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OLIVE TREE WITH FRUIT, LEAVES, SEEDS *(OLEA EUROPAEA)*

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ABSTRACT: The olive tree is a plant that has a very wide value among cultures. Olives are very popular not only in the production of olive oil, but also in direct consumption. Furthermore, the olive tree is traditionally considered a symbol of peace, fertility and resilience, which gives it a cultural significance. The olive tree is not only important from a food and cultural point of view; It is also of great medicinal value. Various components of the olive plant have been linked to various health benefits in traditional medicine and modern research. Olive leaves, in particular, contain important components such as polyphenols, flavonoids and oleuropein. Oleuropein has antioxidant and anti-inflammatory properties and may support the immune system. Oleuropein's antimicrobial property may also play a role in fighting infections. Extracts from the leaves of the olive tree have also shown potential in some research on their anticancer effects.The aim of this study is to discuss every aspect of the olive tree in detail and to highlight the potential of olive trees, their fruit, leaf and seed, which are a part of our daily life, on our health.

KEYWORDS: Olive, oleuropein, olive leaf

I. INTRODUCTION

Olive (*Olea europaea*) is a tree belonging to the Oleaceae family and belongs to the same family as plants such as lilac and jasmine [1]. The name of the olive derives from the Greek words "elaia" and the Latin words "olea" and "olivum", and has spread to other European languages as "olivum" [2]. Olives are grown in many parts of the world today, but the Mediterranean region still serves as the main center of olive cultivation in the world. About 98% of olive cultivation is done in the Mediterranean region [3]. Olives are also the raw material of olive oil and are commercially important as an important source of olive oil in the Mediterranean region [4]. In addition, olives, whose fruits, wood and leaves can be used in many areas, are also considered as an important source of economic income for commercially cultivated countries [5]. It is known that the olive tree grows in the Mediterranean, Aegean, Marmara and Southeastern Anatolia regions in Turkey, and that olives and olive oil have an economic value in terms of trade and have an important position in Turkish cuisine. The longevity of the olive tree, the fact that it does not shed its leaves in winter and its sturdy, woody trunk have attracted people's attention in every period [6]. According to a legend, the olive, which is also frequently mentioned in the holy books, marked the end of the flood when the dove returning to Noah's ark brought an olive branch in its mouth, and since the time of the flood, the olive branch has been seen as a symbol of peace [7]. The olive tree and olive oil occupy an important place in people's daily lives today and are used as a product that transcends borders [8]. Olives are also used in areas such as cosmetics, pharmaceutical industry and animal nutrition. It is known that the olive leaf was first used as a medicine in Ancient Egypt. The health benefits of the olive tree, which has been cultivated over the years, have been further elucidated by recent research [9].

The Spread of the Olive Tree in the Historical Process : Although the history of the olive tree is not known exactly, it is known that it dates back to ancient times. The oldest known remains of olive trees are the olive leaf fossil, which is thought to be about 39,000 years old, unearthed during archaeological excavations on the island of Santorini on the Aegean Sea. In the archaeological excavations carried out in the Sahara region in Africa, the remains of an olive tree dating back to 12,000 BC were found. As a result of research on historical sources, it has been learned that the olive tree was first grafted in the Mediterranean regions and was grown to obtain olive oil from an average of 4,000 BC [10]. The word olive was first encountered in written texts around 3000 BC; It is known that its visual form was found on the walls of the Palace of Knossos on the island of Crete at the same time [11]. It is known that the cultivation and use of olives first took place in the countries on the Mediterranean coast. In our country, olive cultivation has been carried out since ancient times [12]. There are archaeological finds showing that olive cultivation became widespread in the Mediterranean during the Bronze Age and later periods.

The olive trade and culture began primarily with the Phoenicians' trade in olives and olive oil and later spread throughout the Mediterranean through the trade of olive tree seedlings [13]. The olive has been seen as a symbol of peace, fertility, victory, and holiness for many societies throughout history, and in ancient civilizations, olives were considered a gift from the gods to humanity. It has also been a symbol of the continuity of humanity for different cultures and religions [14].Today, with the discovery of America in its geography, olive agriculture has spread beyond the borders of the Mediterranean and has been carried first to the West Indies and then to the American continent. Olive oil was first brought to the American continent by the Spaniards, and then olive seedlings spread [15]. In the 1560s, olive trees began to be cultivated in Mexico, and later it is known that olives were also grown in regions such as Peru, California, Chile and Argentina [16].

Olive Production in the World and in Turkey: 97 percent of olive production in the world is made in Mediterranean countries. 98.1 percent of olive oil production and 87.7 percent of olive oil consumption in the world are made in Mediterranean countries. Mediterranean countries account for 90-95 percent of the total world crop yield [15]. According to FAO (2021) data, there is a 5% increase in the number of olive groves all over the world between 2012 and 2021. It is also noted that the graph of increase in the number of olive grove areas continues. When the olive groves of the countries are compared, it can be said that Spain is in the leading position, followed by Tunisia, Italy, Morocco, Turkey, Greece and Syria, respectively (Figure 1).

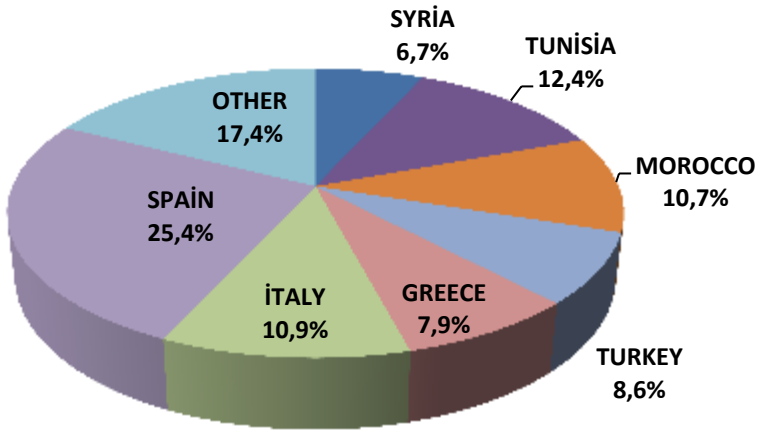

Figure 1. Distribution of world olive groves by country (FAO 2021)

In Turkey, olives have played an important role throughout history and have been an integral part of our cultural fabric. With both its fruit consumed as food and olive oil production, olives are one of the leading agricultural and economic products in Turkey. Turkey occupies an important position in olive production worldwide. In particular, the support and budgeting efforts carried out between 2005 and 2013 played an important role in increasing the presence of olive trees. As a result of these efforts, a significant increase in the number of olive trees has been observed throughout Turkey, reaching approximately 180 million [17].

Use of Olives in Traditional Medicine : It is known that olive tree parts and olive oil are used with different methods for therapeutic purposes among the people all over the world today. For example, olive leaf is used in the digestive, kidney and urinary tracts in France; Cardiovascular in Germany; It is known to be used in Slovenia for high blood pressure and urinary difficulties. In East Africa, the infusion prepared from the bark of the olive tree is left overnight and then taken orally for tapeworm infection . Olive oil is also known to be applied externally as an emollient and epithelial restorer for ingrown nails . Olive tree leaf is widely used in Mediterranean folk medicine as a common remedy for gout. Olive tree leaves are used in Tunisian folk medicine as a remedy for many inflammations and bacterial infections, such as gingivitis, jaundice and cough. Olive tree fruits and leaves are used in the treatment of hemorrhoids and rheumatism, as vasodilators in vascular disorders. The boiled extract of the leaves is used in Morocco to treat hypertension and diabetes. Olive oil is mixed with lemon juice to treat gallstones. A decoctionary extract or infusion of fruits and leaves is used to treat diabetes. In the Canary Islands, the infusion prepared from olive leaves is taken orally hypotensively, while for hemorrhoids it is administered through the rectum . In many countries, the fruits and leaves of the olive tree are used to treat diabetes and hypertension. It is also known that olives and olive oil have been used for many years

among the people to treat various wounds, reduce burn pains and ensure rapid healing of wounds, as well as to relieve abdominal pain, digestive system problems and various ailments in babies [18].

II. OLIVE TREE (OLEA EUROPAEA)

Olive tree botanical study : *Olea europaea* (Figure 2) is a tree belonging to the Oleaceae family in the plant kingdom, known as olive, famous for its fruit, and is an example of about 20-25 genera in its family (Table 1). Olive trees, due to their structure, belong to tropical and warm temperate regions of the world [4].

Tablo 1. *Olea europaea* taxonomy

Kingdom:	**Plantae (Plants)**
Phylum:	Magnoliophyta (Angiosperms)
Class:	Magnoliopsida (Dicotyledons)
Order:	Lamiales
Family:	Oleaceae (Olive family)
Genus:	Olea
Species:	*Olea europaea*
Subspecies	*Description*
Olea europaea subsp. europaea	Common olive, cultivated variety.
Olea europaea subsp. cuspidata	Wild olive, grows naturally in the wild.

Olive trees are usually a tree or shrub with a thick trunk that can grow up to 10 m tall. With sessile leaves, lanceolate or obovate in shape, dark green tops and silvery-gray underparts, this tree has fragrant white flowers 3-4 mm long. The fruit is round or oblong-shaped, black when ripe, brownish-green, or rarely ivory-white in color [19].

Figure 2. Olive trees (*The European Union*) (wikipedia.org/wiki/Zeytin)

It can be produced from seeds or steel. The mode of production does not have much effect on the root system. Its roots are not very deep and generally show an olive fringe root structure. In shallow soils with a heavy constitution and where the bedrock is close to the surface, the roots cannot go very deep. The place where the olive roots are densest is between 25-60 cm [20]. The olive tree is dependent on the wind for self-pollination or cross-pollination, it is a monoecious plant. [21]. The thermophilic properties of mesomorphic leaves suggest that the daily water potential changes due to rapid changes in leaf turgor. Trees can protect themselves from drought by closing their stomata during hot daylight hours, effectively reducing water loss [22].

Olive fruit : The olive fruit is an elliptical-shaped fruit with weights ranging from 2-12 grams. Anatomically, it is made up of three parts: the epicarp, which is the outer shell, the mesocarp, which is the fleshy part, and the endocarp, which contains the nucleus (Figure 3) [23].

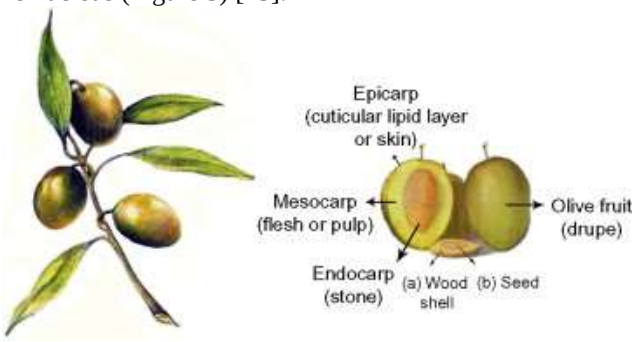

Figure 3. Olive fruit cross-section www.sciencedirect.com/topics/nursing-and-health-professions/oleum

The epicarp makes up 1-3% of the olive and has a structure that protects the fruit and is covered with a waxy layer. In the ripening process, the bark starts from bright green and turns pale green, yellow, purple-pink and finally black. Epicarp is especially important in the production of table olives because it prevents water ingress and protects the fruit from various damages. The mesocarp is the edible part of the olive along with the skin and makes up 70-80% of the total fruit weight. This part has a structure in which components containing water and oil are stored. Green olives usually contain 70-75% water, while the oil content of black olives ranges from 14-15% to 30%. The endocarp makes up 18-22% of the olive, and the seed inside the kernel represents 2-4% by weight. This portion contains 22–27% fat [23].

The fruits usually reach their normal size at the end of August, while from September the oil begins to be collected. Fruit color changes to yellow in October, oil collection reaches its maximum in November, and fruits turn black in December [34]. Olives, unlike other fruits, contain oleuropein, which gives the fruit a bitter taste. Oil is obtained from the flesh and seeds of olives, and the amount of oil increases until a certain time. The optimal harvest time is when the bark changes from green to purple [24]. The chemical composition of the olive fruit **(Table 2)** often depends on genetic factors, with many factors such as ripening index, climatic conditions and agricultural practices having an impact on the composition. The mesocarp layer makes up 70-80% of the olive and contains lipids, sugars, fiber, protein, organic acids, salts, phenolic compounds, pectin, and various other components.

Table 2. Components of olive fruit mesocarp

COMPONENTS %	
Humidity 60-75	
Lipidler	10-25
Reducing Sugar 3-6	
Non-Reducing Sugar ≤0.3	
Mannitol	0,5-1,0
Crude Fiber 1-4	
Protein 1-2	
Ash ≤1.0	
Organic Acids and Salts 0.5-1.0	
Phenolic Compounds 2-3	
Pectin Compounds ≤0,6	
Other components 3-7	

Olive leaf : Olive tree leaves (Figure 4) are evergreen in color, so they exhibit a green appearance in all seasons. When the leaves fall, they are immediately replaced by new ones, thus ensuring a continuous greenery. In young

trees, the leaves are usually small and dark green in color; Their upper part is light green, while their lower part can take on a matte tint. The shape and size of the leaves can vary depending on the olive variety. The leaves are usually sessile [25]. Under normal conditions, the leaves live approximately between 18 and 30 months, except for factors such as disease or extreme heat/cold. The olive leaves are thick, leathery and arranged opposite around the stem. During the pruning of the olive tree, approximately 25 kg of leaves accumulate from each tree, and these leaves are used in a significant amount in the olive oil industry [26].

Figure 4. Olive tree leaves

The leaves of the olive tree reflect the health status of the plant well. Diseases usually affect the leaves first, and therefore changes in the leaves can be signs of the disease. Photosynthesis is done by the intake of light, which affects the development of leaves. It has been observed that olives develop better on branches exposed to light. The rate of photosynthesis of leaves that do not receive direct light slows down. Furthermore, in extreme temperatures or colds, the photosynthesis of leaves can change suddenly, causing the olive fruit to be rapidly affected by weather conditions [24].

The chemical composition of olive leaves and branches varies depending on many factors, including various factors such as variety, pruning time, tree age, etc. The leaves have a highly variable dry matter content. Fiber (lignin, hemicellulose, and cellulose) accounts for 33–56% of the total dry weight, crude protein 6–13%, and fat 4–11% [27]. Phenolic and triterpenic compounds can reach 6.5% and 4.6%, respectively. The most commonly known phenolic compounds include oleuropein, verbascoside, hydroxytyrosol, apigenin 7-glucoside, and luteolin 7-glucoside [28].

Olive pit : While the seed constitutes approximately 18-22% of the fruit, the weight of the seed in the inner part constitutes 2-4% of the fruit and contains a high percentage of oil. The weight, size and easily separable of the kernel from the flesh is one of the important factors in determining the quality of the olive. Olive pits have a structure that mainly contains hemicellulose, cellulose and lignin. Kernel oils are rich in fatty acids such as omega-3 and omega-6. In addition, the amount of protein in the kernel is higher than the amount of protein in other parts of the olive. Kernel oil is used in the food, pharmaceutical and cosmetic industries, as well as in the production of the whole kernel and the seeds, resins, plastic fillers it contains, has various industrial applications [29].

III. OLIVE TREE GROWING CONDITIONS

Soil : The most suitable soil structure for olive groves is generally loamy, clayey-loam, slightly calcareous and gravelly. The depth of the soil should be at least 1.5-2 meters, and it should be rich in organic matter and nutrients. In addition, there should be no salinity problems, the water holding capacity should be high, and the pH value should be in the range of 6-8 [5].

Altitude and direction : Places with an altitude higher than 800 meters are not suitable for olive cultivation. Since the olive tree is a heat-loving plant, southern slopes should be preferred in very cold regions [5].

Precipitation : The annual rainfall for olive cultivation should generally be between 700-850 mm. Rainfall, especially in winter and spring, is important for good flowering and fruiting [30]. Generally, if high rainfall or summer irrigation is provided in temperate regions, large trees with long trunks and strong vegetative parts grow [31]. If the lack of water occurs during the shoot growth period, shoot development is reduced, and if it occurs during fruit formation, olive yields may also decrease [32].

Climate : Due to their location in the Mediterranean basin, the olive groves have adapted well to subtropical climatic conditions with long and dry summers [33]. Annual and monthly average temperature levels are important for olive trees to grow and bloom. In addition, cool periods are needed for the formation of flower buds [34].To provide an optimal temperature environment for olive growing, the average annual temperature in olive growing regions should generally not be below 14.5°C. For this reason, the coastal regions of Southern Marmara, the Aegean region, the Mediterranean coast and the western parts of Southeastern Anatolia have been recognized as the most suitable regions for olive cultivation. The texture of olive trees often dies below -5°C, and at lower temperatures, leaves, branches, shoots and trunks are damaged [35]. At temperatures below -7°C, leaves fall off and twigs dry out, which can lead to severe yield losses. At temperatures below -10°C, the tree will die completely [36].

Bioactive Compounds in Olive Tree

Table 3. Phenolic compounds found in olives

Flavonoids

Anthocyans	***Sekoiridoitler***	***Flavonoller***
Cyanide-3 glycoside Cyanide-3 ceraffycosis Siyanidin-3-rutinosit Cyanide-3-Cafferutinocyte	Oleuropein Dimetiloleuropein Ligstrosit	Cuercetin-3-rutinocytes
Phenolic acids	***Flavones***	***Phenolic alcohols***
Chlorogenic acid Kaffeik asit p-hydroxybenzoic acid Procatechuic acid Vanillic acid P-Kumarik Asit O-coumaric acid Ferulic acid Sinapik asit Benzoic acid Sinnamik asit asit Gallic acid	Luteolin-7-glycoside Luteoline-5-glycoside Apigenin-7-glycoside	(3,4-dihydroxyphenyl)ethanol (3,4-DUREA) ***Hydroxycinnamic acid derivatives*** Verbascocyte

Olives have a high content of flavonoids and are also highly valued for nutritional applications. Flavonoids provide positive protection against carcinogenic, cardiovascular, and microbial diseases [37]. Typical examples of flavonoids found in olive leaves include luteolin **(Figure 5),** rutin, and luteolin-7-glucoside [38].

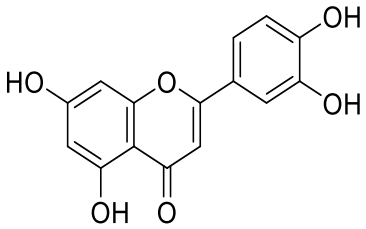

Figure 5. Luteolin

Phenolic alcohols : The phenolic alcohols found in olives are hydroxytyrosol (Figure 6) and tyrosol. These components have antioxidant properties. Hydroxytyrosol is particularly abundant in olive oil and has antioxidant potential [39]. Since it is a precursor to oleuropein, it is responsible for the intense taste and aroma of the oil.

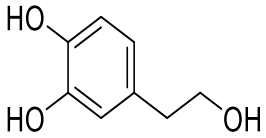

Figure 6. Hydroxytyrosol (wikipedia.org/wiki/Hydroxytyrosol)

The hydroxytyrosol in olive oil can be found in free form, in acetate form, or as part of more complex compounds such as oleasain, oleuropein, and verbascoside [40]. Oleuropein converts to the oleuropein aglycon form by enzymatic hydrolysis and eventually converts to hydroxytyrosol, which is an indicator of the ripening of olives [41].

Phenolic acids : Studies have shown that olive tree fruits and leaves contain chlorogenic acid (Figure 7), caffeic acid (Figure 8), p-hydroxybenzoic acid, protocateic acid, vanillic acid, homovanillic acid, sinapic acid, p-coumaric acid, o-coumaric acid, benzoic acid, cinnamic acid, and gallic acid [42].

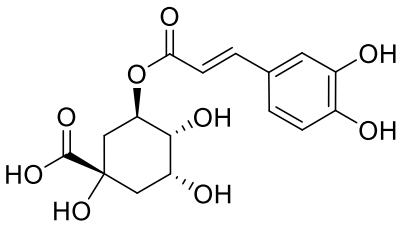

Figure 7. Chlorogenic acid

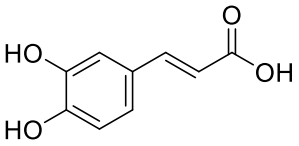

Figure 8. Caffeic acid

Secoiridoids : The most abundant secoiridoid glycosides in olives are oleuropein, demethyloleuropein, ligstroside [43]. These are also precursor compounds of many alkaloids. The best known compounds of this class are oleuropine and ligstroside. Secoiridoids inhibit autoxidation and photooxidation of fat [44].

Oleuropein : Oleuropein (Figure 9) can be found in the Oleaceae, Gentianaceae, and Cornaleae families and other plant species,[45] however, it is most abundantly found in the olive tree, and oleuropein, the main phenolic component of the olive tree, can be found in high amounts in olive oil, fruit, seeds, and leaves [46]. Studies show that the amount of oleuropein in olive oil generally varies between 0.005% and 2%, 0.87% in the case of waste generated during olive oil production, and between 1% and 14% in olive leaves [47].With the ripening of the olive fruit, there is a decrease in the content of oleuropein. The development of the olive fruit usually takes place in three stages: growth, green ripening and black ripening [48]. With maturation, oleuropein, oleuropein aglycon form and glucose are formed [49] The oleuropein aglycon form can also be broken down into hydroxytyrosol and elenoic acid by exposure to esterase [50]. Although all of these phenolic compounds are present in olive oil, the basic form is oleuropein aglycone [51].

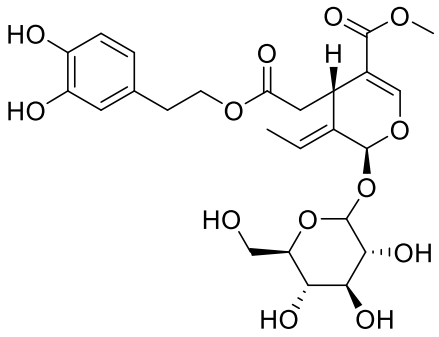

Figure 9. Oleuropein

Oleuropein exhibits a variety of biological and pharmacological properties, including antioxidant, anti-inflammatory, antimicrobial, and anticancer [52]. Due to the association of olive oil and olive products with the Mediterranean diet and the healthy lives of people in that region, olives are considered to be an alternative to COVID-19 as a preventative [53]. Therefore, it has been suggested that oleuropein may have a strong potential in combating and slowing down the symptoms of the disease [54].

Tocopherols : Tocopherols are antioxidant compounds found in the structure of olives and their oil. The tocopherol found in the highest amount in olives is alpha tocopherol, which is the most active form of vitamin E **(Figure 10)** [55]. Alpha-tocopherol constitutes 95% of the tocopherol composition, and β-tocopherol and γ-tocopherol constitute the remaining 5% [56].

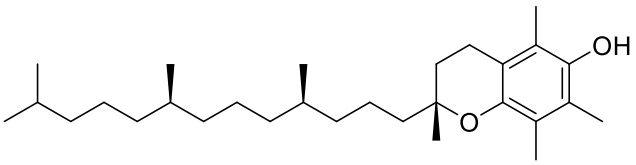

Figure 10. Alpha-tocopherol

Triterpenoids : Maslinic acid and oleanolic acid, the main triterpenic acids of the olive plant, have important activities in terms of health. The extract from the olive fruit contains 73.25% maslinic acid and 25.75% oleanolic acid [57].

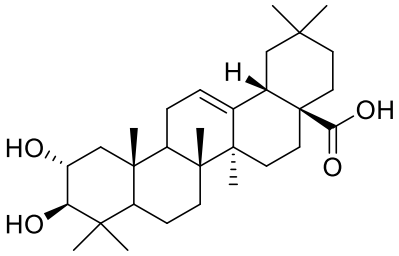

Figure 11. Maslinic acid

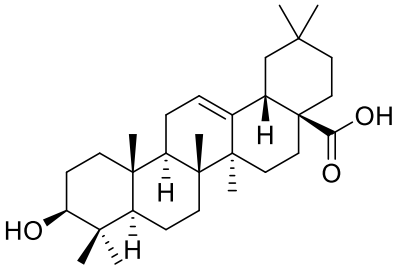

Figure 12. Oleanolic acid

As a result of a study, *maslinic acid* (Figure 11), oleanolic acid (Figure 12), erythrodiol β-amyrin and sitosterol were isolated from the leaf of the Olea europaea plant, and maslinic acid and oleanolic acid were isolated from the bark of the fresh fruits [58]. Maslinic acid is known to have important effects such as anti-inflammatory, antimicrobial, antioxidant, antiviral, antitumoral. Likewise, oleanolic acid, a triterpenoid compound that is biologically active, is often found in the epicuticular wax, which prevents plants from losing water and is a defensive barrier against pathogens [59].

Hydrocarbons and sterols : Hydrocarbons are one of the minor groups of compounds in olives and olive oil. The most prominent hydrocarbon is a triterpene called squalene, and it is an intermediate product of the cholesterol biosynthesis pathway. Furthermore, another hydrocarbon found in very small amounts in olives and

olive oil is β-carotene [60]. Sterols are important components of the cell membrane. The phytosterols found in olives and olive oil are beta-sitosterol, stigmasterol, and campesterol [61].

Fatty acids : *In a study conducted on the leaves of Olea europaea*, it was determined that the leaves contain saturated fatty acids, palmitic acid, stearic acid (Figure 13), lignoseric acid, and unsaturated fatty acids linolenic acid, linoleic acid, oleic acid (Figure 14), palmitoleic acid, and small amounts of arachidonic acid and docosatteneroic acid [62].

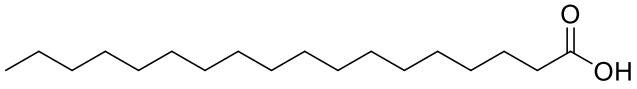

Figure 13. Stearic acid

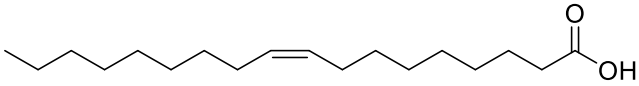

Figure 14. Oleic acid

Biological Activities of the Olive Plant (*Olea europaea*)

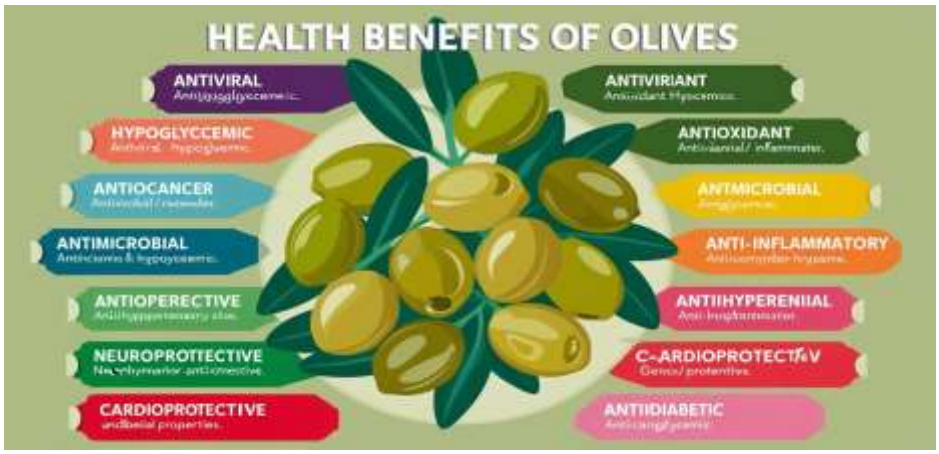

Figure 15. Biological activities of the olive plant

Antioxidant activity : Antioxidants are compounds that delay or inhibit oxidation. Oleuropein exerts an antioxidant effect by reducing the oxidation of LDL cholesterol. Oxidized LDL is the most harmful form of cholesterol and can damage blood vessels. Many studies on animals show that oleuropein has a strong antioxidant effect. In a study in which the antioxidant properties of fifty-five medicinal plants were examined, it was determined that olive leaf extract had the highest antioxidant effect [63]. Olive leaf extract has been reported to reduce oxidative stress by increasing the activity of antioxidant enzymes in diabetic mice [64]. In another study, it was reported that the DPPH IC50 value, which is one of the indicators of the antioxidant capacity of olive leaf extract, was more effective in extracting water than ethanolic extraction [65].Oleuropein is the olive's essential secoiridoid compound and has powerful antioxidant properties. Different antioxidant activities of phenolic compounds in leaf extracts were examined and it was determined that flavonols, flavan-3-ols and flavonoids with catechol structure were the phenolic compounds with the most effective antioxidant effect. It was also revealed in another study that olive leaf or extract mixed with olive oil provides resistance to oxidative degradation, and this effect depends on the phenolic content in the leaves and extract [66].

Antidibetic activity : *The use of olea europaea* in alternative medicine in the treatment of diabetes has been confirmed in a number of experimental studies. The plant has also been involved in the treatment of diabetes in traditional medicine. Some researchers have suggested that antidiabetic patients can be treated with good antioxidants, with the idea that antioxidants will lower blood glucose levels by reducing oxidative stress. In this regard, hypoglycemic alloxane-diabetic rabbits were treated to reduce their oxidative stress with oleuropein, a powerful antioxidant abundant in olive leaves and fruit. Diabetic rabbits were treated with oleuropein for up to 16 weeks. Following treatment, blood glucose levels and most antioxidants were observed to be close to the levels of normal control rabbits. This study proved the antidiabetic and antioxidative effects of oleuropein [67].

The hypoglycemic effect of ethanolic and petroleum ether extracts of olive leaves has been investigated in alloxane-induced diabetic mice. Metformin was used as standard. Ethanolic extract has been observed to significantly reduce serum glucose compared to the standard. Petroleumether extract, on the other hand, has been determined to have no antidiabetic effect (68). On the other hand, leaf extract has also been found to markedly impair glucose tolerance and correct hyperglycemia in type 2 diabetic obese mice [69]. In diabetic rats induced for four weeks on a diet rich in streptozotocin and fat, the hypoglycemic efficacy of 200 and 400 mg/kg doses of ethanol extract of leaves was studied on metabolic markers. Ethanol extract of the leaves has been observed to cause a significant reduction in body weight, correct glucose levels, and reduce inflammatory and metabolic markers [70].

Antimicrobial activity : Microbial foodborne diseases are a major public health concern, causing many health problems, preventable deaths, and increased economic burden. Every year, at least two billion people around the world are affected by microbial foodborne diseases. For this reason, these diseases are considered one of the biggest public health problems in the world. According to the World Health Organization, there are 5000 deaths from microbial-borne diseases every year in Europe [71]. Oleuropein, as a natural antimicrobial compound, slows down the growth rate of microorganisms and inhibits their development. In Topuz and Bayram's study, oleuropein was isolated from the leaves of different olive varieties and its antioxidant and antibacterial properties were evaluated. S. aureus was the most sensitive bacteria to oleuropein extracts, while Escherichia coli O157:H7 was the most resistant. Data from this research suggest that oleuropein, thanks to its proven antioxidant and antibacterial activity, could potentially increase the shelf life of food products [72].

Anti-flammatuar activity : Inflammation is the response of living tissues to injury. The main objective of this response is to protect the organism from toxins that cause cellular damage and to clear the necrotic cell and tissue residues formed as a result of injury [73]. In rats, olive leaf extract treatment after paw inflammation and edema triggered by intraplantar injection of carrage was observed to reduce inflammation in a statistically significant manner. In the same study, it was stated that olive leaf extract reduced TNF-α in a dose-dependent manner against increased interleukin-1 and Tumor Necrosis Factor-α concentrations in increased carrageen-induced inflammation [74]. Hydroxytyrosol purified from olive leaf has been indicated to have the ability to reduce inflammation in vitro through inhibition of pro-inflammatory cytokines [75]. On the other hand, olive leaf extract treatment was found to significantly inhibit the secretion of TNF-α from Polymorphous Nuclear Cells depending on the concentration after lipopolysaccharide stimulation [75]. In the study by Sahranavard and his team, investigating the anti-inflammatory activity of oil-free extracts of the olive fruit, aqueous and methanolic extracts were shown to reduce pain in the second phase of the formalin test [76].

Anti- cancer activity : Cancer is one of the leading causes of death worldwide. Recent epidemiological studies suggest that olive oil may play an important role in fighting cancer. Studies conducted in countries such as Greece, Italy and Spain, which are especially in the Mediterranean region, have revealed that there is a relationship between olive oil consumption and the risk of developing cancer. It has been reported to have a protective effect against many types of cancer [77]. In one study, olive leaf extract was found to exert an antiproliferation effect on leukemia cells [78]. Furthermore, raw olive leaf extract with rich oleuropein content has been shown to inhibit the proliferation of breast and bladder cancer cells [79]. In one of the most recent studies, certain concentrations of oleuropein were exposed to breast cancer cells. It has been observed that cell apoptosis is induced at the concentration of IC50 found after 48 hours and oleuropein at the same concentration also shows a strong antioxidant effect. These findings from scientific studies suggest that oleuropein can be used as a potential chemotherapeutic agent for the treatment of many cancers [80].A study has shown the selective cytotoxic effects of olive leaf extracts on hepatocellular cancer. Olive leaf extracts triggered cell death in cancer cells and reduced their ability to multiply. These findings highlight the potential of olive leaf extracts in the prevention of liver cancer [81]. Furthermore, in a study examining the anticancer activity of pectins from olives on bladder cancer, extracts with high polyphenol content and pectin-rich polysaccharides were observed to induce significant cancer cell death in four human bladder cancer cell lines [82].

One study examined the anticancer effect of oleuropein on colon cancer. The results showed that exposure to oleuropein in colon cancer cell lines provided significant inhibition depending on dose and duration. Likewise , in HT29 and SW480 human colon adenocarcinoma cell lines, it has been observed that oleuropein stops the proliferation of cancer cells and initiates cell death. In the HT29 cell line, exposure to oleuropein has been shown to inhibit cell proliferation as well as trigger cell death by increasing the activity of the p53 gene [83].

Antihypertensive activity : Hypertension is one of the most common causes of cardiovascular diseases, especially myocardial infarction and stroke. Today, many hypertension patients use antihypertensive drugs to achieve normal blood pressure levels. However, due to factors such as the side effects and cost of medications, it is important to investigate natural and herbal alternatives [84].

In a study, the effect of olive leaf extract on blood pressure at daily doses of 500 mg and 1000 mg was examined in trials on identical twins. The results showed that the group that received high-dose olive leaf extract had a significant decrease in average blood pressure [85]

Cardioprotective activity : The active ingredients in olive leaf are known to have hypocholesterolemic and antihypertensive effects as well as cardioprotective effects. These positive effects are often associated with the effects of polyphenolic compounds in olive leaves, such as reducing oxidative stress and regulating tissue inflammation [88]. One study investigated the cardioprotective effects of oleuropein in mice. Oleuropein pretreatment has been observed to be protective against myocardial infarction and prevent the onset of heart failure [89]. In a study to reduce the cardiotoxic effects of an antineoplastic drug called Doxurubicin (DXR), oleuropein was found to exert a protective effect against the cardiotoxic effects induced by Doxurubicin [90].

Antitrombotic activity : Thromboembolic diseases are among the leading causes of death worldwide, and hence there is a need for effective treatments [91]. An anti-platelet effect study on rabbits revealed the following results: no significant effect on clotting time was observed in rabbits who received low-dose oleuropein treatment for 8 weeks. However, when a higher dose was given, the antiplatelet effect became more pronounced. This result may be due to the fact that Oleuropein's antiplatelet effect alters the exogenous coagulation system, but does not alter its endogenous system [92].

Gastroprotetive activity : A study was conducted to check the effect of olive leaf extract on the gastric defense system. Olive leaf extract was administered at doses of 40, 80 and 120 mg/kg, while the reference drug ranitidine was given intragastric at a dose of 50 mg/kg in a positive control. The protective effect of both the extract and ranitidine was similar, and as a result, olives were found to have significant gastroprotective activity. It has been suggested that the activity may be due to the antioxidants in its composition [93].

Anti-obesity activity: The anti-obesity effects of olive leaf extract have been investigated on a high-fat dietary pattern in mice. The extract was shown to significantly reduce food use efficiency, weight gain, visceral fat accumulation, and serum lipid composition in mice on a high-fat diet. In mice treated with the extract, the activity of the body's markers of heat generation and fat cell formation was reduced. [94].

IV. CONCLUSION

The olive tree *(Olea europaea*) is a plant that is widely spread in the world and cultivated in many countries where the Mediterranean climate is dominant. The importance of the olive tree manifests itself in many areas such as agriculture, food, culture, health and environmental sustainability. It is a plant that has attracted the attention of researchers due to its different uses and especially its health benefits. As a result of phytochemical research carried out on Olea europaea, many classes of components such as secoiridoids, lignans, biophenols, flavonoids, flavone glycosides and terpenoids have been found in different parts of the plant, the most common and noteworthy compounds are oleuropein, maslinic acid, oleonolic acid. These chemical compounds are responsible for many beneficial effects for human health. *As a result of studies conducted on the Olea europaea* plant, it has been determined that the plant and its important components have antidiabetic, anticancer, antimicrobial, antifungal, antiviral, antioxidant, antihypertensive, gastroprotective, anti-inflammatory, antinoceptive, neuroprotective and cardioprotective activities. Most mentioned pharmacological studies are aimed at confirming their traditional use. Some of its traditional uses, (especially antioxidant, antidiabetic, anticancer, etc.), have been extensively explored by several researchers. The health potential of *Olea europaea can* be taken to a further stage with research and experimentation to be used as a treatment for many diseases in the future, allowing its clinical use in modern medicine, new drug formulations can be developed. In addition, considering all these therapeutic effects, it is possible to say that the use of olives in daily nutrition is also very beneficial to health.

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