

Essential Fatty Acids



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Abstract

Essential fatty acids have been shown to have positive effects on insulin sensitivity, thermogenesis, anabolism, and much more. These processes entail the use of many complex mechanisms, however. Of prime importance is their function in hormone synthesis. By passing through the cyclooxygenase, or lipoxygenase enzymatic pathways, fats are able to form several hormones known as eicosanoids. These hormones elicit many anabolic attributes. Highlighted features in this study include: how to maximize hormones, mechanisms of fatty acids functions, and optimal EFA ratios for the athlete.

Essential Nutrients

Approximately 50 ingredients which are necessary for maintenance, growth, health, and ultimately survival have been discovered, but cannot be manufactured by the body. The majority of these are nutrients that must be supplied through diet because the body cannot provide them. Included are: oxygen, water, light, a source of energy, 13 vitamins, 8 essential amino acids (10 for children), 20-21 minerals, and 2 essential fatty acids (EFAs). If just one of these components are lacking, your performance will suffer. Later on, the importance of, 'the complete package,' and its role in the optimization of essential fatty acids will be discussed [53].
Hormones

EFAs play a vital role in hormone synthesis. This next section will begin with eicosanoids.

Eicosanoids

Eicosanoids function in intercellular (between cells) communications. They are modified 20-carbon fatty acids with a 5 carbon ring in the center. The center ring forces the molecule to bend over itself, producing 2 extended parallel chains, facing away from the ring. Furthermore, because they are lipids, they easily cross the plasma membrane, and are insoluble in water. The 3 classes of eicosanoids hormones are: prostaglandins, leukotrienes, and thromboxanes.

To form eicosanoids, the molecule of fat must go through one of two enzymatic pathways. That is, the cyclooxygenase, or lipoxygenase pathway. The former leads to the production of prostaglandins and thromboxanes. The latter produces leukotrienes. This trio of eicosanoids will be discussed subsequently [53].

Prostaglandins- Unlike most hormones, which circulate in the blood and function as messengers effecting tissues from specific glands, prostaglandins exert local effects in their area of synthesis. They are biologically active lipid hormones found within the plasma membrane of almost every cell. As hormone-like chemicals, they monitor cellular actions. Discovery was made in 1930 from the prostate gland of a sheep; hence, the name prostaglandins. About 30 PGs have been discovered.

Prostaglandins and their receptors have several effects on numerous physiological processes; these can be minor or major. Examples are: controlling local hormone response, blood clotting, inflammation, pain, fever, pepsin and HCl secretion in the stomach, nerve functions, calcium metabolism, and much more. However, these functions have been narrowed down to 3 phases: series one, two, and three. Lastly, the conversion of arachidonic acid through the cyclooxygenase pathway forms PGH₂, which is the parent compound of other prostaglandins and thromboxanes. Other series will be discussed further on [53].

Thromboxanes- these are very similar to prostaglandins, and go through the same pathway for formation. They can help reduce blood loss from injuries, assist blood clotting, and many other roles which help maintain homeostasis [16].

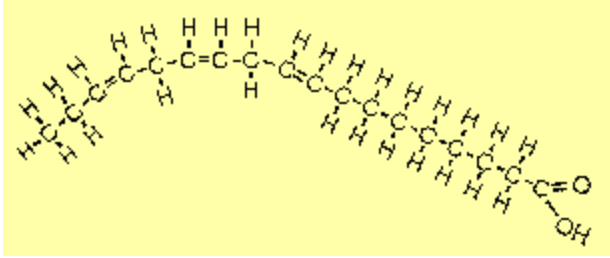
Leukotrienes- formed via the lipoxygenase pathway, leukotrienes possess many potent actions on essential organs and systems. These include: regulation of certain white blood cells, smooth muscle contraction, assistance of the immune system, cardiovascular system, and nervous system, among others.

Leukotrienes have been shown to be effective supplements for ailments such as: rheumatoid arthritis, psoriasis, and inflammatory bowel disease [58]. Additionally, studies display them to be effective anti-inflammatories, as well as assisting diseases such as asthma, rheumatoid arthritis, and inflammatory bowel disease [31].

And with that, we're ready to get down to the meat of the article: essential fatty acids!

Omega-3

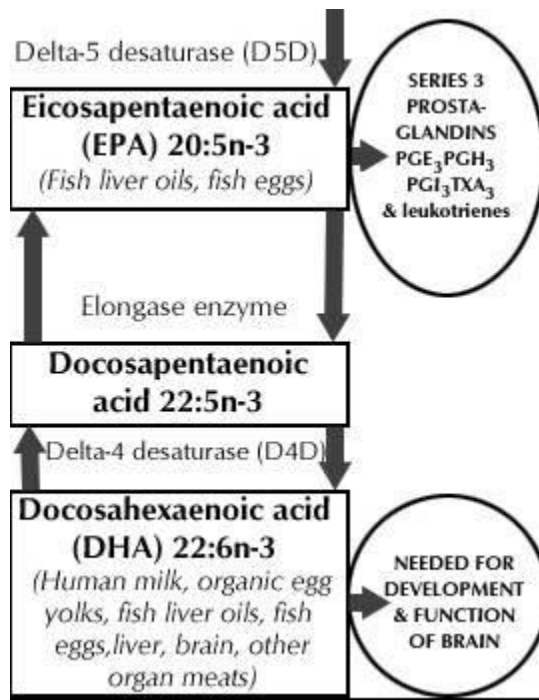
Omeegas-3s are polyunsaturated fats, but are commonly called super unsaturated to distinguish them from omega-6s. Its main component is Alpha-linolenic Acid (LNA). Scientifically, it is called cis-w_{3,6,9}-octadectrienoic acid. Other synonyms are 18:3w₃, or 18:3n₃, w₃, and n₃ fatty acids. The number before the colon denotes the amount of carbon atoms, and the number after indicates total double bonds. The human body needs LNA for survival, but cannot manufacture it, which makes it an essential fatty acid.



EFA's have several functions, such as cell membrane structure, energy via oxidation, and as mentioned previously, production of hormones, which brings us to our next topic: LNA derivatives.

Derivatives

LNA is the starting material for the biosynthesis of Docosahexaenoic Acid (DHA), and Eicosapentaenoic Acid (EPA). It converts to the derivative Stearidonic Acid (SDA), to eicosatetraenoic acid (ETA), and to Eicosapentaenoic Acid (EPA), respectively. From here, EPA forms DHA in a 4-step process of elongation, elongation, desaturation, and chain shortening, in that order. Desaturation is the introduction of double bonds; the enzymes that do this are called desaturases. Elongation catalyzes the addition of 2-carbons to fatty acids [68]. From here, several eicosanoids are formed, producing an abundance of anabolic effects. EPA manufactures series 3 prostaglandins. This article will primarily focus on the latter two derivatives, EPA and DHA.



EPA and DHA

In an epidemiological (the study of diseases in populations and states) survey, fascinating observations were made on the Greenland Eskimos, using approximately 1800 people over a 25 year period. Results show that they have a lower risk and

often a complete absence of diseases such as acute myocardial infarction, diabetes mellitus, thyrotoxicosis, bronchial asthma, multiple sclerosis, and psoriasis. Why would this be? The answer is clear: their diet, which is rich in EPA and DHA from fish [34].

EPA is termed 20:5n3, while DHA is 22:6n3. These oils play a vital role in our body. For example, EPA is the most potent factor in prevention of prostaglandin series 2, which can induce many side effects (discussed later). Many more beneficial attributes will be shown shortly. First, conversions must be discussed.

Most studies in humans have shown that high doses of LNA convert to EPA at a low rate, and conversion to DHA is severely restricted. Furthermore, a diet with a high omega-6-3 ratio can reduce this by 40 to 50%! Thus, it is suggested to consume 2-3 portions of fatty fish per week, or 1.25 g EPA + DHA per day, while keeping your omega-6s under control [24]. The British Nutrition Foundation also recommends a daily intake of EPA and DHA in amounts corresponding to the intake of 3 to 4 g standardized fish oil or 2 to 3 portions of fatty fish weekly [25]. Many other journals testify to these reports as well. [46,47].

Good sources of EPA and DHA are fatty (at least 10%), fresh, cold-water fish such as sardines, trout, salmon, eel, and mackerel.

Anabolic effects

Lower PG2s

Series 2 prostaglandins can have serious adverse affects. We will get into more detail when we discuss omega-6 fatty acids, but suffice it to say, lowering its production would be of benefit to the athlete [77]. Consequently, omega-3s (particularly EPA, which as stated above, is the most potent omega-3 in series 2 prevention; EPA stops AA from being released so it can't form PG2S) have been shown to inhibit the production of prostaglandin series 2, which is produced by w6s [74]. The effect of consuming more w-3s and lowering w-6s is amazing. These include decreased water retention and inflammation, as well as cardiovascular health.

For example, they tested a diet rich in omega-3 oils--using fish oil--and a diet rich in omega-6 oils--using corn oil--on female mice [54]. The results showed that dietary supplementation with w3s over w6s inhibited the production of pro-inflammatory cytokines and slowed progression of immune-complex-mediated kidney injury. This may be due to the enhanced ability of the cells to dispose of harmful reactive oxygen intermediates.

Another study compared fish oil to safflower oil over a 5 month period. The results showed splenic natural killer cells and lymphokine-activated killer cells were proportional to the concentration of n6s, but reduced by n3s [5].

Additionally, supplementation with n-3 has also been shown to enhance the immune system, largely due to decreased PG2s [27,56].

There are many more benefits to this method [67], and be sure that this information will be taken into account when ratios are discussed.

Anti-inflammatory

N3 fatty acids have been shown to suppress inflammation by decreasing the production of pro-inflammatory cytokines and series 2 prostaglandins, making them of use for several chronic inflammatory diseases [4]. It has been postulated that they may help relieve delayed onset muscular soreness (DOMS), but results are not very convincing [44].

Lower triglyceride and cholesterol levels

Omega-3s--particularly EPA and DHA found in fish--have been shown to lower serum triglyceride, total cholesterol levels, and phospholipids [45]. From his study, Tato F. et al. states [69], 'We conclude that in FCH moderate doses of long-chain n-3 fatty acids are highly effective in lowering pathological VLDL triglycerides, VLDL cholesterol, and VLDL apo B.' In another study on the benefits of omega-3s, plasma triglycerides were reduced by 58% and plasma cholesterol concentration by 34% [70]! The results are incredible.

Cancer

Studies show that w3s can help prevent cancers, such as colon and breast cancer. In a study with fatty fish, they compared subjects using high (2 servings), and moderate (0.5 servings) amounts of fish weekly. The results showed supplementing with fish twice weekly was more effective in decreasing the risk of cancer [71]. These benefits may be related to reduced series 2 prostaglandins.

Additionally, in a series of case-control studies conducted in Italy and Switzerland between 1991 and 2001, the role of n-3 polyunsaturated fatty acid intake in the etiology of cancer of oral cavity and pharynx (736 cases, 1772 controls), esophagus (395 cases, 1066 controls), large bowel (1394 colon, 886 rectum, 4765 controls), breast (2900 cases, 3122 controls), and ovary (1031 cases, 2411 controls) cancers were tested. From this comprehensive experiment, it was concluded that, 'All the estimates were statistically significant, excluding that for rectal cancer, and consistent across strata of age and gender. These results suggest that n-3 PUFAs decrease the risk of several cancers [73].'

Kidneys

Using patients with IgA nephropathy--renal (kidney) diseases--it was tested how effective omega-3s were. They concluded that the n3s can slow the rate of renal function loss effectively [17]. Several other scientific authorities also recommend w3s for renal maintenance [18,26].

Insulin Sensitivity

If you have read any of our articles, you know just how valuable insulin sensitivity is. Simply put, increased sensitivity promotes a much greater anabolic response to insulin and increases your fat-burning ability immensely, while insulin resistance leads to elevated fat storage, reduced hypertrophy, and increased susceptibility to diseases such as diabetes. For more, study the following articles: Metabolic Primer Part I, and Endocrine Insanity Part III.

Here is the exciting part: studies show omega-3s can increase insulin sensitivity drastically, while its counterpart--omega-6s--in higher dosages may lead to insulin resistance.

For instance, a fascinating study was performed on rats using high-fat diets and various lipids to assess their effect on bodyweight regulation, adiposity, and metabolism. Results showed that rats who consumed high amounts of saturated or n-6 polyunsaturated fatty acids became obese, insulin resistant, and gained the most fat, while fish oils showed to be a superior fat in the experiment [57].



Another study stated that the negative effects of a high-sucrose diet, which induced insulin resistance and mild glucose intolerance, were counteracted by enhanced dietary intake of omega-3 polyunsaturated fatty acids [51].

Storlien LH et al. tested the effects of certain fats on rats. Subjects who had diets rich in polyunsaturated (omega-6) fatty acids developed severe insulin resistance. Afterward, they substituted 11% of the fatty acids in the polyunsaturated fat diet with long-chain omega-3 fatty acids from fish oils. The omega-3s were shown to effectively normalize insulin action [66].

Furthermore, Chicco A et al. composed a diet with 7% of the calories coming from cod liver oil--which is rich in omega-3 fatty acids--on male Wistar rats. The end results showed a significant reduction in plasma insulin levels throughout the day, due to enhanced insulin sensitivity [11].

Popp-Snijders C et al. performed an excellent study for the effects of Omega-3s on diabetics. Six non-insulin-dependent diabetics supplemented with just 3 g of the omega-3 fatty acids daily, over an 8 week time span. The subjects showed enhanced insulin sensitivity and lower plasma triglyceride levels [55].

Another experiment was performed on rats. First, they implemented a diet high in omega-6 and saturated fatty acid, which again lead to insulin resistance. Afterward, they replaced simply 6 percent of the linoleic omega-6 fatty acids from safflower oil with long-chain polyunsaturated omega-3 fatty acids from fish oil. This resulted in the prevention of insulin resistance [62].

It should be noted that in Western society diabetes has become a prevalent disease. This can be largely attributed to the lopsided ratio of omega-6:3 fatty acids. Diabetics will want to take close notice of these results, and adjust their diets accordingly [62].

So, as you see, a diet rich in Omega-6s can lead to insulin resistance, while a diet full of Omega-3s will inevitably increase insulin sensitivity [39,40,14].

Thermogenesis

The omega-3 has the distinctive ability of enhancing thermogenesis and lipid metabolism (increased usage of fat), thereby reducing body fat deposition. Clarke SD contributes to this, stating, '[Omega-3s exert their] effects on lipid metabolism and thermogenesis by up-regulating the transcription of the mitochondrial uncoupling protein-3, and inducing genes encoding proteins involved in fatty acid oxidation (e.g. carnitine palmitoyltransferase and acyl-CoA oxidase) while simultaneously down-regulating the transcription of genes encoding proteins involved in lipid synthesis (e.g. fatty acid synthase) [14].'

The effect of what they are saying is this: food, as well as our own body, contains what is known as 'potential chemical energy.' That is, energy held within the bonds of molecules. A good analogy is to think of a boulder placed on a 100 foot hill. By position, when the boulder is on top of the hill, it has the potential to turn into kinetic energy (the energy of movement) if someone were to tip it off the hill so that it began to roll. High-energy bonds within molecules are high-energy because when those bonds are broken, energy is released, which can be used to do work (force x distance=work).

They use the term Lipid Oxidation for a very specific purpose. The organelle in your body known as mitochondria is responsible for extracting energy from lipids (fats), and using it to synthesize or build our energy currency known as ATP (refer to Adam's tibialis article). Oxidation is referred to because oxygen is required for this process to occur (oxidation refers to an atom accepting electrons from another atom). The entire process is known as cellular respiration, because you need the respiratory system to consume the oxygen needed for the extraction of energy from these food groups, or stored energy deposits such as your own adipose tissue. Carnitine is an essential protein needed for fat breakdown, and thus, when the body encodes for more of it and other vital proteins required for this process, fat breakdown increases. Genes code for proteins. Likewise, by down-regulating certain genes which code for proteins that enhance the formation of fatty molecules, you logically slow down the process. As a result, the above effects are additive to enhanced fat-burning.

Nervous system

N3s are high in biologic structures which require fast movement, like transport mechanisms in the brain and retina. Due to this, it appears that omega-3s may have functions with the nervous system benefiting vision and the brain, among others. [49]

Hypertension (high blood pressure)

Omegas-3s are potent supplements in the reduction of blood pressure. For example, a thorough study was composed using 31 placebo-controlled trials on 1356 subjects using fish oils. A significant drop in blood pressure was observed. They noted that its benefits are strongest for those with heart-related diseases [48].

Its great effectiveness may be due to alteration of prostaglandin metabolism, vascular endothelial function, increased vascular responses to pressure agents, restriction of vascular smooth muscle production, and decreased cholesterol.

Joints

Bodybuilders apply tremendous pressure to their joints on a day-to-day basis. It is vital that we have a strong, smooth-running skeletal system to push ourselves to the max. In assistance of our goals, I present omega-3s.

W3s have shown tremendous results in soothing tender joints and stiffness. For example, w3s were tested on patients with arthritis. The results showed a significant reduction in disease activity, pain assessment, and number of weak joints. In addition, morning stiffness and several tender joints were relieved [35].

Another 24-week study was done on 17 patients with rheumatoid arthritis. Supplementation consisted of 54 mgs of EPA and 36 mgs of DHA. They reported a significant improvement in tender and swollen joints [36].

Several other scientific authorities attest to its benefits for joints as well [42,75,50]. These results are attributed to a reduction in prostaglandin series 2, its lubricating effects on our joints, construction of cell membranes, and w3's other anti-inflammatory influences displayed earlier.

Skin

Omega-3s have been shown to work wonders on skin inflammations, disease, and overall skin perfection, such as softer, smoother, healthier skin. Dr. John A. Grossman, board certified aesthetic plastic surgeon, states [19], 'For softer skin, get plenty of omega-3 fatty acids in your diet.' Due to these findings, several companies have designed sprays, foods, and other supplements containing omega-3s for smoother skin [63,64,19].

Deficiency in omega-3s can produce several skin disorders such as dermatitis, skin atrophy, scaly dermatitis, edema, dry skin, and much more [16].

These benefits are attributed to enhanced skin blood flow, decreased PG2s, and its role in anti-inflammation [65].

Platelets

Platelets are disks circulating in our blood stream that aid in blood clotting. Sticky platelets form clots easier, while less-sticky platelets reduce clot formation. Sticky platelets promote heart attacks, along with other cardiovascular disorders. The former is induced by series 2 prostaglandins, while reduced stickiness is promoted by omega-3s.

Omega-3s and 6s were tested for their effects on platelet adhesion. The results showed w3s were inhibitory to platelet adhesion, while a diet rich in omega-6s stimulated it [2]. There are several other sources which testify to these effects as well [41,27].

Sources

Sources high in omega-3 fatty acids include flax (58%), chia (30%), hemp seed oil (20%), pumpkin (15%), fish (31%), canola oil (7%), and walnuts (5%). Other sources are flax meal, flax bread, omega-3 rich eggs, dark leafy greens such as spinach, and fish oil tablets, among others.

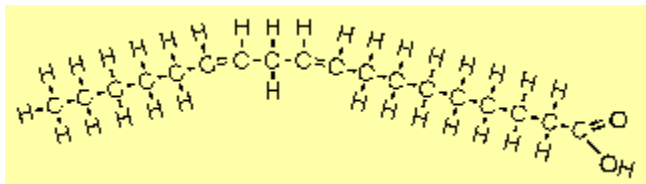
Deficiencies

Because EFAs are needed for the function of virtually all tissues, the list of side-effects for deficiencies is vast. This includes hemorrhagic dermatitis, weakness, impaired vision, tingling sensations, mood swings, edema, dry skin, sticky platelets, high blood pressure and triglycerides, hemorrhagic folliculitis, immune and mental deficiencies, skin atrophy, and scaly dermatitis, among others [3,33,30]. Some have suggested omega-3s for the reduction of symptoms in PMS, but most studies display poor results [15]. Lastly, EFAs in general are vital for growth and development [43].

Later on, I will discuss the recommended usage of Omega-3s in relation to their essential counterpart.

Omega-6

Omega-6s are polyunsaturated fats. Its main component is Linoleic Acid (LA). Scientifically, it is called cis-w6,9-octadecatrienoic acid. Other synonyms are 18:2w6, or 18:2n6, w6, and n6 fatty acids. Again, the number before the colon denotes the amount of carbon atoms, and the number after indicates total double bonds. It is the second essential fatty acid.

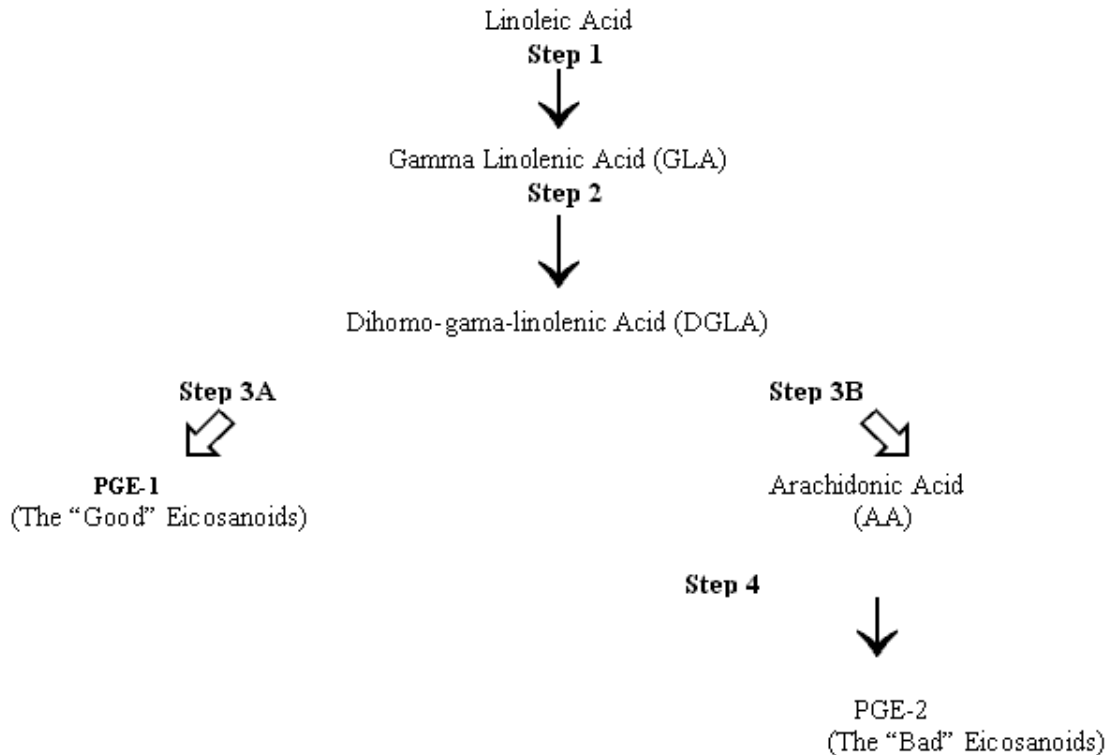


Derivatives

Linoleic Acid is the starting material for omega-6 derivatives. First, it is turned into gamma-linolenic acid (GLA, or 18:3w6), then to dihomo-gamma-linolenic acid (DGLA, 20:3w6), then to arachidonic acid (AA, or 20:4w6), and AA can be further converted to docosapentaenoic acid (DPA, or 22:5w6)). To turn AA into DPA, your body uses a 4-step process consisting of elongation, elongation, desaturation, and chain shortening, respectively. Again, desaturation is the introduction of double bonds. The enzymes that do this are called desaturases. Elongation catalyzes the addition of 2-carbons to fatty acids. This process occurs on the surface of the endoplasmic reticulum (excluding chain shortening), and leads to the formation of DPA [68].

DGLA forms series one prostaglandins, which are anabolic. AA forms series 2 prostaglandins, which serves some benefit, but for the most part generates unhealthy and catabolic results. This includes platelet aggregation, cardiovascular diseases, and inflammation, among other side-effects.

Fortunately, series one prostaglandins help to inhibit AA from being released to form PG2s, but the most potent prevention of PG2 is EPA, as discussed earlier.



In summary, omega-6s can convert to DGLA, and then to series one prostaglandins, which are good, but can additionally be converted to AA, and form series 2 prostaglandins, which are bad.

Anabolic effects

Cardiovascular health

N-6s have been shown to play an important role in cardiovascular maintenance. These effects are attributed to the metabolism of prostaglandin series one, which reduces platelet stickiness, relaxes blood vessels, enhances circulation, lowers blood pressure, and inhibits prostaglandin series 2 [54].

Anti-inflammation

Omega-6 has demonstrated anti-inflammatory effects. For example, patients with rheumatoid arthritis supplemented with GLA and, at the end of the experiment, there was a great reduction in joint inflammation [21]. Other studies testify to these results as well [22].

Lowers cholesterol

Horrobin DF et al. states [28], "For 30 years it has been known that linoleic acid can lower elevated cholesterol levels. However, the mechanisms, and exact derivative that accomplishes this, is still unclear." But, from his research he showed that GLA--linoleic acid's first derivative,--has cholesterol-lowering actions 170 times greater than the parent molecule, which means linoleic must be converted to GLA for these benefits to occur. The conversion is done by the enzyme delta-6-desaturase. This enzyme can be inhibited by aging, diabetes-mellitus, alcohol, catecholamines, trans-fatty acids, and saturated fats. Direct GLA consumption would therefore be beneficial for lower cholesterol.

Other journals testify to these benefits as well. For example, one showed omega-6s significantly lowered plasma total and low-density lipoprotein (LDL) cholesterol by 8 percent and 14 percent, respectively [59].

Other benefits

Omega-6s have even more benefits. Tests show they can increase thermogenesis [72], fat oxidation [61], play a role in sympathetic nervous system stimulation [52], and increase the usage of fatty acids for energy [13]. Mechanisms are very similar to the in-depth explanations I displayed under omega-3s.

Sources

Omega-6s are abundant in our society. Sources include chia (40%), evening primrose (81%), almonds (17%), flax (14%), natural peanut butter (30%), grape (71%), hemp (60%), pumpkin (50%), canola (30%), safflower oil (75%), sesame (45%), and walnuts (51%). 15% of turkey and chicken fat comes from omega-6. However, these are usually eaten without skin, which eliminates most of the fat. Good sources of GLA are evening primrose (9%), borage oil (20%), and black currant seed oil (18%).

Deficiencies

As with omega-3s, the list of side-effects for w6 deficiency is long. These include inflammatory skin, inherited skin condition, atopic dermatitis (eczema), growth retardation, poor wound healing, decreased immune system, and much more [20,29]. Note that w6s are vital for healthy skin, but not quite as potent compared to omega-3s. They also help maintain our cell membranes.

EFAS=Delicate!

Essential fatty acids are very sensitive. They must be handled with care or they are useless. Three important factors to monitor are heat, air, and light.

Heat- heating oils rich in EFAs at high temperatures will increase oxidation, and can change the chemical structure, rendering its benefits useless. I recommend against high-temperature-frying and deep-frying foods rich in EFAs. Add the oils in after you are done cooking and then mix them within the dish. Boiling is much safer than frying, due to lower temperatures. Keeping the temperature around 100 C can help

prevent oxidation and the other negative effects listed above. The best way to go is to get your EFAs raw, i.e. sushi.

Air- exposing these fats to air will promote rapid oxidation, leading to toxic, spoiled oils, which can harm your body. I recommend sealing them in tight containers; never leave them out in the air too long.

Light- when essential fatty acids are exposed to high amounts of light, they can be broken down into many toxic substances. Oxidation explodes, free radicals are produced, and the end result is rancid, toxic, worthless oils. To avoid these effects, EFAs need to be stored in dark, dense containers.

The complete package

In order for all the benefits of essential fatty acids to occur, you need to have a complete diet. Absence of any essential nutrient will inhibit your results. One valuable nutrient for this process is vitamin E.

Vitamin E

Vitamin E helps polyunsaturated fats (PUFUs) tremendously. It is effective at chain-breaking and, as an antioxidant, vitamin E is critical for preventing oxidation of PUFAs [60,76].

The commonly recommend ratio of vitamin E:PUFU is least 0.6 mg Vitamin E/g PUFA. Higher levels may be necessary for diets that are rich in fatty acids containing more than two double bonds [76].

However, vitamin E deficiency is unlikely, especially considering the fact that plants from which many EFAs are derived (I.e. safflower oil) contain high amounts of vitamin E.

Other important factors in the optimization of EFAs are vitamin B-complex, and ZMA. For this, I refer to the following articles: Supplement Review ZMA and How it Works, A comprehensive discussion on B-Complex & its relation to peak performance.

Essential Fatty Acid Ratios and Recommendations

There is no set number for total EFA consumption, or the ratio between omega-6s and omega-3s. This must be adapted according the person's requirements, goals, and results. Below I will present what must be considered.

There are several factors to be taken into account for ratios. First, on average, (this can be different, however) w6s are more frequent throughout our bodily tissues; overall it is near a 4:1 ratio in favor of omega-6. Also, the conversion of omega-3 is four times quicker than omega-6. Both EFAs compete for absorption, and can effect each other's metabolism [6,24]. N6 derivatives, however, are much more harmful to n3 production [38]. Also, EFAs have shown synergistic effects, suggesting they should both be used for optimal gain [7].

To avoid deficiency, results show that 1-4% of your calories need to come from n6s, and about 1% from n3s [8,32]. No toxicity level has been found for EFAs. Several

studies have been performed on animals consuming large amounts, with no adverse effects. In addition, many cultures, such as the Eskimos, consumed great amounts of EFAs (primarily w3s), and were one of the healthiest societies ever; just make sure you consume your vitamins.

An interesting situation is in the United States (USA). An increase in vegetable oils, rich with w6s, has the USA's ratio of n6:n3 skyrocketed to about 10:1. It has been postulated that this is a major factor for the increased diseases (especially cardiovascular) within our society today [37].

With these statistics in mind, many authorities recommend a higher ratio of n6:n3, much lower than the United States average, however. Between 4:1 (In favor of n6) and 1:1 has been recommended [10], but this is based on just the minimal requirements and normal everyday function, not the athlete.

For optimal performance, around 10% of your total calories coming from essential fatty acids has been suggested [9].

Now, the real question is what is best for the athlete? It is the opinion of this author that the evidence clearly shows a higher ratio of Omega-3 to omega-6 is much more beneficial. The reasons I and several other athletes opt for this are:

1. Enhanced insulin sensitivity- as I displayed through several studies, n6 can promote insulin resistance, while n3 leads to increased insulin sensitivity. This in itself is more than enough reason to lower w6s and raise w3s.
2. Reduced PG2s- series two prostaglandins have been shown to promote several diseases, and are quite catabolic. The strongest agent against this is the omega-3, EPA. By increasing your omega-3s, you will decrease your risk for disease and avoid the negative effects of the aforementioned hormone. This will likewise decrease inflammation, improve your immune system, prevent cardiovascular diseases, and much more.
3. Increased Derivates- as stated earlier, w6s have a much stronger negative effect on w3 metabolism. By increasing this, you will help balance/optimize eicosanoid production.
4. Maximum results- overall, omega-3s have a stronger and wider list of benefits than omega-6s. Your skin will improve drastically, nervous system will be enhanced, joints and inflammation will decrease at a higher rate, increased thermogenesis, and the prevention of several diseases, such as cardiac-related ones.

Now, let me reiterate, there are no set optimal ratios or daily recommended intakes for EFAs.

In several situations, people have opted for a higher ratio of n3:n6. For example, from a study on cancer, particularly breast cancer for women, it was concluded that, 'These results are consistent with the hypothesis that a higher (n-3)/(n-6) PUFA ratio may reduce the risk of breast cancer, especially in premenopausal women [23].' Diabetics also have adjusted their diets, due to omega-3s insulin-enhancing effects. And Eskimos are an excellent example of what a higher ratio of omega 3:6 can do.

So going with a higher ratio of omega-3s is not new, and many have implemented this scheme into their diet plan.

I recommend around a 2:1 and 3:1 ratio of omega-3:omega-6. This can be adjusted, however, according to your results and goals. At least 30% of your daily fat should come from EFAs, and going higher is perfectly fine. I would monitor this by how your body responds.

If you are new to essential fatty acids, I suggest you start at a minimal dosage, and progressively increase them, in order to let your body adapt to it and avoid any gastrointestinal distress.

As far as what to consume, the main derivatives I would focus on are EPA and DHA. I recommend at least 3 grams total daily, along with your other omega-3s, such as flax. You can get this from fish or fish oil supplements.

A sample day for me may include: 3 Tbsp of flax, 2 Tbsp natty pb, 1 Tbsp safflower oil, plenty of dark leafy greens, and 10 oz of salmon.

Chart

Below I have included a vast essential fatty acid chart. I will give the percentage of fats, which come from omega 6 and omega 3 fatty acids for several foods. Enjoy!

Food	Omega 3%	Omega 6%
Cashew	0%	6%
Walnut	5%	51%
Safflower	0%	75%
Chia	30%	40%
flax	58%	14%
Pumpkin	15%	50%
Grape	0%	71%
Sunflower	0%	65%
Hemp	20%	60%

Wheat germ	5%	50%
Evening Promise	0%	81%
Corn	0%	59%
Sesame	0%	45%
Canola	7%	30%
Natural Peanut Butter	0%	30%
Almonds	0%	17%
Pistachio	0%	19%
Olive oil	0%	8%
Kukui	29%	40%
Soybean	7%	50%
Rice bran	1%	35%
Salmon	30%	0%
Borage oil	0%	34%

Conclusion

To conclude this article, I turn to the apostle Paul [1]:

Romans 8:31-39

31 What shall we then say to these things? If God be for us, who can be against us? 32 He that spared not his own Son, but delivered him up for us all, how shall he not with him also freely give us all things? 33 Who shall lay any thing to the charge of God's elect? It is God that justifieth. 34 Who is he that condemneth? It is Christ that died, yea rather, that is risen again, who is even at the right hand of God, who also maketh intercession for us. 35 Who shall separate us from the love of Christ? shall tribulation, or distress, or persecution, or famine, or nakedness, or peril, or sword? 36 As it is written, For thy sake we are killed all the day long; we are accounted as sheep for the slaughter. 37 Nay, in all these things we are more than conquerors through him that loved us. 38 For I am persuaded, that neither death, nor life, nor

angels, nor principalities, nor powers, nor things present, nor things to come, 39 Nor height, nor depth, nor any other creature, shall be able to separate us from the love of God, which is in Christ Jesus our Lord.

Keep it Hardcore,

Venom
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God.

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