

Omega Fatty Acids Influence on Cardiovascular Health, Immune Response, Cognitive Function & Skeletal Health

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Discussion

FATTY ACIDS: ESSENTIAL FOR HEALTH

Fatty acids are essential to physiological function, health, and homeostasis. They provide the substrate for lipids, one of the three main components of biological structure (along with proteins and carbohydrates). Fatty acids comprise key structural components of cell membranes in the form of phospholipids and contribute to cellular membrane stability. Fatty acids are approximately 30% of total energy intake in humans, providing fuel for cells and tissues.¹ Fatty acids are metabolized in the cellular mitochondria to yield large amounts of ATP (adenosine triphosphate), the coenzyme involved with intracellular energy transfer.

Essential for healing and repair, fatty acids influence cellular response and the health of all human physiological systems. Fatty acids are necessary for hormone production, cellular function and repair, healthy cardiac function, immune response, nervous system health, eye health, epithelial repair, and skin health. Fatty acids are also precursors for lipid mediators, influencing signal transduction pathways and gene transcription. As ligands of nuclear receptors they affect gene expression, modulate gene transcription, and significantly influence cell-signaling.¹⁻⁴

Lipids exert a profound influence on neuronal membrane dynamics and neurotransmitter function. The mammalian brain contains the highest concentration of lipids compared to other organs. Its dry weight is about 80% lipids. Essential fatty acids, found to comprise about 15% to 30% of the human brain, exert a profound influence on brain health, cognition, and mood.³

ESSENTIAL FATTY ACIDS

Essential fatty acids (EFAs) - the omega-3 and omega-6 fatty acids - cannot be manufactured in our body and must be consumed on a regular basis through fresh, whole foods. Since dietary fatty acids are incorporated into cellular

membranes, the oils in our diet influence the permeability, fluidity, and health of cell membranes. Fatty acid intake (quality and quantity) is a driving factor in supporting healthy modulation and function of cellular, immune, inflammatory, and hormonal processes. It can drive either pro- or anti-inflammatory processes.¹⁻⁴

BALANCED RATIO OF ESSENTIAL FATTY ACIDS

A balanced dietary intake of essential fatty acids is essential for health. While human physiology requires beneficial omega-6 fatty acids, excessive intake of omega-6 fatty acids accelerates free radical damage and promotes inflammation. It is thought that for over 100,000 generations humans have evolved with a dietary omega-6 to -3 ratio of around 2:1, which reflects an intake of naturally healthy omega-3 fatty acids from plants, animals, and fish. Research suggests that while a healthy dietary ratio of up to 4:1 can benefit health, the optimal dietary ratio of around 2:1 is found to calm inflammation and provide a wide array of health benefits.^{3,5,6}

EFAs AND DISEASE

Unprecedented changes in diet and agricultural practices have occurred over the last 100 years. Ample documentation shows there is a dramatic increase of omega-6 to omega-3 polyunsaturated fatty acids in human circulation and tissues. Multiple studies report the modern dietary ratio of omega-6 to -3 fatty acids is about 17:1, reflecting an over-consumption of omega-6 oils concurrent with a pronounced deficiency of omega-3 oils. This is widely recognized as a contributing factor to many disease processes including cardiovascular, cellular dysfunction, autoimmune, and inflammatory conditions.^{3,5,7}

Unhealthy fatty acid consumption promotes pro-inflammatory compounds that contribute to disease formation, inflammatory conditions, and adversely influences mental health.^{3,6} Numerous studies note a correlation between the huge shift in Western diets over the last century

away from EFA consumption, particularly omega-3 fatty acids, with a vast increase in cognitive and psychiatric disorders.³ This is linked with increased production and circulation of inflammatory mediators (eicosanoids, cytokines), increased inflammatory gene expression, and higher incidence of inflammatory diseases.^{3,6}

OMEGA-3 FATTY ACIDS

There are three main forms of omega-3 fatty acids. Alpha-linolenic acid (ALA), plentiful in the plant kingdom, is also found in the fatty tissues of grass-fed and wild animals.^{5,7} Wild and free-range animals are found to have greater omega-3 fatty acid concentrations in their tissues than commercially-raised animals.³ Walnuts, flax seeds, hemp seeds and chia seeds are especially high in ALA. The two other forms of omega-3s, EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), are found in fish and in marine algae. Wild fish contains much higher quantities of EPA and DHA than farmed fish.^{5,7}

Each of these three types of omega-3 fatty acids contributes to essential physiological processes. They are found to promote cardiovascular health, enhance immune function, improve memory, be neuro-protective, and encourage bone health and density – to name several of many key functions.^{5,7}

Lipids, particularly the long-chain PUFAs (polyunsaturated fatty acids) such as EPA and DHA, are vital modulators of neural function. They are also precursors of lipid mediators including eicosanoids (prostaglandins, leukotrienes, thromboxanes), resolvins, and neuroprotectins. Lipid mediators produced by EPA and DHA are found to be anti-inflammatory, enhancing resolution of the inflammatory

process.^{2,8}

Eicosanoids exert a wide influence in regulatory, autocrine, and paracrine systems.² They perform numerous regulatory functions in the brain, immune system, inflammatory response, and in other systems.³ A study administering a combination of fish oil and borage oil together found positive changes in inflammatory markers with a decrease in leukotriene production and other factors that influence the inflammatory response.⁶

Omega-3 fatty acids are known for their ability to promote bone formation. Studies find that the ideal 2:1 ratio of omega-6 to omega-3 fatty acids supports healthy bone density and minimizes bone loss, especially in women after menopause. Regular intake of healthy omega-3 fatty acids is associated with higher bone mineral density in the absence of estrogen.^{7,9} This is thought to be partially due to the anti-inflammatory influence of the omega-3s, which decrease cytokine production. Cytokines normally stimulate bone breakdown as part of the body's natural process (the bone cycle) where the bones are continuously broken down and rebuilt.^{7,10} Omega-3 fatty acids are involved with regulation of calcium excretion, growth hormone secretion, fatty acid formation, and osteoblast formation.^{11,12}

A balanced variety of healthy dietary fatty acids powerfully enhances physiological function, homeostasis, and healing processes at all levels. A balanced ratio of fatty acids can be achieved through a wholesome diet of fresh, natural foods, along with supplementation of high-quality fatty acids from fish and plant sources.

Table 1. Names and Abbreviations of the Omega-6 and Omega-3 Fatty Acids

Omega-6 Fatty Acids			Omega-3 Fatty Acids		
Linoleic acid	LA	18:2n-6	α-Linolenic acid	ALA	18:3n-3
γ-Linolenic acid	GLA	18:3n-6	Stearadonic acid	SDA	18:4n-3
Dihomo-γ-linolenic acid	DGLA	20:3n-6	Eicosatetraenoic acid	ETA	20:4n-3
Arachidonic acid	AA	20:4n-6	Eicosapentaenoic acid	EPA	20:5n-3
Adrenic acid		22:4n-6	Docosapentaenoic acid	DPA (n-3)	22:5n-3
Tetracosatetraenoic acid		24:4n-6	Tetracosapentaenoic acid		24:5n-3
Tetracosapentaenoic acid		24:5n-6	Tetracosahexaenoic acid		24:6n-3
Docosapentaenoic acid	DPA (n-6)	22:5n-6	Docosahexaenoic acid	DHA	22:6n-3

Source: <http://pi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids#vision>

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Fish Oil

Throughout time, humans have relied on fish to provide food and two essential nutrients for health – proteins and fatty acids. Regular dietary consumption of fish is found to be a factor in longevity and health and can decrease risk of cardiovascular and other disease.¹³⁻¹⁶ Many studies correlate fish consumption with mental health including relief from depression, decreased suicide, and improved cognition. Low omega-3 levels are found in those with major depressive disorders and in those with dementia and ADHD (attention deficit hyperactivity disorder).³

Omega-3 fatty acids and fish oils are found to benefit protein metabolism and counteract unhealthy anabolic processes such as cachexia and similar disabilities.¹⁷ Fish oils benefit those with joint diseases such as arthritis and can help reduce neck and back pain, likely through their influence in calming the inflammatory process.^{8,18-20} Omega-3 fish oils are found to inhibit COX-2 expression along with the oxidative metabolism of AA (arachidonic acid) to the inflammatory prostaglandins.^{8,21,22}

Omega-3 fatty acids in fish and fish oils are known for their cardio-protective capacity and studies show they help decrease risk of sudden cardiac death from arrhythmia.^{23,24-27} Part of their cardio-protective benefit is conferred through their influence on ventricular repolarization^{15,28} and on neural cardiovascular control.²⁹ Omega-3 fatty acids are found to be beneficial and synergistic in combination with statin drugs for those with dyslipidemia.³⁰ They can benefit serum lipid levels and help reduce CRP (C-reactive protein) levels and are also found to lower the omega-6 to omega-3 serum phospholipid levels.³¹

EPA and DHA

While the essential fatty acids EPA and DHA can be synthesized from ALA, the conversion efficiency is low. The main source of EPA and DHA is fresh fish and further supplementation with fish oils is beneficial. DHA is essential for neurological, cognitive, and visual development and health. High concentrations of DHA are found in cell membranes of the retina and in phospholipids of the brain's gray matter.⁴ EPA and DHA are key components of the cell membrane's phospholipids and cholesterol esters. These factors are essential to neuronal cell membranes and also integral to intracellular membranes including that of the mitochondria.³

Studies find that EPA and DHA benefit bone mineral density in those with rheumatoid arthritis.¹⁸ Fish oil EPA and DHA both suppress formation of the inflammatory eicosanoids.³²

EPA is found to improve the prognosis of chronic inflammatory diseases including atherosclerosis. Studies have also discovered that EPA protects endothelial cells through modulating protein function.^{31,33,34} It is reported to halt the build-up of fatty deposits in the arteries and to decrease platelet clumping and triglyceride levels.^{23,35,36}

DHA demonstrates protective ability for the immune, nervous, and cardiovascular systems. It plays a particularly vital role in brain and retinal health and function. Because DHA is highly concentrated in the retina, eating three or more servings of oily fish per week could reduce risk of age-related macular degeneration by 70%, according to one study. DHA can also benefit those with dry eyes and other eye issues.³⁷⁻³⁹

Healthy intake of omega-3 oils, particularly DHA, is found to benefit those with depression, attention disorders, or other memory and learning challenges.⁴⁰ Many studies report benefits to cognitive function and memory in the elderly.⁴¹⁻⁵⁰ DHA is found to be preventive against synaptic damage and memory loss and could be protective against beta-amyloid production, accumulation, and potential toxicity.⁵¹⁻⁵⁵



Borage Seed Oil

Borage is widely grown in the Mediterranean regions where it has been used for culinary and medicinal purposes since ancient times. Borage seed oil is especially rich in the omega-6 oil GLA (gamma-linolenic acid), which comprises about 25% to 38% of its fatty acid constituents.⁵⁶⁻⁵⁹ Other fatty acids in Borage seed oil include linoleic acid and oleic acid along with small amounts of palmitic and other fatty acids. Borage seed oil is high in tocopherols and phenolic compounds, both of which contribute to its high resistance to oxidation and its potent antioxidant properties. It is found to strongly suppress TNF (tumor necrosis factor).⁵⁶⁻⁵⁸

Borage seed oil is shown to decrease inflammation, improve bone health, and to benefit healthy skin and healthy regulation of lipid metabolism. Borage seed oil is found to exert beneficial influence in multiple conditions including respiratory conditions, rheumatoid arthritis, menopause, and atopic dermatitis among others.^{58,59}

GLA, a conditionally-essential fatty acid and omega-6 PUFA, is naturally found in plant seed oils including evening primrose, borage, black currant, and hemp seed. Breast milk is naturally high in GLA and DGLA (dihomogamma linolenic acid).⁵⁹ Borage seeds are considered one of the best sources of GLA, which is an intermediate of many essential compounds in the body including PGE1 (prostaglandin E1) and its derivatives.⁵⁸ Studies find that GLA suppresses chronic and acute inflammation.⁶¹

GLA is found to benefit osteoporosis, diabetes, and cancer.⁵⁸ It is also found to significantly reduce cell proliferation, to induce apoptosis, and to decrease ROS (reactive oxidative species) generation including lipid peroxidation.⁶⁰ In human glioma, GLA is found to exert selective antitumor action in vitro and in vivo.⁶⁰ Borage seed oil and GLA are found to be cytotoxic which is thought to be mediated primarily via lipid peroxidation and free radical generation.^{58,60}

GLA is metabolized to DGLA, the immediate precursor to PGE1 (an eicosanoid with anti-inflammatory and immune-regulatory properties).⁶¹ DGLA also exerts anti-inflammatory influence and is found to suppress 5-LOX activity.⁶¹ GLA and DGLA modulate immune response through direct action on T-lymphocytes. DGLA is found to suppress synovial cell proliferation and benefit rheumatoid arthritis patients.⁶¹ EFAs, including GLA, are found to enhance the integrity and fluidity of the cell membrane.⁵⁹



Sea Buckthorn Berry Oil

Sea Buckthorn, a flowering shrub with golden-orange berries, was revered as food and medicine by the Greeks, Romans, Russians, Tibetans, and Chinese. Traditionally, the berries were used as food and the leaves to make a beverage tea. In Tibet, the berries are referred to as the “Holy Fruit of the Himalayas”. Offering a potent array of nutrients, Sea Buckthorn Berry has been used since ancient times for its medicinal and nutritional qualities.

Sea Buckthorn Berry Oil (SBBO) is widely studied and research demonstrates its ability to support healthy function in many body systems. SBBO contains an outstanding profile of fatty acids, nutrients, and antioxidant compounds that nourish and support eye systems, cardiovascular function, resilient skin, healthy cellular response, and digestive health. The plant’s Latin name *Hippophae* comes from the Greek words for horse

(*hippos*) and shiny (*phaos*). The ancient Greeks added Sea Buckthorn berries to the diet of their horses to support the horse’s health, vision, and the shine of their coat and hair.

SBBO contains a unique fatty acid profile, offering a nutritious blend of omega-3, -6, -7 and -9 unsaturated fatty acids. It is one of only a few plants that is especially rich in the omega-7 fatty acid palmitoleic acid. The omega-7 group of fatty acids has captured the interest of researchers, notably for its ability to calm inflammation and support healthy functions of many body systems.

The golden-orange Sea Buckthorn berries are particularly high in the carotenoid complex including carotene, lutein, zeaxanthin, and lycopene. Studies show that carotenoids in a fatty acid base provide much better bioavailability and absorption.⁶² The potent antioxidant activity attributed to Sea Buckthorn berries derives partially from its highly concentrated content of flavonoids, vitamin C, tocopherols, tocotrienols, and a rich array of carotenoids.

SBBO also contains natural plant sterols (mainly B-sitosterol). Plant sterols are found to help calm inflammation and promote healthy hormonal function. The fatty acids and phytosterols along with the carotenoids and flavonoids found in SBBO nourish healthy cardiovascular system function.⁶³⁻⁶⁵ Sea Buckthorn berries are rich in flavonols, which many studies indicate are cardio-protective.⁶⁶ Reports suggest that Sea Buckthorn Berry flavonoids support cardiac function while lowering blood viscosity and helping to scavenge free radicals.⁶⁷

For more information on any of the ingredients listed here, including extensive research or individual monographs compiled by Donnie Yance, please email info@naturaedu.com.

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Sea Buckthorn Berry Oil

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Borage Seed Oil

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