.98	71.34	3.43
Shoulder steak bnls	1133	37	4.35	1.23	73.73	1.30
Flanken style ribs	1107	9	10.31	1.77	70.47	1.42
Flanken style ribs bnls	1110	1	7.45		70.87	
Neck pot roast bnls	1121	6	4.99	2.14	73.86	1.72
Pot roast bnls	1080	21	6.30	2.16	72.93	1.65
7-bone pot roast	1033	4	7.40	2.93	72.32	2.63
7-bone steak	1035	6	7.48	2.44	72.15	2.11
Blade roast	1064	4	7.92	1.59	71.93	1.44
Blade steak	1066	5	9.61	1.63	69.93	1.12
Blade steak bnls	1073	24	5.58	2.25	73.41	1.90
Top blade steak BI	1138	2	7.77	0.24	72.03	0.24
Under blade pot roast	1150	1	4.77		73.79	
Under blade steak	1152	3	7.00	0.44	72.04	0.52
Under blade pot roast bnls	1151	20	7.55	1.82	71.97	1.54
Under blade steak bnls	1158	18	6.41	2.57	72.76	2.22
Mock tender roast	1115	3	3.65	1.08	74.45	0.88
Mock tender steak	1116	19	3.23	1.58	75.27	1.44
Top blade roast bnls	1137	14	6.95	1.65	72.66	1.47
Top blade steak bnls	1144	28	7.32	2.70	72.10	2.15
Top blade steak (flat iron)	1166	7	7.88	2.11	72.25	1.83
Eye steak bnls	1102	32	8.92	2.53	70.41	2.19
Chuck average		**327**	**6.90**	**0.15**	**72.36**	**0.12**

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

Table 15
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef rib

			Extractable fat, %		Moisture, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD
Beef Rib						
Roast large end	1218	4	9.15	2.81	70.59	2.36
Steak large end	1222	4	8.74	1.00	69.92	1.51
Back ribs	1182	33	11.67	3.48	67.81	2.85
Roast small end	1235	4	8.53	2.73	70.25	2.16
Roast small end bnls	1238	1	9.02		70.08	
Steak small end	1239	4	8.62	2.45	69.72	2.24
Steak small end bnls	1245	7	7.09	2.71	71.06	1.84
Ribeye steak	1209	46	7.97	3.18	70.61	2.46
Ribeye roast	1192	1	12.55		67.63	
Short ribs	1259	3	11.45	3.04	69.25	1.65
Short ribs bnls	1265	1	8.49		70.79	
Ribeye rst lip on BI	1193	5	7.75	2.28	70.58	1.62
Ribeye stk lip on BI	1197	44	7.58	2.59	70.63	1.92
Ribeye stk lip on bnls	1203	39	8.02	2.80	70.21	2.32
Rib average		**196**	**8.61**	**0.20**	**70.00**	**0.16**

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

Table 16
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef loin

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat, %		Moisture, %	
			Mean	SD	Mean	SD
Beef Loin						
Top loin steak	1398	21	7.74	2.86	70.39	2.05
Top loin steak bnls	1404	51	5.49	1.99	71.67	1.69
Tenderloin steak	1388	33	4.78	1.77	73.44	1.68
T-bone steak	1369	43	6.27	1.77	71.54	1.58
Porterhouse steak	1330	21	6.99	2.67	70.92	2.38
Sirloin steak	1358	1	5.27		72.81	
Shell sirloin steak	1346	1	6.26		70.28	
Ball tip roast	1307	4	3.85	1.57	72.75	2.14
Ball tip steak	1308	13	4.26	1.50	72.74	1.46
Flap meat steak	1326	1	5.70		74.11	
Tri tip roast	1429	12	7.57	2.98	70.99	2.41
Tri tip steak	1430	16	6.58	1.65	71.73	1.62
Top sirloin rst bnls cap off	1419	1	2.50		73.25	
Top sirloin steak bnls	1422	23	4.04	1.41	73.26	1.28
Top sirloin stk bnls cap off	1426	22	3.67	1.21	73.36	1.06
Top sirloin cap steak bnls	1421	4	4.72	0.97	72.85	0.65
Loin average		**267**	**5.60**	**0.17**	**72.06**	**0.14**

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

Table 17

Means and standard deviations for percentage extractable fat and moisture (separable lean only) for retail cuts from the beef round

Approved URMIS[a] name	UPC[b]	*n*	Extractable fat, %		Moisture, %	
			Mean	SD	Mean	SD
Beef Round						
Steak	1494	1	4.49		72.73	
Steak bnls	1501	15	2.83	1.79	74.12	1.51
Top round roast	1455	6	2.04	0.69	74.60	0.79
Top round roast cap off	1454	7	2.72	0.86	73.44	0.60
Top round steak, 1st cut	1556	6	3.31	2.16	73.46	1.54
Top round steak	1553	36	3.24	1.33	73.41	1.28
Bottom round rump roast	1519	20	4.74	1.87	73.03	1.68
Bottom round roast	1464	23	4.44	1.97	72.81	1.70
Bottom round steak	1466	27	5.24	2.38	72.41	1.78
Eye round roast	1480	24	3.30	0.94	73.96	1.10
Eye round steak	1481	28	3.07	1.01	73.79	1.11
Bottom round rst (triangle)	1463	2	8.79	0.71	69.98	0.26
Tip roast	1525	5	3.92	1.27	75.07	1.27
Tip steak	1527	10	3.55	1.34	74.33	1.15
Tip roast cap off	1526	2	2.87	0.56	74.72	0.59
Tip steak cap off	1535	17	3.15	1.29	74.64	0.90
Sirloin tip center steak	1550	7	4.44	2.33	73.58	1.58
Sirloin tip center roast	1549	4	4.42	1.13	74.68	1.06
Sirloin tip side steak	1543	8	2.91	0.83	74.54	0.97
Cubed steak	1577	31	3.72	1.57	73.63	1.50
Round average		**279**	**3.71**	**0.17**	**73.59**	**0.13**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)

[b]Universal Product Code

Table 18
Means and standard deviations for percentage extractable fat and moisture (separable lean only) for miscellaneous beef retail cuts

			Extractable fat, %		Moisture, %	
Approved URMIS[a] name	UPC[b]	*n*	Mean	SD	Mean	SD
Beef shank cross cuts	1636	39	2.97	1.25	75.51	1.22
Beef Brisket						
Whole bnls	1615	3	6.24	1.29	72.96	1.19
Point half bnls	1628	1	6.57		71.87	
Flat half bnls	1623	14	3.90	1.79	74.66	1.76
Middle cut bnls	1626	2	5.07	0.81	74.07	0.97
Flat cut bnls	1622	14	4.86	1.82	73.86	1.57
Point off bnls	1629	5	3.81	1.00	74.42	0.64
Edge cut bnls	1624	1	6.64		71.50	
Beef flank steak	1581	38	5.72	1.92	72.77	1.65
Beef Plate						
Skirt steak bnls	1607	22	9.81	4.71	69.92	3.81
Skirt steak rolls bnls	1611	5	8.58	2.89	70.18	2.48
Short ribs	1599	7	12.13	3.17	67.99	3.33
Spareribs	1598	1	12.07		68.40	
Short ribs bnls	1605	7	6.43	3.49	72.89	3.11
Short ribs flanken style	1603	9	13.61	4.03	67.69	3.04
Beef for stew	1727	42	4.26	1.50	73.75	1.54
Beef for stirfry		29	4.03	2.08	72.87	1.67
Miscellaneous average		**239**	**4.99**	**0.19**	**73.36**	**0.15**

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

Table 19
Means and standard deviations for percentage extractable fat and moisture for ground beef

		Extractable fat, %		Moisture, %	
Declared lean/fat percentage	*n*	Mean	SD	Mean	SD
73/27	10	22.67	3.13	60.34	2.10
75/25	3	23.94	1.99	59.37	2.21
78/22	4	17.83	3.60	63.65	2.29
80/20	49	17.02	2.81	64.54	2.22
81/19	3	22.32	1.22	60.10	0.26
85/15	50	13.38	2.63	67.22	2.16
90/10	35	8.88	2.00	71.29	1.67
91/9	2	8.75	1.40	71.57	0.83
92/8	4	7.69	0.89	71.88	1.09
93/7	40	8.11	3.3	71.76	3.15
95/5	7	4.34	1.33	74.63	1.47
96/4	28	6.04	2.06	72.66	1.88
Ground beef average	**235**	**13.41**	**7.06**	**67.42**	**5.57**

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

Table 20
Least square means ± SEM[a] for percentage extractable fat and moisture of retail cuts from the chuck, rib, loin, and round primals, and other miscellaneous beef cuts

Percentage	Chuck	Rib	Loin	Round	Misc	P > F
Extractable fat	6.90 ± 0.15b	8.61 ± 0.20a	5.60 ± 0.17bc	3.71 ± 0.17bcde	4.99 ± 0.19bcd	<0.0001
Extractable moisture	72.36 ± 0.12bc	70.00 ± 0.16bcde	72.06 ± 0.14bc	73.59 ± 0.13a	73.36 ± 0.15a	<0.0001

[a]SEM is the standard error for least square means.
Means within the same row lacking a common letter (a-e) differ $P<0.05$.

4.4. Comparison of data between the National Database and present study

One of the primary objectives of this study was to compare these data with that reported in the National Database. If the information shown in the National Database does not accurately represent the cut representation of retail beef cases in the United States today, the information is outdated and needs to be reassessed.

A difference that needs to be mentioned between this study and the National Database before making comparisons is the origination of values for fat, moisture, and separable components. The values for fat, moisture, and separable tissue components in the National Database are derived from both regression equations reported in Jones (1988) and actual means reported from Warhmund (1999), and the values reported in the present study are all actual means. Table 21 compares the percent difference in separable fat and extractable fat percentage of eleven different cuts between the present study and the National Database. This study found the mean percent separable fat for a ribeye steak, lip on, bone-in to be 13.4% lower than that shown in the National Database. The mean separable fat percentage is 29.53% lower for four cuts from the loin and 66.95% lower for three cuts from the round than what can be found for these cuts in the National Database. These eleven cuts from the chuck, rib, loin, and round averaged to have 34.68% less separable fat on a percentage basis than data reported in the National Database. Extractable fat percentages were very comparable from this study to those found in the National Database. However, the mean extractable fat percentage for a tenderloin steak (UPC 1388) was found to be 26.69% lower in this study and 20.78%

lower for a top round steak (UPC 1553). Data for many of the other cuts sampled for the present study were not available in the National Database for comparison.

Table 21
Comparison of USDA National Database information with information from current study for separable and external fat

Approved URMIS[a] name	UPC[b]	2006 Survey Separable fat, % Mean	USDA, National Database Separable fat, % Mean	Difference[c], %	2006 Survey Extractable fat, % Mean	USDA, National Database Extractable fat, % Mean	Difference, %
Beef Chuck							
Shoulder stk bnls	1133	4.84	5.00	-3.20	4.35	4.24	+2.59
Top blade stk bnls	1144	0.62	1.00	-38.00	7.32	6.57	+11.42
Mock tender stk	1116	1.14	0.00		3.23	3.40	-5.00
Chuck average		**2.20**	**2.00**	**+10.00**	**4.97**	**4.74**	**+4.85**
Beef Rib							
Ribeye stk lip on BI	1197	17.32	20.00	-13.40	7.58	5.04	+50.40
Rib average		**17.32**	**20.00**	**-13.40**	**7.58**	**5.04**	**+50.39**
Beef Loin							
Top loin steak bnls	1404	13.43	14.00	-4.07	5.49	5.15	+6.60
Tenderloin steak	1388	5.21	18.00	-71.06	4.78	6.52	-26.69
T-bone steak	1369	12.11	10.00	+21.10	6.27	6.16	+9.10
Top sirloin steak bnls	1422	8.01	13.00	-38.38	4.04	4.08	-0.98
Loin average		**9.69**	**13.75**	**-29.53**	**5.15**	**5.48**	**-6.02**
Beef Round							
Top round steak	1553	2.51	6.00	-58.17	3.24	4.09	-20.78
Bottom round steak	1466	3.86	10.51	-63.27	5.24	4.31	+21.58
Eye round steak	1481	1.73	8.00	-78.38	3.07	3.00	+2.33
Round average		**2.70**	**8.17**	**-66.95**	**3.85**	**3.80**	**+1.32**
Total		**6.43**	**9.59**	**-34.68**	**4.96**	**4.78**	**+4.60**

[a]Uniform Retail Meat Identity Standards (Industry-Wide Cooperative Meat Identification Standards Committee, 2003)
[b]Universal Product Code
[c]Difference, % = {(National Database data – 2006 Survey data) / National Database data} *100

CHAPTER V

SUMMARY AND CONCLUSIONS

It is apparent through several different reports (Cross et al., 1986; Savell et al., 1989; Jones et al., 1992 a,b,c; and Wahrmund, 1999) that consumers prefer to purchase lean beef cuts and that retailers have been relatively proactive in meeting these expectations. This study validates perceptions that fat trim levels have continued to decrease at the retail level since a survey similar to this was last conducted (Savell et al., 1991). This study also indicated that as external fat trim decreased, the percentage of separable lean increased, but more importantly, separable fat decreased. Industry efforts to decrease the amount of seam fat seen in retail cuts have proved to be successful; however, more can still be done for cuts from the rib and chuck.

This study also suggests that external fat thickness levels reported in the National Database do not entirely encompass those found on cuts in retail cases throughout the United States, especially for those cuts purchased for this research. Additionally, information cannot be found for all cuts presented in retail cases in the National Database. More research needs to be conducted in order to acquire data for cuts not represented in the National Database.

As the beef industry continues to make strides in improving quality and yield grades of beef carcasses and employ innovative fabrication styles, the ultimate composition of retail cuts will continue to change as well. Surveys like this help to give the industry a benchmark of where attempts for improvements have been successful and what areas exist that we must focus on to best meet the needs of consumers.

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