ALPHA-LINOLENIC ACID (ALA) AND ITS HEALTH BENEFITS: A REVIEW

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ABSTRACT

A very common known polyunsaturated fatty acids ω-3 which included a stearidonicacid , a-linolenic acid, docosapentaenoic acid , eicosapentaenoic acid , docosahexaenoic acid. Human biological system was incapable for the synthesis of omega-3 fatty acids to their body therefore an adequate amounts should be intake from fish-oils and fish, few components like ω-3 fatty acids which had not been produced by living bodies so efficiently, adequate amounts were obtained from the fishes and oil-products of fishes and other of the sources which were withdrawn from the plants such as canola, flaxseed, walnut and most known chia seeds. Many of the studies which could carried out in related to omega-3 PUFAs on the health benefits. This review have briefly described about the structural features, metabolism, and omega-3 sources, their effects on health as cardiovascular diseases, cancer, inflammatory diseases and Alzheimer and dementia diseases.

Key Words: ALA, Cardiovascular disease, cancer, Alzheimer Disease

1. INTRODUCTION

Omega-3 fatty acids are polyunsaturated long-chain fatty acids (PUFAs) with 18 to 22 carbon atoms in their chain. The term omega-3 refers to the location of the first dual methylene bond interrupted from the methyl end of the fatty acid at the third carbon atom, including alpha-linolenic acid (ALA; cis-9, cis-12, cis-15-Omega-3, the polyunsaturated fatty acids (n-3) refers to bunch of unsaturated fatty acids (PUFAs) in regarding the primary covalent bond on methyl end group at the third part of carbon. In particular, the humans are incapable to synthesize sufficient quantities of omega-3 in relation of delta-15 and delta-12 desaturase enzyme that helps to produce the double bonds and in the removal of hydrogen atoms which was important to make omega-3 PUFA's **(Scorza, 2015; Tejada *et al.*, 2016).** Therefore ω-3 fatty acids having enough amount to get from numerous food sources like plants, marine and from microorganism. Polyunsaturated fatty acid were extracted from ALA, a vital fatty acid, and added SDA, EPA, DPA and DHA. A vast studies has proved that it is essential and beneficial in treating cardiovascular diseases, Alzheimer, dementia and in fetal development DHA (**Finley and Shahidi, 2001; Lopez *et al.*, 2011; Shahidi and Ambigaipalan, 2018)**. These fatty acids contributes not only on substrate to energy but also as an integral membrane components; they play a vital process into organism's proper functioning and take part

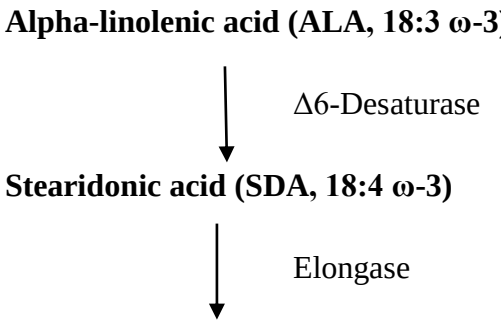
in many brain physiological processes. In particular, ω-3 acids were crucially perfoms the main part in neuronal growth, development, health and neuronal disease. It's a main and important modulator of brain which regulates the oxidative stress machanisms and their functions. DHA fatty acid act as main structure part of brain which consists of these fatty acids of 22-carbon chain those are assembled into lipids and synaptic cortex membranes, representing the 35% content in related to synaptic membrane **(Taha et al., 2010).**

2. STRUCTURE

ω-3 fatty acids having linear long chains of the PUFA's to their chain upto 18-22 C atoms. The term omega-3 mention the location among the primary methylene interrupted the tertiary carbon atom of dual bond towards the fatty acid chain from methyl end , including ALA(*cis*-9,12 ,15-octadecatrienoic acid, 18:3), SDA (*cis*-6,9,12,15-octadecatetraenoic acid, 18:4), DPA (*cis*-7,10,13,16,19-docosapentaenoic acid, 22:5), EPA (*cis*-5,8,11,14,17-eicosapentaenoic acid, 20:5), and DHA(*cis*4,7,10,13,16,19- docosahexaenoic acid, 22:6).

3. METABOLISM OF OMEGA-3 FATTY ACIDS

The synthesis metabolism pathway of some omega-3 PUFAs from dietary ALA.SDA was the first ALA synthesized metabolite that leads to EPA, DPA, and DHA synthesis. These desaturase required the conversions (almost 5 and albeit 6),the microsomal system contains an elongase chain shortening oxidation into peroxisomes. The main important procedure for release of omega-6 from linoleic acid(18:2 omega-6) which was the end product where arachidonic acid (20:4 omega-6). The ω-6 PUFAs metabolic pathway from linoleic acid may uses the similar enzymes for the omega-3 PUFAs metabolism pathway. Since the ALA level is generally lower down the diet amount of human in place of the plasma, linoleic acid and cell levels of some-6 PUFAs tend to be highest as compared to some-3 PUFAs **(FAO, 2010).** Alpha-linolenic acid , Desaturase Stearidonic acid, Elongase Eicosatetraenoic acid 5-Saturase Eicosapentaenoic acid, ElongaseDocosapentaenoic acid, Elongase Tetra co-sapentaenoic acid, 6-Desaturase Tetra cosahexaenoic acid, Peroximal chain-shortening Docosahexaenoic acid, FIG. Metabolic pathway towards ?-linolenic acid synthesis of omega-3 PUFA.



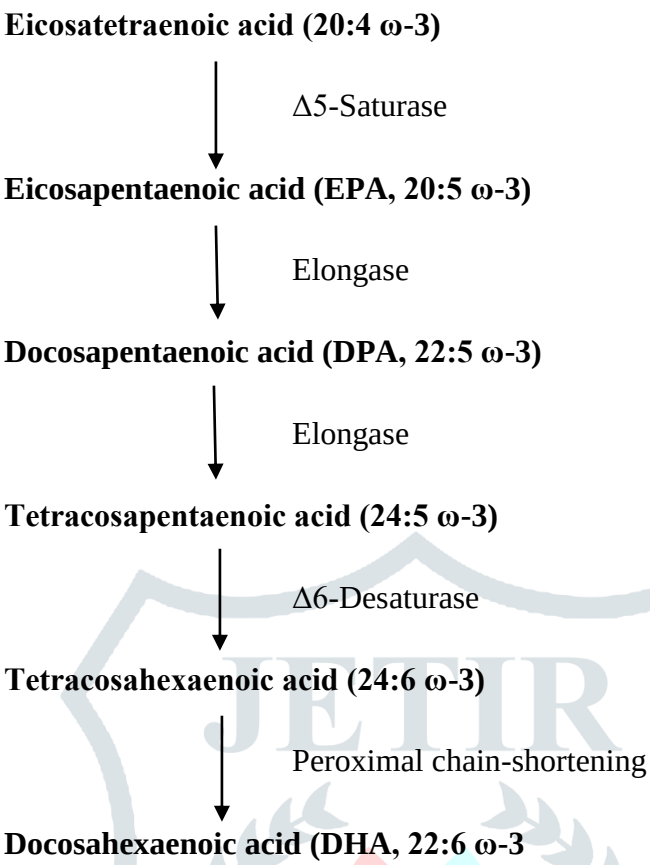


Fig 3.1 Metabolic pathway for α-linolenic acid synthesis of omega-3 PUFA

4. SOURCES OF OMEGA-3 FATTY ACID

Omega-3 fatty acids were extensively researched out from the aquatic sources and is primarily synthesized in the phytoplankton's and algae and then it is transferred to the marine animals like fishes while consuming. The major sources includes liver of lean white fishes as halibut and cod, the oily gills of fishes like salmon, mackerel and menhaden and in the blubber of marine sources lseals and whale have omega-3 especially EPA and DHA in them **(Shahidi, 1998).** DPA has been found in trace amount in aquatic sources and fish oil.

The plant sources that contains omega-3 mainly includes little amount of seed and seeds and regarded amount of vegetable oils **(FAO 2010).** Flaxseeds, chia seeds, canola, echium along with walnut were the superb good sources of alpha linolenic acid whereas corn, high concentration sources of alpha linolenic acid (ALA) and a good amount is available in canola, walnut and soybean oil while the DHA and EPA had been found in richest amount into sardine, herring oil and salmon.

Crustaceans, bivalves and cephalopods, besides fish and marine mammals, also contain some -3 PUFA .As compared to further cooked fish of various tested seafoods, salted mackerel included an excessive amount of

DHA (4.57 g/100 g was a cooking sample) and EPA. Numerous species of algae have been recognized as DHA sources such as Crypthecodinium cohnii and Schizochytrium species.

The 2 main algal DHA compounds at 55%-40% respectively for the overall fatty acids **(Senanayake and Fichtali, 2006).** EPA and DHA should been synthesized with ALA as a precursor in the bodies of human. However, there is limited bioconversion from ALA to EPA and DHA; therefore, we need sufficient amount of dietary products intaking of LC-3s.

Also highest sources vitamins that are mixing completely in fat are marine oils. Cod, whales, halibut, shark, haddock and tuna livers are used primarily in the manufacturing of vitamin A and supplement oils

5. Selected food sources of ALA, EPA and DHA

FOODS **Grams per serving**

	ALA	**DHA**	**EPA**
Flaxseed oil, 1 tbsp	**7.26**	**-**	**-**
Chia seeds, 1 ounce	**5.06**	**-**	**-**
Salmon, Atlantic, wild, cooked, 3 ounces	**-**	**1.22**	**0.35**
Herring, Atlantic, cooked, 3 ounces	**-**	**0.94**	**0.77**
Mackerel, Atlantic, cooked, 3 ounces	**-**	**0.59**	**0.43**
Salmon, pink, canned, drained, 3 ounces	**0.04**	**0.63**	**0.28**
Soybean oil, 1 tbsp	**0.92**	**-**	**-**
Oysters, eastern, wild, cooked, 3 ounces	**0.14**	**0.23**	**0.30**
Mayonnaise	**0.74**	**-**	**-**
Kidney beans, canned ½ cup	**0.10**	**-**	**-**
Egg, cooked, 1 egg	**-**	**0.03**	**-**
Chicken, breast, roasted, 3 ounces	**-**	**0.02**	**0.01**

Milk, low-fat(1%), 1 cup	**0.01**	-	-

6. HEALTH BENEFITS OF OMEGA-3 FATTY ACIDS

6.1 CARDIOVASCULAR DISEASES

According to the studies, the people who intake fishes that contains omega-3 in their daily diet has minimal death risk by the cardiovascular diseases**(Albert *et al.*,1998).**

PUFA on major cardiovascular state like, atrial fibrillation ,congenital heart disease, stroke, myocardial infarction ,rhythm disorders, coronary heart disease, heart failure, subclinical atherosclerosis, valvular disease, and peripheral arterial disease **(Mozaffarian *et al.*, 2016).** The LC ω-3 Polly unsaturated fatty acids, particularly eicosapentaenoic acid and DHA, decreases the health danger of cardiovascular disease by changes in lipid and haemostatic factors regarded to bleeding time and platelet aggregation. Docosahexaenoic acid exhibits an antiplatelet aggregation, a reduction of TAG (triacylglycerols), and an antiarrhythmic effect **(Uauy and Valenzuela, 2000)**

6.2 CANCER

Several clinical studies and experiments reveals the omega-3 is beneficial in reducing the risk of cancer. They have shown an affect in different kinds of cancer, that includes breast, colon, colorectal, lung, ovarian, stomach, pancreatic prostate,and skin **(Kato *et al.*,1997, Takezaki*et al.*,2003).** ω-3 fatty acids had used in the enhancement of chemotherapy's tolerance and efficacy **(Mocellin*et al.*, 2017).**

In breast cancer patients, flaxseed exerts antiproliferative activity and 25g of flax is suggested daily for the women before its menopausal stage. By increasing protein-caloric indulge and tolerating anticancer therapy, the omega-3 is mainly using supplement as nutritional for radiotherapy patients having brain and throat cancer helps to regulate body weight, improving in their standards of life **(Pedrazzoli*et al.*,2017).** PUFAs are invading and inhibiting the development of tumor cells by reducing levels of cyclooxygenase (COX-2) and (PGE2) and therefore giving as a natural COX inhibitor. In a study conducted, four tablets per day (EPA(510)mg –(340)mg DHA) were administered upto 66 days in which 33 patients treated in which chemotherapy giving to post-advanced non-small-cell lung cancer and noted a approx. increasing of body weight due to harmful antioxidant and anti-inflammatory impacts of some polyunsaturated fattyacids. **(Finocchiaro*et al.*, 2012).** Together with conventional cancer therapies like radiotherapy of cancer, chemotherapy of cancerous cells and chemo-radiotherapy, supplementation with PUFAs (600 mg to 3.6 g) could potentially making of toxicity and Improving the rate of survival patients suffering from cancer. In related to cancer treatment, omega-3 supplementation may also prevent neurotoxicity **(Vilar-Gonz'alez*et***

***al.*, 2017).** Supplementation with omega-3 fatty acids (for 7 days upto 3 gm) showed post incorporated range of eicosapentaenoic acid for the colonic muscle and colonic mucosal cells layer in comparison to DHA into the complete diets of patients with colorectal cancer just related to surgery.

Plasma EPA levels increased in patients regarding to pancreatic cancer and advanced lung cancer supplemented with ~3 (1 g DHA+2 g EPA every day), where plasma DHA levels remains unchanged. The factors that may effect the consistency of omega-3 on the cancer must be the sources of omega-3 whether it is a plant or a marine source and the type (ALA, EPA, or DHA), the amount of the omega-3 and the genetic factors.

6.3 INFLAMMATORY DISEASES

The highly consumed ω-3 is referred to work at a lower risk of mortality from inflammatory diseases. The anti-inflammatory and immunomodulatory of fatty acids with different effects were mediated by attenuating inflammatory eicosanoids and leukotrienes, cytokines and by altering endothelial and activation of cell-cell and the function of immunity cells. Eicosapentaenoic acid is a mostly referred lipoxygenase pathway substrate leading to the development of same inactive leukotriene B5 (LTB5) at the highest expensive value of leukotriene B4 (LTB4); the latter was a potent chemical factor for leukocytes. Omega- 3 Fatty acids decrease ex-vivo formation for cytokines of pro-inflammatory after stimulation of lipopolysaccharide lymphocytes **(Calder,2013)** monocytes .The working expressions of pro-inflammatory cytokines, adhesive cells, and adhesion of monocytes molecules to endothelial layer of cells which had been shown by half omega-3 fatty acids. Accompanied by low binding of lymphocytes cells and monocytes cells of humans to stimulate the cytokine endothelial cells, attenuation in adhesion related to molecule expression for some 3 fatty acids **(De-Caterina *et al.*,2000).**

6.4 ALZHEIMER AND DEMENTIA DISEASES

The studies of epidemiological showed that minimum intakes of some omega-3 (PUFAs) which were associated to the high risk of dementia, particularly for disease of Alzheimer's. PUFA's brain functional action mechanism includes membrane-bound enzyme activity, modifications to membrane fluidity, ion channel function, neurotransmitter production and activity, receptor number and affinity and signal transduction that controls neurotransmitter activity and neuronal growth factor **(Yehuda *et al.*, 2005).** Various studies concluded the deficiencies in essential fatty acids, particularly omega-3 fatty acids, contributed their attention towards ADHD **(Farooqui and Horrocks 2001; Ross*et al.*, 2003).** It had been found that iron-deficient and sleep-disturbed attention deficit hyperactivity disorder in kids had significantly improved the hemoglobin levels, quality of life, sleep quality and ability to concentrate. Overall, insertion of fishes and omega-3 fatty acids were shown to be positive cognitive health issues to healthy adults, while

intake of some omega-3 PUFAs seems to be controversy when recomended for Alzheimer's disease patients (**Cederholm 2017).**

7. CONCLUSION

In the above review, we came to know about the various sources of omega-3(ALA, EPA and DHA) essential elements which is required to fulfill various needs of our body. These essential elements could be included in the diet from the marine as well as the plant sources. They have high potential in treating and curing several types of diseases out of which some are discussed and mentioned above including cardiovascular diseases, cancer, inflammatory diseases and Alzheimer diseases.Omega-3 has multiple health benefits so it is an essential fatty acids which should be included in our balanced diet.

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