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Review Article

NUTRITIONAL VALUE AND HEALTH BENEFITS OF TABLE OLIVES

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Abstract

Table olives are the main fermented foods in Mediterranean countries and constitute an important part of the Mediterranean diet and also the diet of many non-olive-producing countries. Due to consumers' increasingly demand to incorporate foods into their diets that can help boost or maintain health, as well as help prevent some diseases, interest in table are increased resently. Table olive is a healthy food with high nutritional value consist primarily of water, fat and carbohydrates. Olives are an excellent source of oleic acid, also known as omega 9 or monounsaturated fatty acids (MUFA). And they are a good source of fiber, amino acids, the potent antioxidant vitamin E, iron, copper and other minerals. Moreover, olives are a rich dietary source of phenolic compounds that are linked to powerful antiinflammatory, antibiotic, antimicrobial, antiviral and antinociceptive effects. The disease-preventing effect of table olives is mainly attributed to its unique fatty acid profile and to the presence of some minor components such as tocopherols, carotenoids, phospholipids, triterpenic acids and biophenols. As part of a well-balanced, nutritious diet olives and olive products also provide added protection against many chronic diseases. Olive benefits have been demonstrated for the cardiovascular system, respiratory system, nervous system, musculoskeletal system, immune system, inflammatory system, and digestive system. In this review, it was focused on the active compounds present in table olives and also the contribution of these compounds to the human health was examined in detail.

Keywords: Table olive, health, nutritional value, active compounds.

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Introduction

Olive is the fruit of an evergreen olive tree that grows in the temperate climate of the Mediterranean region (46, 19, 14). Olive tree fruits are the raw material for a number of products, specifically olive oil and table olive (9). Table olive is probably one of the most important and most widely recognized fermented vegetable of the food industry and its elaboration is widespread around the world and represents an important economic source for the producing countries (1). The Turkish National Olive and Olive oil Council (IOOC) (2022) estimates that the table olive's production reached approximately 753.000 tones in the 2022/2023 season.

In the last decades olive products have been attracting increasing interest, due mostly to reports on their health promoting effects. Due to rising awareness about the beneficial effects of optimal nutrition and functional foods among todays's health conscious cosmopolitan societies, the worldwide consumption of olives and olive products has increased significantly, especially in high-income countries such as the United States, Europe, Japan, Canada and Australia, resulting the rapid development of olive-based products (12).

Table olives are important part of a well-balanced, nutritious diet (13), consisting primarily of water, fat, carbohydrates, protein, fiber, pectin, biophenols, vitamins, organic acids, mineral elements (2,12,24,49) and pigments (12).

In this review, it was focused on the active compounds present in table olives and also the contribution of these compounds to the human health was examined in detail.

Nutritional Characterization of Table Olives

From a nutritional point of view, table olives are well-known sources of compounds with beneficial relevance. These benefits are associated with their fatty acids content, mainly monounsaturated fatty acids, and to minor constituents such as tocopherols, phenolic compounds and phytosterols (49). Composition of the olive fruit epicarp are given in Table 1.

Table 1. Composition of the olive fruit epicarp (11).

Components	%
Moisture	60-75
Oil	10-25
Reducing sugar	3-6
Non-reducing sugar	≤ 0.3
Mannitol	0.5-1.0
Fiber	1-4
Protein	1-2
Ash	< 1.0
Organic acid and its salts	0.5-1.0
Phenolic compounds	2-3
Pectic substances	≤ 0.6
Other compounds	3-7

Sugars are the main soluble components in olive tissues and play an important role, providing energy for metabolic changes. The main simple sugars in raw olive flesh are glucose, fructose, sucrose and mannitol (sugar alcohol) (32). Both soluble reducing and non-reducing sugars have an important role in oil biosynthesis. In table olive processing sugars act as a carbon source to microorganisms for producing secondary metabolites responsible for good characteristics and a distinctive flavour of the commodities. In addition to the free reducing sugars, olive flesh is also rich in numerous glycosides, which can be a supplementary source of carbohydrates for olive fermentation when hydrolyzed (24). Olives are also calorie-dense, having a fat content of approximately 20% (150 kcal/100 g) (25).

Protein conten of the fresh pulp is relatively low, generally between 1 and 3%, and remains almost constant during growth and ripening of the fruits. Arginine, alanine, aspartic acid, glutamic acid and glycine constituted approximately 60% of the free amino acids (Garrido Fernández et al., 1997). The protein content is low (1 g ⁄ 100 g), but nutritional quality is high for the presence of essential amino acids (23).

High levels of monounsaturated fatty acids (mainly oleic acid) which have health benefits and are important for human nutrition play an important role in the nutritional value of table olives (2). The major fatty acids in table olives are oleic, palmitic, stearic, linoleic and palmitoleic acids (44, 51, 26) reported that the most abundant fatty acids in decreasing order of presence in commercial table olives are C18:1, C16:0, C18:2 n-6, and C18:0. The ranges expressed as grams of fatty acids per 100 g of edible portion, for different nutritional fractions are as follows: saturated fatty acids, 2.07-5.99; monounsaturated fatty acids, 5,67-19.42; polyunsaturated fatty acids, 0.52-3.87; and trans-fatty acids, 0.08-0.44. According to current dietary guidance for healthy nutrition, polyunsaturated fatty acids to saturated fatty acids (PUFA/SFA) ratio above 1.5 is associated with good health (38). (44) found PUFA/SFA ratios for processed Meski and Picholine olives 1.7 and 1.6, respectively at the cherry stage. These values showed that Meski and Picholine processed olives had a good health effect.

Phenolic substances are common to many plants, and have evolved as an antioxidant defense to environmental stress resulting from a variety of oxidizing and potentially harmful free radicals (46). Phenolic compounds are of great importance for the olive fruit, being responsible for important characteristics and properties, such as color, taste and texture (30). Table olives contain simple and complex phenolic compounds (at least 30 different phenolic compounds) in amounts ranging between 100 and 350 mg/100g of e.p. (the same quantity of 1kg of extra virgin olive oil) (24). Olive biophenols can be categorized in four major subgroups: (i) phenolic acids and alcohols, (ii) flavonoids, (iii) lignans, and (iv) secoiridoids. The last sub-group include the most characteristic and concentrated phenols in olive fruits (13). Although the phenolic compounds show variations in both quality and quantity, oleuropein, hydroxytyrosol, tyrosol, and verbascoside comprise the main phenols in olive (48). Oleuropein and hydroxytyrosol are naturally occurring phenolic compounds in olive fruits. While oleuropein is present in high amounts in unprocessed olive fruit, hydroxytyrosol is more abundant in the processed fruit. Oleuropein is responsible for the bitter taste of immature and unprocessed olives (45). A plethora of studies have been published concerning the antioxidant activity of oleuropein and its derivatives; the antimicrobial, antiviral, anti-atherogenic and anti-inflammatory activity of oleuropein have also been reported. In a clinical study, it has been shown that olive intake increases polyphenols and total antioxidant potential (TAP) in plasma, thus indicating that olive polyphenols have good bioavailability, which is in accordance with their antioxidant efficacy (21). Owen et al. (2003) reported that consumption of approximately 50 g (approximately 10 table olives) black olive pericarp would provide that about 400 mg of phenolic substances to the daily dietary intake. The percent of wet weight for phenolics in black and green olives was reported as 0.082 and 0.118, respectively (46).

Phenolic compounds also have importance such as residue forming, enzymatic browning substrate, enzyme inhibitor and purity control criteria. The phenolic fraction of the olive fruit is a complex structure. Phenolic fraction quality and component level are closely related to the development and ripening process of the fruit, depending on the season. Table olives and olive oils are known as a valuable source of "functional foods" with the phenolic antioxidant substances they contain (10, 30,49). In the study conducted on Turkish olive varieties, it was determined that olive varieties (Gemlik, Domat, Uslu, Ayvalık and Eşek olives) were rich in phenolic components (17).

Table olives are also rich in natural antioxidants such as vitamins. Of the vitamins found in green table olives, tocopherols are present in relatively high amounts. Assuming the α-tocopherol content as that reported by USDA one serving of 100 g of edible portion of treated green olives can provide about 25% of the RDA of vitamin E (33). They provide also small amounts of B group vitamins as well as liposoluble vitamins such as pro-vitamin A. The vitamin C content is low. (27) found a wide range of values for vitamin B_6 in commercial table olives (0–69.3 µg/ 100 g edible portion).

Other important components of table olives are mineral substances (51) and fresh olives are rich in minerals (5). Minerals have important functions in the body, and they are essential for healthy growth and life.

Mineral substances in table olives are important from nutritional and toxicological point of view (51). The macro elements are phosphorus, potassium, sodium, calcium, magnesium and sulphur and microelements (trace elements) are boron, copper, iron, manganese and zinc. As correspond to a brined product, Na was the most abundant element (18,144–5706 mg kg^{-1}). However, olives can also be a good source of Ca (337–850 mg kg^{-1}), K (82–1180 mg kg^{-1}), Mg (51–197 mg kg^{-1}), and P (57–144 mg kg^{-1}). Fe concentrations were also high in ripe olives (58–131 mg kg_1) but significantly lower in green and directly brined (3.5– 7.7 mg kg^{-1}). Microelements Cu (1.7–11.0 mg kg^{-1}), Zn (1.5–3.6 mg kg^{-1}), and Mn (0.2–1.5 mg kg^{-1}) had concentrations similar to other plants (27).

Dietary fiber (DF) is related to the biochemical changes of cell wall polysaccharides during olive fruit ripening and post harvest processing (9). Table olives are a good source of dietary fibre, which in addition, has a high digestibility rate (18, 28). Olive DF components in whole fruit include peçtin (which is composed of three pectic polysaccharides: arabinans, homogalacturonans and rhamno-galacturonans), hemicelluloses (which is rich in xylans, xyloglucans, glucuronoxylans as well as mannans), cellulose and lignin (Galanakis, 2011). In European Union countries (Reg. CE 1924/2006 and Reg. UE 116/2010) it is possible to write on the label the claim "source of fibre" if the product contains at least 3g of fiber/100g of e.p. Values of dietary fiber in table olives ranged from 2 to 5 g/100 g edible portion (e.p.) (28), so they can be considered as a source of fibre (24). In the research made by Jimenez et al. (2000), the content of dietary fibre was around 12% of the fresh weight, although in dried samples this percentage increased to around 20%.

Organic acids (oxalic, succinic, malic, citric and lactic) are one of the minor components of olive fruit and their amount is 1.5% of the fleshy part (11, 7).

Olive fruits are rich in oleanolic and maslinic acids (triterpenic acids) and the olive triterpenic acids have been attributed with anti-oxidant, anti-hyperglycemic, anti-microbial and anti-cancer activity (39,49).

Table olives are a food with a high nutritional value thanks to the balanced budget of the fatty acids, in which the MUFA predominate, and their consumption contributes to the anti-oxidant dietary fibre, vitamins and minerals assumption. Table olives are rich sources of a wide range of essential micronutrients, essential fatty acids, and biologically-active phytochemicals containing antioxidant compounds and phenolics which promote health benefits (41). Their postulated health benefits seem to be intrinsically linked to the high monounsaturated fat content (4) and to minor constitutes like tocopherols and phenolic compounds (33).

Health Benefits of Table Olives

Compared to other foods, some positive effects of fermented foods in terms of human health have been proven. Positive changes occur in nutritional value as a result of fermentation in various foods, and especially an increase in the amount of essential amino acids (50). Phenolic compounds as food ingredient; They are important with their contribution to human health, their role in the formation of taste and odor, their effects on color, and their antimicrobial and antioxidant effects.

Table olives are very important components of the Mediterranean diet (2,49). Mediterranean diet mainly consists of olive fruit consumption and its products and possesses inarguably beneficial effect on the human health; therefore, studies in olive fruit have attracted the interest of researchers from different scientific disciplines. Epidemiological studies showed that this dietary pattern reduces cancer risk (breast and colon) (48, 20) being in addition protective against cardiovascular and other chronic diseases (13).

Numerous epidemiological surveys have shown an inverse relationship between the intake of fruits and the incidence of coronary heart disease and certain cancers. Many constituents of these dietary components such as polyphenols might contribute to their protective role (49). The consumption of table olives provides a large amount of natural antioxidants which play a major role in the antioxidant activity and in the prevention of many diseases (47). Because table olives are mainly composed of monounsaturated fatty acids, the consumption of table olives can prevent and reduce the risk of cardiovascular diseases, regulate cholesterol levels, stimulate transcription of LDL-cholesterol receptor mRNA and reduce breast canser risks (44,51). It is well-known that the decreased incidence of cardiovascular disease in the Mediterranean area has been partly attributed to the consumption of olive products (8).

Weight loss and management

In an animal study conducted at the University of California at Irvine, researchers found that when dietary intake of oleic acid (abundant in olives) reached the small intestine, it triggered the production of oleoylethanolamide (OEA), a fatty hormone. This hormone is one of many that send a hunger-curbing message to the brain to stop eating. In this study, protein and carbohydrates did not have the same effect, nor did saturated fat. Human studies are needed, but this may help explain how MUFA affects appetite (43, 15).

Anti-cholesterol action

Because table olives are mainly composed of monounsaturated fatty acids, the consumption of table olives can regulate cholesterol levels (51). Both monounsaturated fats and polyphenols found in olives help prevent oxidation of cholesterol, and hence have a remarkable protective and preventive effect against atherosclerosis and related cardiovascular dseases, such as stroke and heart attact.

Antioxidant and anticancer activities

Interest in phenolic compounds is related primarily to their antioxidant activity. They show an important biological activity *in vivo* and may contribute to prevent diseases related to oxygen radical formation when this exceeds the antioxidant defense capacity of the human body. The antioxidant quality of phenolic compounds is mainly due to their redox properties, which allow them to act as reducing agent, hydrogen donators, and singlet oxygen quencher (34). Both olives and olive oil contain substantial amounts of other compounds seemed to be anticancer agent (e.g. squalene and terpenoids) as well as the peroxidation - resistant lipid oleic acid. Habitual high intakes of table olives will provide a continuous supply of antioxidants, which may mediate their effects by reducing oxidative stress via inhibition of lipid peroxidation, thereby inhibiting formation of DNA adducts, factors that are linked to a host of diseases including cancer (36,37) investigated the mechanisms of maslinic acid present in the protective wax-like coating olives with regard to its inhibitory effect on the growth of HT29 colon cancer cell. Their results show that maslinic acid has the potential to provide significant natural defence against colon-cancer.

Diabetes and cardiovascular disease

Monounsaturated fatty acids are recognized as a heart healthy fat and are associated with reducing low-density lipoprotein (LDL) cholesterol levels, but maintaining or increasing high-density lipoprotein (HDL) cholesterol. MUFA also help to normalize blood clotting. Research has shown that MUFA benefits insulin and blood sugar levels, and are particularly beneficial to those who suffer from type 2 diabetes. Type 2 diabetes is also a major risk factor for cardiovascular disease.

Bone health

In animal models, table olives have shown some benefits on bone healths, which is thought to be at least partially the result of minor antioxidant compounds (25). A number of preclinical data demonstrate that polyphenolic compounds derived from olive may protect bone mass, especially in the presence of inflammation (40).

Skin health

Olive polyphenols, being free radical scavengers, contribute positively towards skin health by preventing the oxidative damage linked with the formation of wrinkles and other such disorders such as skin dryness and hyperproliferation.

The antioxidant and antimicrobial activity of some of the most typical biophenols contained in table olives is revealed through biomimetic experiment on the scavenging effect of chain-propagating lipid peroxyl radicals within membranes, and for human skin protection (42).

Conclusion

Olive and its products have become even more valuable since their health benefits have come under light. Consumption of table olives is important from a nutritional point of view due to their contribution of essential fatty acids and mineral substances, phenolic content, protein and dietary fibre to the body. There are reports of various health benefits of consuming table olives such as prevention of coronary heart disease, some cancertypes, and inflammation, due to its highly monounsaturated fatty acid profile and phenolics content. It has been claimed that consuming 5–10 table olives a day might cover the daily intake of polyphenols. Table olives are an important component in the dietary habits of Turkish people. By being consumed at breakfast, not only like an aperitif, as in Turkey and Greece, table olives can be a basic food of the other Mediterranean Countries' diets.

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