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**All About Fats
and Cholesterol**

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Once upon a time, we didn't know anything about fat except that it made foods tastier. We cooked our food in lard or shortening. We spread butter on our breakfast toast and plopped sour cream on our baked potatoes. Farmers bred their animals to produce milk with high butterfat content and meat "marbled" with fat because that was what most people wanted to eat.

But ever since word got out that diets high in fat are related to heart disease, things have become more complicated. Experts tell us there are several different kinds of fat, some of them worse for us than others. In addition to saturated, monounsaturated and polyunsaturated fats, there are triglycerides, trans fatty acids, and omega 3 and omega 6 fatty acids.

Most people have learned something about cholesterol, and many of us have been to the doctor for a blood test to learn our cholesterol "number." Now, however, it turns out that there's more than one kind of cholesterol, too.

Almost every day there are newspaper reports of new studies or recommendations about what to eat or what not to eat: Lard is bad, olive oil is good, margarine is better for you than butter--then again, maybe it's not.

Amid the welter of confusing terms and conflicting details, consumers are often baffled about how to improve their diets. FDA recently issued new regulations that will enable consumers to see clearly on a food product's label how much and what kind of fat the product contains. Understanding the terms used to discuss fat is crucial if you want to make sure your diet is within recommended guidelines.

Fats and Fatty Acids

Fats and Fatty Acids Fats are a group of chemical compounds that contain fatty acids. Energy is stored in the body mostly in the form of fat. Fat is needed in the diet to supply essential fatty acids, substances essential for growth but not produced by the body itself.

There are three main types of fatty acids: saturated, monounsaturated and polyunsaturated. All fatty acids are molecules composed mostly of carbon and hydrogen atoms. A saturated fatty acid has the maximum possible number of hydrogen atoms attached to every carbon atom. It is therefore said to be "saturated" with hydrogen atoms.

Some fatty acids are missing one pair of hydrogen atoms in the middle of the molecule. This gap is called an "unsaturation" and the fatty acid is said to

be "monounsaturated" because it has one gap. Fatty acids that are missing more than one pair of hydrogen atoms are called "polyunsaturated."

Saturated fats (which contain saturated fatty acids) are mostly found in foods of animal origin. Monounsaturated and polyunsaturated fats (which contain monounsaturated and polyunsaturated fatty acids) are mostly found in foods of plant origin and some seafoods. Polyunsaturated fatty acids are of two kinds, omega-3 or omega-6. Scientists tell them apart by where in the molecule the "unsaturations," or missing hydrogen atoms, occur.

Recently a new term has been added to the fat lexicon: trans fatty acids. These are byproducts of partial hydrogenation, a process in which some of the missing hydrogen atoms are put back into polyunsaturated fats. "Partially hydrogenated vegetable oils," such as vegetable shortening and margarine, are solid at room temperature.

Cholesterol

Cholesterol is sort of a "cousin" of fat. Both fat and cholesterol belong to a larger family of chemical compounds called lipids. All the cholesterol the body needs is made by the liver. It is used to build cell membranes and brain and nerve tissues. Cholesterol also helps the body produce steroid hormones needed for body regulation, including processing food, and bile acids needed for digestion.

People don't need to consume dietary cholesterol because the body can make enough cholesterol for its needs. But the typical U.S. diet contains substantial amounts of cholesterol, found in foods such as egg yolks, liver, meat, some shellfish, and whole-milk dairy products. Only foods of animal origin contain cholesterol.

Cholesterol is transported in the bloodstream in large molecules of fat and protein called lipoproteins. Cholesterol carried in low-density lipoproteins is called LDL-cholesterol; most cholesterol is of this type. Cholesterol carried in high-density lipoproteins is called HDL-cholesterol. (See "Fat Words.")

A person's cholesterol "number" refers to the total amount of cholesterol in the blood. Cholesterol is measured in milligrams per deciliter (mg/dl) of blood. (A deciliter is a tenth of a liter.)

Doctors recommend that total blood cholesterol be kept below 200 mg/dl. The average level in adults in this country is 205 to 215 mg/dl. Studies in the United States and other countries have consistently shown that total cholesterol levels above 200 to 220 mg/dl are linked with an increased risk of coronary heart disease. (See "Lowering Cholesterol" in the March 1994 FDA Consumer.)

LDL-cholesterol and HDL-cholesterol act differently in the body. A high level of LDL-cholesterol in the blood increases the risk of fatty deposits forming in the arteries, which in turn increases the risk of a heart attack. Thus, LDL-cholesterol has been dubbed "bad" cholesterol.

On the other hand, an elevated level of HDL-cholesterol seems to have a protective effect against heart disease. For this reason, HDL-cholesterol is often called "good" cholesterol.

In 1992, a panel of medical experts convened by the National Institutes of Health (NIH) recommended that individuals should have their level of HDL-cholesterol checked along with their total cholesterol.

According to the National Heart, Lung, and Blood Institute (NHLBI), a component of NIH, a healthy person who is not at high risk for heart disease and whose total cholesterol level is in the normal range (around 200 mg/dl) should have an HDL-cholesterol level of more than 35 mg/dl. NHLBI also says that an LDL-cholesterol level of less than 130 mg/dl is "desirable" to minimize the risk of heart disease.

Some very recent studies have suggested that LDL-cholesterol is more likely to cause fatty deposits in the arteries if it has been through a chemical change known as oxidation. However, these findings are not accepted by all scientists.

The NIH panel also advised that individuals with high total cholesterol or other risk factors for coronary heart disease should have their triglyceride levels checked along with their HDL-cholesterol levels.

Triglycerides and VLDL Triglyceride is another form in which fat is transported through the blood to the body tissues. Most of the body's stored fat is in the form of triglycerides. Another lipoprotein--very low-density lipoprotein, or VLDL--has the job of carrying triglycerides in the blood. NHLBI considers a triglyceride level below 250 mg/dl to be normal.

It is not clear whether high levels of triglycerides alone increase an individual's risk of heart disease. However, they may be an important clue that someone is at risk of heart disease for other reasons. Many people who have elevated triglycerides also have high LDL-cholesterol or low HDL-cholesterol. People with diabetes or kidney disease--two conditions that increase the risk of heart disease--are also prone to high triglycerides.

Dietary Fat and Cholesterol Levels Many people are confused about the effect of dietary fats on cholesterol levels. At first glance, it seems reasonable to think that eating less cholesterol would reduce a person's cholesterol level. In fact, eating less cholesterol has less effect on blood cholesterol levels than eating less saturated fat. However, some studies have found that eating

cholesterol increases the risk of heart disease even if it doesn't increase blood cholesterol levels.

Another misconception is that people can improve their cholesterol numbers by eating "good" cholesterol. In food, all cholesterol is the same. In the blood, whether cholesterol is "good" or "bad" depends on the type of lipoprotein that's carrying it.

Polyunsaturated and monounsaturated fats do not promote the formation of artery-clogging fatty deposits the way saturated fats do. Some studies show that eating foods that contain these fats can reduce levels of LDL-cholesterol in the blood. Polyunsaturated fats, such as safflower and corn oil, tend to lower both HDL- and LDL-cholesterol. Edible oils rich in monounsaturated fats, such as olive and canola oil, however, tend to lower LDL-cholesterol without affecting HDL levels.

How Do We Know Fat's a Problem?

In 1908, scientists first observed that rabbits fed a diet of meat, whole milk, and eggs developed fatty deposits on the walls of their arteries that constricted the flow of blood. Narrowing of the arteries by these fatty deposits is called atherosclerosis. It is a slowly progressing disease that can begin early in life but not show symptoms for many years. In 1913, scientists identified the substance responsible for the fatty deposits in the rabbits' arteries as cholesterol.

In 1916, Cornelius de Langen, a Dutch physician working in Java, Indonesia, noticed that native Indonesians had much lower rates of heart disease than Dutch colonists living on the island. He reported this finding to a medical journal, speculating that the Indonesians' healthy hearts were linked with their low levels of blood cholesterol.

De Langen also noticed that both blood cholesterol levels and rates of heart disease soared among Indonesians who abandoned their native diet of mostly plant foods and ate a typical Dutch diet containing a lot of meat and dairy products. This was the first recorded suggestion that diet, cholesterol levels, and heart disease were related in humans. But de Langen's observations lay unnoticed in an obscure medical journal for more than 40 years.

After World War II, medical researchers in Scandinavia noticed that deaths from heart disease had declined dramatically during the war, when food was rationed and meat, dairy products, and eggs were scarce. At about the same time, other researchers found that people who suffered heart attacks had higher levels of blood cholesterol than people who did not have heart attacks.

Since then, a large body of scientific evidence has been gathered linking high blood cholesterol and a diet high in animal fats with an elevated risk of heart attack. In countries where the average person's blood cholesterol level is less than 180 mg/dl, very few people develop atherosclerosis or have heart attacks. In many countries where a lot of people have blood cholesterol levels above 220 mg/dl, such as the United States, heart disease is the leading cause of death.

High rates of heart disease are commonly found in countries where the diet is heavy with meat and dairy products containing a lot of saturated fats. However, high-fat diets and high rates of heart disease don't inevitably go hand-in-hand.

Learning from Other Cultures People living on the Greek island of Crete have very low rates of heart disease even though their diet is high in fat. Most of their dietary fat comes from olive oil, a monounsaturated fat that tends to lower levels of "bad" LDL-cholesterol and maintain levels of "good" HDL-cholesterol.

The Inuit, or Eskimo, people of Alaska and Greenland also are relatively free of heart disease despite a high-fat, high-cholesterol diet. The staple food in their diet is fish rich in omega-3 polyunsaturated fatty acids.

Some research has shown that omega-3 fatty acids, found in fish such as salmon and mackerel as well as in soybean and canola oil, lower both LDL-cholesterol and triglyceride levels in the blood. Some nutrition experts recommend eating fish once or twice a week to reduce heart disease risk. However, dietary supplements containing concentrated fish oil are not recommended because there is insufficient evidence that they are beneficial and little is known about their long-term effects.

Omega-6 polyunsaturated fatty acids have also been found in some studies to reduce both LDL- and HDL-cholesterol levels in the blood. Linoleic acid, an essential nutrient (one that the body cannot make for itself) and a component of corn, soybean and safflower oil, is an omega-6 fatty acid.

At one time, many nutrition experts recommended increasing consumption of monounsaturated and polyunsaturated fats because of their cholesterol-lowering effects. Now, however, the advice is simply to reduce dietary intake of all types of fat. (Infants and young children, however, should not restrict dietary fat.)

The available information on fats may be voluminous and is sometimes confusing. But sorting through the information becomes easier once you know the terms and some of the history.

The "bottom line" is actually quite simple, according to John E. Vanderveen, Ph.D., director of the Office of Plant and Dairy Foods and

Beverages in FDA's Center for Food Safety and Applied Nutrition. What we should be doing is removing as much of the saturated fat from our diet as we can. We need to select foods that are lower in total fat and especially in saturated fat." In a nutshell, that means eating fewer foods of animal origin, such as meat and whole-milk dairy products, and more plant foods such as vegetables and grains.

Fat Words

Here are brief definitions of the key terms important to an understanding of the role of fat in the diet. **Cholesterol:** A chemical compound manufactured in the body. It is used to build cell membranes and brain and nerve tissues. Cholesterol also helps the body make steroid hormones and bile acids.

Dietary cholesterol: Cholesterol found in animal products that are part of the human diet. Egg yolks, liver, meat, some shellfish, and whole-milk dairy products are all sources of dietary cholesterol. **Fatty acid:** A molecule composed mostly of carbon and hydrogen atoms. Fatty acids are the building blocks of fats.

Fat: A chemical compound containing one or more fatty acids. Fat is one of the three main constituents of food (the others are protein and carbohydrate). It is also the principal form in which energy is stored in the body.

Hydrogenated fat: A fat that has been chemically altered by the addition of hydrogen atoms (see trans fatty acid). Vegetable oil and margarine are hydrogenated fats. **Lipid:** A chemical compound characterized by the fact that it is insoluble in water. Both fat and cholesterol are members of the lipid family.

Lipoprotein: A chemical compound made of fat and protein. Lipoproteins that have more fat than protein are called low-density lipoproteins (LDLs). Lipoproteins that have more protein than fat are called high-density lipoproteins (HDLs). Lipoproteins are found in the blood, where their main function is to carry cholesterol. **Monounsaturated fatty acid:** A fatty acid that is missing one pair of hydrogen atoms in the middle of the molecule. The gap is called an "unsaturation." Monounsaturated fatty acids are found mostly in plant and sea foods.

Monounsaturated fat: A fat made of monounsaturated fatty acids. Olive oil and canola oil are monounsaturated fats. Monounsaturated fats tend to lower levels of LDL-cholesterol in the blood. **Polyunsaturated fatty acid:** A fatty acid that is missing more than one pair of hydrogen atoms. Polyunsaturated fatty acids are mostly found in plant and sea foods.

Polyunsaturated fat: A fat made of polyunsaturated fatty acids. Safflower oil and corn oil are polyunsaturated fats. Polyunsaturated fats tend to lower levels of both HDL-cholesterol and LDL-cholesterol in the blood.

Saturated fatty acid: A fatty acid that has the maximum possible number of hydrogen atoms attached to every carbon atom. It is said to be "saturated" with hydrogen atoms. Saturated fatty acids are mostly found in animal products such as meat and whole milk. Saturated fat: A fat made of saturated fatty acids. Butter and lard are saturated fats. Saturated fats tend to raise levels of LDL-cholesterol ("bad" cholesterol) in the blood. Elevated levels of LDL-cholesterol are associated with heart disease.

Trans fatty acid: A polyunsaturated fatty acid in which some of the missing hydrogen atoms have been put back in a chemical process called hydrogenation. Trans fatty acids are the building blocks of hydrogenated fats.

Government Advice

Dietary guidelines endorsed by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services advise consumers to:

Reduce total dietary fat intake to 30 percent or less of total calories.

Reduce saturated fat intake to less than 10 percent of calories.

Reduce cholesterol intake to less than 300 milligrams daily.

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