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Editorial

Synergistic Action of Fish Oil and Olive Oil

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Editorial

The essential Polyunsaturated Fatty Acids (PUFAs) are mainly represented by Linoleic Acid (LA; C18:2ω-6) from the -6 family, responsible for the formation of Arachidonic Acid (AA; C20:4ω-6) andα-Linolenic Acid (ALA; C18:3ω-3), Eicosapentaenoic Acid (EPA; C20:5ω-3) and Decosahexaenoic Acid (DHA; C22:6ω-3), that belong to the ω-3 family. LA is present in vegetable oils such as soybean, corn (maize) and sunflower. ALA is found in flaxseed and canola oil, while the main source of EPA and DHA in fish oil present in marine fish fat [1,2].

ALA may be converted to EPA and DHA. In mammals, this conversion occurs slowly, while in plants, as well as marine algae, it occurs efficiently. When fish consume seaweeds, they incorporate EPA and DHA in their tissues [3,4].

EPA, DHA and AA comprise phospholipids of cell membranes and are precursors of eicosanoids, which include Prostaglandins (PGs) and Leukotrienes (LTs) [5]. The eicosanoids formed by the AA, such as PGE_2 and LTB_4, act as inflammatory mediators, while the eicosanoids formed by the EPA, as PGE_3 and LTB_5, have less inflammatory activity [2].

Western diets are characterized by a higher intake of ω-6 fatty acids compared to ω-3 fatty acids, increasing the ω-6/ω-3 ratio. The high consumption of ω-6 fatty acids increases the proportion of AA in membrane phospholipids and hence the formation of AA-derived eicosanoids such as PGs, LTs, Lipoxins and Thromboxanes (TX), resulting in a proinflammatory, prothrombotic and proaggregatory physiologic state [6].

The increased intake of ω-3 fatty acids from fish oils or other seafoods has been associated to anti-inflammatory, hypolipidemic, antithrombotic and vasodilatory properties. When fish or fish oil is ingested, the EPA and DHA are incorporated into cell membranes, partially replacing the ω-6 fatty acids, such as AA. EPA competes for the enzyme cyclooxygenase pathway and 5-lipoxygenase and inhibits the production of eicosanoids from AA, leading to a decrease in PGE_2, LTB_4, and TXA_2 (a potent platelet aggregator and vasoconstrictor) and an increase in PGE_3 and LTB_5 [5-7].

Olive oil is rich in oleic acid (C18: 1ω-9), a ω-9 Monounsaturated Fatty Acids (MUFA). Oleic acid is converted to Eicosatrienoic Acid (ETA; C20:3ω-9), which may also be incorporated into the phospholipid membrane, and is another substrate for the enzyme 5-lipoxygenase pathway forming LTA_3, a strong inhibitor of the synthesis of LTB_4. Oleic acid is known tomodify immune and inflammatory responses[2].

Olive oil has numerous beneficial health effects that are not associated only to the oleic acid mechanisms of action, but also to its minor components, especially when the extra virgin olive oil is used. Extra virgin olive oil is produced under conditions that do not alter its properties (cold press), and retains important components such as tocopherols, polyphenols and bioflavonoids, which are known to have anti-oxidant, anti-inflammatory and anti-atherosclerotic properties. Refined olive oil loses much of these minor components during the process steps [8-12].

Diets rich in olive oil and marine oils have both been associated with reduced cardiovascular risk factors [13,14].Moreover, recent studies have shown additional benefitsin various health conditions when these oils are used in combination, indicating that olive oil could provide a favorable ambiance for fish oil treatments.

In an animal model using apolipoprotein E-deficient mice,Eilertsen et al., 2011 [15] studied the antiatherogenic effect of extra virgin olive oil in combination with seal oil. The authors found that the combination produced a significant inhibition of atherosclerotic plaque formation in the aorta of female mice. In the male mice, the antiatherosclerotic effect was only significant in the thoracoabdominal region of the aorta. Although the authors did not study the effect of the oils individually, it was hypothesized that a synergistic effect occurred between marine PUFAs and the antioxidant compounds present in extra virgin olive oil. The authors also demonstrated that olive oil remarkably prevented the oxidation of n-3 PUFAs. The authors concluded that the co-supplementation inhibited arterial plaque formation and progression, particularly in female apoE-deficient mice [15].

Although sparse, some studies have been performedin humans. Vognild et al. [16], 1998 studied the effects of dietary marine oils and olive oil on fatty acid composition, platelet membrane fluidity, platelet responses and serum lipids in healthy subjects. The authors concluded that the combination of cod liver oil and olive oil could produce better effects on platelet function than the oils given separately [16].

Ramírez-Tortosa et al., 1999 found a significant decrease in plasma triglycerides and a protective effect on the LDL susceptibility to oxidative modifications after a 3-month intervention with extra virgin olive oil and fish oil in male patients. The authors hypothesized that phenolic antioxidants, such as α-tocopherolpresent in olive oil could protect n-3 PUFA LDL from oxidation, which could occur in a setting of high consumption of n-3 PUFA alone [17].

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Camuesco et al., 2005studied the combined effect of olive oil and fish oil in colonic inflammation of rats with Dextran Sulfate Sodium(DSS-induced colitis). The authors found that the incorporation of fish oil, significantly decreasing colonic TNF-α and LTB4 levels increased the beneficial effects of olive oil. The attenuation of colonic injury induced by DSS was more evident in the group treated with both fish oil and olive oil than the attenuation observed for the olive oil group [18].

Our group studied this synergistic effectinitially in patients with rheumatoid arthritis [8] and thereafter in patients with metabolic syndrome [19].

Berbert et al., 2005found that improvements in several clinical parameters related to rheumatoid arthritis were more evident and precocious when fish oil supplements were used in combination with olive oil, rather than receiving fish oil alone. The authors hypothesized that olive oil provided additional decrease in inflammatory activity since minor components of the oil such as tocopherols and polyphenols have high antioxidant and anti-inflammatory potentials [8].

Venturini et al., 2015conducted a 90-day trial to verify if the combined intake of fish oil and olive oil had synergistic effects on lipid profile and oxidative stress parameters in patients with the metabolic syndrome. The authors found a significant decrease in LDL-C and TC/HDL, LDL/HDL ratios in the group receiving both fish oil and olive oil. The group receiving fish and olive oils also showed an increase in the antioxidant defenses, measured by an increase the total antioxidant plasma capacity and a decrease in the prooxidant state, measured by in lipid peroxidation and Advanced Oxidation Protein Products levels (AOPP). The results indicated a synergistic effect between fish oil and olive oil. The authors associated the decrease in prooxidantmarkers to a decrease in the proinflammatory status provided by the fish oil supplementation in addition to the antioxidant effects of polyphenols present in the olive oil [19].

Although some studies suggests that olive oil may act synergistically with fish oil by increasing the incorporation of n-3 fatty acids in cell membranes [20,21], there is a clear need for more basic studies to verify the molecular pathophysiological mechanisms behind this synergistic action.

Studies investigating the co-supplementation of olive oil and fish oil remain scarce. Therefore, more randomized, placebo controlled clinical trials are needed to confirm a synergistic effect between the two oils and the mechanisms of action involved. However, the available studies collectivelyindicate that fish oil and olive oil have complementary mechanisms that result in better effects on than the oils given separately.

References

1. Wolters M. Diet and psoriasis: experimental data and clinical evidence. Br J Dermatol. 2005; 153: 706-714.
2. James MJ, Gibson RA, Cleland LG. Dietary polyunsaturated fatty acids and inflammatory mediator production. Am J Clin Nutr. 2000; 71: 343S-348S.
3. Pestka JJ, Vines LL, Bates MA, He K, Langohr I. Comparative Effects of n-3, n-6 and n-9 unsaturated fatty acid-rich diet consumption on lupus nephritis, autoantibody production and CD4+ T cell-related gene responses in the autoimmune NZBWF1 mouse. PLoS One. 2014; 9: e100255.
4. Abedi E, Sahari MA. Long-chain polyunsaturated fatty acid sources and evaluation of their nutritional and functional properties. Food Sci Nutr. 2014; 2: 443-463.
5. Dawczynski C, Hackermeier U, Viehweger M, Stange R, Springer M, Jahreis G. Incorporation of n-3 PUFA and γ-linolenic acid in blood lipids and red blood cell lipids together with their influence on disease activity in patients with chronic inflammatory arthritis - a randomized controlled human intervention trial. Lipids Health Dis. 2011; 10: 130.
6. Simopoulos AP. Essential fatty acids in health and chronic disease. Am J Clin Nutr. 1999; 70: 560S-569S.
7. Grindel A, Staps F, Kuhnt K. Cheek cell fatty acids reflect n-3 PUFA in blood fractions during linseed oil supplementation: a controlled human intervention study. Lipids Health Dis. 2013; 12: 173.
8. Berbert AA, Kondo CR, Almendra CL, Matsuo T, Dichi I. Supplementation of fish oil and olive oil in patients with rheumatoid arthritis. Nutrition. 2005; 21: 131-136.
9. Lozano-Sánchez J, Castro-Puyana M, Mendiola JA, Segura-Carretero A, Cifuentes A, Ibáñez E. Recovering bioactive compounds from olive oil filter cake by advanced extraction techniques. Int J Mol Sci. 2014; 15: 16270-16283.
10. Bogani P, Galli C, Villa M, Visioli F. Postprandial anti-inflammatory and antioxidant effects of extra virgin olive oil. Atherosclerosis. 2007; 190: 181-186.
11. Visioli F, Caruso D, Grande S, Bosisio R, Villa M, Galli G, et al. Virgin Olive Oil Study (VOLOS): vasoprotective potential of extra virgin olive oil in mildly dyslipidemic patients. Eur J Nutr. 2005; 44: 121-127.
12. Covas MI, Ruiz-Gutiérrez V, De La Torre R, Kafatos A, Lamuela-RaventósRM, Osada J, et al. Minor components of olive oil: evidence to date of health benefits in humans, Nutr Rev. 2006; 64: S20–S30.
13. Covas MI, Konstantinidou V, Fitó M. Olive oil and cardiovascular health. J Cardiovasc Pharmacol. 2009; 54: 477-482.
14. Bjerregaard P, Mulvad G, Pedersen HS. Cardiovascular risk factors in Inuit of Greenland. Int J Epidemiol. 1997; 26: 1182-1190.
15. Eilertsen KE, Mæhre HK, Cludts K, Olsen JO, Hoylaerts MF. Dietary enrichment of apolipoprotein E-deficient mice with extra virgin olive oil in combination with seal oil inhibits atherogenesis. Lipids Health Dis. 2011; 10: 41.
16. Vognild E, Elvevoll EO, Brox J, Olsen RL, Barstad H, Aursand M, et al. Effects of dietary marine oils and olive oil on fatty acid composition, platelet membrane fluidity, platelet responses, and serum lipids in healthy humans. Lipids. 1998; 33: 427-436.
17. Ramírez-Tortosa C, López-Pedrosa JM, Suarez A, Ros E, Mataix J, Gil A. Olive oil- and fish oil-enriched diets modify plasma lipids and susceptibility of LDL to oxidative modification in free-living male patients with peripheral vascular disease: the Spanish Nutrition Study. Br J Nutr. 1999; 82: 31-39.
18. Camuesco D, Gálvez J, Nieto A, Comalada M, Rodríguez-Cabezas ME, Concha A, et al. Dietary olive oil supplemented with fish oil, rich in EPA and DHA (n-3) polyunsaturated fatty acids, attenuates colonic inflammation in rats with DSS-induced colitis. J Nutr. 2005; 135: 687-694.
19. Venturini D, Simão AN, Urbano MR, Dichi I. Effects of extra virgin olive oil and fish oil on lipid profile and oxidative stress in patients with metabolic syndrome. Nutrition. 2015; 31: 834-840.
20. Crawford M, Galli C, Visioli F, Renaud S, Simopoulos AP, Spector AA. Role of plant-derived omega-3 fatty acids in human nutrition. Ann Nutr Metab. 2000; 44: 263-265.
21. Mangas-Cruz MA, Fernández-Moyano A, Albi T, Guinda A, Relimpio F, Lanzón A, et al. Effects of minor constituents (non-glyceride compounds) of virgin olive oil on plasma lipid concentrations in male Wistar rats. Clin Nutr. 2001; 20: 211-215.