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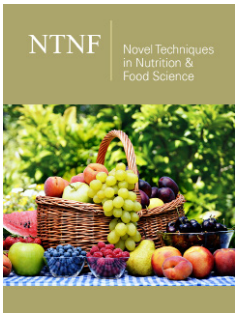
Extra Virgin Olive Oil Composition and its Bioactive Phenolic Compounds

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Abstract

Olive oil is a functional food that has a high level of oleic acid and minor components with biological properties. Oleic acid, linoleic and linolenic acids are bioactive lipids with anti-inflammatory and/or proresolving activities. Phenolic compounds and tocopherols in extra virgin olive oil are effective due to their antioxidant, anti-inflammatory, and neuroprotective activities. Non-saponifiable fraction containing minör componenets including phenolic compounds present up to 2% by weight have protective and antioxidant effects. The presence and types of phenolic compounds are important for extra virgin olive oil's nutritional value and phenolics content is a very important parameter for the quality and sensory properties including flavor, astringency, pungency, and bitterness. Polyphenols play an important role in oxidative di-stress, telomere length and healthy aging, by just modulating redox function. The positive correlations were proved between the daily intake of phenolic compounds in the Mediterranean diet and health. The goal of the current mini review is to summarize the current understanding components of extra virgin olive oil as well as the significance of its bioactive polyphenols.

Keywords: Extra virgin olive oil; Bioactive compounds; Phenolic compounds; Bioavailability; Antioxidant

Introduction

Extra virgin olive oil is made through harvesting, washing, crushing, malaxing of olives and the separation and centrifugation of the oil phase [1,2]. Olive oil contains several constituents with biological properties as being major source of lipids for Mediterranean diet. It is high in Monounsaturated Fatty Acids (MUFAs) and is a functional food having several trace constituents with biological properties. This included extra virgin olive oil among the healthy lipids with antioxidant and protective properties [3,4]. The Mediterranean diet is also effective in curing metabolic syndrome, reducing risk of cardiovascular disease and preventing aging. Consuming extra virgin olive oil may work by many ways activation of metabolic pathways, providing proper lipid metabolism, reducing endothelial damage and blood pressure with anti-inflammatory activity [4].

Extra Virgin Olive Oil Composition

Extra virgin olive oil contains saponifiable fraction (98-99%) made up of triacylglycerols and such as oleic, linoleic, palmitic, and stearic acids, as well as minor unsaponifiable fraction (1-2%) contains vitamins, such as tocopherols, polyphenols (primarily tyrosol, hydroxytyrosol, oleuropein), sterols, phospholipids, waxes, squalene, other hydrocarbons [1,2,4-6]. Oleic acid is one of the main characteristics of olive oil that is associated with health. Phenolic compounds, oleic acid, polyunsaturated fatty acids, phytosterols, squalene, tocopherols are effective on consumer health [7]. Oleic acid (55-85%) is the most abundant monounsaturated fatty acid in olive oil, followed by saturated palmitic acid (7.5-20%), polyunsaturated linoleic (3.5-21%), and linolenic (1%) acids [2,8]. High oleic acid and low linoleic acid content resulting in a high nutritional value in extra virgin olive oil more resistant to oxidative damage. Global consumption and production of olive oil has increased steadily

due to the recognition of its health-promoting properties and its effect on cardiovascular disease, cancer and diabetes [9]. Cultivar, location, latitude, climate, cultivar, ripening stage significantly affect, fatty acid composition [2] a decrease in polyphenol content and an increase in polyunsaturated fatty acids results in reduced oxidative stability and shorter shelf-life [10]. The non-saponifiable class of olive oil, phenols, pigments, tocopherols, and squalene have drawn a lot of attention, due to their antioxidant activity. Olive variety, cultivation conditions, fruit ripening stage, and oil production conditions significantly affect the concentrations of the non-saponifiables in olive oil [2,11]. One of the main hydrocarbons present in olive oils is squalene ($C_{30}H_{50}$) range from 0 to 16mg/kg have a significant impact on both the health benefits like preventive effect on breast cancer and cardiovascular diseases and oils' shelf life [2,12]. Colour is a very important initial evaluation factor for olive oil. The pigments that contribute to the distinctive green colour are chlorophylls and the carotenoids and chlorophyll compounds give the oil its characteristic color [2,11,13]. Olive fruits are green while they are still in the development stage, but once they begin to ripen, chlorophyll begins to break down along with the production of anthocyanin, which will cover the fruit and color it black. Carotenoids can protect EVOO against photosensitive oxidation, but when light is present, chlorophyll and pheophytin strongly promote oxidation. Olive oil carotenoids are natural antioxidants and effective on human health. Chlorophylls may function as antioxidants in the dark, possess antioxidant, anti-mutagenic, and chemo preventive properties [13]. Chlorophyll content in extra virgin olive oil can vary from 10 to 30mg/kg, carotenoids from 1 to 20mg/kg, lutein from 0.2 to 3.4mg/kg, and β-carotene from 0.4 to 5.1mg/kg. [2]. Sterols and triterpene alcohols are important carriers of olive oil's bioactive properties since they are effective as blood cholesterol-lowering agents in humans as well as reducing cardiovascular disease risk. The sterol profile is used as a "fingerprint" and is considered a purity parameter. Extra virgin olive oil contains 80% β-sitosterol, up to 4 and 7% campesterol and Δ5-avenasterol, respectively. Erythrodiol and uvaol, which vary from 1 to 20mg/100g are present in EVOO as triterpene dialcahols [2,10,14]. Tocopherols are minor components with high antioxidant activity affecting the oil's stability and storage time. Tocopherols and tocotrienols have vitamin E activity. The concentrations of tocopherols in the oil changes depending on cultivar, ripening, territory, climate, production methods, storage conditions [14] varying from 100 to 760mg/kg of oil, the alpha tocopherol accounts for 90 to 95% of the total tocopherol content [2,14,15]. According to the European Food Safety Authority (EFSA), average requirements for tocopherol could be 11-13mg/day, with a daily-tocopherol intake linked with adequate absorption of fat dietary sources [15]. The flavor derived from phenolic compounds affecting positive attributes and defects in the oil are used for the oil's quality classification [2]. The composition of the volatile fractions determines the positive and unfavorable properties of virgin olive oils. Several of these volatile compounds are produced enzymatically by the Lipoxygenase (LOX) route from free polyunsaturated fatty acids, primarily linoleic and linolenic acids [8,16,17]. The LOX pathway hydrolyzes triglycerides and phospholipids after milling. Pentene dimers, secoiridoids, oleacein, and oleocanthal, are positively correlated with extra virgin olive oil bitterness and pungency, strongly activating two most important TAS2Rs receptors [17]. 2-hexenal, 3-hexenyl acetate, 1-hexanol are responsible for the distinct pleasant sweetness and octane, ethanol, -2-heptenal, 1-octen-3-ol, propanoic acid, ethyl propanoate, hexanal, nonanal, 2,4-hexadienal, 2-decenal, pentanoic acid are the volatiles that accountable for the negative attributes in extra virgin olive oil [16]. Cultivar, climate, agronomic factors, olive oil extraction, filtration and storage have an impact on the volatile composition [2,8] of olive oil.

Polyphenols

The health benefits of extra virgin olive oil are primarily due to its high concentration of oleic acid and phenolics [2,3,6,18,19]. Phenolic compounds play a variety of physiological functions in the stability, nutritional, and sensory characteristics of extra virgin olive oil and they may be present up to 50 to 1000mg/kg. The metabolites produced during processing as well as those initially found in olive fruit are included in virgin olive oil's phenolic fraction [6]. Oxidative stress and inflammation significantly contribute to cardiovascular and neurodegenerative diseases since phenolics directly contribute to human cells' redox balance. Thus, it has has been shown that the phenolic compounds have antioxidant, anti-inflammatory, antimicrobial, and antitumoral properties. They can also modulate gene expression to safeguard proteins involved in cellular mechanisms for oxidative stress resistance, inflammation, and lipid metabolism [1,6,20]. Phenolic substances play a variety of physiological roles in the stability, nutritive content, and sensory properties of the oil. Cultivar, agronomic factors, ripening stage, oil processing technologies, storage, and packaging conditions both affect phenolic content [2-4,18,19] and the synthesis and/or degradation of phenolic compounds [6]. Simple phenols (hydroxytyrosol, tyrosol), polyphenols (flavonoids, apigenin, luteolin), lignans (pinoresinol, 1-acetoxypinoresinol), secoiridoids (oleuropein, glycosylated oleuropein, demethyleoleuropein, elenolic acid, ligstroside their aglycons and an isomer of the oleuropein aglycon (3,4-DHPEA-EA) and oleocanthal (p-HPEA-EA)) are present in extra virgin olive oil. Secoiridoids and lignans are the most concentrated polyphenols in extra virgin olive oil [21]. They give extra virgin olive oil several desirable properties, including preventing oxidation, extending shelf life, and imparting bitter, astringent, and pungent organoleptic characteristics. They also exert strong antioxidant activity and show preventive action against cancer and cardiovascular diseases [1-3,18,19,21] along with reducing the chance of neurodegenerative illnesses and maintaining human well-being [20]. Tyrosol and hydroxytyrosol (absorption rates range from 40 to 95%) are extensively metabolised and the most absorbed phenolics are from the small intestine [6]. The molecules hydroxytyrosol and oleuropein and related compounds, in accordance with EFSA, are responsible for olive oils' health effect. A daily dose of 2-15mg of hydroxytyrosol or oleuropein related compounds is required for the scientific validation of health claims. PUFA are protected from oxidation by these polyphenols and tocopherols that have a positive impact on consumer health [2,7,15]. Positive correlations were found

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between phenolic compounds and health in the Mediterrenean diet. Enriching extra virgin olive oil with its own phenolics or from other sources has been proposed as an interesting strategy to increase daily phenolic compound intake [2]. Consuming 22 grams of virgin olive oil per day, which contains 366mg/kg of polyphenols, helps to increase the HDL's cardio protective qualities. It was demonstrated that supplementing 25mL/day of phenol-enriched olive oil for three weeks substantially reduced several serum metabolites associated with cardiovascular risk. These findings point to the significant potential of extra virgin olive oil on cardiovascular disease and in the treatment of cardio metabolic diseases [22]. The antioxidant activity of extra virgin olive oil is not always linked to its high total phenol content. Each phenolic compound has an antioxidant capacity that is primarily determined by its chemical composition. Polyphenol absorption in the gut appears to be dose- and time-dependent and related to polarity [3]. Furthermore, bioavailability of phenolic compounds in extra virgin olive oil can change with intestinal microbiota [3] which may alter the bioaccessibility and antioxidant activity [4]. Bioavailability of hydroxytyrosol, tyrosol, and oleuropein have been searched intensively [3]. EFSA, (2012) has recognized a health claim "olive oils containing at least 5 mg of hydroxytyrosol and its derivatives per 20g of olive oil" should be consumed daily to protect low-density lipoprotein from oxidation [2]. The American Food and Drug Administration (FDA, 2018) has also acknowledged the positive impacts of EVOO phenolic compounds on human health. In the superfood group, EVOO bottles with "qualified health claim" that daily consumption of about 2 tablespoons, or 23 grams of olive oil, can decrease the chance of coronary heart disease and oral diseases [23,24].

Conclusion

Extra virgin olive oil as the main lipid source of the Mediterranean diet, that contains bioactive components with biological properties. Extra virgin olive oil is a food that contains a major saponifiable fraction (oleic acid, saturated and unsaturated acids (linoleic, palmitic, and stearic acids), as well as a minor unsaponifiable fraction (tocopherols, polyphenols (tyrosol, hydroxytyrosol, oleuropein), sterols, phospholipids, carotenoids, chlorophylls, waxes, squalene, other hydrocarbons) have protective and antioxidant effects. A high MUFA concentration may enhance the serum lipid profile and lessen changes brought on by free radicals and oxidized low-density lipoproteins. By merely modifying redox function, olive oil phenols have a significant impact on oxidative stress, telomere length, and effective aging. Phenolics absorb differently in the stomach depending on their chemical structure's polarity, dose, and passage of time. Additionally, the unique individual characteristics of the intestinal microbiota can alter the bioaccessibility and antioxidant activity of the phenolic component of extra virgin olive oil. According to the EFSA, the molecules hydroxytyrosol and its derivatives (such as the oleuropein complex and tyrosol) are what give olive oil its positive impacts on human health. Bioactive polyphenols, whose chemistry is crucial for comprehending and evaluating the health advantages of extra virgin olive oil consumption in future research studies.

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