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Amount of Fat and Cholesterol in Meat

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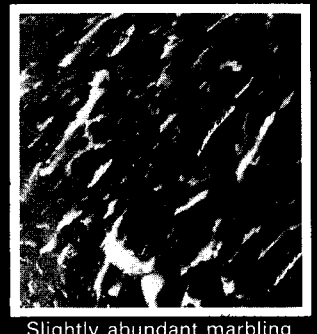
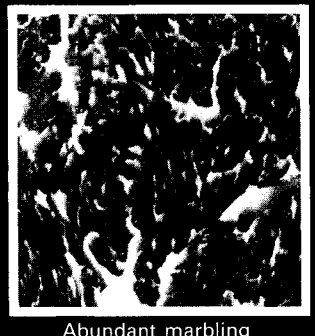
Slight marbling

Modest marbling



Slightly abundant marbling



Abundant marbling

MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AGRICULTURE

Amount of Fat and Cholesterol in Meat

On the cover: The photographs on the left are examples of four degrees of marbling in beef. They illustrate variations in fat content of a specific muscle because of quality grade. The photographs on the right are examples of three beef carcass yield grades. They illustrate how fat to lean ratios can vary in a specific cut prior to trimming.

Many consumers of meat and meat products are concerned about fat and cholesterol content. This folder points out how fat and cholesterol vary among types of meat and how to select meat that varies in fat and caloric content. It does not attempt to list the fat and cholesterol content of every available meat and meat product since such detailed information is available from references listed on the last page.

What is Fat?

Fat is adipose tissue deposited around, between, and within muscles of meat animals during growth and development. Fat is a very concentrated form of energy: it contains about 2.25 times more energy than protein and carbohydrate. Fat is a major component of meat. Other components include water, protein, vitamins, and minerals.

Fat Type

All fat is not alike. Fat is made up of connective tissue and lipids, such as various fatty acids, that consist of carbon, hydrogen, and oxygen atoms. If all carbon atoms are joined by single chemical bonds, the acids are called saturated acids. If one or more double bonds occur on the chain of carbon atoms, the acid is unsaturated, has a lower melting point, and is more oily. So, unsaturated acids with double bonds become "saturated" with hydrogen into single bonds when hydrogen atoms are added to them in the normal metabolism of the animal.

Table 1. Percentage of saturated fatty acids and unsaturated fatty acids in the fat of meat*

Species	Total saturated fatty acids	Total unsaturated fatty acids	Ratio of unsaturated/ saturated fatty acids
Lamb, cooked, separable lean	56	44	.78
Veal, cooked, separable lean	48	52	1.08
Beef, Choice, cooked, separable lean	45	55	1.22
Pork, fresh, cooked, leg, loin and shoulder, separable lean	38	62	1.63
Chicken fryers, cooked, flesh, skin, and giblets	30	70	2.33
Turkey, all classes, total edible, raw	29	71	2.45

*Lamb, veal, chicken and turkey data from *Nutritive Value of American Foods in Common Units*. Agriculture Handbook 456. Beef data from USDA Handbook 8-13. Pork data from USDA Handbook 8-10.

Animal fat contains a higher proportion of saturated fatty acids than does most fat from plant sources. Table 1, however, shows animal fats are not all saturated and the proportion of saturated fat to unsaturated fat varies with the animal. Of the red meats, lamb fat is the most saturated and pork fat is the least saturated. This is why lamb fat is hardest at room temperature, pork fat is softest, and beef fat is in-between. It also is the reason why pork cannot be stored in the freezer as long as beef or lamb.

All fatty acids do not have the same effect in the body. Stearic acid is one of five saturated fatty acids present in beef. It represents 31 percent of the saturated fatty acid total. Recently, stearic acid is thought by some researchers to have a cholesterol-lowering effect in the body.

Fat in the Diet

Since 1967, total per capita consumption of oil and fat in the U.S. has significantly increased (see Figure 1). This increase is due to increased consumption of vegetable oils (154 percent of 1967 values), primarily salad and cooking oils. Consumption of animal fats (primarily lard and butter), has decreased (84 percent of 1967 values).

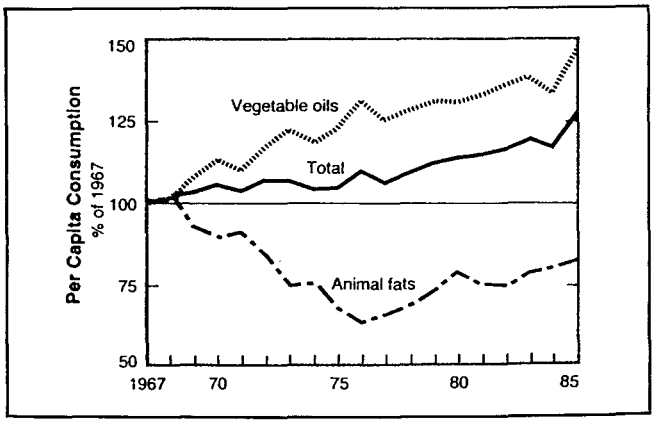


Fig. 1—Changes in the Per Capita Consumption of animal and vegetable fats and oils in the U.S. by year. From USDA (1986). Animal fats include butter.

Fat Amount

Many factors influence the total fat content of meat, including the definition of meat, meat grade, cut-to-cut variation, muscle-to-muscle variation, level of visible intramuscular fat within the lean (marbling), method of cooking, and degree of doneness.

Some published values of meat composition are not realistic for consumer purposes. For example, values of 24 and 23 percent fat, respectively, in the entire beef carcass of Choice and Select grades are almost meaningless for consumer purposes. These values are derived from all fat present in the carcass, yet much of this fat is trimmed before it goes to the meat counter, and many individuals do not eat much of the fat remaining on the meat after cooking. When the carcass is trimmed of all fat, the composite of all the cuts from Choice and Select grade beef carcasses have a total fat content of 7 and 5 percent, respectively.

Fat content varies considerably from cut to cut. For example, a Choice beef round has a total edible tissue (fat and lean) fat content on a raw basis of 12.3 percent, while a wholesale rib from the same carcass has a fat content of 37.4 percent (as listed in Composition of Foods, Agriculture Handbook 8).

These values for wholesale cuts' fat content are misleading to consumers who do not eat all the fat present in the cut.

Specific muscles within the same carcass vary in fat content. The muscle-to-muscle variation in fat content is apparent (table 3, reading across). The top loin with a modest (Choice) amount of marbling has 6.0 percent fat, while the corresponding top round has 3.7 percent fat. The amount of marbling or visible intramuscular fat within a muscle (see cover photos) also influences the fat content (table 3, reading down). The variation in marbling also influences caloric content (table 3, reading down).

Table 3. Muscle-to-muscle and marbling influence on fat and caloric content of raw beef*

	Longissimus muscle (large muscle in top loin)		Semimembranosus (top round)	
Marbling level+	Percent fat	Calories per 100 grams (3½ ounces)	Percent fat	Calories per 100 grams
Slight (found in Select)	3.4	119	2.8	114
Modest (found in Choice)	6.0	140	3.7	121
Slightly abundant (found in low Prime)	8.6	161	4.6	128

*Longissimus muscle data from *J. Food Science*, 51:838. Semimembranosus data from *J. Animal Science*, 27:1532.

+The marbling levels in beef are devoid, practically devoid, traces, slight, small, modest, moderate, slightly abundant, moderately abundant, and abundant (see cover photos). A recent report to a National Academy of Sciences Committee indicated that beef with a "minimum traces" level of marbling contains 1.74 percent fat and each degree of marbling above that adds 1.27 percentage units of fat.

Table 4. Influence of marbling on fat and caloric content of raw pork*

	Longissimus muscle (Large muscle in pork loin chops)	
Marbling level	Percent fat	Calories per 100 grams
Devoid	3.1	116
Slight	3.7	121
Modest	5.0	131
Slightly abundant	6.9	147
Abundant	10.4	175

**Journal of Food Science*, 29:70.

The data in tables 3 and 4 substantiate that consumers can purchase meat with widely varying fat and caloric content by selecting various cuts or meat with various levels of marbling (see cover photos). For example, top round with slight marbling has 2.8 percent fat in the muscle, while top loin with slightly abundant marbling has 8.6 percent muscle fat. Selection of meat according to content of trimmable fat further varies the amount of fat in retail meat purchased (see cover photos).

The values in tables 3 and 4 mean most to consumers concerned about fat intake and calories. These values demonstrate how visual selection of cuts from the meat counter with different levels of marbling can markedly influence fat content and calories. Consumers concerned about these aspects should learn to evaluate cuts of meat for marbling content even though the meat already has been graded and trimmed of most extra fat.

Cooking procedure also can affect fat content (see table 5). Cooking effectively removes 8 to 10 percentage units of fat present in raw ground beef.

Table 5. Effect of commercial cooking method on composition of ground beef patties*

Cooking method	Grams of fat per 100 grams (3½ ounces) of product (Same as % of raw product)	Calories resulting from 100 grams (3½ ounces) of raw product and then cooked
Raw	18.1	237
Broiled	10.0	164
Grill fried	10.5	169
Microwaved	8.0	146

**Journal of Food Science*, 39:715.

Quantities of moisture are lost from meat during cooking. In extra lean beef patties, water loss is about 85 percent of the total cooking loss and fat about 15 percent. However, in regular ground beef patties, water loss is about 65 percent of the cooking loss and fat about 35 percent. This means as the fat content of ground beef increases, the cooking loss is made up more and more of fat. Conversely, as the fat content of ground beef decreases, the cooking loss is made up more and more of moisture. Although heavily marbled steaks lose some fat from the muscle, cooking does not remove significant quantities of fat from the lean portion of thick steaks or chops. Cooking does remove some fat from the trimmable fat portions of meat.

How much fat is necessary to insure adequate flavor, juiciness, and tenderness? Results from various consumer studies indicate that 3 to 7 percent intramuscular fat (slight to a moderate amount of marbling) is necessary for "acceptable" palatability of intact muscle meats; namely steaks, chops, and roasts. Marbling definitely is not a major factor in tenderness. The influence of marbling on meat enjoyment (flavor and juiciness) varies with such things as individual tastes, cooking methods, degree of doneness, and use of flavorings. Choose meat with various fat levels until you are satisfied with both taste and calorie content.

Minnesota rules and regulations require that ground beef contain no more than 30 percent fat; lean ground beef no more than 22 percent fat; and extra lean ground beef no more than 15 percent fat. Most consumers purchase ground beef according to intended use. For broiled patties, 30 percent fat content may be acceptable; 16 to 20 percent is recommended for medium to well done patties. At lower fat levels, the cooked product will lack juiciness. If the ground beef product is to go in a casserole or meat loaf, where most of the cooked-out fat still remains in the cooking container, extra lean ground beef (no more than 15 percent fat) should be selected. Most sausage items, such as frankfurters, have a 30 percent allowable fat maximum. Fresh pork sausage, however, can contain up to 50 percent fat although most contains 38 percent. Low fat sausage products are available.

What is Cholesterol?

Cholesterol is a compound in bile, gallstones, cell membranes, and especially nerve tissue. It is an essential constituent of body cells in animals and is synthesized in the human body. Because it is a component of all animal cell membranes, it is present at different levels in animal foods. Plant foods do not contain cholesterol.

The concern over cholesterol in food is controversial. An enormous number of studies on the dietary health effects of

lowering or raising blood cholesterol have been published in the scientific literature. The results are almost always debated among the scientific community. The debate centers around three issues: (1) What changes in diet, if any, result in lowering serum cholesterol in humans? (2) If serum cholesterol can be lowered by dietary means, does this lower the incidence of coronary heart disease? (3) Are there other factors such as genetics, stress, weight reduction, smoking, and exercise that are more important (or easier to achieve) in lowering the incidence of coronary heart disease?

Cholesterol Amount

The cholesterol content of different species of meat often is misunderstood. For example, data in table 6 indicate that veal and lamb have a higher cholesterol content than beef and pork.

Table 6. Milligrams of cholesterol in 100 grams (3½ ounces) of edible portion*

Beef, raw, Choice, separable lean	60
Pork, raw, leg loin and shoulder, separable lean	65
Lamb, raw, without bone	71
Veal, raw, without bone	71
Chicken, raw, flesh and skin	81
Turkey, raw, flesh and skin	74
Shrimp, raw, flesh only	150
Brains, raw	2,000

*USDA 8-13 for beef, 8-10 for pork and *Journal of American Dietetic Association*, 61:134, for other foods.

Cholesterol content of meat is affected by several other variables. For example, cholesterol values have been expressed on a wet basis (known as "as is" or "as consumed") and on a dry weight basis (to take into account differences in moisture content of various foods). One study (*Journal of Food Science*, 51:1162) compared cholesterol content of raw beef patties containing either 9.5, 21.0 or 28.5 percent fat. On a wet weight basis, the low fat patties had less cholesterol. However, on a dry basis, the low fat patties had more cholesterol. From a practical standpoint, cholesterol content based on dry weight is of little use since meat is consumed wet or "as is."

Cholesterol values are reported also on raw and cooked product. One study (*Journal of Animal Science*, 65:1531) reported a value of 63 mg cholesterol/100 g of raw beef muscle. When cooked, the value was 80 mg/100 g of cooked meat, which was 27 percent higher and proportional to the percentage cooking loss. The higher value in cooked meat is a result of an increase in concentration due mostly to loss of moisture during cooking and not an actual increase in the amount of cholesterol.

The trimmable fat (subcutaneous fat or fat on the edge of a steak) from a beef steak has been shown (*Journal of Animal Science*, 65:1531) to have more cholesterol (99 mg/100 gm) than the muscle portion of the same steak (63 mg). Another study (*Meat Science*, 47:1638) confirmed this difference. Thus, trimming fat off cuts of meat and discarding it would significantly reduce cholesterol intake.

Can cholesterol intake be reduced by choosing low-fat ground meat? In the above study with patties, cholesterol content of cooked patties was not different across the three fat percentages. This was explained by a greater amount of cholesterol found in the cooking drip in high-fat patties compared with low-fat patties.

Can cholesterol content be reduced by choosing meat with little marbling? One study (*Journal of Food Science*, 47:716) showed no difference in cholesterol content of cooked steaks that had varied widely in marbling level (Standard, Select, Choice and Prime) when raw. Although the cholesterol content of raw steaks was slightly higher in the more heavily marbled steak, these researchers explained that muscles with higher fat tend to lose more cholesterol during cooking through drippings.

Why is there a low correlation between fat content of raw muscle and the amount of cholesterol in cooked muscle (*Journal of Food Science*, 53:969)? Early work (*Journal of Animal Science*, 25:1145) demonstrated that marbling is low in cholesterol and most of the cholesterol within muscle actually originates from muscle cell membranes and intracellular structures. A more recent study (*Journal of Food Science*, 53:718) showed that when lipid is increased within muscle, as would occur as animals grow, cholesterol in the membrane component decreased while cholesterol in the lipid storage component increased. The result is no overall change in cholesterol content of muscle. This compensation through changes in subcellular distribution of cholesterol did not occur in adipose tissue (subcutaneous fat). Thus, cholesterol continues to be deposited in this tissue as animals grow and is the reason adipose tissue (trimmable fat) has more cholesterol than muscle tissue.

Removing trimmable fat from retail cuts prior to cooking has been shown to have negligible effects on the cholesterol content of cooked beef (*Journal of Food Science*, 50:1029) and cooked pork (*Journal of Food Science*, 53:1602). The greater benefit from such a practice appears to be elimination of the temptation to eat the cooked fat off the plate.

In any event, it should be emphasized that choosing meat with less marbling and not eating the trimmable fat on a steak or chop reduces the number of calories. Making these decisions may be the most important aspect of the presence of fat in meat and is more widely accepted as important to human health because calorie intake and obesity are strongly related.

Summary

Fat content in meat varies because of the definition of meat (whole carcass vs. trimmed cuts vs. separable lean). Fat content also varies from cut-to-cut, from muscle-to-muscle, with level of marbling, and with cooking method. Highly marbled, cooked meat does not contribute any more to cholesterol intake than does meat with little marbling, but the number of calories increases as marbling increases.

Detailed Composition Data

"Composition of Foods: Beef Products—Raw, Processed, Prepared." *USDA Agriculture Handbook* 8-13, 1986.

"Composition of Foods: Pork Products—Raw, Processed, Prepared." *USDA Agriculture Handbook* 8-10, 1983.

"Nutrient Composition of Lamb of Two Age Groups." *Journal of Food Science*, 49:1233, 1984.

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