

In chemistry, particularly in biochemistry, a fatty acid is a carboxylic acid with a long aliphatic chain, which is either saturated or unsaturated. Most naturally occurring fatty acids have an unbranched chain of an even number of carbon atoms, from 4 to

Written by Ruairi Robertson, PhD on January 15, Omega-3, omega-6 and omega-9 fatty acids are all important dietary fats. Interestingly, each one has a number of health benefits for your body. An imbalance may contribute to a number of chronic diseases. Here is a guide to omega-3, -6 and -9 fatty acids, including what they are, why you need them and where you can get them. What Are Omega-3 Fatty Acids? The term "polyunsaturated" refers to their chemical structure, as "poly" means many and "unsaturated" refers to double bonds. Together they mean that omega-3 fatty acids have many double bonds. There are many types of omega-3 fats, which differ based on their chemical shape and size. Here are the three most common: EPA also helps reduce symptoms of depression 2, 3. ALA is mainly used by the body for energy 5. Omega-3 fats are a crucial part of human cell membranes. They also have a number of other important functions, including: Omega-3 fatty acids can increase "good" HDL cholesterol. They can also reduce triglycerides, blood pressure and the formation of arterial plaques 6, 7, 8, 9, Taking omega-3s can reduce symptoms of depression, schizophrenia and bipolar disorder. It can also reduce the risk of psychotic disorders for those who are at risk 11, 12, 13, 14, Reducing weight and waist size: Omega-3 fats play an important role in weight management and can help reduce waist circumference 16, Consuming omega-3s in your diet can help decrease the amount of fat in your liver 18, 19, Supporting infant brain development: Omega-3s are extremely important for brain development in babies 4, Omega-3 fats are anti-inflammatory, meaning they can reduce the inflammation in your body that can contribute to a number of chronic diseases 22, 23, People who eat more fish, which is high in omega-3 fats, tend to have a slower decline in brain function in old age. Omega-3s may also help improve memory in older people 25, People with higher omega-3 intake and blood levels tend to have better bone mineral density 27, Omega-3 intake can help reduce symptoms of asthma, especially in early life 29, 30, Unfortunately, the Western diet does not contain enough omega-3s. A deficiency may contribute to chronic diseases like obesity, diabetes and heart disease Omega-3 fats are essential fats that you must get from your diet. They have important benefits for your heart, brain and metabolism. What Are Omega-6 Fatty Acids? Like omega-3 fatty acids, omega-6 fatty acids are polyunsaturated fatty acids. The only difference is that the last double bond is six carbons from the omega end of the fatty acid molecule. Omega-6 fatty acids are also essential, so you need to obtain them from your diet. These fats are primarily used for energy. The most common omega-6 fat is linoleic acid, which can be converted into longer omega-6 fats such as arachidonic acid ARA However, the eicosanoids produced by ARA are more pro-inflammatory 34, Pro-inflammatory eicosanoids are important chemicals in the immune system. However, when too many of them are produced, they can increase inflammation and inflammatory disease Although omega-6 fats are essential, the modern Western diet contains far more omega-6 fatty acids than necessary The recommended ratio of omega-6 to omega-3 fatty acids in the diet is 4:1 However, the Western diet has a ratio between 10:1 and 20:1 Therefore, although omega-6 fats are essential in the right quantities, most people in the developed world should aim to reduce their omega-6 intake Nevertheless, some omega-6 fatty acids have shown benefits in treating symptoms of chronic disease. Gamma-linolenic acid GLA is an omega-6 fatty acid found in certain oils, such as evening primrose oil and borage oil. When consumed, much of it is converted to another fatty acid called dihomo-gamma-linolenic acid DGLA. One study showed that taking a high dose of GLA supplements significantly reduced a number of symptoms of rheumatoid arthritis Another interesting study found that taking GLA supplements in addition to a breast cancer drug was more effective at treating breast cancer than the drug alone Conjugated linoleic acid CLA is another form of omega-6 fat that has some health benefits. For example, one large study found that taking 3. Omega-6 fats are essential fats that are an important source of energy for the body. However, the Western diet contains too many. Omega-9 fatty acids are monounsaturated, meaning they only have one double bond. It is located nine carbons from the omega end of

the fatty acid molecule. Oleic acid is the most common omega-9 fatty acid and the most common monounsaturated fatty acid in the diet. In fact, omega-9 fats are the most abundant fats in most cells in the body. However, consuming foods rich in omega-9 fatty acids instead of other types of fat may have a number of beneficial health effects. Another study found that feeding mice diets high in monounsaturated fat improved insulin sensitivity and decreased inflammation. The same study found that humans who ate high-monounsaturated fat diets had less inflammation and better insulin sensitivity than those who ate diets high in saturated fat. Omega-9 fats are non-essential fats, since they can be produced by the body. Diets that replace some saturated fats with omega-9 fats may have benefits for metabolic health.

Which Foods Contain These Fats? You can easily obtain omega-3, -6 and -9 fatty acids from your diet. However, it is important to get the right balance of each. The Western diet contains far more omega-6 fats than necessary, and not enough omega-3 fats. Here is a list of foods that are high in omega-3, -6 and -9 fatty acids. However, you can also obtain these omega-3s from other marine sources, such as algal oils. ALA, on the other hand, is mainly obtained from nuts and seeds. There are no official standards for daily omega-3 intake, but various organizations offer guidelines. Here are the amounts and types of omega-3s in one serving of the following foods: Nuts and seeds also contain significant amounts of omega-6 fatty acids. According to the Food and Nutrition Board of the US Institute of Medicine, the adequate intake of omega-6s per day is 17 grams for men and 12 grams for women, for adults from 19 to 50 years old. Here are the amounts of omega-6s in grams.

Chapter 2 : Definition: Fatty Acids

There are many common fatty acids that you hear about, four of which are shown below along with acetic acid for comparison: The COOH cap is what makes these molecules acids. You are probably familiar with acetic acid because this is the acid found in vinegar.

W H Freeman ; Search term Figure Fats provide an efficient means for storing energy for later use. Right The processes of fatty acid synthesis preparation for energy storage and fatty acid degradation preparation for energy use are, in many ways, the reverse of each other. We turn now from the metabolism of carbohydrates to that of fatty acids. A fatty acid contains a long hydrocarbon chain and a terminal carboxylate group. Fatty acids have four major physiological roles. First, fatty acids are building blocks of phospholipids and glycolipids. These amphipathic molecules are important components of biological membranes, as we discussed in Chapter Second, many proteins are modified by the covalent attachment of fatty acids, which targets them to membrane locations Section Third, fatty acids are fuel molecules. They are stored as triacylglycerols also called neutral fats or triglycerides , which are uncharged esters of fatty acids with glycerol Figure Fatty acids mobilized from triacylglycerols are oxidized to meet the energy needs of a cell or organism. Fourth, fatty acid derivatives serve as hormones and intracellular messengers. In this chapter, we will focus on the oxidation and synthesis of fatty acids, processes that are reciprocally regulated in response to hormones. Electron Micrograph of an Adipocyte. A small band of cytoplasm surrounds the large deposit of triacylglycerols. An Overview of Fatty Acid Metabolism: Fatty acid degradation and synthesis are relatively simple processes that are essentially the reverse of each other. The process of degradation converts an aliphatic compound into a set of activated acetyl units acetyl CoA that can be processed by the citric acid cycle Figure An activated fatty acid is oxidized to introduce a double bond; the double bond is hydrated to introduce an oxygen; the alcohol is oxidized to a ketone; and, finally, the four carbon fragment is cleaved by coenzyme A to yield acetyl CoA and a fatty acid chain two carbons shorter. If the fatty acid has an even number of carbon atoms and is saturated, the process is simply repeated until the fatty acid is completely converted into acetyl CoA units. The two processes are in many ways mirror images of each other. Fatty acid synthesis is essentially the reverse of this process. Because the result is a polymer, the process starts with monomersâ€”in this case with activated acyl group most simply, an acetyl unit and malonyl units see Figure The malonyl unit is condensed with the acetyl unit to form a four-carbon fragment. To produce the required hydrocarbon chain, the carbonyl must be reduced. The fragment is reduced, dehydrated, and reduced again, exactly the opposite of degradation, to bring the carbonyl group to the level of a methylene group with the formation of butyryl CoA. Another activated malonyl group condenses with the butyryl unit and the process is repeated until a C 16 fatty acid is synthesized.

Chapter 3 : Essential fatty acid - Wikipedia

Fatty acids: Molecules that are long chains of lipid-carboxylic acid found in fats and oils and in cell membranes as a component of phospholipids and glycolipids. (Carboxylic acid is an organic acid containing the functional group -COOH.) Fatty acids come from animal and vegetable fats and oils.

In humans, arachidonic acid This is illustrated by studies in vegans and vegetarians. This effect can be altered by changing the relative ratio of LA: ALA, but is more effective when total intake of polyunsaturated fatty acids is low. Many infant formulas have AA and DHA added to them with an aim to make them more equivalent to human milk. Essential nutrients are defined as those that cannot be synthesized de novo in sufficient quantities for normal physiological function. In the s Arild Hansen showed that in humans: It was characterized by an increased food intake, poor growth, and a scaly dermatitis, and was cured by the administration of corn oil. Later work by Hansen randomized children, mainly black, to four treatments: The infants who received the skimmed milk formula or the formula with coconut oil developed essential fatty acid deficiency signs and symptoms. They found that patients undergoing intravenous nutrition with glucose became isolated from their fat supplies and rapidly developed biochemical signs of essential fatty acid deficiency an increase in This could be treated by infusing lipids, and later studies showed that topical application of sunflower oil would also resolve the dermal symptoms. Arachidonic acid is the major precursor of prostaglandins , leukotrienes that play a vital role in cell signaling, and an endogenous cannabinoid anandamide. Particular fatty acids are still needed at critical life stages e. Conjugated fatty acids like calendic acid are not considered essential. Authoritative sources include the whole families, but generally only make dietary recommendations for LA and ALA with the exception of DHA for infants under the age of 6 months. Because the LC-PUFA are sometimes required, they may be considered conditionally essential fatty acids, or not essential to healthy adults. Essential fatty acids play a part in many metabolic processes , and there is evidence to suggest that low levels of essential fatty acids, or the wrong balance of types among the essential fatty acids, may be a factor in a number of illnesses, including osteoporosis. Some plant-based foods contain omega-3 in the form of alpha-linolenic acid ALA , which appears to have a modest benefit for cardiovascular health. This elongation of ALA is inefficient. Conversion to DHA is higher in women than in men; this is thought to reflect the need to provide DHA to the fetus and infant during pregnancy and breast feeding. Vegetable Lipids as Components of Functional Food lists notable vegetable sources of EFAs as well as commentary and an overview of the biosynthetic pathways involved. EFA content of vegetable sources varies with cultivation conditions.

Chapter 4 : What are Fatty Acids? (with pictures)

The two essential fatty acids most important to good health are omega-3 and omega-6. But we need these in the right balance in order to protect our hearts, joints, pancreas, mood stability, and skin.

That is why they are termed "essential" fatty acids. However, these fatty acids are different than most other fats. They are not simply used for energy or stored, they are biologically active and have important roles in processes like blood clotting and inflammation. Scientists believe omega-6s are pro-inflammatory, while omega-3s are anti-inflammatory 1. Of course, inflammation is essential for your survival. Scientists have hypothesized that a diet high in omega-6s but low in omega-3s increases inflammation, while a diet that includes balanced amounts of each reduces inflammation 2. Those who follow a Western diet are typically eating way too much omega-6s relative to omega-3s. Many believe this is a serious health problem. Summary An omega-6 to omega-3 ratio that is too high may contribute to excess inflammation in the body, potentially raising the risk of various diseases. Stephan Guyenet , typical omega-6 to omega-3 ratios for pre-industrial populations ranged from 4:1. Hunter-gatherers who ate mostly land animals consumed these fats at ratios of 2:1. Other pre-industrial populations were somewhere in between. Anthropological evidence also suggests that the ratio human beings evolved eating was somewhere around 1:1. Although these populations had a lower life expectancy than modern people, some researchers estimate that chronic lifestyle diseases, such as heart disease and diabetes, were much less common. All of these factors could explain their lower rates of modern lifestyle diseases. However, the effect cannot be solely attributed to a lower intake of omega-6 fatty acids. Summary People who ate a pre-industrial diet had an omega-6 to omega-3 ratio of about 4:1. The ratio today is 16:1. The Problem With the Western Diet Western populations are eating large amounts of processed seed and vegetable oils. Some of these oils are loaded with omega-6s. In the graph below, you can see the dramatic increase in soybean oil consumption in the US, from zero to 24 pounds (11 kgs) per person per year. Soybean oil is currently the biggest source of omega-6 fatty acids in the US because it is really cheap and found in all sorts of processed foods. Stephan Guyenet Thus, the fats people are eating today are leading to actual changes in their bodies, both in terms of their body fat stores and cell membrane health. A high amount of omega-6 in cell membranes is strongly associated with the risk of heart disease, which makes perfect sense given their potential pro-inflammatory effects 5: However, no high-quality controlled studies have investigated the effects of omega-6 acids on heart disease 6 , 7. In fact, it remains unclear whether a high intake of omega-6 fatty acids has any effects on the risk of chronic lifestyle diseases. On the other hand, lots of evidence supports the positive health effects of omega-3 fatty acids. For example, their heart benefits are significant 9 , 10 , Omega-3s may also improve all sorts of mental disorders like depression, schizophrenia and bipolar disorder 12 , 13 , Nonetheless, excessive intake of polyunsaturated fatty acids, including omega-3 and omega-6, has several risks. The double bonds in the fatty acid molecules are very reactive. They tend to react with oxygen, forming chain reactions of free radicals. These free radicals can cause cell damage, which is one of the mechanisms behind aging and the onset of cancer 15 , 16 , Having a relatively low, balanced amount of each is best. Summary The consumption of vegetable oils high in omega-6 has increased dramatically in the past years. Scientists believe this may cause serious harm. Avoid Vegetable Oils High In Omega-6 The single most important thing you can do to reduce your omega-6 intake is avoid processed seed and vegetable oils that are high in omega-6, as well as the processed foods that contain them. Here is a chart with some common fats and oils. Avoid all that have a high proportion of omega-6 (blue bars). You can see that butter , coconut oil , lard, palm oil and olive oil are all relatively low in omega-6. Sunflower, corn, soybean and cottonseed oils are, by far, the worst. Avoid these like the plague. For more information on healthy cooking oils, read this article. Most people store immense amounts of omega-6 fatty acids in their body fat, and it can take a while to get rid of them. If you are concerned about omega-6 fatty acids, use vegetable oils that contain low amounts of omega-6 fatty acids, such as olive oil. Also, consider taking omega-3 supplements or eating fatty fish twice per week. Summary The most important thing you can do to reduce omega-6 intake is to eliminate processed vegetable oils from your diet, as well as the processed foods that contain them. One

problem today is that animals are usually fed grain-based feeds containing soy and corn. This reduces their omega-3 contents, so the polyunsaturated fats in the meat are mostly omega-6 18 , Therefore, if you can afford it, grass-fed meat is definitely optimal. However, even conventionally raised meat is healthy, as long as it is not processed 20 , Even some conventionally raised meats like chicken and pork may be high in omega If you want to decrease your omega-6 intake as much as possible, choose meats from the leaner parts of those animals. One effective way to increase your omega-3 intake is to eat seafood once or twice per week. Fatty fish like salmon are particularly good sources. Cod liver oil is a good choice that contains added vitamins D and A. There are also some plant sources of omega-3 , including flax and chia seeds. However, these contain a type of omega-3 called ALA. For this reason, animal sources of omega-3s, such as fish and grass-fed animals, are usually better choices. Summary You can increase your intake of omega-3 fatty acids by taking supplements or eating grass-fed meat or fatty fish. The Bottom Line Scientists suspect that a high intake of omega-6 fatty acids, relative to omega-3, may promote several chronic diseases. However, there is still no compelling evidence to support this theory. More high-quality studies are needed to investigate the potential health effects of excessive omega-6 fat intakes. If you are concerned, this is a simple guide to optimize your balance of the omega fats: Avoid vegetable oils high in omega-6 and the processed foods that contain them. Eat plenty of omega-3 rich animals, including something from the sea at least once or twice a week. If needed, supplement with an omega-3 source like fish oil.

Chapter 5 : omega-3 Fatty Acids | C60H92O6 - PubChem

Fatty acids are the building blocks of the fat in our bodies and in the food we eat. During digestion, the body breaks down fats into fatty acids, which can then be absorbed into the blood. Fatty acid molecules are usually joined together in groups of three, forming a molecule called a triglyceride.

Chapter 6 : What is a Fatty Acid? | HowStuffWorks

Fatty acid: Fatty acid, important component of lipids (fat-soluble components of living cells) in plants, animals, and microorganisms. Generally, a fatty acid consists of a straight chain of an even number of carbon atoms, with hydrogen atoms along the length of the chain and at one end of the chain and a.

Chapter 7 : Essential Fatty Acids Benefits, Sources & Recipes - Dr. Axe

Fatty acids are found in oils and other fats that make up different foods. They are an important part of a healthy diet, because the body needs them for several purposes. They help move oxygen through the bloodstream to all parts of the body.

Chapter 8 : What Are Saturated Fatty Acids? / Nutrition / Fats

A fatty acid is one of the major components of a triglyceride, which is a form of lipid that is used in the body to store energy. A lipid is just a type of molecule that includes, among other.

Chapter 9 : Saturated fatty acid | Define Saturated fatty acid at blog.quintoapp.com

However, there are two types of fatty acids that your body is unable to synthesize: linoleic acid (omega-6 fatty acid) and alpha-linolenic acid (omega-3 fatty acid). Alpha-linolenic acid is converted in the body to the active forms of omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA).