

Figure 1. Examples of marbling within a ribeye.

In addition to marbling, there are other ways to evaluate muscle for quality. Firmness of muscle is desirable, as is proper color and texture. Desirable ribeyes will exhibit an adequate amount of finely dispersed marbling in a firm, fine textured, bright, cherry-red colored lean. As an animal matures, the characteristics of muscle change, and muscle color becomes darker and muscle texture becomes coarser (Hale et al., 2004).

MATURITY

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 (Burson, 2004):

Maturity Age

- A 9 - 30 months
- B 30 - 42 months (2 1/2-3 1/2 years)
- C 42 - 72 months (3 1/2-6 years)
- D 72 - 96 months (6 - 8 years)
- E over 96 months (over 8 years)

Maturity is estimated visually by cartilage ossification (hardening of cartilage into bone), rib bone shapes, and lean color and texture.

During the early stages of growth, more ossification occurs in the hind portion of the backbone (sacral and lumbar vertebrae), progressing with advancing maturity toward the forequarter (thoracic vertebrae). As animals advance from A to E maturity, there is fusion of the sacral vertebrae, more ossification of the cartilage tips of the lumbar and thoracic vertebrae occurs, and rib bones become wider and flatter (Table 1).

In young beef carcasses the lean flesh is light cherry red in color and fine in texture. With advancing maturity the lean becomes progressively darker in color and more coarsely textured. Mature carcasses (D and E) may have lean that is dark red and coarse textured.

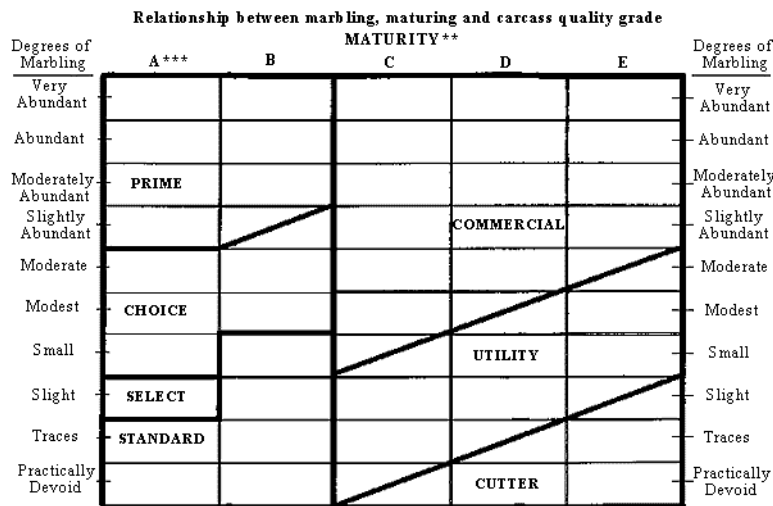
Carcass maturity is determined initially from the skeletal characteristics and adjustments made according to the lean characteristics. The final maturity of the carcass cannot be adjusted more than one full maturity group from the maturity indicated by its bones and cartilages.

Table 1. Guidelines for Determining Skeletal Maturity.

Maturity	Sacral Vertebrae	Lumbar Vertebrae	Thoracic Vertebrae
A	Distinct separation to completely fused	Cartilage evident to nearly completely ossified	No ossification to slight evidence of ossification
B	Completely fused completely ossified	Nearly completed ossified to ossified (10-25% ossified)	Partially ossified to moderately ossified
C	Completely fused	Completely ossified	Moderately ossified to considerable ossification with cartilage outline plainly visible (30-70%)
D	Completely fused	Completely ossified	Considerable ossification with cartilage outlines plainly visible to barely visible (70-100%)
E	Completely fused	Completely ossified	Cartilage outline barely visible to completely ossified

QUALITY GRADING

The beef quality grades are Prime, Choice, Select, Standard, Commercial, Utility, Cutter and Canner. Since 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 (Burson, 2004).



*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.

Figure 2. Relationship between marbling, maturing and carcass quality grade* (Burson, 2004).

FINAL QUALITY GRADE (HALE, 2004)

After the degree of maturity and marbling has been established, the final quality grade is determined.

Meat graders assign a yield grade to a carcass by evaluating:

1. The amount of external fat;
2. The hot carcass weight;
3. The amount of kidney, pelvic, and heart fat; and
4. The area of the ribeye muscle.

Graders evaluate the amount of external fat at the 12th rib by measuring the thickness of fat three-fourths the length of the ribeye from the chine. They adjust this measurement to reflect unusual amounts of fat in other areas of the carcass. Carcass weight is the “hot” or unchilled weight in pounds (taken on the slaughter-dressing floor shortly after slaughter). The amount of kidney, pelvic, and heart (KPH) fat is evaluated subjectively and is expressed as a percentage of the carcass weight (this usually will be from 2 to 4 percent of carcass weight). The area of the ribeye is determined by measuring the size (in inches, using a dot-grid) of the ribeye muscle at the 12th rib.

YIELD GRADE (HALE, 2004)

Yield Grade is the indicated yield of closely trimmed (1/2 inch fat or less), boneless retail cuts expected to be derived from the major wholesale cuts (round, sirloin, short loin, rib, and square-cut chuck) of a carcass. Yield Grade is indicated on a scale of 1 to 5, with Yield Grade 1 representing the highest degree of cutability.

Yield Grade equals $2.50 + (2.50 \times \text{adjusted fat thickness, inches}) + (0.20 \times \text{percent kidney, pelvic, and heart fat}) + (0.0038 \times \text{hot carcass weight, pounds}) - (0.32 \times \text{ribeye area, square inches})$.

DESCRIPTIONS OF THE FIVE YIELD GRADES

Yield Grade 1

The carcass is covered with a thin layer of external fat over the loin and rib; there are slight deposits of fat in the flank, cod or udder, kidney, pelvic and heart regions.

Yield Grade 2

The carcass is almost completely covered with external fat, but lean is very visible through the fat over the outside of the round, chuck, and neck.

Yield Grade 3

The carcass is usually completely covered with external fat; lean is plainly visible through the fat only on the lower part of the outside of the round and neck.

Yield Grade 4

The carcass is usually completely covered with external fat, except that muscle is visible in the shank, outside of the flank and plate regions. There are usually large deposits of fat in the flank, cod or udder, kidney, pelvic and heart regions.

Yield Grade 5

Generally, the carcass is covered with a thick layer of fat on all external surfaces. Extensive fat is found in the brisket, cod or udder, kidney, pelvic and heart regions.

A short cut method to determine USDA beef yield grade is shown in Table 2.

Base yield grade: $3.0 = .40 \text{ Backfat; } 600 \text{ lb Hot carcass weight; } 11.0 \text{ sq in REA; } 3.5\% \text{ KPH. PYG = Preliminary Yield Grade}$

As an example: A carcass has .40 in. of backfat; 750 lb carcass; 13.0 in. ribeye area and 3.0% KPH, using the above table to determine yield grade:

$PYG = 3.00 + .80$ (adjustment for carcass weight) $- .66$ (adjustment for ribeye area) $- .10$ (adjustment for KPH) = 3.04 . In the official USDA grading program the decimals are dropped and the yield grade is reported as 3.

Table 2. Short cut method to determine yield grade.

Variable	Backfat	PYG
Backfat	0.00	2.00
	1.10	2.25
	0.20	2.50
	0.30	2.75
	0.40	3.00
	0.50	3.25
	0.60	3.50
	0.70	3.75
	0.80	4.00
	Carcass Wt.	Adjustment
Carcass Weight	850	+1.0
	800	+.6
	750	+.8
	700	+.4
	650	+.2
	600	None
	550	-.2
	500	-.4
	Ribeye	Adjustment
Ribeye Size	14.0	-.99
	13.5	-.82
	13.0	-.66
	12.5	-.49
	12.0	-.33
	11.5	-.16
	11.0	None
	10.5	+.16
	10.0	+.33
	9.5	+.49
	KPH	Adjustment
KPH	1.0%	-.50
	1.5	-.40
	2.0	-.30
	2.5	-.20
	3.0	-.10
	3.5	None
	4.0	+.10
	4.5	+.20
	5.0	+.30

Table 3. Relationship between yield grades and cutability (Burson, 2004).

Yield Grade	% Boneless, Closely Trimmed Retail Cuts 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	43.3 - 45.4

CONCLUSIONS

The U.S. beef grading system continues to be used to determine carcass characteristics and often as a means to set price for the producer. However, components of the system are subjective which can lead to inaccuracies. Additionally the system does not address quality from a palatability or tenderness perspective to the extent it should. Marbling can make beef more tender as fat is less resistant to shear force and fat lubricates the mouth while chewing. However, tenderness is as much a function of muscle structure and management factors relative to the carcass. At some point the beef industry will need to develop a system that also addresses tenderness so that consumers will have additional information for their buying decisions.

REFERENCES

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