FISH OILS AND HUMAN HEALTH

Eda ÖZER ANDIZ, Mustafa ÜNLÜSAYIN
Department of Seafood Processing Technology, Faculty of Fisheries, Akdeniz University, Campus, Antalya, Turkey

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Abstract:
Fish oils have been essential for human life development, growth and they play critical roles in health and reproduction. Especially of those sources of food which contain adequate levels of polyunsaturated fatty acids (PUFAs) is importantly. On the other hand PUFA’s sources of food which have suitable ratios of the n-3 (18-carbon, α-linolenic acid, ALA) to n-6 (18-carbon linoleic acid, LA) PUFAs is more importantly. In recent years, the importance of adequate and well balanced diets have understood and nutritional habits were started to be changing with growing technology. It’s known that n-3 and n-6 long chain fatty acids source in especially oily fish had to in our diet in balance. Fish oils play important role prevention of cardiovascular problems, effective for the visual function, brain development and growth. In this review polyunsaturated fatty acids which have an impact on human health were able to be reviewed for this reasons.

Keywords:
Fish oil, Lipids, PUFA, Essential oils, Human health
Introduction

Many of the fatty acids can be synthesized by humans, but there is a group of polyunsaturated fatty acids (PUFAs), the essential fatty acids that the human body cannot produce - omega-3 (n-3) and omega-6 (n-6) fatty acids. Omega-3 fatty acids eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA); however, the data on the shorter-chain omega-3 fatty acid ALA were far less certain (Wang et al., 2004). The major sources of EPA and DHA in food and dietary supplements were found in fatty fish, fish products, marine oils, and certain algae oils. It is influenced not only by the kind of fish but also by the maturity, season, food availability and feeding habit. Fat deposition occurs in muscle tissue (e.g. carp, herring), in liver (cod, haddock, saithe) or in intestines (blue pike, pine, perch). Fish and fish oils contain omega3 (n-3) fatty acids; in particular, EPA (C20:5 x3) and DHA (C22:6 x3) (Holub and Holub, 2004), which is originated from phytoplankton and seaweed in the food chain (Visentainer et al., 2007). The rate of conversion by humans of ALA to EPA is low, with estimates ranging from 0.2% to 15%, as is the conversion of EPA to DHA (Kris-Etherton et al., 2002). However, in two researches have been reported that high intakes of ALA significant increases in long chain omega-3 fatty acids in various body compartments (Francois et al., 2003). Major sources of dietary and supplemental ALA are from soybean and canola oils, walnuts and flax seed (Sontrop and Campbell, 2006).

The parent omega-6 fatty acid is linoleic acid (C18:2 n-6, LA) and the parent omega-3 fatty acid is α-linolenic acid (C18:3 n-3, ALA). Omega-6 fatty acids as arachidonic acid (C20:4n-6; AA) could be synthesized by humans from LA, and omega-3 fatty acids, as eicosapentaeanoic acid (C20:5 n-3; EPA), docosapentaeanoic acid (C22:5 n-3, DPA) and docosahexaenoic acid (C22:6 n-3, DHA), from ALA; however, the conversion of ALA in EPA, DPA and DHA is low and these omega-3 fatty acids are considered essential fatty acids too. Therefore, both n-3 and n-6 PUFA are entirely derived from the diet and necessary for human health (Rubio-Rodriguez et al., 2010).

Since the conversion of ALA to EPA and DHA are not particularly efficient in humans. Preformed dietary sources of EPA and DHA are the best way to ensure adequate intake; oily fish such as tuna, salmon, mackerel, and sardines are rich in preformed EPA and DHA (McGregor et al., 2001).

Health Effects of Fish Oils

The long chain EPA and DHA could alter cell membrane structure and function by increasing fluidity (Yaqoob and Shaikh, 2010) and n-3 fatty acid (FA) rich particles use direct lipid–lipid proteoglycan interactions for blood clearance and cell uptake (Densupsoontorn et al., 2008, Murray-Taylor et al., 2010). The most noticeable effects come from studies where the substitution of saturated fat with oleic acid has been tested. Isocaloric replacement of about 5% of energy from saturated fatty acids by oleic acid (or PUFA) has been estimated to reduce coronary heart disease risk by 20–40% mainly via low-density lipoprotein (LDL) cholesterol reduction (Kris-Etherton, 1999). The other beneficial effects on risk factors for cardiovascular disease (CVD) such as factors related to thrombogenesis, in vitro LDL oxidative susceptibility and insulin sensitivity have been reported by Kris-Etherton (1999) and Vessby et al., (2001). n-3 PUFAs have the ability to respond to inflammation in atherogenesis through direct and indirect mechanisms. A direct mechanism through which n-3 PUFA decrease inflammation includes its rapid effect on the regulation of transcription factors (Arterburn et. al., 2006) and indirect modes of actions include the production of three- and fiveseries eicosanoids and inflammation-resolving lipid mediators (Adkins and Kelly, 2010).
Figure 1. Biosynthesis pathways of omega-6 (n-6) and omega-3 (n-3) polyunsaturated fatty acids (adapted from de Roos et al., 2009 and Dunbar et al., 2014)

In many European countries, estimates of EPA+DHA intake are rather scarce. Mean dietary intakes of these fatty acids among adults have recently reported a daily intake of 265 mg in Austria, 380 mg in France, 250 in Germany and 90 mg in The Netherlands (EFSA, 2009). Recommendations of EPA + DHA intake from international authorities range 200–650 mg per day and are based on the convincing inverse relationship observed between its consumption and a decreased risk of CVD (WHO, 2003, EFSA, 2005). The American Heart Association (AHA) estimates based on consumption of one portion (125 g) of oily fish (2 g EPA + DHA per 100 g on average) and one portion of lean fish (0.2 g/100 g) result in an approximate intake of 3 g of DHA + EPA per week or 430 mg per day. This association also established intakes of 1 g of EPA + DHA from fish or fish oils for subjects with clinical history of CVD and a
found that a mixture of 4.4g EPA and 2.2g DHA alleviated depression (versus placebo) in those with treatment-resistant depression. This was a two-month study involving patients who were on anti-depressants that were not working. As with the other omega-3 studies discussed, the fish oil was well-tolerated and no adverse events were reported by Su (2003).

It is well recognized that n-6 PUFA, especially arachidonic acid are needed for fetal and infant brain development and that n-6 linoleic acid is needed to prevent essential fatty acid deficiency states in humans. Also n-6 PUFA can contribute to decreasing some factors related to human cardiovascular disease (Deckelbaum and Calder, 2010). The n-6 PUFA are known to have pro-inflammatory activity which could play important roles in immune function. Typically, human inflammatory cells contain high proportions of the n-6 PUFA arachidonic acid and low proportions of n-3 PUFA. The significance of this difference is that arachidonic acid is the precursor of two-series prostaglandins and four-series leukotrienes, which are highly-active mediators of inflammation (Calder, 2002). The n-3 long chain PUFA content of plasma phospholipids is significantly increased after patients were fed a low n-6 PUFA diet. These data demonstrate that reducing n-6 PUFA intake for 4 weeks increases n-3 long chain PUFA status in humans in the absence of increased n-3 PUFA intake (Wood et al., 2014). Some negative effects have been reported to be associated with adverse events excessive levels of n-6 including associations with obesity (Ailhaud et al., 2008, Anderson et al., 2010, Massiera et al., 2003, Muhlhausler and Ailhaud, 2013), diabetics, cancer, depression etc. (Turan et al., 2013) although more studies are needed to clarify the relationship with n-3 and n-6 mechanisms of these associations.

Conclusions

The continuing accumulation and publication of evidence of the beneficial health effects of PUFAs captured the attention, not only of the medical that is generally becoming aware of the importance of diet to general physical and mental wellbeing. In fact, the two PUFA families that n-3 and n-6 are biologically connected through the cascade of enzymatic transformations that starts immediately after the intake of precursors from the diet. Moreover, after gathering evidence of insufficient intake of omega-3 fatty acids from the diet, the attention to the fatty acid composition present in food increased, thus, leading to an interest in the
n-6/n-3 balance as a measure of a healthy diet. Omega-3 and Omega-6 effects different issues in human health. n-6/n-3 ratio in diet is very important for health. The main dietary sources long chain n-3 PUFAs in nature are fish and marine animals and fish oils for healthy and balanced diets.

At least, common views are 1–2 servings of oily fish per week.

**Table 1:** Summary of some studies with health benefits of n-3 (omega-3)

<table>
<thead>
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<th>Impact On Health</th>
<th>Investigations</th>
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<tr>
<td>Dyerberg et al. 1975, 1978</td>
<td>Low incidence of cardiovascular heart disease</td>
<td>Eskimos consume more LC ω-3 PUFAs; lowered plasma triglyceride and cholesterol levels; lowered LDL and VLDL; high immunoreactive anti-thrombin AT-III, heparin cofactor</td>
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<tr>
<td>Mozaffarian et al. 2005</td>
<td>Reduction of chronic heart failure and prevention of cardiovascular disease EPA + DHA reduce risk of coronary heart disease including acute coronary related sudden death</td>
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<tr>
<td>Biondo et al. 2008</td>
<td>Alters toxicity of chemotherapeutic drugs</td>
<td>EPA and/or DHA alters toxicity and activities of chemotherapeutic drugs</td>
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<tr>
<td>Cicero et al. 2009</td>
<td>Reduced blood pressure</td>
<td>n-3 PUFAs reduce blood pressure via effect on endothelial function</td>
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<td>Makhoul et al. 2011</td>
<td>Effects on obesity</td>
<td>Triglycerides and C-reactive protein attenuated in adults with high red blood cell EPA and DHA</td>
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<tr>
<td>Rix et al. 2013</td>
<td>Decrease in cardiac arrhythmia</td>
<td>Evidence for prevention and treatment of atrial fibrillation</td>
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<td>Nikolakopoulou et al. 2013</td>
<td>Skin and oral cancer</td>
<td>Selectively inhibits growth and induces cell death in early and late stage cancer</td>
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<tr>
<td>Tousoulis et al. 2014</td>
<td>Lowered triglycerides</td>
<td>n-3 PUFAs lower triglyceride concentrations up to 27%</td>
</tr>
<tr>
<td>Tousoulis et al. 2014</td>
<td>Improved endothelial function</td>
<td>Reduce adipogenesis and lipogenesis in adult rodents n-3 PUFAs improve endothelial vasomotor function via improved vasodilation and improved systemic arterial compliance anti-inflammatory effect</td>
</tr>
</tbody>
</table>
References


Simopoulos, A.P. (2006): Evolutionary aspects of diet, the omega-6/omega-3 ratio and genetic


