



# MEAT

Let's Cook It Right!

---

Questions and Answers  
about Cooking MEAT,  
POULTRY and FISH

EXTENSION BULLETIN 520  
Home & Family Series - May 1966

Cooperative  
Extension Service  
MICHIGAN STATE  
UNIVERSITY  
East Lansing

# MEAT

## Let's Cook It Right!

By Anita Dean and Muriel Brink Extension Specialists in Foods and Nutrition

---

An ample supply of meat helps provide American consumers with one of the most nutritious diets in the world. Meats are important nutritionally for the amounts and quality of the protein they provide as well as being sources of iron, B-vitamins and energy.

Its delicious aroma and flavor along with a lasting feeling of satisfaction after a meal account for meat's popularity. Generally it is the first choice when planning or ordering a meal. Meat commands a higher proportion of the family food dollar than is required for other foods of similar nutritive value.

What homemaker doesn't rate herself as a cook on the quality of her roast beef? A homemaker's objective often is to match the prime ribs served at a

favorite restaurant. An appreciation of the above factors can help her approach this ideal.

Today's basic cookbooks supply excellent tested recipes as well as descriptions of cooking techniques. Commercial companies offer directions for preparing their product either on the label or in inexpensive leaflets, some of which are listed on page 8. We have tried not to duplicate this information. The questions and answers which follow will help you understand why meat, fish, and poultry are cooked according to certain recommended practices.

Cooking is more interesting when you appreciate the reasons for the recommendations. As your understanding increases, you may gradually be able to free yourself from complete dependence on recipes.

---

### Question

### Answer

## TENDERNESS

1. When I shop for meat, how can I tell what is tender and what isn't?

1. Check the grade of meat on the label or ask the butcher. USDA beef grades of *prime*, *choice*, *good*, and *standard* come from young animals and are more tender than lower grades. Most meat at the supermarket is *choice* and *good*. Grades may also be listed according to the packer's grades and retailer's brands. (See Extension Folder 306, Food Shoppers Guide, page 9-10).

Identify the meat cut—round steak for example—and consider the location from which it was cut—the hind leg of the animal. Muscles exercised frequently, such as the neck and legs, are less tender because exercising makes them large and strong, and they are held together by a fairly large proportion of thick connective tissue. In contrast, the tenderloin under the back bone has had very little exercise, and has small, short fibers and very little connective tissue.

2. How is tender meat different from less tender meat?

2. Muscle structure affects tenderness. A muscle is made up of bundles of fibers. Each fiber, each bundle of fibers, and each muscle is surrounded by its own type of connective tissue.

The amount and kind of connective tissue influences tenderness and method of cooking. *Collagen* and *elastin* are the basic forms of

## Question

3. How do packers tenderize meat?

4. What are some other commercial tenderizers?

5. How effective are the commercial tenderizers available at the supermarket?

6. Does *papain* tenderizing occur before or during cooking?

7. Can enzyme-treated meat become too tender and mushy or crumbly?

## Answer

connective tissue. Muscles containing a low ratio of connective tissue are tender. Collagen in muscle structure gives a less tender cut; a high ratio of elastin in muscle structure gives a tough cut which will not become tender during cooking.

Meat with slender fibers is often more tender than meat with thicker fibers. The diameter of muscle fibers depends on heredity, exercise, age of animal, and the specific muscle.

3. Aging or ripening is a tenderizing process used by packers. In aging, the natural enzymes in meat make it more tender and juicy and improve its flavor. Animal muscles become rigid soon after slaughtering, (the condition known as rigor mortis). Meat or poultry cooked or frozen while the muscles are still rigid will be tough. After rigor passes, meat gradually becomes more tender. If meat or poultry is frozen while in rigor, the tenderizing process stops but is resumed on thawing, although final tenderness may be reduced.

Pork, lamb, and veal are marketed immediately after the passing of rigor. Higher grades of beef, with a good covering of fat, are usually held two weeks at 35° F. Some manufacturers shorten the aging time by increasing the temperature and controlling bacterial growth with ultra-violet light. Most beef reaches the consumer within ten days after slaughter.

4. Some meat packers inject an enzyme solution into the jugular vein of beef animals about ten minutes before slaughter. Enzymes are a part of all living cells and speed up chemical reactions, but are not changed themselves during the process.

Beef treated this way is more uniformly tender than meat sprinkled with a powdered form of tenderizer. Injection also improves the quality of lower beef grades and makes the cuts from higher grades more uniformly tender.

The trade name, "Pro-Ten", represents USDA grades of *prime*, *choice*, and *good*. The trade name, "Tendered" is used for USDA *standard* and *commercial* grades of beef. The added enzyme has no effect on the meat until it is cooked.

5. Most commercial tenderizers contain the enzyme, *papain*, which comes from the green fruit of the papaya plant. The powdered form has a limited effect, especially on large pieces, since it does not penetrate deeply into the meat when applied to the surface only.

"Forking in" helps the enzymes get into the meat for more even tenderizing, but reduces juiciness when the treated meat is braised. Powdered tenderizers are more effective on thinner cuts of meat, such as round steak.

6. The greatest tenderizing occurs during cooking, with the greatest tenderizing action of *papain* at temperatures between 140° and 176° F. (rare to well done). The enzyme is inactivated by the time the meat reaches the well done stage.

7. Yes. Overtenderization may result from:

- too much enzyme
- using enzymes on tender or cube steaks
- holding temperature of the enzyme-treated meat for a long

## Question

8. Can you tenderize meat by marinating it?
9. What happens to meat during cooking?

## Answer

period in the range (140° to 176° F.) These temperatures may occur when rare beef is held warm for serving.

8. Yes, as in a sauerbraten with a large amount of vinegar in the marinade, but very little in marinades with small amounts of vinegar. Sour cream, tomatoes, or acid fruit juices, however, may add special and unusual flavors. Table salt has a slight tenderizing effect.

9. Cooking develops flavor, affects tenderness, and may sterilize meat. Cooking changes most of the muscle structure. Meat contains muscle tissue, connective tissue (white—*collagen* and yellow—*elastin*), fat and water.

**Proteins** in the muscle fibers are coagulated by heat, causing a progressive increase in firmness. This explains why raw meat is more tender than cooked meat. Rare beef is generally more tender than well done beef.

**Collagen** heated in the presence of liquid changes to gelatin. This is a tenderizing process. Connective tissues within and around muscles, in skin, and in bone, contain more collagen than elastin.

**Elastin** is relatively unchanged by heat or moisture.

**Fat** melts and blends with liquid from the muscle tissue during the cooking process.

**Water** evaporates during cooking, which together with changes in protein and fat, causes shrinkage.

# PREPARATION

1. What are some factors that affect cooking time?

1. **Cooking temperature**—A slight change in temperature affects the time needed to cook meat to a certain degree of doneness.

**Method of cooking**—Broiling, pan-broiling, and frying are quick methods of cooking meat by dry heat.

**Size and shape of cut**—In general, the larger the cut, the fewer minutes per pound are required to cook it. However, a chunky cut requires longer cooking than a flat, thin one of the same weight.

**Style of cut**—A standing rib roast cooks in considerably less time than if it is boned and rolled. As much as 5 to 10 minutes per pound more time may be necessary to cook the rolled roast. Weight, surface area, and the shortest distance to the center of the thickest portion must be considered.

**Degree of doneness desired**—A six-pound standing rib roast requires 2 1/4 hours to reach 140° F. (rare), 2 1/2 hours to reach 160° F. (medium), and 3 1/4 hours to reach 170° F. (well done).

**Composition of the meat**—The amount of fat covering a roast affects cooking time—the more fat, the faster the roast cooks after the fat begins to melt. Melting fat is an excellent conductor of heat. It also prevents some evaporation.

**Initial temperature of the meat**—Cooking takes more time when the initial temperature of the meat is low than when it is higher. Meat still frozen when cooking is started requires a long cooking time; part of the heat is used to melt the ice before the temperature can rise above the freezing temperature of meat.

## Question

2. Why are low temperatures generally recommended for cooking meat, fish, and poultry?

3. What is the relationship between cooking losses and lower temperatures, below 325° F?

4. What are the results of cooking meat at high temperatures (425° to 450° F.)?

5. What are some cooking methods recommended for tender cuts?

6. What cooking methods are generally recommended for less tender cuts?

7. Can less tender cuts of beef such as chuck and rump roasts be dry roasted?

8. Some recipes call for "searing" to achieve a nicely browned product. Is this necessary?

9. What is the best way to tell when a roast or turkey is done?

10. Why must pork be cooked to the well-done stage?

## Answer

2. Low temperature results in more uniformly cooked meat, juicier, more tender meat, fewer and better drippings, less watching during cooking, less work in cleaning the oven, and more easily carved meat. In general, you will have more meat to serve and it will be more attractive.

3. Oven temperatures below 325° F. lengthen cooking time and cause greater cooking losses. Oven temperatures below 300° F. are not recommended for the average homemaker's use because of inaccuracies in the oven thermostats. Equipment manufacturers are developing ovens which will maintain accurate low temperatures.

4. High temperatures result in greater losses and fewer servings, which increases the cost per serving. The meat will be less tender and juicy, and drippings will be less palatable.

5. Dry heat methods including broiling, pan broiling, roasting and frying.

6. Moist heat methods including braising, stewing, pressure cooking, or cooking in water. Meat which has been wrapped in foil is steamed and, therefore, a form of moist heat cookery.

7. These cuts traditionally have been braised, rather than cooked by dry heat. Studies have shown that most people prefer oven-roasted to pot-roasted or braised beef. A recent study has shown it may be possible to use the dry heat methods on the less tender cuts of meat. Choice grade blade or rump roasts roasted at either 325° F. or the very low temperature of 225° F. tended to be more juicy and as tender as the comparable braised cuts.

8. It's optional. Place the meat on an open pan in a very hot oven for a few minutes; then either reduce the heat or remove the roast to a cooler oven. The theory behind this method was that the initial high oven temperature would form a crust on the meat to hold in the juices. However, studies show that meat roasted at a constant oven temperature shrinks less during cooking than seared meat. Searing did not increase the palatability of the roasts, but did give a browner crust. Roasting at a constant oven temperature (300° to 350° F.) is more convenient and results in a nicely browned roast with better drippings.

9. A meat thermometer is the most accurate guide to the stage of doneness of meats, such as roasts, thick steaks and chops, and turkeys. The temperature inside the meat, as recorded on the meat thermometer, shows exactly how done the meat is. Beef is roasted or broiled to rare, medium, or well done (internal temperature of 140°, 160°, and 170° F. respectively). This takes the guesswork out of determining the degree of doneness. Time-weight tables are also useful guides for scheduling meat preparation. Since the temperature of roasts and poultry continues to rise after the meat has been removed from the oven, it is a good idea to remove roast meats and poultry from the oven about 15 to 30 minutes before carving and serving. This allows the meat to "set" and permits easier carving.

10. Fresh pork is cooked well done for sterilization and for development of full flavor. Although sufficiently tender and low in

## Question

## Answer

connective tissue to be broiled, small cuts are more successfully braised because slow cooking develops more flavor than does rapid cooking. In recent studies rib and loin pork roasts cooked to 170° F. required less cooking time, had greater cooked meat yields, were juicier, and were comparable in flavor and tenderness to roasts cooked to 185° F. This is well above 137° F.—the temperature that kills the parasite, trichinae, which causes trichinosis. Not all pork loses its pink even when well done.

The National Live Stock and Meat Board now recommends that fresh pork be cooked to a lower internal temperature of 170° F. rather than the previously recommended 185° F. Cured pork products including bacon can be cooked to a somewhat lower temperature than fresh pork, but should be cooked to an internal temperature of at least 145° F. With the exception of bacon, these products have been brought up to 142° F. during processing. Temperature of 160° F. is recommended for "Cook Before Serving" hams and 125° to 130° F. is recommended for "Fully Cooked" hams (which includes all canned hams). Read labels carefully for special instructions in cooking.

11. What method of cooking is usually recommended for veal? Why?

11. Veal (from the calf), is treated somewhat differently because of its lack of fat, and relatively high proportion of connective tissue. In order to prevent excessive drying and to soften connective tissue, braising rather than broiling is recommended for small pieces. Fat from other sources may be added to compensate for lack of fat and to strengthen the mild flavor. Long, slow cooking is especially important in order to soften connective tissue. For this reason, veal is roasted at a temperature not exceeding 300° F. and is not served rare.

12. What cooking methods are recommended for lamb? Why?

12. Because of tenderness, lamb cuts which for other kinds of meat are cooked by moist heat may be cooked by dry heat methods. Lamb roasts and chops are cooked either well done or medium by dry heat methods. The fell (paperlike membrane) covering the lamb carcass usually is left on a leg during roasting. *Mutton cooks better with moist methods* because it is stronger in flavor and less tender.

13. Which types of variety meats are tender or less tender?

13. Brains and sweetbreads are extremely tender.

Liver and lamb kidney are tender.

Heart and tongue and beef kidney are the least tender.

14. What causes cooked liver to be dry and tough?

14. Overcooking. Most liver is cooked sufficiently when the color changes. Cooking time may be as short as 5 minutes for thinly sliced liver.

15. How can you tell when fish is well done?

15. The most important thing to remember in cooking fish is that too often it is over-cooked. Fish is done when its protein has set or coagulated. At this stage the flesh flakes easily when tested with a fork, and it will be moist and tender, and have a delicate flavor. Many small fish require less than ten minutes total cooking time. Overcooked fish and shellfish are tough and dry.

16. Are there advantages to wrapping roasts and turkeys in foil before baking?

16. None, except shorter cooking time. But there are distinct disadvantages in terms of (1) increased weight loss due to cooking, (2) greater fuel consumption, and (3) steamed flavor. Aluminum foil

## Question

17. Is it necessary to thaw frozen meat before cooking?

## Answer

acts as a heat insulator equivalent to lowering the oven thermometer approximately 75° F.

17. Roasts can be cooked from either the frozen or thawed state. If roasting from the frozen state, place directly into the oven and allow one-third to one-half again as long for cooking or roasting fresh or thawed meat. Breading will adhere better to thawed cuts. Thin cuts can be cooked from either a frozen or thawed state.

# COOKING METHODS

1. Why do cured meats retain their red color after cooking?

2. Why does some well-done poultry and well-done roast meat still look slightly pink? My family objects to this color.

3. What causes the bones of some frozen chickens to darken?

4. What causes color to change in some frozen turkeys?

5. What nutrients are supplied by the meat group?

1. Nitrites (chemical compounds) used in curing meats act on the substance called *myoglobin* in the meat to form the pigment characteristic of ham, corned beef, and other cured meats. This pigment remains red during cooking but may turn brown when the meat is exposed to light and air.

2. The pinkish color in well-done roast meat and poultry is not a sign of under-doneness or poor quality. It develops when meat or poultry is cooked uncovered by dry heat, either in an oven or over an open fire. Certain substances in the atmosphere of a heated gas or electric oven or in the hot air of an outdoor fire may react chemically with the pigment in the meat or poultry to produce a heat stable pink or red color. These substances are the same as those that give a reddish color to smoked ham and other cured meats. The meat of present-day young, thin-skinned chicken or turkey tends to develop pink color. This pink color is not related to doneness.

3. Freezing and thawing cause the pigment to leach out of the bone marrow. The dark color is formed during cooking. It is more apt to occur in broilers and fryers than in older birds because of the less advanced stage of bone development in the young birds at time of freezing.

4. A reddish brown color may result from lack of finish or fat, slow freezing, or poor bleeding in the initial stages of processing.

A blackish or reddish color may be the result of bruising during handling and processing. Bruises may look reddish in color in the early stage and turn dark blue and black later. They are similar to black and blue bruises on humans caused by coagulated blood. A bird bruised one week before slaughter will develop blue or blackish bruises. Slaughter and processing bruises are reddish rather than blackish. Turkeys with such bruises may not be sold as Grade A.

"Freezer burn" due to inadequacy of wrap as a moisture barrier permits moisture to escape from frozen meat.

5. Meats are important as suppliers of quality protein. Two servings of foods from the meat group contribute about half the protein recommended for one day for an adult. The rest comes from other foods of the other groups primarily milk, breads, and cereals. The

## Question

6. What vitamins are lost during meat cookery?

7. Does the method of preparation influence the calorie value of meat?

## Answer

meat group as a whole is also valuable for iron, B vitamins, thiamine, riboflavin, and niacin. It is depended on to provide about half the iron recommended daily.

6. Losses are greater for thiamine than for other B vitamins (B6, Riboflavin, Niacin, Pantothenic acid) because it is more sensitive to heat. Thiamine is retained better in beef cooked rare than well done, in meat roasted at low rather than high oven temperatures, and in meat cooked for short periods. The drippings of braised and stewed meat contain a substantial portion of B vitamins of meat. This is of little significance if all the broth is used with the stew. Higher retentions of thiamine are associated with shorter cooking times being highest for frying, intermediate for broiling and lowest for braising.

7. Calorie value of meat can be reduced by trimming fat. For example, three ounces of broiled sirloin steak including lean and fat yields 330 calories. When the visible fat is trimmed away, the remaining 2 ounces of lean steak furnishes only 115 calories. This difference of 215 calories is important to the calorie conscious person. The fat which accumulates in the pan during cooking is also a concentrated source of calories to be considered.

## Recommended Reading

1. The Experimental Study of Foods, Ruth M. Griswold, Houghton Mifflin Co., Boston, 1962.

2. Handbook of Food Preparation, American Home Economics Assoc., 1600 Twentieth Street, N.W., Washington 9, D.C.

3. Food Shopper's Guide, F 306, MSU Bulletin Office, P. O. Box 231, East Lansing, Mich.

4. Home Canning of Meat and Poultry, G 106, Office of Information, U.S. Department of Agriculture, Washington, D.C. 20250.

5. Freezing Meat and Fish in the Home, G 93, Office of Information, U.S. Department of Agriculture, Washington, D.C. 20250.

6. Home Freezing of Poultry, G 70, Office of Information, U.S. Department of Agriculture, Washington, D.C. 20250

7. Turkey on the Table the Year Around, G 45, 1961, Office of Information, U. S. Department of Agriculture, Washington, D. C. 20250. (15c)

8. Tips on Cooking Fish and Shellfish; Fish Recipes from the Great Lakes; Basic Fish Cookery — Test Kitchen Series 2,

(25c) U. S. Department of Interior, Fish and Wildlife Service, Washington 25, D. C.

9. Facts About Meat — Information on how to select meat, care for it, and cook it correctly; Lessons on Meat — A source book for professional use; 101 Meat Cuts — Identification of Meat Cuts and cookery methods for each\*; Meat Carving Made Easy — Clear, concise instructions on how to carve meat\*; National Livestock and Meat Board, Home Economics Department, 36 South Wabash Ave., Chicago, Illinois 60603.

10. How to Select and Cook Ham, American Meat Institute, 59 East Van Buren Street, Chicago, Ill.

11. Leaflets on buying and cooking lamb, American Sheep Producer's Council, 18 East 2nd Avenue, Denver 3, Colorado.

12. Cooking the Big and Small Turkey\*, Broiler—Fryer—The All Purpose Chicken\*, A Scientist Speaks About Chicken\*, How to Carve Turkey\*, Turkey Comes Apart for Faster Cooking\*, Prize Winning Chicken Recipes\*; Poultry and Egg National Board, 8 South Michigan Ave., Chicago, Ill. 60603

\*Publications from non-government sources are for sale.

*The authors wish to thank Mary Morr, Assistant Professor of Foods and Nutrition, Michigan State University, for her valuable suggestions in the preparation of this publication.*

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U. S. Department of Agriculture, N. F. Rabton, Director, Cooperative Extension Service, Michigan State University, E. Lansing, Mich.

2P-7-66-70M-HO