

Meat Yield, Quality, and Value

Requirements Prior to Slaughter

Documentation of age. Because of the danger of Bovine Spongiform Encephalopathy (BSE), also known as mad-cow disease, it is now required that packing plants document the age of all of animals that are harvested. Research has shown that animals older than 30 months are at risk of carrying BSE. As a result, packing plants must remove all Specified Risk Material (SRM) such as spinal column, brain, and nerve ganglia of undocumented cattle and cattle older than 30 months. Many small packers require only a signed affidavit stating that the producer knows the animals are younger than 30 months. The producer should be able to provide documentation if requested. Other packers have a qualified person (usually a DVM) age the animal by oral dentition.

Withdrawal times for medications. One of the most important and often overlooked food safety aspects in beef is the presence of residual medications or other items that should not enter the human food chain. These are a result of producers not following the labeled withdrawal times for any injectable or orally administered medications or vaccines. Most packing plants require a signed affidavit stating that all withdrawal times have been followed and no residuals should be present since label directions were followed.

Management and nutritional requirements to insure meat quality. Numerous management and nutritional factors may influence meat quality. Besides following labeled withdrawal times, there are several things you can do to maximize meat quality:

- Withdraw feed (but not water) 12 to 24 hours before harvest. Minimizing gut fill reduces the chances of gut rupture during dressing and of contamination to the carcass.
- Minimize stress on the animal during transport and handling. Excess stress during the time prior to harvest may have negative impacts on meat quality. Longer-term stress from excessive transport, weather changes, or mixing unfamiliar cattle can cause the cattle to use energy stores in the muscle. This results in a condition called *Dark Cutter*, which causes a large price discount to the carcass.
- Document feed and feed additives. Many of today's contamination risks can be traced to feed sources and additives such as minerals, proteins, and fat supplements. Thorough documentation of everything included in an animal's diet is essential for proper tracing to contamination sources. Keeping feed tags from feedbags and diet formulations from the feedmill is a good way to document these sources.

Dressing and Dressing Percentage

Dressing is the process of removing the hide, head, feet, and internal organs during harvest (slaughter). What is left is the carcass, which contains the bones, muscle, meat, and fat. The first measure of yield is calculated as a dressing percentage:

$$\text{Dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Live weight}} \times 100$$

Hot carcass weight (HCW) is the weight of the carcass after removal of the items listed above; *live weight* is the weight of the animal just prior to harvest. The more weight on the carcass, the higher the dressing percentage. This is usually affected by muscling, fat cover, or both. Fatter carcasses and more heavily muscled carcasses have higher dressing percentages. The amount of fat is usually the most variable and therefore has the greatest impact on dressing percentage. Differences in the weight of the hide, internal organs, head, and so forth can also impact dressing percentage. The biggest variable in those items removed from the carcass during dressing is the gut—more specifically, the amount of gut fill. If an animal is fed right up

until the time of harvest, it will have a full gut when the live weight is taken, resulting in a lower dressing percentage. The following table provides estimates of dressing percentages:

Table 1. Estimates of Dressing Percentages

Animal	Factor	Typical Dressing Percentage
Cull cow	Low amount of muscle/fat	47 to 50
Grass-fed/short-fed	Low amount of fat	58 to 62
Typical YG3 feedlot steer	Mostly fat	62 to 64
Overly fat (YG%)/double muscled	High amount of muscle/fat	63 to 67
Bulls	High muscle	65 to 69

USDA Quality and Yield Grading Calculations

Quality grading. Quality grading is a determination of the eating quality of meat from beef carcasses. This grading is a combination of two specific factors: maturity and marbling.

- **Maturity.** The maturity of an animal refers to its chronological age and is determined by evaluation of the exposed bony cartilage and the lean texture of the carcass. The maturity is important to eating quality because as an animal gets older, the connective tissue, also known as *gristle*, becomes cross-linked and tougher to chew. The maturity scores are as follows:

A = younger than 30 months

B = 30 to 41 months

C = 42 to 59 months

D = 60 to 72 months

E = older than 72 months

While the above ages in months are generally correct, the ultimate determination is made by evaluating the carcass and not by birth records or actual animal age.

- **Marbling.** The little flecks of fat that are found within muscle are called *intramuscular fat* or *marbling*. Having more marbling in the muscle tends to improve the eating quality of meat within a maturity score. Marbling has been shown to significantly improve flavor, juiciness, and to a certain extent, tenderness. It is appropriate to think of marbling as an “insurance policy” for good-eating beef steaks and not a guarantee of tenderness or any other eating quality. The amount of marbling in loin muscle is determined by trained meat graders and therefore may be somewhat subjective. Nevertheless, it has been shown to be the most valuable and accurate method for determining eating quality.

There are eight possible USDA quality grades: Prime, Choice, Select, Standard, Commercial, Utility, Cutter, and at one time, Canner. Only “young” beef receive the top four grades, and the bottom four are generally reserved for “old” beef. Nearly all commercially produced beef in the United States marketed through quality grocery stores and restaurants is from young beef. Commercial, Utility, and Cutter beef is usually further processed or sold in deeply discounted retail outlets and restaurants. Figure 1 shows the designation of USDA quality grades.

Degrees of Marbling	Maturity ^{1,2}					Degrees of Marbling
	A ³	B	C	D	E	
Slightly abundant	Prime					Slightly abundant
Moderate			Commercial			Moderate
Modest	Choice					Modest
Small						Small
Slight	Select			Utility		Slight
Traces					Cutter	Traces
Practically devoid	Standard					Practically devoid

Figure 1. USDA quality grades

¹Assumes that firmness of lean is comparably developed with the degree of marbling and that the carcass is not a “dark cutter.”

² Maturity increases from left to right (A through E).

³ The A maturity portion of the figure is the only portion applicable to bullock carcasses.

Yield grading. Unlike quality grading, which determines eating quality, USDA yield grading measures the quantity of meat that we can expect to get from a carcass. It is expressed as the yield of boneless, closely trimmed retail cuts (BCTRC) from the round, loin, rib, and chuck. Yield grading is calculated as follows:

$$2.5 + (0.0038 \times \text{HCW}) + (2.5 \times \text{fat}) + (0.2 \times \% \text{KPH}) - (0.32 \times \text{rib eye area})$$

HCW = hot carcass weight

fat = subcutaneous fat measured opposite the rib eye at the 12th rib

KPH = kidney, pelvic, and heart fat as a percentage of the HCW

rib eye area = the area of the longissimus muscle at the 12th rib in square inches

The result of the above equation is expressed as a number rounded to the nearest tenth and is expressed on a scale of 1 to 5.

Interpretation

Quality grading. The higher the quality grade, the higher the expected eating quality. So, a Prime steak should be of higher eating quality than a Select steak. Also, the eating quality is only applied to steaks from the carcass, such as NY strip, rib eye, and T-bone, and not to roasts or ground products. Roasts tend to have higher amounts of gristle and are generally tough, even if they are taken from a Prime carcass. Additionally, ground beef is just that: ground pieces of lean and fat. Ground beef quality is almost solely dependent on the fat content percentage of the ground product.

Eating quality should be viewed as an insurance policy as it relates to the USDA quality grade. In other words, it is possible to get a Standard steak that eats wonderfully, but the odds of getting that steak are small compared to getting one that is graded Prime or Choice. Figure 2 illustrates relative eating quality from 0 to 10, with 0 representing poor eating quality and 10 representing great eating quality. The shaded area represents all steaks that we would find in each quality grade. As it shows, Prime is very high in eating quality and has very little variation (~8 to 10 in eating quality). While Standard may be very high in eating quality, on average these steaks

are not as good and have much more variability (~0 to 9 in eating quality). This illustrates the insurance policy theory when selecting steaks from a higher quality grade.

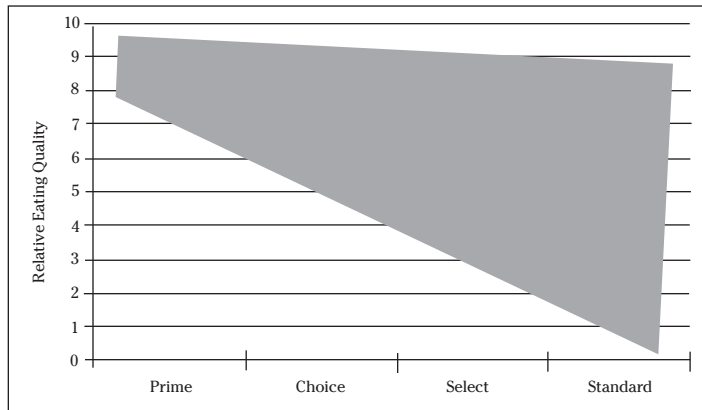


Figure 2. Relative eating quality

Yield grading. While quality grading is the subject of much speculation and interpretation, yield grading is more straightforward. Table 2 shows the relative yield of BCTRC that we would expect out of the four major wholesale cuts from a beef carcass.

Table 2. Relative Yield of BCTRC

USDA Yield Grade	Percentage of BCTRC
1.0 – 1.9	54.6 – 52.6
2.0 – 2.9	52.3 – 50.3
3.0 – 3.9	50.0 – 48.0
4.0 – 4.9	47.7 – 45.7
5.0 – 5.9	45.4 – 43.4

A good way to remember these yields is the following: a base YG 3.0 will yield 50 percent BCTRC, and a change of one full YG in either direction will change the percentage of BCTRC by ~2 percent. The difference in YG1 and YG5 may be more than 10 percent difference in yield.

Basic Fabrication of a Beef Carcass

Basic primal or wholesale cuts of a beef carcass are illustrated in figure 3. These primal cuts are packaged either whole or in parts (subprimals) in vacuum-packages. The cuts are then boxed at the packing plant, four to eight (or more) of the same cuts per box. These primals and subprimals are then shipped to retail outlets and restaurants where they are cut into individual portions and offered for sale. For complete information regarding primal and subprimal cuts, refer to the USDA Agricultural Marketing Service Web site: <http://www.ams.usda.gov/lsg/imps/imps100pc.pdf>.

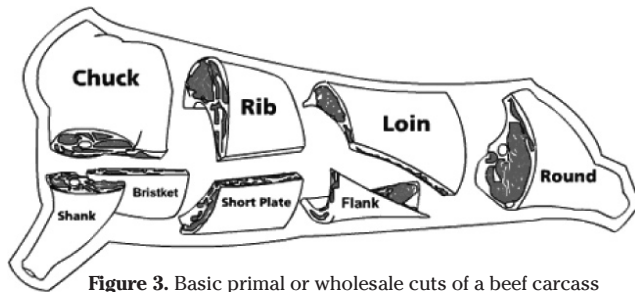


Figure 3. Basic primal or wholesale cuts of a beef carcass

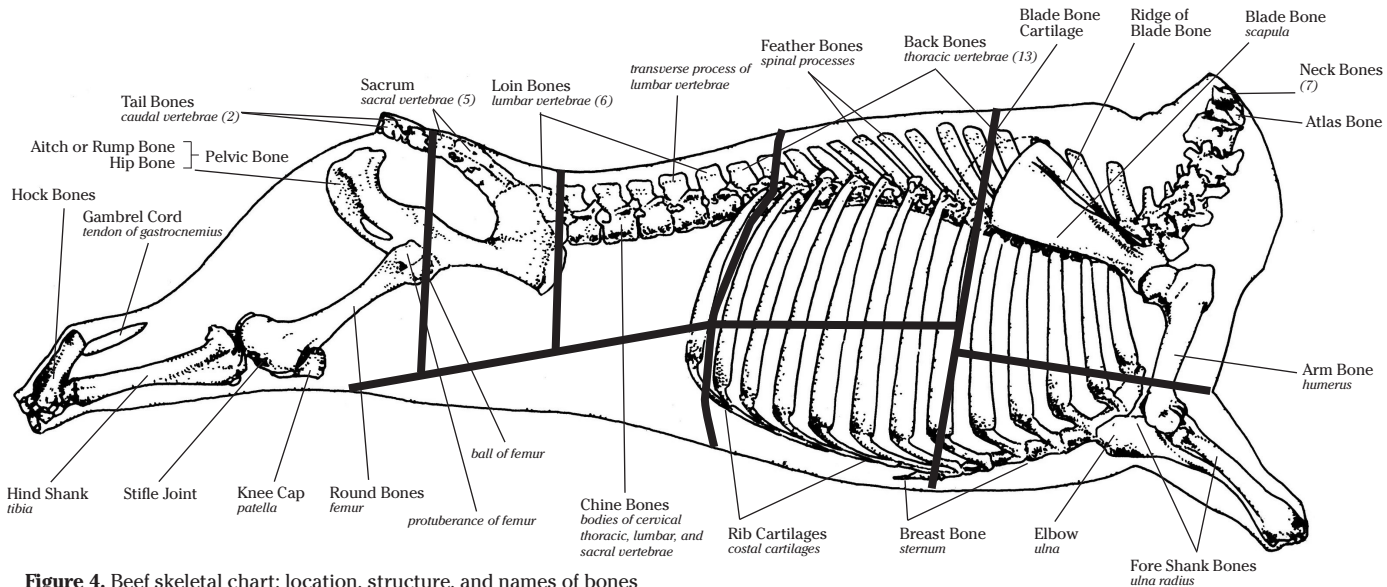


Figure 4. Beef skeletal chart; location, structure, and names of bones

Source: Adapted from a publication of the American Meat Science Association.

Note: Dark lines on the skeleton above represent the approximate location for each separation.

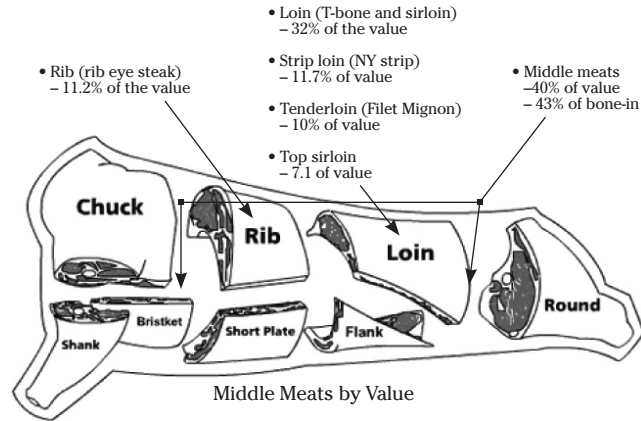
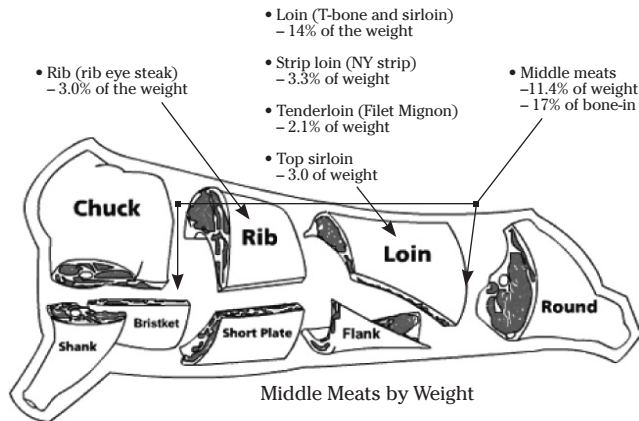


Figure 5. Relative yield of various cuts

Value-Based Pricing of Meat

To get a handle on the true value of the animal at market, we must have a good understanding of the potential profit losses or opportunities. Since we sell meat as dollars per pound, a good understanding of where weight is lost in the process is paramount.

We start with the following:

- We have a 1,200-pound live steer on our premises. We haul the steer to the packer.
- During transport we lose 1 to 5 percent (12 to 60 pounds), commonly called *drift*.
- At harvest we lose 35 to 40 percent of live weight during dressing (415 to 475 pounds).
- When we hang the carcass in the cooler, even for 48 hours, we lose 1 to 10 percent of carcass weight in cooler shrink (1 to 8 pounds).
- During fabrication, the amount of meat is determined by the USDA YG. We lose 46 to 54 percent of carcass weight from bones and fat trimming (at least 355 pounds).

Therefore, our 1,200-pound animal yields 283 to 412 pounds of meat. When we cook the steaks, roasts, or ground beef, we lose another 25 percent, so we end up with about 212 to 309 pounds of edible product.

In our example of the 1,200-pound steer, let's assume the following:

- We paid \$0.80 per pound, or \$960.
- If it cost \$50 per head to harvest and \$0.50 per carcass pound to cut and wrap, that would add another \$50 + \$378 (1,200 pounds x 63 percent dress = 756 pounds x \$0.50 per pound), or a \$1,388 total investment in that steer.
- To break even selling just the meat, we would have to charge an average of \$3.37 to \$4.90 per pound (\$1,388/412 pounds or \$1,388/283 pounds) for steaks, roasts, and ground beef. That means more than \$1.50 difference per pound in the price of our retail cuts, depending on the yields or weight losses at each stage.
- Steaks (middle meats from the figures above) are ~11 percent of the weight (283 to 412 pounds BCTRC x 11 percent = 31 to 45 pounds middle meats) and 40 percent of the value (\$1,388 x 40 percent = \$555). To break even, we would need to charge between \$12 and \$17 per pound.