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The Fat of Life: _A Nutritional Guide to Fatty Acids

,_One of the great medical myths of the past fifty years has been the notion that fats (more properly called lipids) are evil. Of course, like all other enduring myths, there is a grain of truth at the core. Literally thousands of studies over the past half century have traced high-fat diets to increased risk of heart disease. The most famous of these, the Framingham Heart Study, followed _a representative sample of 5,209 adults in Framingham, Mas-sachusetts, to examine the circumstances and risk factors as-_sociated with heart disease. The Framingham study was an _epidemiological study designed to learn how those who develop cardiovascular diseases differed from those who remain free of the diseases over a long period of time. Epidemiology is a branch of medical science devoted to the large-scale study of populations and disease; epidemiologists search for risk factors and causes of illnesses through statistical associations and other methods.

Along with such culprits as smoking and sedentary lifestyle, the Framingham scientists found danger in diets high in fat. This study and many others over the past few decades have driven the point home: diets high in fatty foods, from bacon to butter to red meat, greatly increase our chances of acquiring cardiovascular disease, reducing not just the length but also the quality of life. The problem is not simply excessive amounts of fat or cholesterol clogging arteries or adding inches to our waistlines. Certain fats, like the omega-6 and omega-3 fatty acids act as powerful hormone-like agents, playing many roles in health and disease. The Framingham scientists, with their focus on cholesterol and saturated fats, overlooked the damaging effects of another type of fat, the omega-6 fats.

With a genuine paradigm shift, we must develop an accurate view of the diversity of fats, with a range of health benefits and risks. Although some dietary fats are implicated in heart disease, others may reduce the risk of these illnesses, and even treat or prevent a range of other diseases, such as arthritis, depression, and diabetes. Some lipids suppress inflammation, others promote it. Some fats raise cholesterol, others lower it. Some make cell membranes rigid, others render them flexible.

The Essential Fats

The data from the medical literature are clear: do not lump all types of dietary fat together in a single, negative category. Excessive consumption of saturated fat and cholesterol certainly can cause disease and a greater chance of early death. But other fats, termed the essential fats, are necessary for optimal health. In the yin and yang of proper physiological balance, the essential fatty acids—the omega-3 and omega-6 oils—are health enhancers.

I want to stop here to point out my use of the term oil. We have used the term fat in a general way, but oils and fats (both lipids) differ in their chemical structures. Oils (olive, canola, and fish oil, for instance) are liquid at room temperature; fats (butter and lard) are solid. These subtle chemical differences produce vastly different chemical effects in the body.

The role of the essential fatty acids in the body and brain can be best understood in terms of what we know about lipids—fats as well as oils—and their impact on health and disease.

The Cholesterol Issue

Researchers investigating risk factors in the Framingham study initially homed in on not so much the total consumption of lipids, but on detection of high blood levels of one particu-_lar lipid: cholesterol. A soft, waxy substance found among other lipids in the bloodstream and in the - body's cells, cholesterol is needed to form cell membranes, certain hormones, and specific tissues.

Like other lipids, cholesterol cannot dissolve in the bloodstream, which is mostly water, and must be transported throughout the body by carriers in the blood called lipoproteins. Two lipoproteins are particularly important. The low-density lipoproteins (LDLs), when carrying cholesterol, are sometimes called "bad" cholesterol, and high-density lipoproteins (HDLs) are also known as "good" cholesterol when combined with cholesterol.

Too much LDL cholesterol circulating in the blood within a pro-inflammatory environment can promote atherosclerosis ("hardening of the arteries"), which is the buildup of a thick, hard coating called plaque within the walls of the arteries. Just like a clogged pipe, if arterial walls accumulate too much plaque, blood flowing through them will be blocked. Arterial plaque can block flow of blood to the heart, leading to heart attack (myocardial infarction), or block the flow of blood to the brain, causing a stroke (cerebrovascular accident).

About a quarter of all cholesterol is carried through the body by HDLs, thought to be beneficial. The data suggesting that HDLs promote health come from two sources: epidemiological studies linking high levels of HDL to lower rates of heart disease and laboratory studies examining exactly what HDL does to cholesterol at a cellular or molecular level. The latest studies indicate that HDL's role is complex, but that one of its actions _is to carry cholesterol away from the arteries and back to the liver, where it is passed from the body. Some experts believe _that HDL cholesterol can even break down the cholesterol in plaque, potentially leading to a reopening of partially clogged arteries.

According to the American Heart Association, excess cholesterol in the body comes from two sources: (1) the liver, which produces about 1,000 milligrams of cholesterol a day from other substances; (2) dietary saturated fat and cholesterol of the sort that are found in animals and dairy products.

Grouping the Fatty Acids: Essential and Nonessential Fats

Researchers today realize that not all fats are created equal. Anyone who does supermarket shopping is likely to know there are four major categories of fat listed in the labels of the foods we eat: cholesterol, saturated fatty acids, monounsaturated fatty acids, and polyunsaturated fatty acids. Of the three fatty acid categories, only one—the saturated fats found in animal and dairy products—have been implicated in raising LDL, or bad cholesterol. Most foods contain a combination of all three fatty acids in differing proportions. Nutritionists assign foods to a general fat category based on the proportions of each fatty acid contained in the product (see Table 2–1).

What You See Is What You Get: _Fatty Acids Function Based on Their Chemical Form

Like other biochemicals, fatty acids function based on their chemical structure. Essentially chains of carbon atoms with hydrogen atoms attached off to the side, the various fatty acids differ based on the number of carbon atoms in the chain and the types of bonds they share with each other (see Figure 2–1).

Fat in 3D: The Chemical Structure of the Fatty Acids

In essence, chemical bonds are created when electrons are shared between two atoms. This sharing of electrons makes atoms stick together (a bond). Carbon atoms found in nature always have four bonds available to link up with other atoms. Since the carbons are in a chain, it makes sense that two of those bonds are usually taken up with links to adjacent carbon atoms. That leaves two bonds open for other atoms, usually hydrogen. If two hydrogen atoms attach to each carbon atom in the chain, that chain is said to be "saturated"—it contains as much hydrogen as possible, with each carbon-carbon bond consisting of a single, shared electron.

Saturated fatty acids are very stable chemicals. They are also solid or stiff at room temperature. In fact, the processed foods industry uses so much saturated fat precisely because of its chemical stability and solid, pliable form.

When fatty acids are "unsaturated," it means that some of the carbon atoms in the chain have double bonds with each other and less hydrogen is present—hence the term unsaturated. The carbon-carbon double bond is the chemical signature of an unsaturated fat. Monounsaturated fats have a single double bond, and polyunsaturated fats have two or more.

Solid, Liquid, and in-Between

The differing chemical structures of the fatty acids lead to a useful variety of attributes in the physical world. The saturated fatty acids are generally solid in form, like butter, even at room temperature, and are the most chemically stable. Most of the time we consume saturated fatty acids in meat, dairy, and processed food products, including beef, veal, lamb, pork, lard, poultry, butter, cream, milk, cheese, cookies, and crackers.

Coconut and palm oil (known as the tropical oils) contain a high proportion of saturated fatty acids. Because of their specific fatty acid composition, the tropical oils are liquids at room temperature. The tropical oils are used widely in food processing because, as liquids, they are easy to handle, and because of their saturated fat content, they extend the shelf life of many foods. While useful to the food industry, however, these fats and oils can contribute to coronary artery disease.

Also hazardous to health are the so-called trans-fatty acids, found in margarine and other synthetic foods. Created in the laboratory, trans-fatty acids result when manufacturers add hydrogen to unsaturated vegetable oil. Due to the configuration of the new chemical bonds—different from those found in most naturally occurring saturated fatty acids—trans-fatty acids are even more stable than those of saturated fatty acids. The advantage is longer shelf life without spoiling for processed foods. The disadvantages, according to a spate of recent studies, include risk for coronary heart disease in excess of that associated with saturated fat.