
Omega-3 and Its Anti-Inflammatory Properties – The Key to Fight Inflammation Effectively

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Abstract: Since at least the 1950s, when cod liver oil was found to be effective in treating illnesses including dermatitis and arthritis, the therapeutic effects of omega-3 fatty acids, which are plentiful in some fish oils, have been identified. Scientists observed in the 1980s that Eskimos who ate a fish-rich diet had better heart health than their mainland counterparts. A number of human illnesses are influenced by inappropriate, excessive, or uncontrolled inflammation. 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) are able to produce a variety of n-3 PUFA-derived metabolites, including, which can reduce signs of depression and have anti-inflammatory properties. Specialised pro-resolving mediators (SPMs), also known as maresin (MaR) and protectin (PD), have significant anti-inflammatory effects. They are advantageous in all inflammatory disorders and also regulate the neurological system, blood pressure, coagulation, blood glucose tolerance, and processes associated with inflammation.

Keywords: Inflammation, Anti-Inflammatory Response, Omega-3 and Arachidonic Acid

1. 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. Utilising specific immunoresolvent molecules, including as resolvins, lipoxins, protectins, and maresins [1] which mediate the resolution of inflammation is one technique. This tactic aids the body in regaining equilibrium by actively and carefully managing

"planned resolution." In some illnesses, these mediators activate systems that signify the physiological end of the acute inflammation phase. [2] This methodical inquiry focuses on the ways inflammatory biomarkers and lipid profiles are affected by omega-3 fatty acids and pro-resolving lipid mediators. Four categories of pro-resolving molecules are distinguished. The initial one is endogenous lipoxin (LX), and the second is arachidonic acid (AA), which controls the

acute inflammation resolve process and promotes healing via receptor agonists [3]. The omega-3 polyunsaturated fatty acid derivatives resolvins and, more recently, protectins and maresins (PUFAs) are included in the second category. These substances, like LX and receptor agonists, have pro-resolving characteristics. [4], By emphasising boosting the "off signal" as opposed to merely obstructing the "on signal," they also provide a promising new approach to inflammation control [5]. Additionally, it reduces the possibility of adverse effects brought on by conventional anti-inflammatory drugs. Numerous studies that looked into how these lipid mediators affected the resolution of inflammation found that there were notable increases in nitric oxide (NO) and total antioxidant capacity (TAC), as well as a sizable drop in malondialdehyde (MDA).

Inflammation is influenced by complex lipid, lipoprotein, metabolite, and hormone concentrations, all of which can be altered by PUFA ingestion.

A) Non-esterified PUFAs have the ability to directly affect inflammatory cells via intracellular or extracellular "fatty acid receptors," the latter of which may include transcription factors like peroxisome proliferator activator receptors (PPARs). [6]

B). PUFAs may undergo oxidation (either enzymatically or without the use of enzymes), and the oxidised derivatives may then interact directly with inflammatory cells via surface or intracellular receptors. PUFA that has not been esterified or that has been esterified into more complex lipids, including cyclic or cellular lipids. Membrane phospholipids and lipoproteins that are intact, such low-density lipoprotein (LDL) [7].

C) As previously mentioned, PUFAs can be incorporated into the phospholipids of inflammatory cell membranes. They play crucial functions in this situation by guaranteeing the ideal conditions for membrane protein function, preserving membrane order (or "fluidity"), and regulating the formation of lipid rafts. [8].

Second messengers like diacylglycerol are created from membrane phospholipids, and it has been shown that the fatty acid composition of these second messengers, as specified by phospholipid precursors, can affect their function..[9].

The intracellular release of (unesterified) PUFAs, which can function as signalling molecules or transcription factor ligands (or ligand precursors), is also facilitated by membrane phospholipids. Convolved in the sequence of different cellular and tissue reactions, such as immunological and inflammatory components, or a precursor for the production of lipid mediators. Therefore, as previously discussed, changes in membrane phospholipid fatty acid content may alter the activity of cells involved in inflammation via the following mechanisms: — changes in physical membrane properties like 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 signalling pathways, either by altering the expression, activity, or affinity of membrane [10].

2. Specific Medical Benefits of Omega-3 Consumption

1) Promoting heart health:

Lower blood pressure, triglycerides, and the risk of cardiovascular disease and stroke are all linked to fish oil rich in the omega-3 fatty acid. [11]

2) Improving joint health:

Studies have demonstrated that fish oil rich in omega-3 fatty acids can help to lessen joint pain and inflammation while also improving joint function. [12]

3) Boosting brain health:

As previously mentioned, studies have demonstrated that fish oil rich in omega-3 fatty acids enhances learning, memory, and brain function.

4) Helping with mood disorders:

Fish oils high in omega-3 fatty acids have been demonstrated in numerous studies to help lessen the signs and symptoms of depression and bipolar disorder. [13]

5) Promoting skin health:

Omega-3 fatty acid-rich fish oil has been demonstrated to enhance skin health by lessening the visibility of wrinkles, dryness, and acne. [14]

6) Supporting weight loss:

Omega-3 fatty acid-rich fish oil has been demonstrated to enhance skin health by lessening the look of wrinkles, dryness, and acne. Similar results were found in people who also took part in a course to change their lifestyle. [15]

The chain of omega-3 polyunsaturated fatty acids (PUFAs) contains several carbon-carbon double bonds. They are polyunsaturated due to the high number of double bonds in their chain. The position of the first double bond, numbered from the tail, that is, the omega (-) or n- end, determines the kind of fatty acid being used. As a result, between the three and four carbon atoms from the tail end, the first double bond in omega-3 fatty acids is created. You must consume a certain amount of certain necessary nutrients. They can be found in sardines, salmon, tuna, halibut, and other shellfish, including algae and krill [16], lake trout, some vegetables, and nut oils. These PUFAs, which are held in the phospholipids of the membrane, are essential for a variety of cellular processes, including the preservation of the shape of the cell membrane. Signalling, cell-to-cell communication, and fluidity N-3 polyunsaturated fatty acids (PUFAs) have anti-inflammatory properties and may lessen the risk of long-term illnesses like arthritis, cancer, and heart disease. They also control the growth and operation of the nervous system, blood pressure, coagulation, and glucose tolerance. Omega-3 fatty acids (DHA) include -linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Omega-3 fatty acids are frequently referred to as ""Vitamin F,"" which is derived from the word "fatty acids." Despite the fact that their EPA and DHA content is influenced by factors including the climate, environment, and fish food, cold water fish have more body fat than warm water fish.. [17].

Flaxseed, canola (rapeseed), soybean, pumpkin seed,

perilla seed oil, walnut, and their derivative oils are all sources of ALA. EPA and DHA are responsible for the majority of the beneficial benefits. The body must transform ALA from flax and other vegetarian foods into EPA and DHA. Other significant marine sources of n-3 PUFAs include krill, algae, microalgae, and crustaceans. Antarctic krill oil is a rich source of antioxidants, including long-chain n-3 PUFAs, phospholipids, vitamins A and E, and marine carotenoids (such as astaxanthin and fucoxanthin). Due to their excellent n-3 and n-6 fatty acid balance, autotrophic macro- and microalgae are currently being explored for large-scale commercial omega-3 synthesis. Other EPA and DHA marine sources include sponges, bacteria, fungus, plants, and, in particular, autotrophic macro- and microalgae.

The benefits of omega-3 or marine n-3 PUFAs for preventing atherosclerosis, plaque rupture, cardiovascular mortality, and general health may be attributed to their anti-inflammatory qualities. Numerous diseases, including diabetes and cardiovascular disease (CVD), are characterised by chronic inflammation [1, 2]. Hyperglycemia, which is brought on by type 2 diabetes, has a range of effects on leukocyte numbers, polymorphonuclear neutrophil (PMN) and monocyte function. These include the production of extracellular superoxide dismutase, AGE formation, sialic acid, insulin (IGF), C-reactive protein (CRP), and factor alpha tumour necrosis, among others. matrix metalloproteinase (MMP) 1, 3 and (TNF-) [19].

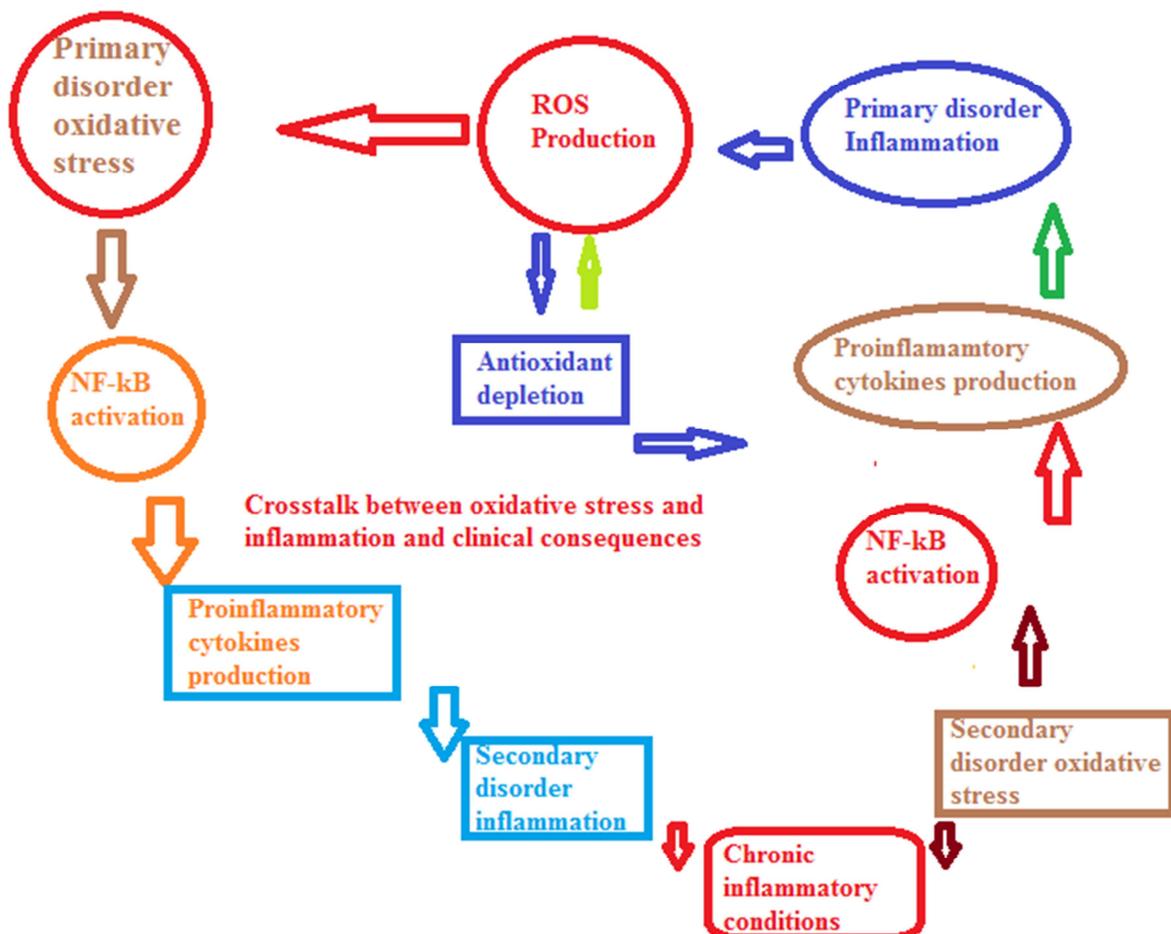


Figure 1. Crosstalk between oxidative stress and inflammation and clinical consequences.

3. Conclusion

In order to assess the advantages of fish oil supplements in inflammatory and autoimmune conditions such as rheumatoid arthritis, Crohn's disease, ulcerative colitis, psoriasis, lupus erythematosus, multiple sclerosis, and migraines, a number of human clinical trials have been done. Numerous placebo-controlled studies on fish oil's effects on chronic inflammatory disorders have revealed important advantages,

such as decreased disease activity and anti-inflammatory drug use. Changes in the fatty acid makeup of cell membranes are mediated by, or at least connected to, some of the ways omega-3 fatty acids affect inflammation. Changes in these elements can impact gene expression, lipid mediator synthesis patterns, cell signalling, and membrane fluidity. Due to their anti-inflammatory qualities, PUFA n-3, or marine omega-3, is useful in treating rheumatoid arthritis and aids in the treatment of other inflammatory diseases and disorders.

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