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# Beef Cookery

The satisfaction of our beef cravings ultimately depends on how beef is cooked – it's that important. A Prime grade steak can be rendered inedible by improper cooking while a lower grade cut can be greatly improved with proper cooking techniques.

## Life-Giving Protein

Outside of water, beef is mainly protein. From the Greek word *proteios* (primary), protein is essential to all living cells. When proteins are ingested, our digestive enzymes break them down into amino acids that are easily absorbed into our bloodstream.

### The three general classifications of meat proteins are:

1. **Myofibrillar Proteins:** include actin and myosin, the most abundant muscle proteins that are important for muscle fiber structure and the relaxing and contracting of muscle.
2. **Stromal Proteins:** also called connective tissues; appear in muscle as collagen, elastin, and in much smaller amounts, reticulin.
  - a. **Collagen:** white, thin and transparent, yet tough; has a major impact on muscle tenderness after cooking as it does not break down easily. Collagen needs moist heat cooking methods to convert it to tender gelatin or should be removed if using dry heat cooking methods.
  - b. **Elastin:** referred to as “yellow” connective tissue; cannot be broken down with any amount of heat and should be removed prior to cooking.
3. **Sarcoplasmic Proteins:** also known as water soluble proteins; include hemoglobin and myoglobin, which contains pigments that give beef its red color; include a wide variety of enzymes that contribute to the aging process.

## How Proteins Cook

There are concurrent toughening and tenderizing changes that take place when beef is cooked. The extent of each (at any given point during the cooking process) depends on the cooking time, temperature, cooking environment and composition of the muscle. Most of the toughening changes are due to some proteins (myofibrillar) being denatured and losing some of their water-holding capacity. Interaction between denatured proteins also causes some toughening. The solubilization process of other proteins (collagen) has a tenderizing effect because they turn into gelatin when heated in a moist environment. Fat also improves tenderness due to its lubricating effect when it melts during cooking.

## Brown = Flavor The Maillard Reaction

A common beef cooking technique that should never be skipped is browning. Why? Because browning creates beef flavors that can only be produced through dry heat – unique flavors and aromas that are not intrinsic to the beef itself. During browning, temperatures of 350°F or higher on the surface of the beef cause proteins (amino acids) and carbohydrates (sugars) to caramelize into intense flavors and aromas. There are a very limited number of carbohydrates in meats, enough for the browning reaction. This browning process is called the Maillard Reaction, named after the French scientist who discovered it. Everything from baked goods to coffee beans to beef benefit from this complex reaction of sugars and amino acids caused by higher heat. The Maillard Reaction is the reason why a beef stew has a richer flavor when the beef, vegetables and flour are browned before adding the liquid.

*This browning process is called the Maillard Reaction, named after the French scientist who discovered it.*

*All beef cooking methods fall into two main categories: Dry Heat Methods and Moist Heat Methods.*

## Beef Cooking Methods

Beef develops its desirable flavor and aroma during cooking. True meaty, umami flavor begins with the application of heat as it transforms proteins, carbohydrates and fats into their smaller, more flavorful components of amino acids, sugars and fatty acids.

All beef cooking methods fall into two main categories: Dry Heat Methods and Moist Heat Methods. For tender beef cuts use Dry Heat Methods and for less tender cuts use Moist Heat Methods. Tender cuts come primarily from the middle of the animal – the rib and loin – because they are support muscles that receive less exercise and contain less connective tissue. Less tender cuts come primarily from the front and hind sections of the animal – the chuck and round – because these are heavily exercised muscles that develop more connective tissue. While beef cooked in liquid develops a different flavor than beef that is roasted or broiled, heat in general produces the same affect on beef proteins.

As heat denatures myofibrillar proteins causing them to gradually shorten or toughen and release liquid, connective tissues solubilize and begin to break down. The key internal temperature at which these changes begin to take place is 149°F. When beef with low amounts of connective tissue, such as loin and rib cuts, are cooked beyond this temperature, the additional heat continues to toughen them. So fast cooking at higher temperatures is preferred (dry heat). Beef with higher levels of connective tissue, such as some chuck and round cuts, need longer, slower cooking (moist heat) to allow time for the connective tissue to convert to gelatin and become tender.

The sarcoplasmic proteins – hemoglobin and myoglobin – are also denatured during cooking. The color change in these pigments is the primary indicator for degrees of doneness in beef. As the temperature of the beef increases, the muscle becomes progressively opaque, changing from red to pink to brown. The color of beef juices also changes from pink to pale amber.

|                           | <b>Up to 122°F<br/>(internal Temperature)</b>                                                               | <b>122°F to 149°F<br/>(internal temperature)</b>                                                                                                                                                                      | <b>149°F and over<br/>(internal temperature)</b>                                                                                                                            |
|---------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TENDERNESS/TEXTURE</b> | Muscle fiber width and length gradually decreases. Collagen fibers “buckle,” but tenderizing is negligible. | Muscle fiber width rapidly decreases (from 113°F to 144°F) and extensively shrinks in length (from 131°F to 149°F). Proteins coagulated by 144°F begin to break down when tissue is held 30 minutes or more at 140°F. | Muscle tissues harden and become tough. Connective tissue shrinks. Solubilization of collagen is about half completed at around 143°F (higher for meat from older animals). |
| <b>JUICINESS</b>          | Muscle loses a slight amount of water.                                                                      | Water content of muscle decreases as proteins are broken down. Tender meat is juicy at this point.                                                                                                                    | Beef becomes less juicy as temperature increases.                                                                                                                           |
| <b>COLOR</b>              | Center of beef becomes bright red. Outside becomes grayish-brown as temperature rises.                      | Beef cooked rare (140°F internal temperature) is red with a thin brown layer on surface.                                                                                                                              | Beef at 160°F is medium pink in color. Beef at 170°F is well done and brown throughout.                                                                                     |
| <b>MICROORGANISMS</b>     | Most microorganisms are still actively reproducing at these temperatures.                                   | Most yeasts and molds are inactivated by moist heat of 140°F for 10 minutes.                                                                                                                                          | Pathogenic bacteria is destroyed at 149°F for 12 to 15 minutes.                                                                                                             |

SOURCE: *The Meat We Eat*, 14th Edition, ©Interstate Publishers, Inc. 2001.

## Dry Heat Cooking Methods:

- Broiling
- Grilling
- Oven Roasting
- Skillet Cooking/Sauté/Stir-Frying

Characterized by quick cooking at higher temperatures, dry heat methods use uncovered pans, direct heat and no additional liquid. Browning via the Maillard Reaction is a key flavor factor. Best used with tender cuts, dry heat methods minimize the toughening effect of heat on muscle fibers.

*Broiling & Grilling:* Cooking time is critical in broiling and grilling since thinner cuts such as steaks, kabobs and burgers, are cooked at higher temperatures and can easily overcook.

*Oven Roasting:* This cooking method takes place in an open pan in the oven without liquid. Lower oven temperatures result in less moisture loss, producing higher yields. Some very tender cuts with less connective tissue can be roasted at higher temperatures with juicy, flavorful results: tenderloin, rib and ribeye.

*Stand Time:* Since the internal temperature of a roast continues to rise after cooking, it's best to remove the roast from the oven when the thermometer registers 5°F to 10°F below the desired doneness. Roasting illustrates how the protein denaturing process can sometimes be reversed. If a roast is immediately carved after removing from the oven a substantial amount of juice is squeezed out and lost. But when the roast is allowed to stand for 15 to 20 minutes, the proteins are able to reabsorb some of the moisture that was released during heating, producing a firmer, juicier, easier to carve roast.

*Sauté/Stir-Frying:* A variation of sautéing, stir-frying cooks thin, uniform beef pieces quickly in a small amount of fat in an open skillet or wok. For best results, use tender beef cuts, though some less tender cuts, such as flank, can be stir-fried when cut into thin strips. The classic Chinese technique called “velveting” enhances the texture of stir-fried beef strips with the aid of a cornstarch marinade. The cornstarch binds the flavors to the beef by sealing in juices and protects the beef during cooking.

## Moist Heat Cooking Methods:

- Braising/Pot Roasting
- Cooking in Liquid/Stewing/Poaching

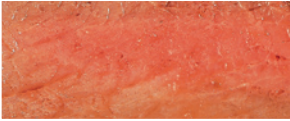
A slow, gentle process, moist heat methods take place over low heat in a tightly covered pan to which liquid has been added. The beef is typically browned before adding the liquid to add color and flavor. Best used with less tender cuts, moist heat methods solubilize collagen and develop natural beef flavors. Steam, which is produced from the liquid and retained by a tight-fitting cover, converts tough collagen into tender gelatin.

During long, slow cooking in moist heat, beef flavor components leach into the cooking liquid creating delicately flavored meat. The lack of strong browned beef aromas also reduces flavor intensity. So ingredients such as broth and wine are often used in place of water to produce a flavorful, aromatic sauce or gravy. The difference between cooking in liquid/stewing and braising/pot roasting is in the amount of liquid. Cooking in liquid/stewing uses more liquid, usually enough to cover the beef.

*When the roast is allowed to stand for 15 to 20 minutes, the proteins are able to reabsorb some of the moisture that was released during heating, producing a firmer, juicier, easier to carve roast.*

## Degree of Doneness

medium rare



medium



well done



Perfectly cooked, flavorful beef achieves a balance between the minimum amount of cooking needed for maximum palatability and food safety. Meat thermometers and the visual appearance of the beef aid in determining degrees of doneness.

### Whole Muscle Beef Cuts

- 145°F medium rare
- 160°F medium
- 170°F well done

### Ground Beef

- 160°F medium
- 170°F well done

Braised or stewed beef is always cooked until well done. Tenderness is the clue to doneness; beef is fork-tender when a utility fork can be inserted without resistance and then releases easily when pulled out. Cooking beyond the fork-tender stage can result in dry, stringy beef.

Processing and foodservice industries follow the FDA's Model Food Code, which outlines in detail how long beef can be held at certain interim cooking temperatures. For more information on the FDA Model Food Code, go to [www.cfsan.fda.gov/~dms/foodcode.html](http://www.cfsan.fda.gov/~dms/foodcode.html)

Beef color is also an indicator of degrees of doneness. The protein pigments of hemoglobin and myoglobin are denatured during cooking and change from red to pink to brown. To the left is a Beef Steak Color Guide illustrating these color changes from medium rare to well done beef.



## Beef Cookery Recommendations

| BEEF CUT                            | APPROXIMATE TOTAL WEIGHT<br>(PER 725 LB. CARCASS*) | DRY HEAT<br>COOKERY | MOIST HEAT<br>COOKERY |
|-------------------------------------|----------------------------------------------------|---------------------|-----------------------|
| <b>Chuck</b>                        | <b>210 lbs/29%</b>                                 |                     |                       |
| Beef Shoulder Center (Clod)         | 14 to 18 lbs                                       | ⊗                   |                       |
| Beef Shoulder Top Blade (Flat Iron) | 8 to 12 lbs                                        | ○                   |                       |
| Beef Chuck Eye Roll                 | 16 to 20 lbs                                       |                     | ○                     |
| Beef Chuck Mock Tender**            | 5 to 7 lbs                                         |                     | ○                     |
| Beef Chuck Blade                    | 32 to 36 lbs                                       |                     | ○                     |
| Beef Chuck Arm                      | 34 to 36 lbs                                       |                     | ○                     |
| Beef Shoulder Tender                | 1 to 2 lbs                                         | ○                   |                       |
| <b>Rib</b>                          | <b>68 lbs/9%</b>                                   |                     |                       |
| Beef Rib                            | 38 to 40 lbs                                       | ○                   |                       |
| Boneless Beef Ribeye                | 18 to 20 lbs                                       | ○                   |                       |
| Boneless Beef Rib Lifter Meat**     | 7 to 8 lbs                                         | ○                   |                       |
| <b>Loin</b>                         | <b>116 lbs/16%</b>                                 |                     |                       |
| <b>Loin-Short Loin</b>              |                                                    |                     |                       |
| Beef Porterhouse/T-Bone             | 20 lbs/10 lbs                                      | ○                   |                       |
| Beef Tenderloin                     | 14 to 18 lbs                                       | ○                   |                       |
| Beef Top Loin (Strip)               | 24 to 32 lbs                                       | ○                   |                       |
| Beef Loin Tails **                  | 2 to 4 lbs                                         | ○                   |                       |
| <b>Loin-Sirloin</b>                 |                                                    |                     |                       |
| Beef Top Sirloin (Boneless)         | 24 to 26 lbs                                       | ○                   |                       |
| Beef Sirloin Cap**                  | 5 to 7 lbs                                         | ○                   |                       |
| Beef Bottom Sirloin Tri-Tip         | 7 to 8 lbs                                         | ○                   |                       |
| Beef Bottom Sirloin Ball Tip**      | 7 to 8 lbs                                         | ⊗                   |                       |
| Beef Bottom Sirloin Flap**          | 7 to 8 lbs                                         |                     | ○                     |
| <b>Round</b>                        | <b>156 lbs/22%</b>                                 |                     |                       |
| Beef Top Round                      | 34 to 40 lbs                                       | ⊗                   |                       |
| Beef Top Round Cap**                | 6 to 8 lbs                                         | ⊗                   |                       |
| Beef Eye Round                      | 10 to 14 lbs                                       | ⊗                   |                       |
| Beef Bottom Round (Flat)            | 28 to 32 lbs                                       |                     | ○                     |
| Beef Round Tip – Center             | 5 to 7 lbs                                         | ○                   |                       |
| Beef Round Tip – Side               | 7 to 8 lbs                                         | ⊗                   |                       |
| <b>Thin Cuts</b>                    | <b>135 lbs/19%</b>                                 |                     |                       |
| Beef Flank Steak                    | 4 to 5 lbs                                         | ⊗                   |                       |
| Boneless Beef Brisket               | 17 to 19 lbs                                       |                     | ○                     |
| Beef Outside Skirt Steak            | 4 to 6 lbs                                         | ⊗                   |                       |
| Beef Inside Skirt Steak             | 4 to 6 lbs                                         | ⊗                   |                       |

\*Commodity trim estimates, weights vary depending on trim and fabrication levels of the processor.

\*\*Muscles more frequently used in commercial applications.

⊗ = needs tenderizing

SOURCE: National Cattlemen's Beef Association on behalf of The Beef Checkoff