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Omega -3 and its anti-inflammatory properties – the key to fight inflammation effectively

Abstract

The therapeutic effects of omega-3 fatty acids, which are abundant in some fish oils, have been known since at least the 1950s, when cod liver oil was discovered to be useful in treating conditions such as dermatitis and arthritis. Scientists observed in the 1980s that Eskimos who ate a fish-rich diet had better heart health than their mainland counterparts. Inflammation that is inappropriate, excessive, or uncontrolled contributes to a variety of human disorders. One of the primary pathophysiological pathways causing neuropsychiatric and neurodegenerative illnesses has been identified as inflammation. Despite the fact that inflammation plays a role in many illnesses, there are currently no viable anti-inflammatory therapy methods. Omega-3 polyunsaturated fatty acids (n-3 PUFAs) may decrease depressing symptoms and exert anti-inflammatory effects through the production of various n-3 PUFA-derived metabolites, including. Maresin (MaR) and protectin (PD), collectively known as specialized pro-resolving mediators (SPMs), act as potent anti-inflammatory agents. They also control the nervous system, blood pressure, clotting, blood glucose tolerance and inflammatory processes and are favorable in all inflammatory diseases.

Keywords: inflammation, Anti-inflammatory response, n-3 PUFAs and arachidonic acid

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Abbreviations: NO, nitric oxide; TAC, total antioxidant capacity; PPARs, peroxisome proliferator activated receptors; AA, arachidonic acid; LDL, low-density lipoprotein; DHA, docosahexaenoic acid

Introduction

Both the development and resolution of inflammation should be efficient in healthy persons, and switching off inflammation signals should be accompanied by a decrease in pro-inflammatory components. Use of certain immunoresolvent molecules that mediate inflammation resolution, such as resolvins, lipoxins, protectins, and maresins,[1] is one technique. This strategy supports the body in returning to equilibrium through active and carefully regulated "planned resolution." These mediators stimulate pathways that signal the physiologic end of the acute inflammatory phase in some disorders.[2] This systematic investigation focuses on the impact of omega-3 fatty acids and pro-resolving lipid mediators on inflammatory biomarkers and lipid profiles. Pro-resolving molecules are classified into four categories. The first is endogenous lipoxin (LX), and the second is arachidonic acid (AA), which promotes healing via receptor agonists and governs the acute inflammation resolution phase.[3] The second category includes omega-3 polyunsaturated fatty acid derivatives resolvins and, more recently, protectins and maresins (PUFAs). These substances, like LX and receptor agonists, have pro-resolving characteristics.[4] They also offer a promising new strategy to inflammation control by focusing on increasing the "off signal" rather than simply blocking the "on signal".[5] It also lowers the risk of side effects associated with typical anti-inflammatory medicines. Several research have been undertaken to investigate the role of these lipid mediators in the resolution of inflammation, and they discovered significant improvements in total antioxidant capacity (TAC) and nitric oxide (NO), as well as a large decrease in malondialdehyde (MDA).

PUFA consumption can change complicated lipid, lipoprotein, metabolite, and hormone concentrations, all of which influence inflammation.

A. Non-esterified PUFAs can act on inflammatory cells directly via surface or intracellular "fatty acid receptors," the latter of which may contain transcription factors such as peroxisome proliferator actisvated receptors (PPARs).[6]

B. PUFAs can be oxidized (enzymatically or non-enzymatically) and oxidized derivatives can act directly on inflammatory cells through surface or intracellular receptors - oxidation can occur with unesterified PUFA or esterified PUFA into more complex lipids such as cyclic or cellular lipids. Membrane phospholipids and intact lipoproteins such as low-density lipoprotein (LDL).[7]

C. PUFAs can be integrated into inflammatory cell membrane phospholipids (as described above). They perform critical roles in this context, ensuring the proper environment for membrane protein action, maintaining membrane order ("fluidity"), and controlling lipid raft formation.[8]

Membrane phospholipids are precursors for the formation of second messengers like diacylglycerol, and it has been demonstrated that the fatty acid content of these second messengers, as defined by phospholipid precursors, can influence their activity.[9]

Furthermore, membrane phospholipids operate as a substrate for the intracellular release of (unsterilized) PUFAs, which can act as signaling molecules or transcription factor ligands (or ligand precursors). Convoluted in the order of various cellular and tissue responses, including components of inflammation and immunology or precursor for the manufacture of lipid mediators. As a result, as previously discussed, changes in membrane phospholipid fatty acid content may alter the activity of cells involved in inflammation via: : — changes in physical membrane properties such as membrane order and raft structure; - changes in the pattern of lipid mediators produced, with different mediators having different biological activity and potency; - act on cellular signaling pathways, either by altering the expression, activity or affinity of membrane receptors, or by altering the intracellular signaling mechanism resulting in altered activity transcriptional activity and gene expression.[10]

Specific medical benefits of Omega-3 consumption

a. Promoting heart health-Fish oil high in the fatty acid omega-3 is associated with lower blood pressure, triglycerides, and the danger of cardiovascular disease and stroke.[11]

b. Improving joint health-Fish oil high in omega-3 fatty acids has been shown in studies to assist in reduce joint inflammation and discomfort while also enhancing joint function.[12]

c. Enhancing brain health-As stated previously, fish oil high in omega-3 fatty acids has been shown to improve brain function and memory.

d. Helping with mood disorders-Several studies have shown that fish oils rich in omega-3 fatty acids can help reduce symptoms of depression and bipolar disorder.[13]

e. Promoting skin health-Fish oil rich in omega-3 fatty acids has been shown to improve skin health by reducing the appearance of wrinkles, dryness, and acne.[14]

f. Supporting weight loss-Fish oil rich in omega-3 fatty acids has been shown to improve skin health by reducing the appearance of wrinkles, dryness, and acne.

Similar findings were discovered in those who also participated in a lifestyle modification programme.[15]

Omega-3 polyunsaturated fatty acids (PUFAs) have had more than one carbon-carbon double bond in their chain shown in Figure 1. Because of the abundance because of the double bonds in their chain, they are polyunsaturated. A fatty acid is defined by the placement of the first double bond, numbered from the tail, that is, the omega (-) or the n- end. As a result, the initial double bond is formed in omega-3 fatty acids here between third and fourth carbon atoms from the tail end. Certain essential nutrients must be obtained through diet. Sardines, salmon, tuna, halibut, and other shellfish like algae and krill,[16] as well as lake trout, certain vegetables, and nut oils, contain them. These PUFAs, which are stored in membrane phospholipids, are involved in a number of cellular functions, including the maintenance of cell membrane structure. Fluidity, signaling and cell-to-cell interaction.

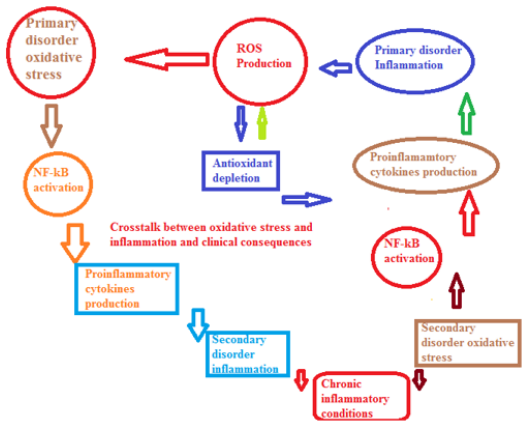

Figure 1 Crosstalk between oxidative stress and inflammation and clinical consequences.

N-3 polyunsaturated fatty acids (PUFAs) contain anti-inflammatory effects and may help decrease the likelihood of long-term diseases such as heart disease, cancer, and arthritis. They also regulate blood pressure, coagulation, glucose tolerance, and the growth and function of the neurological system linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) are all omega-3 fatty acids (DHA). Omega-3 fatty acids are also known as ""Vitamin F" is derived from the word "fatty acids." "Cold water fishes have greater body fat than warm water fishes, although their EPA and DHA concentration is controlled by variables like the climate, environment, and fish food.[17]

ALA is found in flaxseeds, canola (rapeseed) oil, soybeans, pumpkin seeds, perilla seed oil, walnuts, and their derivative oils. The majority of the positive effects are attributed to EPA and DHA. ALA from flax and other vegetarian meals must be converted by the body into EPA and DHA. Krill, algae, microalgae, and crustaceans are other important marine sources of n-3 PUFAs. Antioxidants such as marine carotenoids (such as astaxanthin and fucoxanthin), vitamins A and E, and phospholipids including long-chain n-3 PUFAs are abundant in Antarctic krill oil. Other EPA and DHA marine sources, such as sponges, bacteria, fungi, plants, and, in particular, autotrophic macroalgae and microalgae, are currently being studied for large-scale commercial omega-3 production[18] because to their excellent n-3 and n-6 fatty acid balance.

The anti-inflammatory properties of omega-3 or marine n-3 PUFAs may contribute to their preventative advantages against atherosclerosis, plaque rupture, cardiovascular mortality, and overall well-being. Chronic inflammation is a hallmark of several disorders, including diabetes and cardiovascular disease (CVD)1,2. Type 2 diabetes produces hyperglycemia, which affects leukocyte counts as well as polymorphonuclear neutrophil (PMN) and monocyte function through a variety of mechanisms. These include AGE synthesis, increased release of extracellular superoxide dismutase, and secretion of proinflammatory cytokines such as interleukin-1 beta (IL-1), sialic acid, insulin (IGF), C-reactive protein (CRP) and factor alpha tumor necrosis, (TNF-) and matrix metalloproteinase (MMP) 1, 3.[19]

Conclusion

A series of human clinical trials have been conducted to evaluate the benefits of fish oil supplements in inflammatory and autoimmune disorders such as rheumatoid arthritis, Crohn's disease, ulcerative colitis, psoriasis, lupus erythematosus, multiple sclerosis, and migraines. Multiple placebo-controlled trials of fish oil in chronic inflammatory diseases have shown significant benefits, including reduced disease activity. Some of the ways omega-3 fatty acids affect inflammation is mediated by, or at least related to, changes in the fatty acid composition of cell membranes. Changes in these components can affect membrane fluidity, cell signaling, gene expression, and lipid mediator synthesis patterns. PUFA n-3 or marine omega-3 are effective in treating rheumatoid arthritis and help in the treatment of other inflammatory diseases and disorders due to their anti-inflammatory properties.

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Conflicts of interest

Author declare there are no conflicts of interest towards the article.

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