Omega 3 Fatty Acids

What are omega-3 fatty acids?

You've probably been hearing about omega-3 fatty acids in recent years. The reason? A growing body of scientific research indicates that these healthy fats help prevent a wide range of medical problems, including cardiovascular disease, depression, asthma, and rheumatoid arthritis.

Unlike the saturated fats found in butter and lard, omega-3 fatty acids are polyunsaturated. In chemistry class, the terms "saturated" and "polyunsaturated" refer to the number of hydrogen atoms that are attached to the carbon chain of the fatty acid. In the kitchen, these terms take on a far more practical meaning.

Polyunsaturated fats, unlike saturated fats, are liquid at room temperature and remain liquid when refrigerated or frozen. Monounsaturated fats, found in olive oil, are liquid at room temperature, but harden when refrigerated. When eaten in appropriate amounts, each type of fat can contribute to health. However, the importance of omega-3 fatty acids in health promotion and disease prevention cannot be overstated.

The three most nutritionally important omega-3 fatty acids are alpha-linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).

Alpha-linolenic acid is one of two fatty acids traditionally classified as "essential." The other fatty acid traditionally viewed as essential is an omega 6 fat called linoleic acid. These fatty acids have traditionally been classified as "essential" because the body is unable to manufacture them on its own and because they play a fundamental role in several physiological functions. As a result, we must be sure our diet contains sufficient amounts of both alpha-linolenic acid and linoleic acid.

Dietary sources of alpha-linolenic acid include flaxseeds, walnuts, hemp seeds, soybeans and some dark green leafy vegetables. Linoleic acid is found in high concentrations in corn oil, safflower oil, sunflower oil, and canola oil. Most people consume a much higher amount of linoleic acid than alpha-linolenic acid, which has important health consequences. For more information on the proper ratio of these fatty acids in the diet, see our FAQ entitled, A New Way of Looking at Proteins, Fats, and Carbohydrates

The body converts alpha-linolenic acid into two important omega-3 fats, eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA). These fats can also be derived directly from certain foods, most notably cold-water fish including salmon, tuna, halibut, and herring. In addition, certain types of algae contain DHA. EPA is believed to play a role in the prevention of cardiovascular disease, while DHA is the necessary for proper brain and nerve development.

How it Functions

What are the functions of omega-3 fatty acids?
Every cell in our body is surrounded by a cell membrane composed mainly of fatty acids. The cell membrane allows the proper amounts of necessary nutrients to enter the cell, and ensures that waste products are quickly removed from the cell.

Promoting Healthy Cell Membranes

To perform these functions optimally, however, the cell membrane must maintain its integrity and fluidity. Cells without a healthy membrane lose their ability to hold water and vital nutrients. They also lose their ability to communicate with other cells. Researchers believe that loss of cell to cell communication is one of the physiological events that leads to growth of cancerous tumors.

Because cell membranes are made up of fat, the integrity and fluidity of our cell membranes is determined in large part by the type of fat we eat. Remember that saturated fats are solid at room temperature, while omega-3 fats are liquid at room temperature. Researchers believe that diets containing large amounts of saturated or hydrogenated fats produce cell membranes that are hard and lack fluidity. On the other hand, diets rich in omega-3 fats produce cell membranes with a high degree of fluidity.

In addition, recent in vitro (test tube) evidence suggests when omega-3 fatty acids are incorporated into cell membranes they may help to protect against cancer, notably of the breast. They are suggested to promote breast cancer cell apoptosis via several mechanisms including: inhibiting a pro-inflammatory enzyme called cyclooxygenase 2 (COX 2), which promotes breast cancer; activating a type of receptor in cell membranes called peroxisome proliferator-activated receptor (PPAR), which can shut down proliferative activity in a variety of cells including breast cells; and, increasing the expression of BRCA1 and BRCA2, tumor suppressor genes that, when functioning normally, help repair damage to DNA, thus helping to prevent cancer development.

Animal and test tube studies published in the November 2005 issue of the International Journal of Cancer suggest yet another way in which the omega-3 fatty acids found in cold water fish—docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA)—help protect against breast cancer development.

All dietary fatty acids are incorporated into cell membranes, and the type of fatty acids dictates how a cell responds and grows. Researchers found that omega-3 fatty acids affect cell growth by activating an enzyme called sphingomyelinase, which then generates the release of ceramide, a compound that induces the expression of the human tumor suppressor gene p21, which ultimately causes cancer cell death.

In the animal experiments, mice were fed diets rich in either omega-3 (fish oil) or omega-6 (corn oil) fatty acids after which breast cancer cells were implanted. Three weeks later, tumor volume and weight was significantly lower in mice on the omega-3 rich diet. In the lab culture experiments, when cells were treated with DHA or EPA, sphingomyelinase activity increased by 30-40%, and breast cancer cell growth dropped 20-25%.

Prostaglandin Production

Omega-3 fats also play an important role in the production of powerful hormone-like substances called prostaglandins. Prostaglandins help regulate many important physiological functions including blood pressure, blood clotting, nerve transmission, the inflammatory and allergic responses, the functions of the kidneys and gastrointestinal tract, and the production of other hormones.

In essence, all prostaglandins perform essential physiological functions. However, depending on the type of fat in the diet, certain types of prostaglandins may be produced in large quantities, while others may not be produced at all. This can set up an imbalance throughout the body that can lead to disease.

For example, EPA and DHA serve as direct precursors for series 3 prostaglandins, which have been called "good" or "beneficial" because they reduce platelet aggregation, reduce inflammation and improve blood flow. The role of EPA and DHA in the prevention of cardiovascular disease can be explained in large part by the ability of these fats to increase the production of favorable prostaglandins.

The omega 6 fats serve as precursors for series 1 and series 2 prostaglandins. Like the series 3 prostaglandins produced from omega-3 fats, series 1 prostaglandins are believed to be beneficial. On the other hand, series 2 prostaglandins are usually considered to be "bad" or "unhealthy," since these prostaglandins promote an inflammatory response and increase platelet aggregation. As a result, it is important to ensure proper balance of omega-3 and omega-6 fats in the diet.

EPA Directly Anti-Inflammatory

A recently identified lipid (fat) product our bodies make from EPA, called resolvins, helps explain how this omega-3 fat provides anti-inflammatory effects on our joints and improves blood flow.

Resolvins, which have been shown to reduce inflammation in animal studies, are made from EPA by our cellular enzymes, and work by inhibiting the production and regulating the migration of inflammatory cells and chemicals to sites of inflammation. Unlike anti-inflammatory drugs, such as aspirin, ibuprofen and the COX-2 inhibitors, the resolvins our bodies produce from EPA do not have negative side effects on our gastrointestinal or cardiovascular systems.

Deficiency Symptoms

What are deficiency symptoms for omega-3 fatty acids?
Recent statistics indicate that nearly 99% of people in the United States do not eat enough omega 3 fatty acids. However, the symptoms of omega-3 fatty acid deficiency are very vague, and can often be attributed to some other health conditions or nutrient deficiencies.

Consequently, few people (or their physicians, for that matter) realize that they are not consuming enough omega-3 fatty acids. The symptoms of omega-3 fatty acid deficiency include fatigue, dry and/or itchy skin, brittle hair and nails, constipation, frequent colds, depression, poor concentration, lack of physical endurance, and/or joint pain.