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Virgin olive oil as a fundamental nutritional component and skin protector

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Abstract

Fats are indispensable to life not only as an energy source but also for their structural role in the skin, retina, nervous system, lipoproteins, and biologic membranes. They are also precursors of important hormones and constitute the vehicle for the absorption of liposoluble vitamins. Nutritionists recommend a balanced lipid intake corresponding to a total amount of fats equal to 25% to 30% of total calories with a ratio in monounsaturated and polyunsaturated fatty acids. Thus, olive oil, with its balanced fatty acid composition, is of high nutritional value. Moreover, extra virgin olive oil, extracted from a fruit, has an important value related to the antioxidant power of minor components. Extra virgin olive oil contains 98% to 99% triglycerides and 1% to 2% minor components. In the triglycerides, the main fatty acids are represented by monounsaturates (oleic), with a slight amount of saturates and an adequate amount of polyunsaturates. The minor components are α-tocopherol, phenol compounds, carotenoids, squalene, phytosterols, and chlorophyll. Factors that can influence olive oil's composition, especially in regard to its minor components, are the cultivar, area of production, time of harvesting, and degree of technology used in its production. Therefore, an evaluation of the biologic value of extra virgin olive oil and its use as a topical raw material in cosmetic dermatology is reported.

Introduction

Fats are not only indispensable to life as an energy source but also for their structural role in the skin, retina, nervous system, lipoproteins, and biologic membranes. Fats are also precursors of important hormones and constitute the vehicle for the absorption of liposoluble vitamins. In view of this, their incorrect use can lead to serious illness such as atherosclerosis and malignancies.

Therefore, an evaluation of the biologic value of fats is called for by examining their makeup in fatty acids and minor components. Following is a list of components that can be considered:

- Fatty acids composition (saturated, monounsaturated, polyunsaturated ω-6, polyunsaturated ω-3)
- Polyunsaturates/saturates ratio
- Omega-6/omega-3 ratio
- Antioxidant content
- Antioxidant/polyunsaturates ratio
- Presence of minor biologically active components

Extra virgin olive oil contains 98% to 99% triglycerides and 1% to 2% minor components. In the triglycerides the main fatty acids are represented by monounsaturates (oleic), with a slight amount of saturates (palmitic, stearic) and an adequate presence of polyunsaturates (linoleic and α-linolenic). The minor components are α-tocopherol, phenol compounds, carotenoids (β-carotene and lutein), squalene, phytosterols, and chlorophyll (in addition to a great number of aromatic substances). Factors that can influence (to a degree) the composition of extra virgin olive oil, especially in regard to its minor components, are the type of cultivation (cultivar), area of production, time of harvesting, and degree of technology used in its production.

Some polyunsaturated fatty acids with 18 carbon atoms (linoleic, 18:2 ω-6, and α-linolenic, 18:3 ω-3), although indispensable for cell structure and function, cannot be synthesized by the body and must be consumed preformed in food.

These polyunsaturated fatty acids are therefore referred to as “essential,” or essential fatty acids (EFAs). It must be noted, however, that in most cases EFAs do not interact directly in the above-mentioned biologic activity, but only after the chain undergoes an elongation to 20 or 22 carbon atoms and subsequent desaturation. This is brought about (mainly in the liver) by certain enzymes (elongase and desaturase). The long-chain polyunsaturated fatty acids are responsible for the main function attributed to the essential polyunsaturated fatty acids.

Through the above-mentioned enzymatic reaction, linoleic acid gives way for diomo-γ-linolenic acid, 20:3 ω-6 (gamma-linolenic acid), and arachidonic acid, 20:4 ω-6. α-linolenic acid gives way for eicosapentaenoic acid, 20:5 ω-3, and docosahexaenoic acid, 22:6 ω-3.

The long-chain polyunsaturated fatty acids, after being synthesized from EFA by the body in the form of esters (together with a certain amount of EFA), become part of the phospholipid component of the lipoproteins that transport lipids in plasma and structure the cell membranes with the aforementioned structural and functional capacities. At this point, they do not need to be stable because they can be hydrolyzed (by phospholipase A_2) for the subsequent formation of prostaglandins (by cyclooxygenase) and leukotrienes (by lipoxygenase) (Figure 1).

The two series ω-6 and ω-3 are, however, in contrast with each other in many aspects. Therefore, it seems important that they be present in a correct ratio in the diet, because an excess of linoleic acid can inhibit the endogenous synthesis of the long chains of α-linolenic acid (eicosapentaenoic acid and docosahexaenoic acid) with consequent damage to the body. The ratio between the ω-6 and the ω-3 series should never be less 10:1, especially during growth because the long-chain ω-3 series are fundamental for brain and retina development. They also have other important functions: anti-cancer, antiplatelet aggregation, anti-inflammatory, and protection against dryness of the skin.

The recommended ratio is found in olive oil, whereas the same cannot be said for other vegetable oils, with the exception of linseed and soy oils. It should also be noted that Δ-6-desaturase (a key enzyme in the synthesis of long-chain polyunsaturated fatty acids) can be inhibited by the peroxidative action of oxygen free radicals with particular limitation of the formation of diomo-γ-linolenic acid (20:3 ω-6), which has an important protective activity in the skin, especially in atopic dermatitis.

The recognition of the essentiality of polyunsaturated fatty acids, together with the fact that their consumption decreases cholesterol plasma levels, gave rise to great interest in them (particularly in regard to linoleic acid, 18:2 ω-6) to the point of recommending a high intake in the diet mainly through the use of seed oils. At the present time, however, doubts have arisen in regard to these recommendations because of the easy peroxidation that polyunsaturates can undergo.

During the normal production of energy, it is inevitable that the body forms some oxygen free radicals that can be dangerous, in particular, the hydroxyl radical (OH•). If the free radicals produced are not neutralized, they can damage some macromolecules as deoxyribonucleic acid (DNA), proteins, and especially polyunsaturated fatty acids component of phospholipids in the biologic membranes and the lipoproteins, causing even serious and irreversible damage.

The body defends itself against peroxidative damage with antioxidants, some of which are naturally present (eg, certain enzymes, α-1-antitrypsin, uric acid, and ferritin) and some of which are in the form of foods (tocopherols, carotenoids, and polyphenols). In the event of imbalance between prooxidant and antioxidant factors, the body undergoes *oxidative stress,* which causes modifications in cell function that when totally compromised can cause cell death.

Polyunsaturates, although indispensable, constitute a mark for oxygen free radicals because the methylene positioned between the two double links (divinylmethane group) constitutes a vulnerable point that allows the subtraction of a hydrogen atom through a homolytic scission and subsequent formation of a lipid peroxide that will in turn try to stabilize itself, creating a chain reaction (Figure 2).

The intake of polyunsaturates is necessary, but not in high quantities (only 6%–8% of calories from fats [2%–3% of total calorie intake]). At the same time, saturated fatty acids consumption should be moderate (approximately the same amount as polyunsaturates, with a ratio of 1:1). The saturates increase plasma cholesterol levels and act as "promoters" on certain cancer growths (colon, breast, and perhaps uterus and prostate).

Nutritionists recommend a balanced lipid intake corresponding to a total amount of fats equal to 25% to 30% of total calories with a ratio in fatty acids:

- Saturates (6%-8%)
- Monounsaturates (12%-14%)
- Polyunsaturates ω-6 (6%-7%)
- Polyunsaturates ω-3 (0.5%-1.5%)

Olive oil's balanced acid composition gives it a high value (necessary and adequate EFA content with a balanced ratio between the two series), but extra virgin olive oil, extracted from a fruit, has an important value related to the antioxidant power of minor components (Table 1).

Section snippets

Antioxidants in olive oil

Virgin olive oil contains 150 to 200 mg/kg α-tocopherol with an optimum E/polyunsaturated fatty acid ratio (milligrams of vitamin E per gram of polyunsaturates). This ratio, which should never be less than 0.5, is hardly ever found in seed oils, but in extra virgin oil it is 1.5 to 2. In seed oils, the tocopherols present are mainly of β, γ, and δ types scarcely used by the body. The body at the intestinal level absorbs all tocopherol types equally well, but after the liver identifies them, it…

Biologic activity of phenol compounds

- Direct antioxidant activity…
- Increased vitamin A and β-carotene activity…
- Protection and recharge of vitamin E (α-tocopherol)…
- Binding of metal ions that catalyze free radical formation…
- Protection of Δ-desaturase activity…
- Inhibition of phospholipase A_2, concealing arachidonic acid release…
- Inhibition of platelet aggregation…
- Inhibition of cyclooxygenase and lipoxygenase…
- Reduction of plasma cholesterol level…
- Inhibition of low-density lipoprotein (LDL) oxidation…
- Inhibition of some cancer-forming chemicals…
- …

…

Olive oil and atherosclerosis

A high plasma cholesterol level plays an important role in the pathogenesis of atherosclerosis. The plasma cholesterol level depends not only on a high dietary intake, but also from the saturated fatty acid activity that inhibits the cell's receptors for LDL (the lipoproteins that transport cholesterol, which if not taken up by the cell will remain in the blood, determining the increase in cholesterolemia).

Polyunsaturates, in contrast with saturates, promote LDL cell cholesterol entry,…

Neoplasms

The incidence of breast and colon cancer in Southern Italy, Spain, and Greece, where olive oil is widely used, is lower than in other European nations and North America, but in southern Italy this protective effect extends to all forms of cancer.

In addition to epidemiologic data, there are experimental data that document olive oil's protective anticancer effect. Numerous animal studies have shown that olive oil decreases the risk of neoplastic development induced by exposure to cancerous…

Aging

The most accredited theory to explain aging is free radical peroxidation.[16] In addition to modifying DNA replication, oxygen free radicals cause progressive damage to biologic membranes and subcellular organelles, impairing their functionality.

With aging, biologic membrane sensitivity to peroxidative phenomena increases with a progressive loss of functionality, with increased activity of phospholipase A_2 enzyme, which hydrolyzes phospholipids releasing arachidonic acid. This, by the action of…

Skin protection

Since remote times, olive oil has been used as a cosmetic and skin protector. The ancient Egyptians used it to make creams and perfumes, and it is said that the first anti-wrinkle cream was invented by Cleopatra. It seems she used olive oil mixed with milk, incense, and juniper berries, spreading its fame as a basic ingredient for beauty products. Romans used it to oil their bodies after bathing to keep the skin elastic, and this belief has survived to this day with the widespread use of olive…

Topical uses of olive oil

Another interesting aspect of virgin olive oil is its use in cosmetic and dermo-protective creams. The similarity of virgin oil's composition to sebum, given by its high content of squalene, β-sitosterol content, optimum fatty acids content (the presence of oleic acid, which acts as a skin softener), and wealth of antioxidant substances, makes it particularly able to directly protect the skin. When applied to the skin after sun exposure, olive oil has an inhibitory effect on sun-induced cancer…

Conclusions

Olive oil, used since 4000 B.C. by the Mediterranean populations as a food, drug, and cosmetic, has been the object of numerous epidemiologic, clinical, and experimental studies in the last few decades, confirming its protective action and demonstrating how the intuition of ancient Mediterranean populations now has scientific backing.

Because of increased scientific research, the recognition of virgin olive oil's biologic value has notably increased. Currently, we know that in addition to olive…

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