

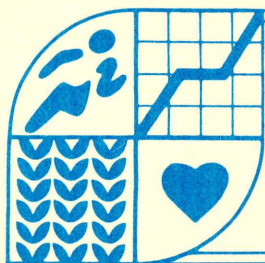
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Dietary Fat Nutrition & Your Health
Michigan State University Cooperative Extension Service
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Dietary Fat

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Fat is a vital nutrient in the human diet. Fat is the most concentrated source of energy, aids in the absorption of fat soluble vitamins A, D, E and K, and provides linoleic acid, an essential fatty acid. On an equal-weight basis, fat provides more than twice the energy of carbohydrate and protein—9 calories from a gram of fat, compared with carbohydrate and protein, which each have 4 calories per gram. (Alcohol contains 7 calories per gram.)

Changes in U.S. fat intake

Today, fat supplies about 37 percent of total calories in the typical American diet, compared with 41 percent in 1980. The United States Department of Agriculture (USDA), American Heart Association and American Cancer Society recommend that 30 percent of total calories be obtained from fat. Consequently, Americans still need to lower their fat intake. Fat is found in fats and oils used in cooking, as well as fat marbling in meat and oils in nuts and seeds.

About 90 percent of dietary fat comes from three categories of food: fats and oils; meat, poultry and fish; and dairy foods. Fruits and vegetables (except olives and avocados) and bread and cereals are very low in fat. The type of fat consumed in the typical American diet has been changing from animal

Percent of Fat from Selected Foods

Percent of Calories from Fat	Foods
100-90	Butter, margarine, oils, pecans, bacon, mayonnaise, lard, cream, baking chocolate, vegetable shortening, olives
90-80	Sausages, most salad dressings, corned beef, cream cheese, unsweetened coconut, walnuts, sesame seeds, California avocado
80-70	Almonds, spareribs, goose, American cheese, cheddar cheese, hotdogs, peanut butter, sunflower seeds, cashews, Florida avocado
70-60	Pork rib (lean and fat), potato chips, whole egg
60-50	Lean ground beef, round steak, doughnuts, peanut butter cookies
50-40	T-bone steak (lean only), roast leg of lamb, ice cream, pork chop, apple pie, french fries, frosted yellow cake, breaded-fried haddock, broiled trout, chocolate chip cookies
40-30	Beef liver, creamed cottage cheese, whole milk, broiled halibut, pound cake, oatmeal-raisin cookies, granola cereal
30-20	2 percent milk, veal, turkey (no skin)
20-10	Roasted chicken (without skin), crab meat, broiled flounder or sole, most breads
negligible amount	Skim milk, dry cereal, egg white, baked or boiled potato, bran flakes, pita bread, dry beans (cooked), fruits and vegetables (except avocados and olives—see above)

sources (mostly saturated) to vegetable sources (mostly unsaturated)—in part, because use of margarine and salad and cooking oils has increased.

Dietary fats— a closer look

What are fats?

Fats, also known as lipids, are chemical substances. They will not mix with water but do dissolve in other organic compounds, such as

alcohol and ether. Fats contain fatty acids that are made up of carbon, hydrogen and oxygen. The carbon is the backbone or skeleton of a fat. Fatty acids vary in the amounts of these three elements they contain.

Glycerides refer to fatty acid chains. They are composed of fatty acids and glycerol. Ninety percent of animal and vegetable fats found in food and fats in the body are triglycerides.

Though not a true fat in the chemical sense, cholesterol is usually grouped with fats because it has many characteristics that are

similar. MSU Extension bulletin E-2141, *Nutrition and Your Health: Cholesterol*, contains cholesterol information. Fat is part of almost all foods. Butter, lard, vegetable oils and margarine are nearly 100 percent fat. These are called "visible" fats. Fat found in whole milk, cream, ice cream, cheese, egg yolk, well-marbled meat, poultry skin, nuts, salad dressings, pastries, some baked products and food mixtures are hidden, or "invisible." Even when all visible fat is trimmed from meats, cooked lean meat still contains 15 to 35 percent fat. Well-marbled, prime (restaurant) or choice grades of meat furnish even higher amounts.

Types of fat

There are three types of fat, which are based on the makeup of their fatty acid chain—saturated, monounsaturated and polyunsaturated. The characteristics of a fat are determined by the kinds of fatty acids in its makeup. Liquid vegetable oils contain larger amounts of polyunsaturated fatty acids. Solid fats, such as lard and the fat in meat, egg yolks and dairy products, contain more saturated fatty acids. In general, vegetable sources of fat are polyunsaturated or monounsaturated, except for palm and coconut oils. Those oils come from vegetables, but are highly saturated. Animal sources of fat are saturated.

All fats, whether liquid or solid, are glycerides containing saturated, monounsaturated and polyunsaturated fatty acids. They differ only in the amounts of each fatty acid type.

What is saturation?

Saturation of fats refers to the number of hydrogen atoms attached to the fatty acid molecule. Compare the idea to a sponge that is dripping wet—it is completely saturated. In a fat, when every carbon has another carbon, hydrogen or an oxygen attached to all four sides, it is saturated.

Saturated fatty acids contain more hydrogen than unsaturated fatty acids.

What are unsaturated fats?

In each molecule of an unsaturated fatty acid, there is a double bond between two carbon atoms. The number of double bonds between carbon atoms determines the degree of unsaturation.

A monounsaturated fatty acid has a single (mono) double bond between carbon atoms. A polyunsaturated fatty acid has two or more (poly) double bonds. These double bonds are spaces, like a sponge, where more hydrogen can be added to the structure of the fatty acid.

Both the number of double bonds, and therefore, the amount of hydrogen and the number of carbon atoms in a fatty acid molecule are of special importance. Together, they influence the nature of fatty acids by altering the temperature at which they are liquid, or their melting point. Fatty acids with fewer carbon atoms tend to be liquid at room temperature. The more unsaturated fatty acids—those with less hydrogen, such as vegetable oils—have lower melting points and tend to be liquid. Saturated fatty acids, such as butter—with more hydrogen—are solid at room temperature.

The naturally unsaturated (low hydrogen) fatty acids, such as those found in vegetable oils, can be made more solid by "hydrogenation"—i.e., the double carbon bond can be broken and hydrogen can be added. This process converts liquid vegetable oils into solid fats such as margarines and shortenings.

Monounsaturated fatty acids are found in greatest quantity in two oils in American supermarkets—olive oil, and canola or edible rapeseed oil. Omega-3 fatty acids are found in the polyunsaturated portion of fish oils. The name "omega-3" refers to the fatty acids' chemical structure. In general, fish

contain more polyunsaturated fatty acids and less saturated fatty acids than meats.

What are phospholipids?

Phospholipids are a group of complex fats containing glycerides (glycerol and fatty acids) and phosphorus and nitrogen compounds. Phospholipids serve to distribute fats throughout water-based liquids, or emulsify them, during digestion and absorption. This emulsifying process breaks the fats up into small particles that the blood can carry. Lecithin is a phospholipid commonly found in animal and plant foods such as egg yolk, beef liver, meats, whole grains, legumes, milk and vegetables. It is also available as a commercial product.

Phospholipids are added in the commercial processing of certain foods because of their emulsifying property. Examples are egg yolk in mayonnaise, and soya lecithin in chocolate candy and some commercial baked products.

What is cholesterol?

Cholesterol is an alcohol compound found only in animal tissues. Cholesterol in the body comes from two sources: that made by the body and that consumed in foods of animal origin. Cholesterol is abundant in egg yolks, organ meats (liver, heart, kidney) and in nerve tissues such as brain. It is essential for the development of our nervous tissue, sex hormones, cell membranes and bile acids. Bile acids are important in the digestion and absorption of fats from the intestine. MSU Extension bulletin E-2141 contains more information on cholesterol.

Digestion and absorption of fats

Fats remain virtually unchanged in the mouth and stomach. Once a fat reaches the intestine, it is

emulsified with the help of bile from the liver and broken down chemically into small units. An enzyme called lipase, which is secreted by the pancreas, breaks down the fatty acid chains (glycerides) into fatty acids and glycerol.

Some fatty acids are absorbed through the intestinal wall directly into the bloodstream and are carried to the liver. Other fatty acids and monoglycerides are absorbed through the intestinal wall cells, where they are recombined into triglycerides. The triglycerides then combine with protein to form lipid/protein combinations called chylomicrons. Chylomicrons enter the lymphatic system and are carried in the lymph to the bloodstream and the liver. These triglycerides may be deposited eventually in body fat stores. Triglycerides in the bloodstream and adipose tissue can be broken down by the body and made available to other tissues as an energy source. Some dietary fat is essential to carry the fat-soluble vitamins and to ensure their proper absorption. During the process of fat absorption, fat-soluble vitamins are transported directly into the bloodstream from the intestine. A totally fat-free diet would not only be low in fat-soluble vitamins, but would also lead to faulty absorption of these vitamins.

Are fats necessary in your diet?

Dietary fat is a concentrated source of energy. It adds flavor and tenderness to foods. Because fat slows down the time it takes food to leave the stomach, a meal containing fat is more satisfying than a very low-fat meal. Fats also serve as carriers of vitamins A, D, E and K.

Certain fatty acids that make up fats can be made by the body, while others can be obtained only through diet. The equivalent of a

tablespoon of most vegetable oils, except for peanut and olive oils, will meet the recommended daily requirements for essential fatty acids. However, because Americans eat meat and dairy foods that are high in fat, it is not necessary to add an extra tablespoon of fat to diets to provide essential fatty acids. Fatty acid deficiencies are extremely unlikely since a major portion of calories in the American diet come from fat. Pediatricians caution against children being fed diets that are very low in fat, because compared to adults, children have a greater need for essential fatty acids and calories for their body weight.

The human body can produce fats from other dietary sources. Carbohydrate and protein can be transformed into fat in the liver. This fat is then transported and stored in the body as fat (adipose) tissue. Stored fat serves as reserved energy.

Fats and heart disease

Fats are combined with protein in order to move through the lymph and blood systems. Fat-protein combinations are known as lipoproteins. Lipoproteins differ in the amount of fat and protein they contain. Low-density lipoproteins have more fat and less protein than high-density lipoproteins. The amount and types of lipoproteins in the blood are important in evaluating an individual's risk of diseases of the heart, blood vessels or circulation, known as cardiovascular disease.

What is atherosclerosis?

Atherosclerosis is a common form of heart disease. In its earliest stage, deposits called plaques, which are made up of fat and other material,

attach to the blood vessel walls. As the disease progresses, the deposits become thicker and eventually become hardened as calcium is deposited. Consequently, the blood vessels lose their elastic nature, and become rigid and partially closed. In this later stage of atherosclerosis, a small blood clot may entirely block the blood vessel. When this occurs in the small vessels feeding the heart, the result is a heart attack. The blockage of a blood vessel in the brain results in a stroke.

In spite of many studies, the nature of this abnormal condition and its development are not well understood. Atherosclerosis is progressive—in some cases, it begins in childhood and advances through young adulthood, often reaching severe forms in the 30s and 40s. The disease is more common in men than in women of childbearing age. However, beyond childbearing years, heart disease is equally as common in men and women of the same age.

Risk factors in atherosclerosis

Studies have helped identify the risk factors related to heart disease. Risk factors include being male; a family history of heart disease; diabetes; obesity; high fat intake; lack of physical activity; smoking; and alcohol consumption. Research has identified the most significant risk factors as:

- cigarette smoking.
- hypertension (high blood pressure).
- high blood cholesterol concentrations.

Individuals can change these risk factors by changing their lifestyle.

An individual with any one of the three major risk factors has a greater chance of suffering a coronary or a stroke than a person without any of these factors. Individuals having any two of the

many risk factors have an even greater chance than individuals with only one risk factor.

But this does not mean that all individuals having one or more risk factors will have a heart attack or a stroke, or that individuals free from these risk factors cannot be affected. A number of other factors appear to be important in predisposing individuals to atherosclerotic disease. Reducing stress is one of the factors that may also reduce risk of heart disease.

Fat and cancer seem to be related

Findings from many studies suggest that a high fat intake is associated with the development of breast and colon cancer. Breast cancer, for example, has its highest incidence among women in Western, industrialized countries like the United States. People in these countries also consume very high-fat, high-protein diets. In Asian countries, where diets are lower in fat and protein, breast cancer rates are also low. In the United States, groups that follow very low-fat diets, such as the Seventh Day Adventists, have much lower cancer rates than the general population.

It is difficult to establish a direct cause-and-effect relationship between fat intake and cancer, because dietary fat exists in combination with other nutrients and food components that may play a role in cancer risk. In addition, diet is only one of many lifestyle factors that may be related to cancer. The American Cancer Society, the National Cancer Institute, and the National Academy of Sciences Committee on Diet, Nutrition and Cancer all support recommendations to reduce dietary fat intake to 30 percent of total calories. It is important to note that these recommendations make no

distinction between saturated and polyunsaturated fat. The recommendation is to decrease total fat.

Calculating fat in the diet

To calculate fat intake, you must know:

- that 1 gram of fat equals 9 calories.
- the number of calories you usually eat each day. To find out your calorie intake, keep several days of food records and use them to determine the calories and grams of fat you have eaten.*

To determine the grams of fat you should eat, use the following formula:

$$\frac{\text{Average daily calories} \times 30 \text{ percent}}{9} = \text{Maximum grams of fat you should eat daily}$$

Several organizations, including USDA, the American Heart Association and the American Cancer Society, recommend limiting the amount of calories from fat to 30 percent of total calories. Nine is the number of calories in 1 gram of fat.

To calculate your current percent caloric intake from fat, do the following:

1. Figure out the average grams of fat you eat each day based on your food records.
2. Multiply the average grams of fat by nine to determine the total calories coming from fat.
3. Divide the total calories from fat by the total average calories you eat daily, and multiply by 100 to determine the percent of calories from fat in your diet.

*From USDA's Home and Garden Bulletin No. 72, Nutritive Value of Foods, available from your county cooperative extension office.

For example, Madge Smith found that her total fat intake in grams for one day was 90 and her total caloric intake was 1800 calories. To determine percent caloric intake from fat, she multiplied 90 by 9, getting 810 calories. Then, she divided 810 by 1800 (.45), then multiplied by 100, which resulted in 45 percent of calories from fat. Using her food record, Madge could now look over food eaten to determine what foods contributed the most grams of fat. This will help to decide how to reduce the fat in her diet.

Changing dietary fat intake

Most scientists agree that Americans need to decrease their fat intake. Reducing total dietary fat will reduce caloric intake and help people with weight management. When total fat reduction is achieved by reducing saturated fat, the proportion of polyunsaturated fatty acids to saturated fatty acids in the diet will increase automatically. This is also desirable in controlling heart disease.

A good rule of thumb is to obtain about 15 percent of calories from protein, 30 percent from fat and 55 percent from carbohydrates.

There is much less agreement on whether dietary cholesterol should be reduced. The American Heart Association currently recommends a daily intake of no more than 300 mg. cholesterol. Some scientists argue that this recommendation is premature because no solid evidence links dietary cholesterol to heart disease. Though everyone should avoid obviously high amounts of cholesterol, drastically reducing dietary cholesterol may best be handled on an individual basis.

A balanced intake of all dietary nutrients requires eating a wide variety of foods. Ample amounts

Fatty Acids in Various Foods

of fruits and vegetables; dairy products; meat, fish, poultry or meat alternates; and whole grain and enriched cereals should be consumed daily. Variety will also ensure that dietary carbohydrate comes primarily from complex sources, such as starches in cereal and potatoes, which furnish other nutrients and are low in fat.

It is recommended that our fat intake be divided among sources so that we receive about 10 percent of our calories from each type of fatty acid—saturated and mono- and polyunsaturated fatty acids. The table on this page, "Fatty Acids in Various Foods," shows the foods with the highest percentage of each of the fatty acids. For variety and to obtain calories from each type of fatty acid, a person might cook with safflower oil, use olive oil in salads or for some cooking, and eat animal products. No one fat source is bad for us. It is the balance from all the fat sources and the total amount of fat in our diets that is important.

Lowering fat in your diet

Dietary changes need not involve a drastic change in eating habits. For example, dietary fat can be significantly reduced by substituting low-fat milk for whole milk and ice milk for ice cream, or by selecting leaner cuts of meat and trimming off any visible fat. Changing cooking habits to replace frying with baking, boiling or broiling will also significantly reduce fat intake.

Being aware of the amount of fat in various foods will help you select lower fat foods. The table "Percent of Fat from Selected Foods" on page 1 can help identify the foods containing lower percentages of fat in our diets. Foods containing higher percentages of fat should be chosen less frequently.

	Saturated %	Fatty Acids	
		Unsaturated Mono %	Poly %
Cooking Fats and Oils			
Canola oil (rapeseed)	6	62	32
Coconut oil	87	6	2
Corn oil	13	24	59
Lard	39	45	11
Olive oil	14	74	8
Palm oil	49	37	9
Palm kernel oil	81	11	2
Peanut oil	17	46	32
Safflower oil	9	12	75
Sesame oil	14	40	42
Shortening (hydrogenated) Soybean & Cottonseed	25	45	26
Soybean oil	14	23	58
Sunflower oil	10	20	66
Spreads			
Butter	62	29	4
Margarine, stick (corn, hydrogenated)	13	46	18
Margarine, tub (corn)	18	39	39
Salad Dressing			
French (regular)	23	20	53
Italian (regular)	14	23	58
Mayonnaise type	15	27	54
Foods			
Beef, eye of round, roasted	38	44	3
Chicken breast, no skin	28	39	22
Egg	30	40	13
Milk, whole	62	29	3
Pork tenderloin	35	45	12
Shrimp, cooked	27	18	41
Tuna, in oil, drained	19	36	35

SOURCE: Table adapted from *A Change of Plate*, by the National Live Stock and Meat Board, 1988, and Handbook No. 8-4, *Composition of Foods, Fats and Oils*, 1979.

Here are some additional tips to reduce fat:

- Remove skin from poultry.
- Do not add fat when browning meats. Instead, use a non-stick pan.
- Place meat on a rack when broiling or roasting so fat can drain away from the meat.
- Use herbs in place of fats to add flavor to meat and vegetable dishes.
- Combine meats with pastas, grains or vegetables to increase the amount of carbohydrate, and therefore decrease your fat intake.
- When using eggs, use only one yolk per serving and add only

egg white for the remainder of the eggs needed.

- Make gravies from broth with the fat removed or with bouillon; thicken with flour or cornstarch. A little cooking wine adds a nice flavor, and the alcohol will evaporate when the gravy is cooked.
- Choose low-fat cheese such as part-skim ricotta, mozzarella or low-fat process cheeses instead of higher fat cheeses.

- Use plain lowfat yogurt seasoned with herbs instead of sour cream.
- Substitute yogurt for part of the mayonnaise or salad dressing in recipes.

Thinking about the sources of fat in your diet will help you to reduce the calories you are obtaining from fat. But do not expect to make drastic changes overnight. Gradual changes in your diet will help you and your family to learn new habits.

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