How to Roast a Cheap Cut of Beef

Contrary to accepted kitchen wisdom, the final internal temperature of the roast is only one factor in determining texture, taste, or juiciness. Choosing the proper cut and oven temperature are just as important.

BY CHRISTOPHER KIMBALL WITH EVA KATZ

Every August, my small town in Vermont holds an annual "ox roast," a covered dish supper that attracts everyone from mountain men to weekenders. The predinner entertainment is cloggers, who dance on plywood set up on two-by-fours. After dinner, the group assembles again to square-dance at the abandoned tennis court (lit by half a dozen table lamps duct-taped to the top of the posts so that we can see), where we "shuck the oyster" and "dig the clam."

The "ox" at that picnic is really a good-size heifer. The two steamship rounds (the back legs from the knee to the hip) are strapped to a homemade rotisserie, which is kept in working order by Russell Bain, our ninety-four-year-old expert metalworker. The fire is started the night before, attended by a half dozen locals stretched out on lawn chairs, drinking coffee, eating spice donuts, and trading gossip. The following morning at six o'clock, the meat is attached to the rotisserie using a length of sheep fencing and a few springs from an old metal bed. My job is to carve the rounds of beef. Over the years one thing has been consistent: Although the rest of the food is quite good, the meat is tough and dry.

I began to wonder what made this meat so tough. Was it just the animal? Was it the internal temperature of the meat? Was it the cooking method? With two dozen roasts and plenty of theories, we set out to find some answers.

The Secrets of Slow Roasting

First, we wanted to try the classic method of roasting beef. We cooked five separate bottom round roasts, each at a different oven temperature, ranging from 300 to 500 degrees. The results were disappointing, but we learned two things. First, the lowest oven temperature was best. The meat that was roasted at 500 degrees became dry, with most of the outer layers of the meat overcooked. The roast cooked at 300 degrees, however, was tenderer and juicier and had better internal flavor. Second, and most important, we found that the internal temperature of the meat does not necessarily determine the juiciness or texture of the roast. A roast cooked at 300 degrees until it reaches an internal temperature of 120 degrees is definitely tenderer and juicier than meat cooked to the same internal temperature in a 500-degree oven. In other words, it's not just where you are going but how you get there.

Why is this true? To fully understand what was happening inside the meat, we photographed four different roasts prepared at different temperatures—250, 350, 400, and 500 degrees. All were cooked to the same internal temperature—130 degrees—and allowed to sit for an additional ten minutes after they were removed from the oven. The roasts were then cut in half and photographed. When we compared the photographs, the answer was immediately apparent. The 500-degree roast was almost entirely overcooked. That is, the center was still red, but 70 percent of the remainder was gray and unappealing. By comparison, the roast cooked at 250 degrees was light red throughout, with only 10 percent of the outer layer gray and overcooked. The roasts cooked at the in-between oven temperatures varied between these two extremes. It's simply a matter of physics. Lower oven temperatures allow sufficient time for the even conduction of heat to the center of the roast from the outer layers. At higher oven temperatures, the outside and inside of the roast have a much larger temperature differential.

Testing Lower Oven Temperatures

Now that we knew that lower oven temperatures were best, we prepared five different bottom round roasts (we selected this cut because it is the worst of the cheap cuts in terms of texture and flavor) at oven temperatures ranging from 175 to 350 degrees. Once again, we encountered the same remarkable discovery as with the first round of tests. Although all the roasts were cooked to the same internal temperature, they were quite different in texture and juiciness. We found that 250 degrees was the ideal oven temperature, turning out a tender, juicy, and flavorful roast when cooked to an internal temperature of 130 degrees (*see* "Roasts Cooked at Constant Temperatures," below, for details). We repeated these tests using chuck roasts—with the same results.

In doing these tests, however, we found a problem with roasting at low temperatures: There is little flavor development on the exterior of the meat. To remedy this situation, we compared three new oven methods with the winner thus far, a constant 250 degrees.

In the first test, we roasted the meat at 350 degrees until it reached an internal temperature of 110 degrees, removed it from the oven for half an hour, then returned it to the oven and roasted it until it reached an internal temperature of 130 de-

Roasts Cooked at Constant Temperatures

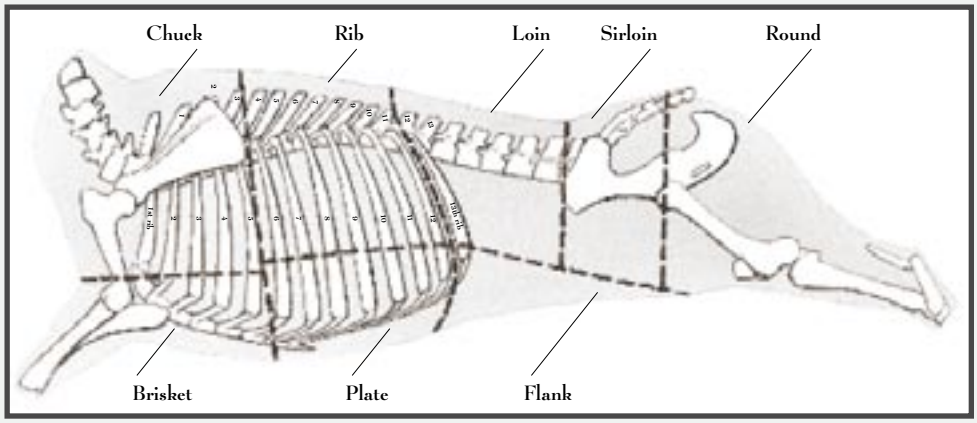
Bottom round roasts were browned on top of the stove in a Dutch oven and then transferred to a heated oven and roasted uncovered at five different oven temperatures until the internal temperature reached 130 degrees. Each roast weighed two pounds. These tests were repeated with chuck roasts with the same results.

OVEN TEMPERATURE	COOKING TIME	COMMENTS
175 degrees	2 hours, 10 minutes	Less flavorful than the other roasts. Slightly chewy; pale exterior. The next day, however, the interior had changed from deep red to a pale, pinkish gray. Very evenly cooked, however.
200 degrees	1 hour, 25 minutes	Juicy, tender, and evenly cooked. Better exterior color than the 175-degree roast.
250 degrees	1 hour	Wonderful flavor; very evenly cooked, tender, and juicy. A winner.
300 degrees	45 minutes	A bit tougher than the lower-temperature roasts. Good outside but uneven cooking inside. Outer crust layers were overcooked.
350 degrees	40 minutes	Exterior well browned. Very uneven cooking, although very good flavor.

The Best Cut for a Cheap Roast

Expensive cuts of beef, such as the tenderloin, can be roasted at very high heat with excellent results. Cheaper cuts, however, are best when roasted at low oven temperatures. I had heard various recommendations for cheap cuts and wondered which among them was actually the very best for slow roasting.

There is no lack of choices here. A side of beef has five sections, referred to in the trade as "primal" cuts. The more inexpensive boneless beef roasts come from one of three of these primal cuts: the chuck, the sirloin, or the round. The chuck is the area from the neck to the fifth rib of the side of beef; the round is the hind leg of the animal from the knee to the hip; and the sirloin is the section between the loin and round, in the hip area (*see* illustration, right). Generally speaking, the chuck is fattier and tenderer than any cut from the round, which is lean and relatively tough. The sirloin falls in between the two.



We roasted ten different cuts: five from the chuck, two from the sirloin, and three from the round. Although I tend to prefer juicier, fattier meat, the top round and the top sirloin were actually quite good. In general, however, the chuck provides more flavor and better texture than the round. *—C.K.*

Cuts from the Chuck

Blade Roast: This was clearly the best roast in the taste test—flavorful, juicy, and tender. However, it does contain connective tissues, which are unattractive, but not unpleasant to eat. The term "blade" refers to the shoulder blade, which is part of the chuck. A "blade roast" refers to the "top blade" muscle, which is similar to the muscle on your back over your shoulder blade.

Chuck-Eye Roast: This is a boneless rib roast that is cut from the center of the first five ribs (the term "eye" always refers to a center-cut piece of meat). The meat has good marbling throughout, which adds both flavor and moisture. This chuck is an extremely tender, juicy, and fatty piece of meat. It would have won first place in our tasting but was marked down for excessive fat content.

Chuck Fillet or Chuck Tender Roast: Made from the "mock tender" muscle located next to the top blade muscle, this cut is tougher, stringier, and less flavorful than chuck-eye. However, many super-markets mislabel this cut as chuck-eye. If the roast appears cone-shaped, it is probably the mock tender muscle and therefore an inferior chuck cut.

Shoulder Roast: Formerly referred to as an "arm roast" because it is the muscle at the top of the arm by the shoulder. It is chewy, the texture is grainy, and not the most flavorful chuck cut.

Under Blade Roast: This is the muscle underneath the shoulder blade. It is quite similar to a blade roast, with lots of connective tissue and lots of flavor.

Cuts from the Round

Roasts from the round tend to be lean and relatively tough compared to chuck roasts. Generally speaking, they should be sliced very thin for serving. (We did not test the sirloin tip muscle, which is roughly equal to the top round in terms of flavor and texture.)

Top Round: Not quite as good as the top sirloin but had good flavor, texture, and juiciness.

Eye of the Round: Less juicy and flavorful than the roasts above.

Bottom Round: The least tender of all the cuts. Mediocre flavor as well.

Cuts from the Sirloin

There are three important cuts for roasts from the sirloin: the top sirloin and the top and bottom rump roast, which are very similar.

Top Sirloin: Relatively juicy, flavorful, and tender. Good coloration on both the outside (dark brown) and inside (bright red). The clear winner among roasts from the sirloin or round.

Bottom Rump Roast: Juicy and with good flavor but not as tender as either the top sirloin or the top round roast. You can also purchase a top rump roast, which is slightly superior in flavor and texture.

ILLUSTRATION BY NENAD JAKESEVIC

grees. (This technique worked well when roasting a loin of pork; *see* "Perfect Pork Roast," May/June 1995.) The results were terrible; the meat was very unevenly cooked, and a large portion was overcooked.

Next we tried roasting at 400 degrees for fifteen minutes, then reducing the heat to 200 degrees until the roast reached an internal temperature of 130 degrees. This method was not bad, resulting in a juicy roast with good texture and flavor inside. But the outer layers of meat were still overcooked.

Finally we tried roasting at 250 degrees until the meat reached an internal temperature of 110 degrees, then increasing the oven heat to 500 degrees and cooking another fifteen minutes or so until the roast reached 130 degrees internal temperature. This technique provided the best of both worlds—terrific flavor development on the exterior and an even, juicy, tender roast on the interior. The contrast of texture and taste between the inside and the outside was wonderful. (*See* "Roasts Cooked at Changing Oven Temperatures," page 21, for details.)

Finally we had found the best method. But we still wanted to go back and make sure that we were cooking the meat to the proper internal temperature. So we cooked five more bottom round roasts to different internal temperatures, starting at 120 degrees and ending at 160 degrees. We found that 130 degrees still delivered the most flavor, the best texture, and the most juice. At 120 degrees, the roast lacked flavor; at 140 degrees, it was a bit chewy; and at 150 degrees internal temperature, it was dry, overcooked, and tough.

Chuck Wins Out

When we repeated these tests with chuck roasts, we did find some difference from the bottom round roasts. While the chuck was also best when cooked to 130 degrees, this fattier cut was acceptable cooked to somewhat higher internal temperatures because the fat kept it more flavorful and moist than a roast from the round. However, it could not go too much higher: The connective tissues, a common ingredient in a chuck roast, became tough and offensive at internal temperatures over 145 degrees. The lesson is that if you prefer your meat on the medium side or if you are concerned with the safety of eating meat that is rare or medium-rare, a roast from the chuck is a better choice than any cut from the round (*see* "The Best Cut for a Cheap Roast," page 19).

In fact, the chuck is on all counts the best cheap cut for slow roasting. In our tests, we found that, generally speaking, the chuck is more tender and flavorful than cuts from the lean and relatively tough round. The sirloin is a mixed bag; the bottom rump roast is not as good as the better round roasts, but the top sirloin and top rump roasts are indeed better than roasts from the round.

Why, then, is it so much easier to find a roast from the round than a chuck roast? Well, having spent some time with a local Boston butcher, we discovered that it is basically for the convenience of the butcher. Given the relatively complex construction of the chuck, preparing a chuck roast is time-consuming. Butchers have to "seam out" the muscles (remove them intact, discarding bone and connective tissues) to create boneless roasts. But (and this is what most butchers do) they can more easily cut a cross section through the chuck to create steaks such as an arm or blade steak, or they can simply sell the chuck as stew or ground meat.

The round, on the other hand, has only one bone and relatively little connective tissue, so the meat is readily sliced off into roast-size cuts. The four muscles of the round—the top round, the bottom round, the sirloin tip, and the eye round—each correspond to the name of a roast. (In human terms, the sirloin tip is the front of the thigh, the top round is the inside, the bottom round is the outside, and the eye round is the back of the thigh. The top and bottom round were so named because butchers traditionally placed the round on a work surface with the inside of the thigh facing up; hence that portion of the thigh was the "top.") Also contributing to the relative abundance of round roasts in the supermarket is the fact that Americans claim a preference for leaner meats, and the round has much less fat than the chuck.

Other Factors: Covered Cooking, Resting Time, and Aging

Now that we had determined the best oven temperature, internal temperature, and type of roast, we decided to investigate some slightly less crucial elements involved in roasting beef, including whether to roast the meat in a covered container, how long to let it rest after cooking, and whether aging the beef would make a real difference.

Some cooks suggest cooking meat in a covered container. The theory is that in a relatively closed environment, moisture from the meat will be less likely to turn to steam and exit the meat. This idea is reminiscent of high school physics lessons: In a large, hot oven, the meat will lose a great deal of moisture in order to create equilibrium while in a smaller environment less water is likely to be released.

When we tested a covered roast, however, we found a slight loss in flavor caused by the fact that the outer crust did not brown sufficiently. Because we did not experience any significant improvement in juiciness or the texture of the interior of the roast when roasting covered, it seemed like a poor idea. These results confirmed our basic understanding of meat cookery, which is that the final temperature of the meat fibers and the quality of the cut, not the moisture content of the surrounding environment, are the determining factors in juiciness and texture.

We then wanted to determine the optimum amount of time a roast should sit after coming out of the oven. We let a roast sit for half an hour, testing it every five minutes until reaching the thirty-minute point. Twenty minutes—the amount of time suggested by most cooks—turned out, in fact, to be the proper waiting period. At that point, the roast was succulent, tender, and juicy, with more flavor than it had in previous tastings. Additional sitting time did not prove helpful to

The Science of Roasting

Natural proteins, such as those found in beef, consist of many separate, coiled molecules. Bonds across the coils hold the protein together in a single unit. When the proteins are heated, however, some of these bonds break, causing the protein molecules to pop loose and unwind (this process is called denaturing). Almost immediately, these unwound proteins bump into each other and bond together. This process is the essence of cooking proteins. It is perhaps easiest to witness when you fry an egg and the white, which is translucent when raw, becomes opaque as it cooks. This change occurs because, while there is plenty of room for light to pass between the natural, bound protein molecules in the raw state, when these proteins become denatured in the heated state, they coagulate (join together) to create a dense, opaque structure.

The relevance of this process to the cooking of meat is that during cooking, these proteins also shrink. The way in which they shrink depends on how hot they are. Under 120 degrees, muscle proteins contract in diameter; over 120 degrees, these proteins start to shrink in length, expelling juices. Because more water is lost when the proteins shrink in length rather than diameter, meat tends to dry out rapidly as it is heated above 120 degrees. The process is much like the wringing of a wet towel. The meat proteins get shorter and tighter, expelling more and more water. And because meat is 75 percent water, there is a dramatic change in texture and juiciness during the cooking process from raw all the way to well done. A roast can lose 30 percent to 40 percent of its weight by the time it reaches an internal temperature of 170 degrees, the point at which the meat is inedible and no additional liquid will be lost. (Cut into a piece of well-done meat, for example, and you'll notice that it will exude no juices.)

The good news, however, is that during cooking the connective tissues (collagen) in the meat start to turn soft and jellylike and act as a lubricant. So as the meat cooks, it is getting both tenderer and tougher at the same time. The trick is to find the point at which the tissue softening is maximized and the juice loss is minimized. The maximum benefit in terms of texture occurs when fatty beef, for example, is cooked to a final temperature of 130 to 140 degrees, the temperature at which the connective tissues start to gelatinize but relatively little juice has been squeezed from the meat.

the texture or flavor.

Next we tested the effect that a moderate amount of aging would have on the meat. Meat is aged to develop the flavor and improve the texture. This process depends upon certain enzymes whose function, while the animal is alive, is to digest proteins. After the animal is slaughtered, the cells that contain these enzymes start to break down, releasing the enzymes into the meat where they attack the cell proteins and break them down into amino acids, which have more flavor. In addition, the enzymes also start to break down the muscles, so the tissue becomes softer. This process can take from one to several weeks. (To age meat for more than a week, however, it must be done under carefully controlled conditions—it should not be done at home.)

To test aging meat at home, we placed a large eye round roast in the refrigerator, uncovered, on a rack above a pan. Each day we sliced off a piece, browned it for five minutes in two tablespoons of olive oil, and then roasted it in a 200-degree oven until the meat reached an internal temperature of 130 degrees. We found that the process does indeed have a tremendous effect on texture and flavor. In order to achieve this effect for the size of roast we were testing, though, the meat needed to sit for four days. After one day, the meat was flavorful and very juicy, but somewhat chewy. On the second day, it was slightly less chewy than the previous day, with the same amount of flavor. After three days, the meat was more tender, had better flavor, and was still juicy. On the fourth day, we hit the jackpot: The meat was still very juicy, extremely tender, and had a terrific, melt-in-your-mouth flavor. This was a winner. Aging the roast for more days did not seem to improve taste, texture, or juiciness.

So four days proved the optimum. Aging the meat for one or two days in the refrigerator, as most cookbooks advise you to do, is insufficient to develop flavor and texture fully. Although it obviously takes advance planning to age your meat for four days, this simple technique dramatically improves the flavor and texture of an inexpensive roast of beef.

SLOW-ROASTED BEEF WITH RED WINE PAN JUICES

Serves 6 to 8

If you have time, refrigerate the roast on a wire rack set over a paper towel–covered plate for four days. This aging process delivers a tender, more flavorful roast. Make sure, however, that before roasting you trim off the parts of the roast that have dehydrated and turned leathery. Tying the roast makes it compact and evenly shaped. Leftovers from a roasted cut of round, by the way, make excellent roast beef sandwiches.

- 1 boneless beef roast, 3 to 4 pounds (*see* "The Best Cut for a Cheap Roast," page 11), aged if possible (*see* note, above) and tied crosswise with twine every inch, then tied lengthwise once or twice
- Salt and ground black pepper
- 2 tablespoons olive oil
- ⅓ cup full-flavored red wine
- 1 cup low-sodium chicken or beef broth

1. Heat oven to 250 degrees. Sprinkle roast with salt and pepper as desired. Heat oil over medium-high heat in Dutch oven or large, heavy, ovenproof pot. Add roast; sear until brown, about 4 minutes each side.

2. Transfer pot to oven and cook, uncovered, until meat thermometer inserted into thickest part of roast registers 110 degrees, 45 minutes to 1 hour. Increase oven temperature to 500 degrees and cook until internal temperature reaches 130 degrees, about 15 minutes longer. (Cooking times will vary depending on size and shape of roast.) Remove roast from pot; let stand 20 minutes before carving.

3. Meanwhile, set pot over medium-high heat; spoon all but 1 tablespoon fat from pot. Add wine, stirring pan bottom with wooden spoon to loosen brown bits; simmer until wine reduces to glaze—about 2 minutes. Add broth; simmer until sauce reduces and thickens slightly, 1 to 2 minutes longer. (For pan juices with a little extra body, juices can be thickened at this point with 1 teaspoon cornstarch dissolved in 1 tablespoon water.) Cut roast into thin slices, adding meat juices to pan juices. Serve immediately with juices passed separately. ■

The Incredible Shrinking Flank Steak

To demonstrate the fundamental theory proposed by this article—that oven temperature is as important as the final internal temperature of the meat—we purchased two flank steaks and cut the first one into four 1-inch-wide pieces. One raw piece was removed and reserved, and the remaining pieces were then roasted at 250 degrees. We removed the strips from the oven at different internal temperatures starting at 120 degrees and increasing to 180 degrees. We then placed the cooked strips on a cutting board and compared them (left column in illustration, below). It was quite clear that the strip cooked to 180 degrees (top strip in left column) had shrunk (signifying a loss of juiciness and tenderness; *see* "The Science of Roasting," page 20) about 30 percent as compared to the raw strip. However, the strip cooked to 120 degrees had very modest shrinkage, about 10 percent. We repeated this test with the second flank steak (right column in illustration) but used a higher oven temperature, 375 degrees. The results were remarkable. Even the piece cooked to 120 degrees had shrunk a good 25 percent as compared to the raw piece. So lower oven temperatures will indeed cause meat to shrink less, even when it is cooked to the same internal temperature.—*C.K.*

250 Degrees Versus 375 Degrees: When roasted at 250 degrees (left column), flank steak shrinks less than at 375 degrees (right column). However, regardless of oven temperautre, meat shrinks more when roasted to an internal temperature of 180 degrees (top row) versus 120 degrees (bottom row–the middle row was roasted to 150 degrees).

Roasts Cooked at Changing Oven Temperatures

Bottom round roasts were browned on top of the stove in a Dutch oven and then transferred to a heated oven and roasted uncovered at changing oven temperatures until the internal temperature reached 130 degrees. Each roast weighed two pounds.

OVEN TEMPERATURE	COMMENTS
Constant 250 degrees	Evenly cooked, tender, and juicy. Exterior still lacking in flavor, however.
350 degrees until internal temperature reaches 110 degrees; remove from oven for 30 minutes; return to oven and cook until done.	Absolutely the worst method of all. Very uneven cooking. A large portion of roast overcooked by the time the internal temperature reached 130 degrees.
400 degrees for 15 minutes; reduce oven to 200 degrees until done.	Good texture and flavor inside and juicy. Outer layers of meat overcooked, however.
250 degrees until temperature reaches 110 degrees; increase oven to 500 degrees until done.	Excellent flavor, juicy, and tender. Wonderful contrast of texture and taste from outside to inside. A winner.