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Health Benefits of Polyunsaturated Fatty Acid (PUFA)

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SUMMARY

Polyunsaturated fatty acids (PUFAs), such as omega-3 and omega-6 fats, are necessary for proper brain function and cellular growth. Human bodies do not synthesize essential fatty acids; they can only be obtained from food sources. Polyunsaturated fatty acids (PUFAs) have multiple beneficial effects on cardiovascular health. They aid in the reduction of triglycerides, a form of lipid in the bloodstream, lower the likelihood of developing arrhythmia (an irregular heartbeat), impede the accumulation of plaque (a combination of fat, cholesterol, and calcium) that can lead to arterial hardening and blockage, and modestly decrease blood pressure.

INTRODUCTION

Lipids or fats are essential nutrients for all living organisms. Lipids comprise fatty acid molecules with a variable chain of methyl and carboxylic acid heads. They can be classified according to their carbon chain saturation. Saturated fatty acids have a maximum number of hydrogen atoms, whereas monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) have one or more double or triple bonds. PUFAs can be further divided based on the location of the first double bond relative to the methyl end of the chain. n-3 and n-6 fatty acids are the most biologically significant PUFA classes with their first double bond on the third or sixth carbon from the chain terminus. These are generally known as omega-3 (ω3) and omega-6 (ω6) fatty acids. Long-chain polyunsaturated fatty acids such as n-3 and n-6 are synthesized from the essential fatty acids α-linolenic acid and linoleic acid, respectively. Essential fatty acids cannot be synthesized by the body and must be obtained through dietary sources. Animals and humans can metabolize essential fatty acids to long-chain derivatives. The health benefits of omega-3 and omega-6 fatty acids and chemical formulas are detailed in Table 1 & 2, respectively.

The ratio of n-6 to n-3 PUFAs is very important to human health. A typical western diet provides n-6 and n-3 PUFAs in a ratio ranging from 8:1 to 25:1, as against the recommendations from national health agencies about 4:1. Lowering the n-6:n-3 ratio would reduce competition for the enzymes and facilitate the metabolism of more downstream products of α-linolenic acid. Many foods contain α-linolenic acid, including certain vegetable oils, dairy products, flaxseed, walnuts, and vegetables. Most human diets are rich in n-6 PUFAs; the greater focus needs to be placed on incorporating n-3 PUFAs. Dietary sources of n-3 PUFAs are readily available but in limited quantity. Fatty fish, such as mackerel, herring, and salmon, provide an excellent source of the long-chain derivatives of α-linolenic acid, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Consuming moderate amounts of polyunsaturated (and monounsaturated), saturated and trans fats can benefit human health. Consumption of unhealthy fats can increase your risk of heart disease and other health problems.

Table 1. The health benefits of omega-3 and omega-6 fatty acids

Omega-3 fatty acids	Omega-6 fatty acids
Reduce triglycerides, a type of fat in your blood	Control your blood sugar
Reduce the risk of developing an irregular heartbeat (arrhythmia)	Reduce your risk for diabetes
Slow the buildup of plaque in your arteries	Lower your blood pressure
Slightly lower your blood pressure	

How much fat to eat?

The 2015 American Dietary Guidelines recommends not exceeding 10% of your total daily calories from saturated fat and trans fats. Eating healthier fats can lead to certain health benefits. Fats contain 9 cal/g, twice the amount of calories found in carbohydrates and protein. Thus, overeating fat can lead to weight gain. However, adding unsaturated fats to a diet filled with unhealthy foods and fats will not be beneficial; instead, replacing saturated or trans fats with healthier fats would be beneficial. Eliminating saturated fats would be twice as effective in lowering blood cholesterol levels as increasing polyunsaturated fats.

Table 2 Names and Abbreviations of the Omega-6 and Omega-3 Fatty Acids

Omega-6 Fatty acids	Abbreviation	Chemical Name	Omega-3 Fatty acids	Abbreviation	Chemical Name
Linoleic acid	LA	18:2n-6	α-Linolenic acid	ALPHA-LINOLENIC ACID	18:3n-3
γ-Linolenic acid	GLA	18:3n-6	Stearadonic acid	SDA	18:4n-3
Dihomo-γ-linolenic acid	DGLA	20:3n-6	Eicosatetraienoic 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
Tetracosapentaienoic acid		24:5n-6	Tetracosahexaenoic acid		24:6n-3
Docosapentaenoic acid	DPA (n-6)	22:5n-6	Docosahexaenoic acid	DHA	22:6n-3

Nutritional Functions of PUFA

PUFA is an eicosanoid composed of prostaglandin and thromboxane. They play an essential role in immune system regulation, blood clots, neurotransmitters, cholesterol metabolism, and the structure of membrane phospholipids in the brain and retina. However, they do not have any influence on the vasoprotective high-density lipoprotein (HDL) or even on the enhancement of HDL production. They help in the reduction of platelets, prolongation of bleeding time, and drop in blood pressure. PUFA is a significant component of most biological membranes, phospholipids, and essential in membrane structure and function. In addition to positive impact on heart and blood vessels with regard to cholesterol, Omega-3 fatty acids have beneficial effects on skin disease, asthma, arthritis, nephritis, lupus erythematosus, and multiple sclerosis. Omega 6 is essential for vision and brain function, highly concentrated in the retina, human brain, and other mammals. Both omega 3 and omega 6 contributes to a membrane, which can influence the function of membrane receptors such as rhodopsin, regulation of membrane-bound enzymes (Na/K-dependent ATPase), and plays a role in signal transduction via having effects on inositol phosphates, diacylglycerol (DAG), and protein kinase. DHA directly influences neurotransmitter biosynthesis, signal transduction, uptake of serotonin, binding of β-adrenergic and serotonergic receptors, and monoamine oxidase activity. Regulation of eicosanoid production from arachidonic acid, whereby EPA competes with arachidonic acid to produce various eicosanoids such as three series of prostaglandins, prostacyclin, and thromboxane; and five series of leukotrienes. Cardiovascular disease (CVD) and cancer, as well as inflammatory, thrombotic, and autoimmune diseases, such as coronary heart disease, hypertension, type 2 diabetes, renal disease, rheumatoid arthritis, ulcerative colitis, Crohn's disease, and chronic obstructive pulmonary disease, are all prevented by PUFA.

Significance of *ω*3/*ω*6 Ratio

Omega-3 PUFAs are perceived as a beneficial dietary intervention for the prevention and treatment of cardiovascular disease. Clinical studies have evaluated the possible benefits of using either n-3 PUFA supplements or the consumption of fish. Besides the amount of PUFA, the ratio of *ω*6/*ω*3 is of nutritional importance as it is the crucial index for the alpha-linolenic acid synthesis of eicosanoids in the body. In infant nutrition, the ratio of n-6/n-3 must be not higher than 10. In Coastal states where mothers consume high amounts of fish rich in n-3 PUFA, n-6/n-3 ratios are significantly lower than that of other inland regions. Increased consumption of plant oils rich in n-6 PUFA and consumption of relatively low marine foods increases the n-6/n-3 ratio. When one has a diet rich in alpha-linolenic acid and lower Linoleic acid consumption levels, EPA and DHA in muscle tissue increased due to reduced competition for Δ6 desaturase. In most Indian consumers, n-6/n-3 intake ratio is equal to 1/30-70, but the ideal balance is 1/5-10 to protect human health. Japanese people only take a perfect balance of 1/2-4, and this is due to their consumption of seafood. In western societies, intake of ω6 is far higher than that of ω3; in the United States, intake of ω6 is 10-30 times higher than that of ω3. Nutritional scientists suggest the 2:1 to 4:1 n-6/n-3 ratio, which indicates a high consumption of seafood.

Omega-6 to omega-3 ratio

The human diet has changed rapidly in recent centuries resulting in a reported increased diet of omega-6 compared to omega-3. The rapid evolution of the human diet away from 1:1 omega-3 and omega-6 ratio. Omega-3 polyunsaturated fatty acids may help prevent heart disease in humans. Both omega-6 and omega-3 fatty acids are essential; humans must consume them in their diet. Omega-6 and omega-3 eighteen-carbon polyunsaturated fatty acids compete for the same metabolic enzymes; thus, the omega-6:omega-3 ratio of ingested fatty acids has a significant influence on the balance and rate of production of eicosanoids, a group of hormones intimately involved in the body's inflammatory and homeostatic processes, which include the prostaglandins, leukotrienes, and thromboxanes, among others. Altering this ratio can change the body's metabolic and inflammatory state. In general, grass-fed animals accumulate more omega-3 than do grain-fed animals, which get relatively more omega-6. Metabolites of omega-6 are more inflammatory (esp. arachidonic acid) than those of omega-3. The necessitates that omega-6 and omega-3 be consumed in α- linolenic acid proportion. Healthy ratios of omega-6:omega-3 range from 1:1 to 4:1.

Sources of PUFA

Fish, particularly oily cold-water fish such as code, tone, and mackerel, are excellent sources of polyunsaturated fatty acids (n-3 PUFA), primarily EPA and DHA. Marine fish is an excellent source of ω-3 critical fatty acid, whereas freshwater fish is a decent source of ω-6 PUFA. The average n-3/n-6 ratio in marine fish varied from 5 to 10, but 1 to 4 in freshwater fish.

CONCLUSIONS

There is considerable evidence that PUFAs cause major cardiovascular benefits. One of the interesting aspects of this beneficial action is that it is not achieved through one mechanism of action but appears to be achieved through different heart, vasculature, and blood impacts. As a therapeutic method, this makes PUFAs even more important. Despite our knowledge, many of the health benefits of PUFAs are yet to be investigated. One of the biggest challenges is discovering how to introduce these compounds into the human diet in safe, therapeutic doses. However, it could be concluded that regular consumption of marine/freshwater fish rich in PUFAs can lead to a healthy life.

REFERENCES

Ruxton, C.H.S., Reed, S.C., Simpson, M.J.A. and Millington, K.J., 2004. The health benefits of omega-3 polyunsaturated fatty acids: a review of the evidence. *Journal of human nutrition and dietetics*, *17*(5), 449-459.

Tapiero, H., Ba, G.N., Couvreur, P. and Tew, K.D., 2002. Polyunsaturated fatty acids (PUFA) and eicosanoids in human health and pathologies. *Biomedicine & pharmacotherapy*, *56*(5), 215-222.

Williams, C.M. and Burdge, G., 2006. Long-chain n− 3 PUFA: plant v. marine sources. *Proceedings of the Nutrition Society*, *65*(1), 42-50.