



Original Research Article

Protein, fat, moisture and cooking yields from a U.S. study of retail beef cuts



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ABSTRACT

Nutrient data from the U.S. Department of Agriculture (USDA) are an important resource for U.S. and international databases. To ensure that data for retail beef cuts in USDA's National Nutrient Database for Standard Reference (SR) are current, a comprehensive, nationwide, multi-phase study was conducted. Samples were collected and analyzed in three phases based on primal category. Using a statistically based sampling plan, 72 beef carcasses per phase were obtained with nationally representative quality and yield grades, genders and genetic types. Retail cuts were fabricated, cooked and dissected to obtain component weights. Nutrient values were determined by validated laboratories using quality assurance procedures. Full nutrient profiles were made available in SR (<http://www.ars.usda.gov/nutrientdata>). Results for 16 beef retail cuts were compared for cooking yield and protein, fat and moisture concentrations. For example, cooked fat levels differed among three roasted cuts and among three grilled cuts from chuck, rib and loin ($p < 0.01$). Cooking yield for roasted ribeye (76%) was lower ($p < 0.001$) than for grilled ribeye (83%) or for chuck eye grilled (80%) or roasted (84%). This study demonstrates the importance of maintaining data for a variety of retail beef cuts due to their unique properties and different cooking methods.

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1. Introduction

The prominence of beef in U.S. diets is evidenced by the estimated 56.3 pounds (25.5 kg) of beef consumed annually per capita (U.S. Department of Agriculture and Economic Research

Service, 2014). Some observational data have suggested links between consumption of red meat, including beef, and increased risk of stroke, heart disease and diabetes (Bernstein et al., 2010; Sinha et al., 2009). However, the "Beef in an Optimal Lean Diet" study (Roussel et al., 2012) indicated that diets including

Abbreviations: CVD, cardiovascular disease; USDA, U.S. Department of Agriculture; SR, USDA National Nutrient Database for Standard Reference; NDL, Nutrient Data Laboratory; NDI, Nutrient Database Improvement; QC, quality control; EP, edible portion.

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3–5 ounces (85–142 g) of lean beef per day lessened cardiovascular disease (CVD) risk (Roussel et al., 2014). Other investigations have also shown that lean red meat is unlikely to increase the risk of CVD or colon cancer (McAfee et al., 2010) or of weight gain (Melanson et al., 2003). Furthermore, red meat consumption can improve nutritional status (Asp et al., 2012) and reduce the risk of noncommunicable diseases worldwide (McNeill and Van Elsland, 2012).

Up-to-date nutrient data for U.S. beef cuts are essential to enable researchers to accurately evaluate beef's role in health and to inform consumers about making healthy selections. Despite evidence of beef's value and popularity (McNeill et al., 2012; Zanovec et al., 2010) as well as dietary recommendations supporting lean meat consumption (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010), per capita U.S. beef consumption decreased by 32.2% from 1970 to 2013 (U.S. Department of Agriculture and Economic Research Service, 2014). This decline might have been due, in part, to an outdated perception of beef as being high in fat and cholesterol (McNeill et al., 2012). Contradicting popular perceptions, the fat content of retail beef cuts declined over the past four decades (McNeill et al., 2012; National Cattlemen's Beef Association, 2014) due to reduced fat trim on marketed cuts (Hiza and Bente, 2011), leaner cattle breeds and improved animal husbandry practices. Therefore, communicating these changes to the public became critical.

Beef nutrient data from the U.S. Department of Agriculture (USDA) have been available since 1926. The USDA issues updates on an ongoing basis, based upon research such as the study described in this report, to reflect nutrient content of beef cuts (Desimone et al., 2013; Dixon et al., 2012; Leheska et al., 2008; Savell et al., 1991; Smith et al., 1989; Wahrmund-Wyle et al., 2000a). The USDA's dataset, the National Nutrient Database for Standard Reference (SR), is the major source of U.S. nutrient data. The Nutrient Data Laboratory (NDL) maintains SR, which plays a crucial role in regulations and provides the scientific basis for research and dietary practice in the United States (Ahuja et al., 2013) and abroad (Merchant and Dehghan, 2006).

Factors such as cooking temperature, portion size and final internal temperature can influence cooking yield, amount of moisture and fat change due to cooking, and amount of fat and moisture in the cooked cut. Since the 1950s, USDA has released cooking yield tables describing changes in food weight due to moisture loss, water absorption, or fat gains or losses during preparation (Roseland et al., 2014). These data are used by researchers to estimate cooked nutrient values based on raw values and by consumers to determine amounts to purchase.

This report provides statistical data comparisons from an in-depth nationally representative beef research study, showing similarities and significant differences in moisture, protein, fat and cooking yields among specific retail beef cuts. These comparisons, made according to cut characteristics and cooking methods, provide a basis for understanding connections between factors that affect the nutrient composition of meat. The purpose of this report is to compare data for nutrients and for cooking yields for chuck, rib and loin cuts from three phases of a comprehensive beef study, and to discuss implications and applications to meat science.

2. Materials and methods

2.1. Study procedures

To provide up-to-date data for different U.S. beef cuts, a comprehensive multi-phase research study was designed and conducted through collaboration among scientists at NDL,

Colorado State University, Texas A & M University, Texas Tech University and the National Cattlemen's Beef Association. The multi-phase nature of the study had three parts, with each part consisting of one or two specific primals and done in consecutive years. Separate phases were necessary to allow sufficient time for personnel to process carcasses for obtaining all of the specified cuts for the study. This Nutrient Database Improvement (NDI) study was funded largely by the Beef Checkoff program. The NDI study obtained analytical values for 32 cuts covering a wide array of nutrients, and various aspects of the study have been reported (Acheson, 2013; Martin et al., 2013; West et al., 2014). This report compares protein, fat, moisture and cooking yields for 16 of the beef cuts from the study, from the chuck, loin and round primals of the beef carcass (Fig. 1).

To address specific hypotheses, ten paired comparisons were made among the 16 cuts (Tables 1 and 2). Most of these hypotheses involved comparisons between cooking methods. For example, cuts fabricated as steaks, which were grilled, were compared to corresponding roasts. These comparisons included chuck eye, tenderloin, shoulder and ribeye boneless and bone-in lip-on cuts. Comparisons were also made of the effects of alternative fabrications, such as bone-in vs. boneless; fat trim levels as 0.0-cm vs. 0.32-cm (0-inch vs. 1/8-inch); thickness as 2.54-cm vs. 5.1-cm (1-inch vs. 2-inch); and lip-on vs. lip-off (tail end of ribeye muscle). The chuck under blade and Denver cut steaks were paired for comparison because Denver cut is fabricated using the *serratus ventralis* muscle from the under blade steak, which is comprised of several muscles.

Fig. 2 illustrates the major steps used to conduct the NDI study (National Cattlemen's Beef Association, 2014). The research team established protocols for each major aspect of the study. Detailed procedures were especially crucial to ensure consistency due to the size and scope of the study and because it was implemented at several sites in three main phases over five years. Retail cuts from chuck and brisket were analyzed in Phase 1, rib and plate in Phase 2, and loin and round in Phase 3. This paper includes results from all phases for seven cuts from the chuck, five rib cuts and four loin cuts.

2.2. Sampling plan and sample acquisition

A statistical sampling plan was developed to obtain up to 72 beef carcasses (36 pairs) per phase. Samples were obtained from major U.S. packing plants in the following cities: Green Bay, Wisconsin; Greeley, Colorado; Dodge City, Kansas; Tolleson, Arizona; Omaha, Nebraska; Plainview, Texas; and Corpus Christi, Texas. Each collaborating university obtained beef carcasses from packing plants in two states.

Carcasses were chosen to be nationally representative for the following criteria, based upon the National Quality Beef Audit containing data on characteristics of U.S. fed cattle (Garcia et al., 2008):

- Quality grade: 67% USDA Choice (50% Upper Choice and 50% Lower Choice) and 33% USDA Select

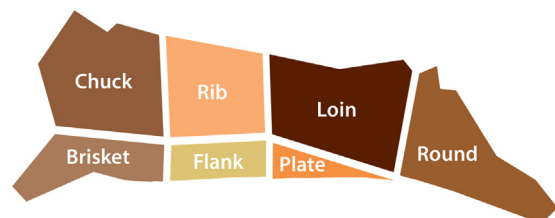


Fig. 1. Beef primal cuts (National Cattlemen's Beef Association, 2013).

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