

# Collecting and Utilizing Carcass Information



## Lesson 4

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### Introduction

USDA Quality and Yield grade have been used for years to evaluate the cutability and palatability of the carcass. The USDA carcass grades facilitate uniform market reporting, provide a tool for expressing and comparing prices, and enhance marketing and merchandising of beef. The grades have also been used as a means for reflecting consumer preference back through the marketing system to producers.

USDA grade standards were officially set in 1926 and the voluntary fee-for-service, grading and stamping service was initiated in 1927. Grade standards have been revised several times, with revisions in the last two decades based on sound research findings and/or concepts intended to improve uniformity and accuracy of application.

Quality grades reflect the expected palatability of cooked beef cuts (i.e., tenderness, juiciness and flavor), while yield grades identify carcasses for differences in cutability – the percentage yield of boneless, closely trimmed retail cuts from the round, loin, rib and chuck.

Many modifications have been made to the official USDA grade standards set in 1926. Some of the recent modifications to the USDA grading system include:

- In November 1987, the official standards were revised to change the name of the USDA Good grade to USDA Select. The revision did not change the requirements for the grade, only the grade name. Since the Good grade was not widely used, this change provided the industry an improved grade term to use in the marketing of this type of beef to consumers who desire an alternative to Choice.
- In April 1989, the official standards were revised to allow the official grade to consist of the quality grade only, the yield grade only, or a combination of both. This change was made to allow the industry greater flexibility in the use of the beef grading system in order to provide consumers with the trimness levels desired.
- In January 1997, the official standards were revised to restrict the Select grade to A maturity only and to raise the marbling degree required for Choice to minimum modest throughout B maturity. These changes were made to improve the uniformity and consistency within the Choice and Select grades.

USDA grading is a voluntary service and should not be confused with meat inspection, a mandatory service that determines the wholesomeness of meat for human consumption and includes responsibilities for sanitation and product labeling.

## USDA Yield Grade

USDA Yield grades is a numerical value from 1 to 5 based upon the yield of boneless, closely trimmed (approximately 0.30 inches), retail cuts (BCTRC) from the round, loin, rib and chuck. These four wholesale cuts make up approximately 75% of the weight, but about 90% of the carcass value.

In the official U.S.D.A. grading standards, yield grades range from 1.0 to 5.9, but only the whole number yield grade is “rolled” on the carcass by the grader. Thus, carcasses with yield grades of 3.0 to 3.9 are rolled yield grade 3; those with yield grades of 4.0 to 4.9 are rolled yield grade 4, etc. Yield grades are not rounded to the next higher whole number for example a yield grade of 3.9 is a yield grade 3 carcass not a yield grade 4 carcass.

Since it would not be practical to dissect all beef carcass to determine the yield of BCTRC the USDA identified 4 factors (measurement) that are used to estimate the yield of BCTRC (yield grade). The 4 factors include

- Fat thickness at the 12<sup>th</sup> rib
- Ribeye area (square inches)
- Hot carcass weight
- Percentage kidney, pelvic and heart fat (KPH)

Using these factors, regression equations were developed that can be used to predict the yield grade itself or the percent of BCTRC.

$$\begin{aligned} \text{Yield Grade} = & 2.5 & + 2.5 (\text{adjusted fat thickness, inches}) \\ & + 0.2 (\text{kidney, pelvic and heart fat percent}) \\ & + 0.0038 (\text{hot carcass weight, pounds}) \\ & - 0.32 (\text{ribeye area, square inches}) \end{aligned}$$

An example of this formula is illustrated in the following example.

Assume:        adjusted fat thickness = 0.4 inches  
                 kidney, pelvic and heart fat = 3 percent of carcass  
                 hot carcass weight = 625 pounds  
                 ribeye area = 12.8 square inches

$$\begin{aligned} \text{Yield Grade} &= 2.5 + 2.5(0.4) + 0.2(3) + 0.0038(625) - 0.32(12.8) \\ &= 2.38 \text{ (based on this example this is a USDA Yield Grade 2 carcass)} \end{aligned}$$

In actual everyday grading of beef carcasses, the regression equation is not used, but a working formula has been developed to simplify the procedure. USDA graders need to evaluate carcasses for both yield and quality grade at chain speed or as fast as 300 to 400 head per hour.

An additional regression equations can be used to calculate the percentage of boneless, closely trimmed retail cuts.

$$\begin{aligned} \text{Percentage BCTRC} &= 51.34 - 5.78 (\text{adjusted fat thickness, inches}) \\ &\quad - 0.462 (\text{kidney, pelvic and heart fat, percentage}) \\ &\quad - 0.0093 (\text{hot carcass weight, pounds}) \\ &\quad + 0.74 (\text{ribeye area, square inches}) \end{aligned}$$

An example of this formula is illustrated using the same assumed carcass measurement listed earlier. Additionally, Table 1 can be used as a quick guide to compare USDA Yield Grade with the Percentage of BCTRC from the round, loin, rib and chuck.

$$\begin{aligned} \text{Percentage BCTRC} &= 51.34 - 5.78(0.4) - 0.462(3) - 0.0093(625) + 0.74(12.8) \\ &= 51.3 \text{ percent} \end{aligned}$$

Table 1 Interconversion of Yield Grade and Percentage Boneless, Closely Trimmed Retail Cuts

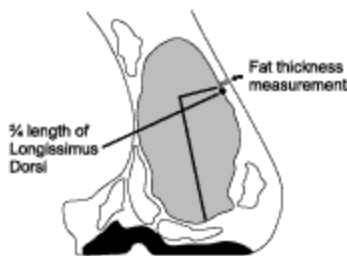
USDA Yield Grade	Percentage of BCTRC from the Round, Loin, Rib and Chuck
1	52.6-54.6
2	50.3-52.3
3	48.0-50.0
4	45.7-47.7
5	43.5-45.4

Preliminary yield grades are based on fat thickness measured between the 12<sup>th</sup> and 13<sup>th</sup> rib because the fat thickness is the major factor used to calculate the yield grade. The relationship between 12<sup>th</sup> rib fat thickness and the preliminary yield grade is listed.

12 <sup>th</sup> rib fat thickness	Preliminary Yield Grade
0.0	2.0
0.2	2.5
0.4	3.0
0.6	3.5
0.8	4.0
1.0	4.5
1.2	5.0

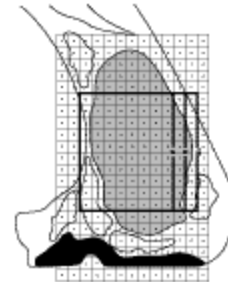
Two very important considerations for beef cattle producers can be made from the preliminary yield grade conversion. First, no matter how trim the carcass is it can not move into the yield grade 1 category unless it also excels in muscling. Secondly, most retailers who display meat in a showcase trim their retail product to a quarter inch or less of external fat and at 0.6 or greater 12<sup>th</sup> rib fat thickness requires a lot of trimming at some point in the processing chain.

The following illustrations indicate where and how 12<sup>th</sup> rib fat thickness and ribeye area is measured.



The 12<sup>th</sup> rib fat thickness is measured perpendicular to the outside fat at a point  $\frac{3}{4}$  the length of the ribeye muscle. This measurement may be adjusted by the grader to reflect unusual fat distribution in the carcass. Special attention is given to fat deposition in the cod or udder, rump, inside round, flank, lower rib, plate and brisket areas. External fat is the most important yield grade factor.

The rib eye area is measured at the 12<sup>th</sup> rib by using a grid expressed in square inches. Evaluators count the number of dots on the grid that are over the ribeye muscle. Each dot is equal to 0.1 square inches. Ribeye area is an indicator of carcass muscling.



Percentage of kidney, pelvic and heart fat (KPH) is a subjective estimate of the amount of fat surrounding the kidney knob, and fat in the pelvic and thoracic (heart) areas as a percentage of the carcass weight. Percentage KPH fat normally ranges from 1.0 to 4.0 percent.

Hot Carcass weight is used along with ribeye area as an indicator of muscling. A larger carcass requires a larger rib eye area to maintain the same yield grade assuming all other factors are equal (fat thickness and KPH fat).

## USDA Quality Grade

The United States Department of Agriculture (USDA) Grading Service attempts to sort through the diversity in the cattle population and assign carcasses into grades of expected eating quality. These USDA quality grades are based primarily on evaluations of carcass maturity and the amount of intramuscular fat (marbling) present in the longissimus muscle between the 12<sup>th</sup> and 13<sup>th</sup> rib. Both of these factors, maturity and marbling, have been shown by numerous researchers to significantly impact beef palatability. Increased maturity has been associated with decreased palatability.

Beef carcass grade standards provide five maturity groups. These are referred to by letters – A through E – with A indicating the carcasses from the youngest animals. Carcasses from young animals (A maturity) are characterized by soft, porous chine bones that terminated in soft, pearly-white cartilage. Rib bones are somewhat narrow and red. The sacral vertebrae show distinct separation, and cartilage is present on the split aitch bone. Lean from such young animals is fine in texture and light red in color. Carcasses from animals with evidences of advanced maturity or old (C, D and E maturity) have hard, white chine bones with outlines of the cartilage on the ends of the thoracic vertebrae. The rib bones are wide and flat, and the ribeye muscle is dark red and coarse in texture.

Degree of maturity, or physiological age as determined from bone and lean maturity, may not be the same as the actual age of the animal in months or years. However, approximate chronological age groupings for maturity degrees are as follows.

Maturity Group	Age
A	9 to 30 months
B	30 to 42 months (2.5 to 3.5 years)
C	42 to 72 months (3.5 to 6 years)
D	72 to 96 months (6 to 8 years)
E	Over 96 months (over 8 years)

Flecks of fat in the lean (marbling), is the other major consideration in quality grading. Marbling is evaluated visually in the ribeye muscle between the 12<sup>th</sup> and 13<sup>th</sup> ribs. Although it contributes only slightly to meat tenderness, marbling probably contributes to the palatability traits of juiciness and flavor. There are ten degrees of marbling (Very Abundant, Abundant, Moderately Abundant, Slightly Abundant, Moderate, Modest, Small, Slight, Traces and Practically Devoid). Internet users can find colored pictures of marbling scores Slight through Slightly Abundant at the following web site [www.abs.sdstate.edu/ars/animaleval/Beef/beefgrade.htm](http://www.abs.sdstate.edu/ars/animaleval/Beef/beefgrade.htm).

**Relationship between marbling, maturing and carcass quality grade**

Degrees of Marbling	MATURITY**					Degrees of Marbling
	A+++	B	C	D	E	
Very Abundant						Very Abundant
Abundant						Abundant
Moderately Abundant	PRIME					Moderately Abundant
Slightly Abundant				COMMERCIAL		Slightly Abundant
Moderate						Moderate
Modest	CHOICE					Modest
Small				UTILITY		Small
Slight	SELECT					Slight
Traces	STANDARD					Traces
Practically Devoid				CUTTER		Practically Devoid

The quality grading chart shows that carcasses of A and B maturity are eligible for the Prime, Choice, Select, and Standard quality grades. Carcasses with older physiological characteristics (C, D and E maturity) qualify only for the Commercial, Utility, Cutter and Canner grades.

Quality grades are determined by combining maturity and marbling characteristics. For

example, A maturity carcasses (typical of most feedlot cattle) require at least a Small degree of marbling to make the Choice grade, whereas a Slightly Abundant amount of marbling is required for Prime. Carcasses of B maturity require a Modest degree of marbling to grade Choice. Also, B maturity carcasses cannot grade Select, but will grade Standard with a small degree of marbling or less.

Quality grading is voluntary, not all carcasses are quality graded. Packers may apply their own “house brand” to merchandise their beef. Carcasses merchandised as ungraded beef usually are those that do not grade Choice or Prime. They generally are termed “No Roll” beef by the industry, because a grade stamp has not been rolled on the carcass

## Dark-Cutting Beef

Dark-cutters sometimes result if cattle are severely stress 12 to 24 hours prior to slaughter. Such stress results in a reduced glycogen (starch) content of the lean, a failure of the muscle color to brighten (bloom) upon exposure to air and a sticky (gummy texture) condition of the lean. Varying degrees of dark-cutting beef from slightly shady to black-cutters can be identified.

There is little or no evidence, which indicates that the dark-cutting condition has any adverse effect on palatability, although the condition does favor microbial growth due to the elevated pH. Dark-cutters are severely discounted by the packing industry, due to poor consumer appeal and short shelf life, therefore it is important to minimize stress and rough handling prior to slaughter.

## Using Ultrasound Data

Real-time ultrasound enables you to get a fast and objective prediction on the carcass composition of your beef cattle. This tool can help you to meet specific market demands and production systems. In addition, carcass composition information could assist you in the genetic selection and breeding of your cow herd.

The disadvantage of ultrasound includes the equipment required to accurately make the measurements and the need for a trained, licensed technician to make the evaluation. Some of the advantages of ultrasound data collection over traditional carcass data collection include:

1. More complete information for the cattle being measured because they must have a recorded weaning weight.
2. Offers a way to evaluate yearling bulls and developing heifers in a non-destructive way (without slaughtering them).
3. Contemporary groups are more complete and accurate.

Real-time ultrasound uses high frequency sound waves. A sound-emitting probe held snugly on the animal's back bounces sound waves off tissues of different densities, such as fat and muscle. An image is created by the reflected sound and appears on the video screen instantly.

The use of real-time ultrasound to measure fat thickness and ribeye area in live beef cattle has become widely accepted. Ribeye area and fat thickness are two traits that are highly related to retail product of the beef carcass and these two traits can be measured with a high degree of accuracy using ultrasound. Additionally, fat thickness and ribeye area are moderately to highly heritable, suggesting that differences found between animals would be expected to be passed on to their offspring.

Real-time ultrasound can also be used to objectively measure marbling in live beef cattle. Marbling, however, is a very subjective score. Therefore, real-time ultrasound is used to predict the actual percent fat in the ribeye muscle.

Marbling is measured or evaluated as the percent intramuscular fat. USDA beef Quality grades are based on the visual amount of intramuscular fat as determined by the USDA grader. Real-time ultrasound has the capability of measuring the actual percent of intramuscular fat in the ribeye muscle between the 12<sup>th</sup> and 13<sup>th</sup> rib. The relationship between percent intramuscular fat (% IMF), USDA Quality Grade, USDA Marbling Degrees and Marbling Scores are listed in Table 2.

Table 2. Percent Intramuscular Fat Relationship to USDA Quality Grade, Degrees of Marbling and Marbling Score

% IMF	Quality Grade	Marbling Degree	Marbling Score
2.3 – 3.0	Select –	Slight 0 – 40	4.0 – 4.4
3.1 – 3.9	Select +	Slight 50 – 90	4.5 – 4.9
4.0 – 5.7	Choice –	Small 0 – 90	5.0 – 5.9
5.8 – 7.6	Choice o	Modest 0 – 90	6.0 – 6.9
7.7 – 9.7	Choice +	Moderate 0 – 90	7.0 – 7.9
9.9 – 12.1	Prime –	Slightly Ab 0 – 90	8.0 – 8.9
12.3+	Prime o	Moderately AB 0 – 90	9.0 – 10.0

Rump fat measurements can also be taken using real-time ultrasound. Rump fat is negatively related to percent retail product and is thought to be an additional indicator of carcass fat. Rump fat measures may be most useful for predicting percent retail product in leaner cattle, which have less 12<sup>th</sup> rib fat.

Currently some breed association are utilizing real-time ultrasound measurements to calculate carcass EPD's. Participating breed association require qualified technician to collect ultrasound images and submits them to the centralized ultrasound processing center for processing. Centralized processing requires standard protocols for image collection, consistency and accuracy in interpretation, cross checks on problem images and unbiased reporting necessary for carcass EPD calculations.

Participating Breed Associations, Centralized Ultrasound Processing (CUP) Technicians and additional information about ultrasound technology can be found at the Iowa State Beef Cattle Ultrasound web page listed. <http://www.extension.iastate.edu/Pages/ansci/ultrasound/>

## Additional Methods to Identify Palatability Attributes

Beef Check-off dollars have been spent to research and evaluate carcass tenderness to reduce a negative eating experience. Dr. J.O. Reagan, executive director of science and Technology for NCBA indicates that the big problem when evaluating tenderness is that most technology used to identify tender carcasses misses a lot of carcasses that should be identified as tender

The 1995 National Beef Quality Audit reported that 84 % of all carcasses from the fed steer and heifer population had marbling scores of “small” or “slight”. For young (less than 30 months of age – A maturity) fed steers and heifers with small marbling represent USDA low Choice beef and slight marbling would represent the USDA Select grade. There usually is considerable price spreads between the USDA Choice and Select grades. A research report done in 1984 by Smith reported no significant differences between the average “small” and “slight” marbling scores for all palatability attributes examined. The beef industry is looking for other methods to help distinguish carcasses palatability attributes.

Dr. Duane Wulf, Meat Science Extension and Research Specialist, South Dakota State University wrote an article on Technologies for Value Assessment of Beef which can be found at the following web site: [www.abs.sdstate.edu/ars/meatsci/may99-3.htm](http://www.abs.sdstate.edu/ars/meatsci/may99-3.htm). Dr Wulf reviewed two on-line methods of assessing the palatability of beef carcasses (Tenderness Classification System

and Colorimeter System) that appear to be promising. Dr Wulf's paper indicates that the Tenderness Classification System is the most accurate system and will probably always be the most accurate system because it is a direct measure of tenderness, whereas USDA quality grades and the Colorimeter Systems are indirect measures of tenderness and/or eating quality. The Tenderness Classification System uses one steak from each carcass and is also quite expensive to operate in its present form. The USDA quality grades and the Colorimeter System are not evasive and are both relatively simple to operate. Therefore, one must weigh accuracy versus expense when deciding which system to use. Table 3 shown below compares the accuracy of the three methods discussed.

Table 3. Accuracy of various methods at predicting eating quality within the young beef (fed steers and heifers) population.	
<b>Method (System)</b>	<b>r<sup>2</sup> for prediction of eating quality</b>
USDA quality grades	0.05 to 0.15
Tenderness Classification (Shackelford 1999)	0.46 to 0.61
Colorimeter System (Wulf 1998)	0.36 to .042

## Heritability Estimates for Carcass Characteristic

Heritability is an estimate of the proportion of the total variation between individuals for a certain trait that is due to heredity as opposed to environmental factors. Heritability estimates range from 0.0 to 1.0. If a trait is highly heritable, rapid progress can be made through selection for that trait. Selection for a trait that is low or close to zero in heritability will result in very little change. The heritability in Table 4, which are expressed on an age- or time-on-feed-constant basis, are moderate to high, ranging from 0.35 to 0.64. These values suggest that selection on most carcass traits should be effective.

Table 4. Average heritability estimates for beef carcass traits (age- or time-on-feed constant basis*)	
<b>Trait</b>	<b>Heritability</b>
Carcass weight	0.41
Rib eye area	0.37
12 <sup>th</sup> rib fat thickness	0.44
Marbling score	0.35
Retail product %	0.36
Retail product weight	0.47
Fat, trim %	0.57
Fat trim weight	0.64
Bone %	0.53
Bone weight	0.57
Warner-Bratzler shear force (tenderness)	0.37
*Marshall Journal of Animal Science, October 1994	

# Summary

Harlan Ritchie, Department of Animal Science, Michigan State University does an excellent job of summarizing the importance of carcass characteristics.

*“There is some debate within the beef cattle industry on whether too much emphasis is being placed on the end-product. This question is raised because reproductive efficiency, early growth, and cost of production are still the factors that have the greatest impact on profitability in cow-calf herds. But as the industry moves to true value-based marketing and more cattle are sold on individual merit rather than on the average, traits related to the end-product will likely increase in economic importance.”*

Today we are in the information age with computers, Internet, digital scales, digital camera's, ultrasound machines, fax machines, e-mail, electronic identification and many more technology advances. Today more than ever, beef cattle producers need to utilize this technology to meet the current consumer demands. Utilizing existing carcass evaluation methods along with incorporating new researched based methods of carcass evaluation will be key to successfully producing a more consistent high quality product.

## Additional References and Readings

Official United States Standards for Grades of Carcass Beef available from the United States Department of Agriculture, Agricultural Marketing Service, Livestock and Seed Division, Standardization Branch, Room 2603 South Bldg., P.O. Box 96456, Washington, D.C. 20090-6456, [www.ams.usda.gov/lsg/lis-mg.htm](http://www.ams.usda.gov/lsg/lis-mg.htm)

Meat Evaluation Handbook available from the American Meat Science Association, 1111 North Dunlap Avenue, Savoy, IL 61874, [www.meatscience.org](http://www.meatscience.org)

Quality and Yield Grades for Beef Carcasses can be found on the Internet at [ianrwww.unl.edu/pubs/beef/rp357.htm](http://ianrwww.unl.edu/pubs/beef/rp357.htm)

The Meat We Eat (book) and Livestock and Carcasses (book) available from the South Dakota State University Bookstore [www.sdstatebookstore.com/](http://www.sdstatebookstore.com/) or you can call (800) 985-8771.

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## Notes:

## Lesson 4 –Quiz

## Collecting and Utilizing Carcass Information

1. True or False      USDA grade standards were officially set in 1926.
2. True or False      USDA Quality grades determine the wholesomeness of meat for human consumption.
3. Yield grade can be used to estimate the percentage yield of boneless closely trimmed retail cuts from what four regions (wholesale cuts) of the beef carcass?
4. Calculate the yield grade and percent boneless closely trimmed retail cuts (BCTRC) for a beef carcass with the following carcass characteristics.

Adjusted fat thickness = 0.6 inches  
Kidney, pelvic and heart fat = 2.5 percent  
Hot carcass weight = 725 pounds  
Ribeye area = 13.5 square inches

Yield Grade =

BCTRC % =

5. True or False      A beef carcass with little or no 12<sup>th</sup> rib fat thickness and average muscle and kidney, pelvic and heart fat would represent a yield grade 1 carcass.
6. List four USDA quality grades for young beef (A and B maturity).

7. USDA quality grades are based primarily on what two carcass evaluations?

8. List two reasons why dark-cutters are discounted by the packing industry.

9. List a new method used to assess palatability of beef carcasses.

10. Most carcass traits have \_\_\_\_\_.

- a) Low heritability
- b) Low to average heritability
- c) Average to high heritability
- d) No heritability

*Please list any questions you may have that weren't answered in this lesson:*

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Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

(Optional) Fax \_\_\_\_\_ E-mail \_\_\_\_\_