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Beef Carcass Grading and Evaluation

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Graduate research assistant David Jones measures the rib eye between the 12th and 13th rib with a transparent grid. The rib eye is measured to the nearest 1/10th inch.

Evaluation of beef quality and composition is important to cattle producers, meat packers and retailers, and consumers. Consumers desire cuts of beef which are lean, nutritious, and possess desirable eating characteristics. Meat researchers have developed reliable methods for measuring the factors that influence eating characteristics and factors affecting yield of lean cuts. Using these evaluation techniques, producers and packers can produce and sell carcasses that meet consumer demand.

This guide has information about standard U.S. Department of Agriculture beef carcass yield and quality grading systems. Other useful and accurate evaluation procedures will also be introduced.

Beef carcass grading is divided into quality grading and yield grading.

Quality Grading

Quality grades indicate the factors related to the sensory characteristics of tenderness, flavor, color, texture, and juiciness. The quality grade is intended to reflect the cooked product's overall acceptability.

The USDA quality grades for steer and heifer carcasses are prime, choice, good, standard, and utility. These grades are determined by balancing maturity and degree of marbling.

Maturity refers to the physiological age of the live animal. Maturity in the carcass is determined by the degree of ossification (bone development) of the split chine bones (back bones) and the color and texture of the cut lean surface.

Cartilage changes into bone as the animal matures. This process of ossification proceeds from the back toward the front portion of the vertebral column. The degree of ossification in the vertebral "buttons" near the thorax, which is the cavity containing heart, lungs, etc., are the most useful in evaluating maturity. Rib bones also become flatter and whiter as the animal matures.

The color and texture of the lean also change with maturity. Meat from young animals is lighter colored and finer textured compared to older beef. Generally, a fine textured

Figure 1. Illustration of the lower limits of nine degrees of marbling (very abundant through traces), referred to in the official United States Standards for Grades of Carcass Beef.

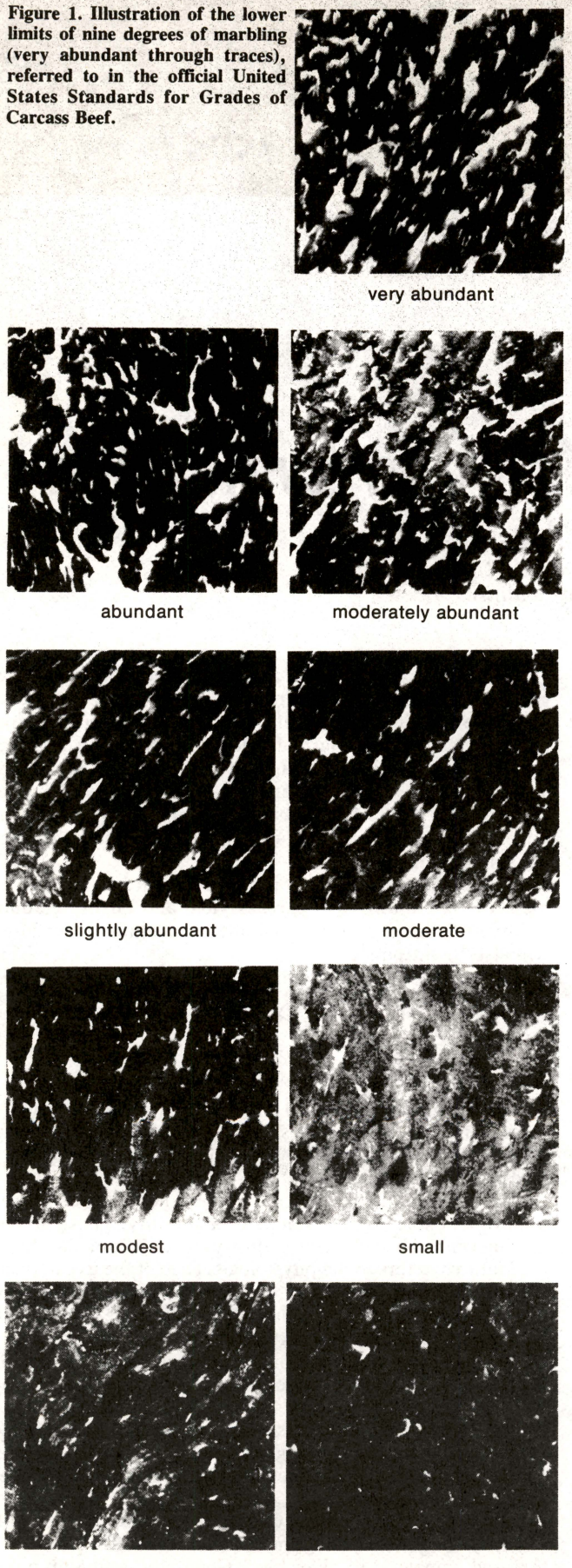
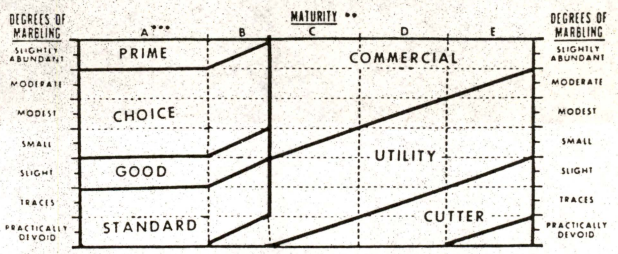


Figure 2: Relationship between marbling, maturity, and carcass quality grade.*



*Assumes that firmness of lean is comparably developed with the degree of marbling and that the carcass is not a "dark cutter."
**Maturity increases from left to right (A through E).
***The A maturity portion of the Figure is the only portion applicable to bullock carcasses.

lean will be more tender than a coarse textured lean. Carcass maturity is closely related to beef tenderness. As the animal matures, changes in the connective tissue cause the meat to be less tender.

The degrees of maturity are A, B, C, D and E. Age ranges for these maturity groups are approximately:

Maturity Group	*Age*
A	9 to 30 months
B	30 to 42 months
C	42 to 72 months
D	72 to 96 months
E	more than 96 months

Dark-cutting beef is not necessarily from older animals but can also result from cattle that were physiologically stressed before slaughter. Dark-cutting beef is highly discriminated against by consumers and retailers. Dark-cutting beef may be reduced up to one full quality grade.

Marbling is fat within the muscle and is evaluated in the rib eye between the 12th and 13th ribs. The ten USDA degrees of marbling are: abundant, moderately abundant, slightly abundant, moderate, modest, small, slight, traces, practically devoid, and devoid. Marbling has a strong correlation with the juiciness and flavor of beef. (See Figure 1.)

Final quality grades are arrived at by a composite evaluation of maturity and marbling. (See Figure 2.)

Yield Grades

Yield grades estimate the quantity or the amount of closely trimmed boneless retail cuts from the loin, round, chuck, and rib. There are five USDA yield grades, 1 through 5. Yield grade 1 carcasses have the highest yield of retail cuts and yield grade 5, the lowest.

The expected boneless retail yield from the round, loin, rib, and chuck is as follows:

Yield Grade	*% of Carcass Weight in Boneless, Uniformly Trimmed Retail Cuts*
1	more than 52.3
2	52.3 to 50.1
3	50.0 to 47.8
4	47.7 to 45.5
5	less than 45.5

These yield figures are sometimes used in carcass show results as a measure of cutability.

Figure 3. Diagram of the cross section of the rib eye between the 12th and 13th rib. This is the lean area where marbling is determined. Also shown is the point where fat thickness is measured to determine yield grade.

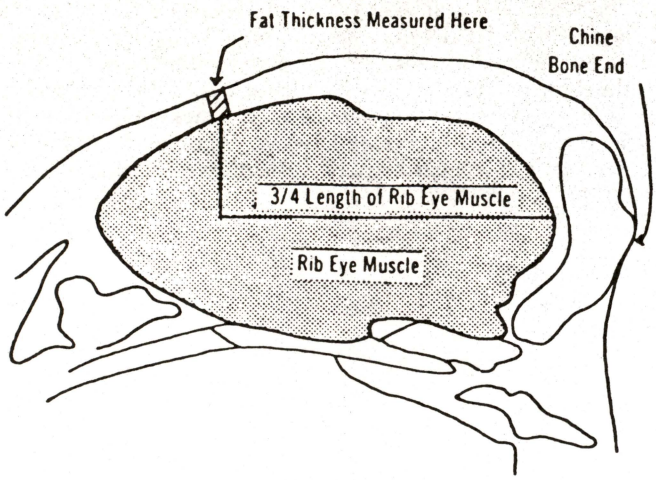
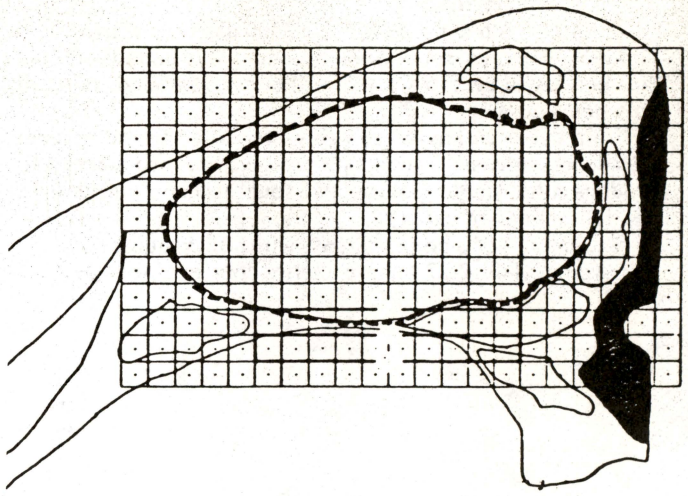


Figure 4: Measuring Rib Eye Area.



Yield grade can also be used to predict the total retail cuts from a carcass or quarter.

Total % Retail Cuts (closely trimmed, semi-boneless)

Yield Grade	*Carcass*	*Forequarter*	*Hindquarter*
1	82.0	84.0	79.9
2	77.4	79.0	74.9
3	72.8	75.6	69.9
4	68.2	71.4	64.9
5	63.6	67.2	59.9

The USDA yield grade is based on four factors: 1) hot carcass weight (pounds); 2) rib eye area at the 12th rib (square inches); 3) adjusted fat thickness over the rib eye at the 12th rib (inches); 4) percent kidney, pelvic, and heart (percent of carcass weight).

These measurements are used in the "official" USDA formula as follows: Yield Grade = 2.5 + [(2.50 x adjusted fat thickness, inches) + 0.20% of kidney, pelvic, and heart + (0.0038 x hot carcass weight, pounds) - (0.32 x area rib eye, square inches)]

When computing yield grades, any decimal is dropped; yield grades are presented as whole numbers. Care and accuracy of these measurements are essential to derive reliable estimates of the cutability. The USDA grader, in practice, estimates the factors and uses a "short-cut" formula.

Fat Thickness. The amount of fat on a beef carcass has the greatest effect on the percent retail yield. As the percent fat increases, the percent muscle decreases. Fat thickness is measured at a point three-fourths of the length of the rib eye (longissmus) muscle from the chine bone, perpendicular to the surface fat, at the 12th rib. This measurement may be adjusted according to the total amount of fat on the carcass. (See Figure 3.)

Rib Eye Area. Total square inches of rib eye is used to estimate muscular development of a beef carcass. This measurement can be taken objectively between the 12th and 13th rib. A calibrated transparent plastic grid placed over the rib eye is commonly used to determine the area. (See Figure 4.)

An alternative method is to trace the perimeter of the rib eye on acetate paper and calculate the area with a compensating planimeter, which is an instrument that measures area of irregularly shaped objects.

Hot Carcass Weight. Hot carcass weight, or 102 percent x chilled carcass weight, is the weight of the carcass after slaughter. The carcass weight has an inverse effect on the percent retail yield.

Kidney, Pelvic, and Heart Fat. The amount of kidney, pelvic, and heart fat is fat accumulated in the body cavity of the carcass. The weight is reported as a percent of the carcass weight. The range of kidney, pelvic, and heart fat is one to eight percent (with a typical average of 3.5 percent).

Yield grades estimate the proportions of lean and fat. Meat graders determine yield grades with fast, simple visual appraisals of fat and muscle of the carcass. Fat thickness, hot carcass weight, and rib eye area are objective measures with kidney, pelvic, and heart fat being a subjective measure.

USDA grading is done on a voluntary basis by the packer. The packer absorbs the cost. When a carcass is submitted for grading, it must be both quality and yield graded.

USDA grades should not be confused with the USDA inspection for wholesomeness.

Beef Carcass Evaluation

The purpose of beef carcass evaluation is to assist beef producers in:

- producing high-quality beef carcasses;
- producing high-yielding beef carcasses;
- identifying superior lines of breeding stock; and
- promoting a desirable, marketable product.

Improving the efficiency of beef cattle production is important to feeders, cow-calf ranchers, and seedstock producers. Feeders can evaluate their feeding and management practices with cutability scores or the percentage or number of their cattle grading choice. Cow-calf ranchers may use grades to rank or performance test their stock. Seedstock producers can ultimately use quality and yield grades in sire evaluation.

Some other guidelines or indexes which may be useful in beef carcass evaluation are a growth factor or loin eye index.

Growth factors can be used to express the composition of growth. Expressing the pounds of retail cuts per day of age is one method.

This figure is determined by this formula: pounds of

trimmed retail cuts per day of age = (carcass weight x cutability) ÷ age in days.

Example: A 600-pound carcass, 400 days old with a Yield Grade 3 (50 percent retail yield) produces 0.75 pounds of retail cuts per day of age: (600 x 0.5) ÷ 400 = 0.75 pounds of retail cuts per day of age.

Loin eye area has been highly correlated to the percent muscle in a carcass. A goal of progressive beef producers is to produce cattle yielding at least two square inches loin eye area per 100 pounds of carcass.

Example: A 550-pound carcass with a 12.5 square inch loin eye would yield 2.27 square inches loin eye area per 100 pounds of carcass. (12.5 ÷ 5.5 = 2.27 square inches loin eye area per 100-pound carcass).

Use of the USDA's Beef Carcass Data Service is a service designed to provide carcass data to breeders or others who don't own the animals at time of slaughter. Cattle are ear tagged with USDA ear tags and upon slaughter the proper quality and yield grade data are forwarded to the purchaser of the ear tags. This is especially helpful to seedstock producers.

For information on source of ear tags and cost of the service contact: Livestock Division, Agricultural Marketing Service, U.S. Department of Agriculture, Washington, D.C. 20250.

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