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Biological Properties of Olive Oil

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ABSTRACT

Background: This review tries to explain various biological properties of olive oil
Methods: In present review, data were obtained via a complete search through online databases including PubMed, Google Scholar, SID and Science Direct to find the relevant titles and paper abstracts using keywords like 'olive oil', 'biological effect' or 'therapeutic' or 'food'. The obtained articles have been reviewed to evaluate different biological and therapeutic properties of olive and its edible products.

Results: Olive fruit and oil and the products obtained from olive tree (e.g., olive leaf extract) have unique medicinal properties. Studies have confirmed the positive effects of olive oil on wound healing, pain relief, cancer treatment, stroke, and cardiovascular diseases. In addition to the sensory properties of olive oil, the consumption of olive oil in the daily diet could enhance the safety and quality of food through antimicrobial and antioxidant compounds.

Conclusion: Considering the unique and significant medicinal and nutritional benefits of olive oil, it is necessary to encourage people toward the consumption of olive oil and increase their awareness about the importance and advantages of this product.

1. Introduction

The olive oil obtained only by mechanical or physical instruments from olive fruit, is virgin olive oil. The fruit should not undergo conditions that cause the oil to change, except for washing, overflowing, centrifuging and filtration.

Based on qualitative criteria, three groups of olive oil are defined as: extra virgin olive oil, virgin olive oil and lampante olive oil. Lampante is a virgin olive oil that is made from spoiled fruits or inappropriate processing and its quality is so low that it can not be used for human

consumption.

Extra virgin olive oil has lower free acidity and lower peroxide value than virgin oil [1].

Generally, extra virgin olive oil contains two groups of chemical compounds; triglycerides, which include 97 to 99 wt% of the oil, and small components that comprise 1 to 3 wt% of the oil. Those triglycerides have mostly one monounsaturated fatty acids (like oleic acid), modest amounts of unsaturated fatty acids (i.e. linoleic and alpha linolenic) and small amounts of saturated fatty acids (i.e. palmitic and stearic acids).

Minor components are a blend of amphitropic, non-polar and polar materials that include hydrocarbons, tocopherols, phenolic compounds, sterols, chlorophylls, carotenoids, terpenic acids, monoglycerides and diglycerides, free fatty acids, esters, and other volatile substances. These minor compounds have special effects on sensory properties and safety of extra virgin olive oil [2].

In this review, various biological properties of olive oil are explained.

2. Materials and Methods

In present review, data were obtained via a complete search through online databases including PubMed, Google Scholar, SID and ScienceDirect to find the relevant titles and paper abstracts using keywords 'olive oil', 'biological effect' or 'therapeutic' or 'food'. The references employed in this study were since 2000 till present. The obtained articles have been reviewed in the Result and Discussion section of the paper to evaluate different biological and therapeutic properties of olive and its edible products.

3. Results and Discussion

3.1. Antimicrobial Properties

Oleuropein in olive acts against both gram positive and negative bacteria [3], as well as mycoplasma [4]. Moreover, phenolic compounds in olive oil destruct bacterial membranes. It is also mentioned by several authors that oleuropein can inhibit the production of enterotoxin B by *Staphylococcus aureus* and has an antiviral effect against herpes and hepatitis viruses [5,6]. Therefore, the presence of different types of olive oil in foodstuff can prolong shelf life of the product and enhance its safety via controlling growth of various groups of foodborne bacteria. In this regard, recently this aspect of olive oil and other olive tree products (like its leaf extract) has got much attention for extending shelf life of foodstuff [7-9].

Studies have also shown that oleuropein has an antiviral effect against type 3 parainfluenza virus. Additionally, the antiviral effect of olive leaf extract has been reported against AIDS virus [10].

3.2. Antioxidant Properties

Olive leaves contain phenolic compounds, terpenes and lipid-soluble compounds, carbohydrates, proteins, minerals and etc. Among the different parts of the olive tree, its leaves have the highest antioxidant activity and free radical scavenging properties. It has been shown that their antioxidant capacity is approximately two and four times higher than the relevant activity of green tea and vitamin C respectively [11]. Oleuropein is the most important phenolic compound of olive leaves. One of the major component of oleuropein hydrolysis is hydroxytyrosol, which has an oxygen radical scavenging capacity of ten times higher than

that of green tea. This compound is rarely found in the nature in free state [11].

Alirezai et al. (2012) examined the effect of olive leaf extract (containing 94% oleuropein) on antioxidant activity of enzymes in liver, stomach and testicular tissues in animal model. The results of their study showed that oleuropein can prevent oxidative stress, and subsequently improves the survival of sperm and prevents changes and damages caused by ethanol in the liver and stomach tissues [12].

Lipid oxidation is one of the main factor limiting shelf life of food products, especially fatty foods. Regarding antioxidant effect of olive oil, the food products containing this oil may keep their oxidative quality for longer periods. It has been widely reported that olive leaf extract can extend shelf life of foodstuffs via directly addition into the food matrix or by addition to food packaging materials [13].

3.3. Effects of Olive Oil on Cancer Treatment

The impact of a diet containing olive oil in reducing the incidence of cancer has been demonstrated (mainly due to the presence of phenolic compounds and unsaturated fatty acids). The phenolic antioxidants of olive oil are able to prevent the destructive effects of free radicals and the resulting mutations on cellular structures [13]. Stoneham et al. (2000) assessed the effect of olive oil on colon cancer [14]. Their findings indicated that the presence of antioxidants and phenolic compounds as well as monounsaturated fatty acids plays an important role in reducing the incidence of that disease .

Fabiani et al. (2002) also emphasized the importance of olive oil as an anticancer agent. They assessed the effect of hydroxytyrosol (major antioxidant constituent of virgin olive oil) on proliferation, apoptosis and cell cycle of cancer cell. Their findings support the idea that hydroxytyrosol may act against cancer via inducing apoptosis in tumor cells and arresting the cell cycle [15].

Vitamin E in olive oil protects the skin against sunlight. Therefore, it can prevent premature aging and skin cancer [6].

3.4. The Effect of Olive Oil on Wound Healing

Wound healing consists of four stages including homeostasis, inflammation, proliferation and regeneration [16]. Any material that can shorten these steps can speed up the process of healing [17]. When skin damages occur, such as scarring, the first reaction of the horny layer is the release of fatty acids to restore the impenetrable barrier. Olive oil contains a high percentage of unsaturated fatty acids and can help to restore the impenetrable barrier. In addition, monounsaturated fatty acids are one of the most important groups of membrane in the wound area, because they increase membrane fluidity in comparison with saturated fatty acids, and thereby accelerate cell metabolism [18].

Episiotomy was initially used as an assist to natural parturition in 1742 [19], and it is a cut in vagina area to prevent irregular ruptures [20]. One of the natural oils that appears to be effective in improving episiotomy ulcers is olive oil. It has been reported that bathing in olive oil can be effective in preventing infection, faster wound healing, and reducing episiotomy pain after parturition [21].

Olive oil, like any other fatty compound, can act as a barrier between open wounds and the outer environment, thus prevents infection. Moreover, olive oil probably accelerates wound healing by sterilizing the wound surface and preventing infection [18]. Episiotomy was first used as an assist to natural parturition in 1742 [19]. It is an incision in the vaginal area to prevent irregular ruptures [20]. Olive oil is one of the natural oils that may be effective in improving episiotomy ulcers. Previous studies have denoted that bathing in olive oil could effectively prevent infections and result in rapid wound healing and reducing episiotomy pain after parturition [21].

Similar to other fatty compounds, olive oil could act as a barrier between open wounds and the outer environment; as a result, it could prevent infections. Moreover, olive oil has been presumed to accelerate wound healing through sterilizing the wound surface and preventing infections [18].

3.5. Olive Oil and Stroke Treatment

Dropping brain metabolites due to reducing blood flow is known as brain ischemia, which reduces oxygen storage and thus causes brain tissue damages or stroke [22]. One approach that can reduce the harmful effects of ischemia in brain is the use of antioxidants. Antioxidant substances in olive oil increase the resistance of cells to oxidation, and because of unsaturated fatty acids, the olive oil can reduce cholesterol levels and thereby prevent the deposition of cholesterol in the blood vessels [23, 24].

Olive oil compounds (oleic acid, linoleic acid, polyphenols, etc.) are absorbed through the gastrointestinal tract and some of them enter into various parts of brain, including the temporal cortex. In such areas, polyphenols and vitamin E have strong antioxidant effects on the accumulated free radicals and acids, and can neutralize them in the case of ischemia. Researchers have found that prevention of ischemic memory disorders due to regular consumption of olive oil is related to the effect of olive antioxidants [25, 26].

Regular consumption of olive oil saves its compounds in the body. The temporal lobe of the brain is vulnerable to ischemia, hypoxia and free radicals. The consumption of olive oil after cerebral ischemia can reduce the mortality of neuronal cells in the temporal lobe and protect the neurons from harmful agents.

Results of a study by Rabiei et al, (2013) showed that pre-treatment of virgin olive oil led to lower degree of cellular death and consequently lower levels of stroke in the tested

animal model, probably via changing brain lipid composition [27]. As a result, olive oil can be an ideal option for pre-treatment of stroke in medical sciences.

3.6. Olive Oil and Pain Treatment

In traditional medicine olive oil is mainly used orally and also topically as pain reliever. Pure olive oil has a natural chemical that acts like a sedative. This substance, which has been named oleocanthal, has an effect like ibuprofen. With daily consumption of ~50 grams of olive oil, the body receive approximately 9 milligrams of oleocanthal. This is equal to one tenth of a dose of ibuprofen which is prescribed to reduce pain in an adult [28]. Besides, oleuropein in olive, has also analgesic effects [29].

Shabrandi et al. (2016) stated that edible virgin olive oil had pain-relieving effect and increased morphine impacts in the chronic phase of pain [30]. In fact, the administration of morphine has more analgesic effect in an animal that consumes edible virgin olive oil regularly. They suggested that due to the pain-killing effects of olive oil (in the diet), some analgesic compounds in olive oil may apply their effect after absorption in the digestive system.

3.7. Olive Oil and Cardiovascular Diseases

Cardiovascular disease was the leading cause of death in the United States in 2008 [31]. The combination of dietary fatty acids affects blood lipids, and blood lipoproteins are associated with the development of atherosclerosis and ischemic heart diseases. High levels of cholesterol, especially in the form of LDL, are known to be a major risk factor for coronary heart disease .

Despite the fact that in Mediterranean countries high levels of fat (~ 40% of total calories) are consumed, rates of coronary heart disease and plasma cholesterol are relatively low [30]. In these countries, people usually take diets contain high amounts of olive oil, which are rich in mono unsaturated fatty acids, especially oleic acid [32].

Many of previous researches have shown that consumption of olive oil has lots of benefits, including the increase of HDL [33], LDL decrease [34], reduction of cholesterol and triglycerides and decrease in cholesterol to HDL ratio [35].

Cardiovascular disease is the leading cause of death in almost two-thirds of diabetics [36]. Increasing blood glucose and lipids is one of the most important risk factors for cardiovascular disease in people with type 2 diabetes [37]. Armin et al. (2010) mentioned that in general, considering the beneficial effect of olive oil in comparison with sunflower oil on some parameters of blood glucose and lipid, replacing solid vegetable oil (40% of total fat intake) with olive oil in the diet of type 2 diabetic patients is more effective than sunflower oil for the prevention of cardiovascular diseases [38].

3.10. Other Health Benefits of Olive

Different compounds of olive not only act as antioxidants but also have anti-inflammatory properties [39]. Olive fruit contains potassium, which is an essential ion for normal function of the body. Research has shown that this ion can be associated with the prevention of cancer. Dietary foods with higher degree of sodium and lower level of potassium can trigger the growth of tumor cells, because they alter the normal pH and also the water balance in human cells [40,41].

Some compounds such as hydroxytyrosol and oleuropein which are abundant in olive, could also prevent osteoporosis. It has been proven that daily consumption of olive oil is effective in increasing the bone mineral content in the elderly [42].

4. Conclusion

Olive fruit and oil alongside with products obtained from olive tree (like leaf extract) has unique medicinal properties. The effect of olive oil on wound healing, pain relief, cancer treatment, stroke and cardiovascular disease has been proven. Moreover, in addition to sensory properties of olive oil, addition of olive oil to daily diet can enhance the safety and quality of the food via the antimicrobial and antioxidant compounds present in the oil. In fact, the aforementioned effects are mainly attributed to the phenolic compounds of olive oil like oleuropein (as an antimicrobial agent), hydroxytyrosol (as an antioxidant agent) and oleocanthal (as a sedative agent), and also the unsaturated fatty acids content of the oil. Considering the unique and significant medicinal and nutritional benefits of olive oil, it is necessary to encourage people toward the consumption of olive oil and increase their awareness about the importance and advantages of this product.

Authors' Contributions

This review article was carried out by all the authors. Z. Y., and M. R., designed and wrote the manuscript. M. H., contributed to carry out data collection and manuscript revision. All authors approved the final manuscript.

Conflict of Interest

The authors affirm that there is no conflicts of interest that may have influenced the preparation of this manuscript.

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