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Chemical Components and Antioxidant Properties for Olive Oil: Review Article

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ABSTRACT

Olive oil has been considered as one of the healthiest ingredients in Mediterranean nations' nutritional regime. Because olive oils include phenolic compounds, which were shown to have several recognized health benefits, they are regarded as nutritious. Numerous latest studies have revealed the anti-inflammatory actions related to phenolic compounds. The statement of olive oil use as well as its potential health benefits—particularly in reducing diabetes mellitus, breast cancer, and cardiovascular diseases—is supported by the cumulative data. Hydroxytyrosol and oleuropein are two examples of phenolic compounds that can be found in extra virgin olive oil, responsible for this oil's unique stability and flavor. Studies that have been carried out in-vivo as well as in-vitro show that the phenolics that are found in olive oil are potent anti-oxidants. They display a number of other significant biological activities which, to a certain extent, support an individual's promotion of health.

Keywords- Functional foods, Antioxidant, Olive oil, Natural food additives, Phenolic compounds.

I. INTRODUCTION

The olive tree (Olea europea L.) can be defined as crucial and traditional crop in Mediterranean nations, with a long history that has resulted in significant genetic variability. Using EST-SNP markers, the World Olive Germplasm Bank in Córdoba, Spain, has revealed 668 distinct genotypes of 1273 accessions from 29 nations (Belaj et al., 2022). To prevent adulteration with lower-quality or more expensive animal fats or vegetable oils, an olive oil's distinctive fatty acid as well as sterol composition serves as a basis for its fingerprint and authenticity (EU, 2022). The geographical traceability regarding olive oils could be significantly impacted by variations in their composition caused by such or other variables. Geographic origin is inextricably linked to a region's climate, cultural agronomic methods, and soil types. When it comes to oils that are protected by designations of origin (PDOs) that have a positive impact on rural and local economies, geographic origin is a crucial economic consideration.

A significant portion of the population's wellness and health systems have historically depended heavily on nutrition as well as natural products made from medicinal plants. Apart from allopathy, alternative medicine has played a significant role in the global healthcare industry (Al-Atar *etal*., 2017). In spite of the availability of modern hospitals and skilled medical personnel, local Arab population still relies on traditional herbal remedies for treating a variety of the chronic diseases and routine issues, like rheumatism, bone fracture, skin-related ailments, asthma, diabetes, urological diseases, stomach problems, constipation, colds, respiratory tract infections, ENT (ear, nose, and throat) problems, fever and cough, measles, typhoid, hepatic and spleen illnesses, toothache, epilepsy, anemia, tuberculosis, disorders of the nervous system, hypertension, scorpion stings, and snake bites along with a number of other tropical illnesses, which include rift valley fever, leishmaniasis, schistosomiasis, and malaria (Al-Assmari *etal*., 2020).. Because of the financial and health-promoting qualities of oil that has been extracted from its fruit, the olive tree can be considered as one of the most important trees on

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Earth. The Mediterranean basin is where the olive tree originated because of the climate there; today, the region produces 75% of the world's olive oil. The top producers are Greece, Turkey, Spain, Italy, Syria, and Morocco, (Fraihat et al., 2017). Extra virgin olive oil has high content of lipids, which helps in the prevention of development of secondary and primary cardiovascular diseases (CVD). It enhances lipid profile and insulin sensitivity. Furthermore, olive oil lowers blood pressure in the arterial system, enhances inflammatory biomarkers, and boosts oxidative stability (Covas *etal*., 2015). Olive oil has a low percentage of saturated fatty acids (SFAs) as well as high concentration of mono-unsaturated fatty acids (MUFAs), especially oleic acid (Sumpio & Huang, 2008). Within fatty acids that are found in olive oil, oleic acid makes up a large portion (55–83%), succeeded by polyunsaturated fatty acids (4–20%) and 8–14% SFAs. Additionally, it includes 1% to 2% of minor compounds with eminent biological qualities, such as sterol, phenolic, tocopherols, triterpenes, and pigments (Covas et al., 2015).

II. OLIVE OIL

Olive oils are utilized as a fundamental component in the dietary habits of Mediterranean nations since they are highly useful in preventing many diseases (fig 1). Oleic acid is the primary fatty acid in olive oil, and MUFAs make up the majority of its nutritional content. Additionally, it contains a few trace amounts of compounds that have strong antioxidant properties, like hydroxytyrosol (Marcelino et al., 2019). According to religious texts including the Bible, the holy Quran, and Homer's writings, olive oil was primarily utilized for spiritual and religious purposes over 2000 years ago (Belarbi et al., 2011). Although there are several varieties of olive oil available, "extra virgin olive oil" is the kind that is traded the most globally. Antioxidant and anti-inflammatory properties of olive oil, which aid in preventing numerous human illnesses, are what have led to its rising popularity (Mays et al., 2018).

Fig 1: Olive oil (Oliveras-Lopez *etal*., 2007)

Virgin Olive Oil

Only the preparatory processes—washing, decantation, centrifugation, and filtration—are used for obtaining extra virgin olive oil; mechanical pressing of the olives is the last stage. Through preserving its minor components during the extraction process, such extra virgin olive oil technology helps to minimize oxidative damage to the oil. Furthermore, in the case when ingested, it enhances health (Deiana et al., 2018). According to Tarhan *etal*. (2017), it has a low acidity index, a high nutritional content, a free fatty acid level of less than 0.80%, and outstanding sensory qualities. Oleic acid (55-83%) makes up the majority of lipid content in extra virgin olive oil, with linoleic and α-linolenic acids coming in second and third, respectively, and stearic and palmitic acids (SFA) coming in last. The local growing conditions as well as the stage of ripening of the olive determine its lipid content. Cold-climate-harvested fruits contain higher levels of MUFAs (Covas *etal*., 2015).

III. CHEMICAL COMPONENTS OF OLIVE OIL

Extra virgin olive oil is more expensive when compared with other types of olive oil because of its limited yield, but it also has the highest polyphenolic concentration. Extra virgin olive oil contributes a delicate aroma, flavor, and pale color because it contains the fewest FFAs (Al-taee, 2020). Extra polyphenols (high polarity) are eliminated during the filtration process, but water is left behind and maintained in the unfiltered form of olive oil. The amount of technological

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processes involved determines how much polyphenolic content is present in olive oil. Approximately 98–99% of triacylglycerols (TAG) are found in olive oil. Triacylglycerols, often known as triglycerides, are a unique combination of the glycerol esters that are connected to several fatty acids. About 83% of monounsaturated fatty acid that is found in olive oils is oleic acid. Stearic acid, ear acid, linoleic acid, and palmitic acid make up the remaining percentage. Virgin olive oil contains a lot of lipophylic or amphiphilic microconstituents. According to AL-Musawi et al. (2016), some of these include tocopherols, phytosterols, phenolic compounds, squalene, and derivatives of terpenic acids. Olive oil contains phenolic acids, lignans, flavonoids, alcohols, and derivatives of oleuropein. Its mean weight ranges from 50 to 100mg/kg of olive oil, depending on agronomic conditions, extraction technology, olive ripening phases, packaging and storage techniques, and more (Baker and Hozan, 2022). Virgin olive oils offer much higher polyphenol amounts when compared to the refined or processed olive oils because of the flavonoids, proteins, glycosides, and phenols found in olive leaves (Olea europaea). Because glycides (such as oleuropein), phenols and alcohols (like tyrosol and hydroxytyrosol), and flavonoids make up most phenols found in olive oils, olive oil is utilized in pharmaceutical applications (Jamal *etal*., 2021). The presence of phenolic compounds gives virgin olive oil its unique sensory characteristics, such as its bitter taste. Olive oil's phenolic content is mostly determined by extraction process because some of its micro-constituents could dissolve in water (Jamal *etal*., 2021).

Olive oil and its major components

According to Mansour *etal*. (2016), compounds found in olive oil have noteworthy biological activities which vary depending on the cultivar as well as geographical origin. The unsaponifiable fractions that make up olive oil's nutritional composition correlate to its total fatty acid content, mostly represented by MUFAs. Olive oil composition, which is divided to unsaponifiable and soluble fractions, contains small compounds that make up approximately 2% of total composition. As of right now, 200 minor compounds have been found, like the hydrocarbonates, pigments, phytosterols, tocopherols, and numerous other substances (Dieana *etal*., 2018).

Fatty Acids

Olive oils include 98–99% fatty acids, mostly TAG, 7.50-20% palmitic acid, 55-83% oleic acid esters, 0.50–5% stearic acid, and 3.5-21% linoleic acid. In terms of the stereospecificity, triolein makes up roughly 40% of TAG found in olive oil. For less frequent esterifications, however, there are two options. The first is the existence regarding 2 oleic acids at sn-2 and -1 positions as well as a single palmitic acid at the sn3 position. The second hypothesis is the existence of one linoleic acid molecule at sn2 position surrounded by 2 oleic acid molecules (Basel, 2014; Salim et al., 2021).

Oleic Acid

Regarding oleic acid's significance in lowering risks of cardiac diseases, there is ongoing discussion but no clear consensus (Voelker, 2019). It is undeniable that replacing saturated fats with PUFA and MUFA lowers the risk of CVD, although the precise mechanism is unclear. It can be as a result of the dispersion regarding saturated fats or certain biological activities linked to oleic acid. The fact that oleic acid doesn't fall within the group of essential fatty acids is well established. It is synthesized by the human body, and as of yet, there have been no documented clinical symptoms or indications of its lack. But outside of the Mediterranean region, several nations—like the UK and USA—consume oleic acids through poultry and meat (Visioli *etal*., 2018). The fatty acid composition of blood shows that an elevated phospholipid or plasma level in the range of 18:1 is connected with higher heart disease risks. This has been established in human investigations and clinical trials. One well-known example has been provided by Wurtz *etal*. (2015), who have shown that a higher risk of CVD is linked to an elevated concentration of serum MUFA through using metabolomic investigations. Conversely, PUFA exhibits the exact opposite behavior. In conclusion, the benefits of MUFA (such as oleic acid) on cardiometabolics are supported by insufficient data (Voelker, 2019). Since oleic acids could be generated de novo, the main disadvantage of such kind of research is that blood concentrations of roughly 18:1 indicate a deprived condition of ingestion. The source of oleates, whether they are of animal or plant origin, may have a significant impact on health (Zong et al., 2018). However, according to certain researchers (Gilingham et al., 2011), substituting oleic acid for saturated fats lowers both total and low-density lipoprotein cholesterol (LDLc). Additionally, replacing carbs with oleic acid lowers the amount of LDLc and triglycerides. Risks of CVD will be decreased by both of such effects.

Phenolic Compounds

Phenolic compounds that are included in olive oils, particularly extra virgin olive oil, have been linked to several favorable health effects in recent research (Crespo *etal*., 2018). The majority of soluble olive oil fraction is composed of phenolic compounds, which include flavonoids, hydroxytyrosol linked to dialdehydic type of 3,4EDA (elenolic acid), secoiridoids (e.g., oleuropein), phenolic acids, and phenolic alcohols (tyrosol and hydroxytyrosol) (Daowd et al., 2022). Olive oil needs to have its acidity reduced in the case when it is extracted because it is above 0.8%. The concentration regarding minor compounds in olive oil is significantly reduced during the refining process. As a result, two commercial varieties of olive oil are produced: extra virgin olive oil and olive oil (Robles-Almazan *etal*., 2018). Since extra virgin olive oil often contains all the minor compounds, it has unique nutritional and pharmaceutical properties.

Oleuropein

Oleuropein, one of the most prevalent compounds that are biologically active as well as an anti-oxidant, is found in olives. According to Barbero et al. (2014), it is composed of elenolic acid, glucose, and hydroxytyrosol (3, 4di-hydroxyphenyl ethanol). Oleuropein is classified as a hydroxytyrosol ester because it has carbohydrate group that is attached

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to oleosidic compound skeleton. According to certain research, oleuropein concentrations in olive plant fruits could reach as high as 140mg/g of dry weight, while in leaves, they might range from 60-90 mg/g (6 to 9%) (Darshna et al., 2023). According to Rusol and Rayaheen's 2019 research, there is a 19% (w/w) content of oleuropein in olive leaves.

IV. MINOR CONSTITUENTS OF OLIVE OIL

Virgin olive oil contains a number of vitamins, including γ- and α- tocopherol (approximately 200 mg per kilogram), as well as pigments, terpenic acids, phytosterols, polyphenols, flavonoids (like quercetin and luteolin), and specific phenolic compounds (Squalene). The unique color of the oil is attributed to β-carotene and chlorophyll (Salim et al., 2021).

Squalene

Olive oil is regarded as significant dietary source of squalene, with 500–700mg per kilogram being a significant quantity. Given that users of olive oil have been shown to be protected against atherosclerosis, it is important to note that squalene exhibits a substantial inhibitory activity on the enzyme β-hydroxy-β-methylglutaryl-CoA reductase (HMG-CoA reductase). An essential enzyme that aids in the creation regarding cholesterol is HMG-CoA reductase. As a drug, the inhibitors related to such enzyme are effective in lowering blood cholesterol levels. Additionally, they have pleiotropic and antiatherosclerotic properties, such as preventing smooth muscle cell growth (Belosta *etal*., 2000).

Olive Oil Phenols

The amount of the phenols in olive oil varies from 150ppm to 700ppm. Numerous reasons influence this concentration variability. The first consideration is the olive plant variety or cultivar selected; for instance, olives from Coratina cultivar have the highest phenolic content. The second component is maturity level since as olive oil and olives are more mature, their phenolic content usually goes down. The amount of phenolic compounds in olives is also influenced by other variables, which include the stage of production, the climate, and presence of the olive fruit fly, Dacus oleae (Salim et al., 2021). To put it briefly, a yield of premium olive oils with a high phenolic content can be obtained by hand-picking olives at the point in their skin color change from light green to dark brown, transporting them quickly to the mill, crushing and pressing them immediately in a clean plant, and keeping the degree of the temperature no more than 25–30 ºC (Salim *etal*., 2021). Olive oil mostly contains hydroxytyrosol, which is the main component of phenolic compounds.

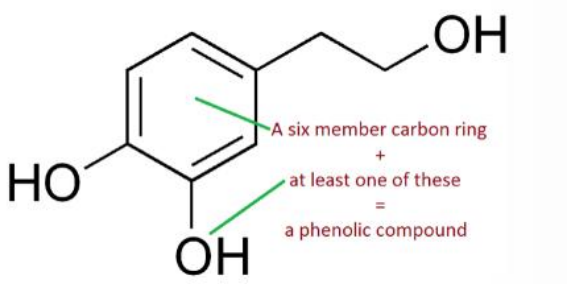

Fig 2: Hydroxytyrosol – An example of phenolic compound that is found in extra virgin olive oil. (Oliveras-López *etal*., 2007)

V. OLIVE OIL'S HEALTH BENEFITS

When olive oil is consumed in its whole, its individual compounds—or synergism—could provide both secondary and primary protection against the development of CVD by raising the concentration regarding HDL-c as well as lowering the concentration of LDL-c. Furthermore, it impacts inflammatory biomarkers, like interleukin-6 and tumor necrosis facto that are thought to be pro-inflammatory substances within the human body. (Figure 3). Because they could stimulate and improve the balance of various beneficial gut bacteria, such compounds are thought to be helpful in improving intestinal health (Marcellino *etal*., 2019). These benefits are attributed to its high nutrient content, which is primarily made up of MUFA with a concentration of roughly 55-83% oleic acid (C18:1). PUFA, which include linolenic acid (C18:3) and linoleic acid (C18:2), make up 4–20% of the overall nutritional content after this. There are a few smaller, yet nutritionally significant compounds like the hydroxytyrosol, oleuropein, and phenols (Foscolou *etal*., 2018). Due to low concentration of FFAs in olive oils, there is a decreased risk of developing inflammatory diseases. Apoptosis in cells, a fundamental contributor in inflammation as well as the development of insulin resistance (IR) in the body, could be brought on by fatty acids (Roncero-Ramos *etal*. 2018). The consumption of extra virgin olive oil, which contains a high concentration of MUFA, especially oleic acid, could aid in regulating blood pressure in the normotensive as well as the hypertensive persons. According to Martín-Pelaez *etal*. (2017), MUFA could aid in the reduction of numerous other cardiac-related risk factors. Through lowering the synthesis of hydrochloric acid and limiting the development of ulcers, oleic acid shields the mucosa and lining of the intestines (Piroddi et al., 2017). Olive oil also contains certain small components, like vitamin E, which promotes sensory

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and nutritional qualities, increases stability, and functions as an anti-oxidant (Martn-Peláez et al., 2017). An anti-oxidant that has been found in extra virgin olive oil called hydroxytyrosol has received a lot of interest recently in the literature (Foscolou et al., 2018). Blood lipid profile is improved, inflammatory cell activation as well as oxidative damage are decreased, and hydroxytyrosol exhibits anti-teratogenic and anti-inflammatory actions. Additionally, it aids in the expression of alpha- and gamma-activated receptors that are activated by peroxisome proliferators, which decreases adipocyte size (Foscolou *etal*., 2018).

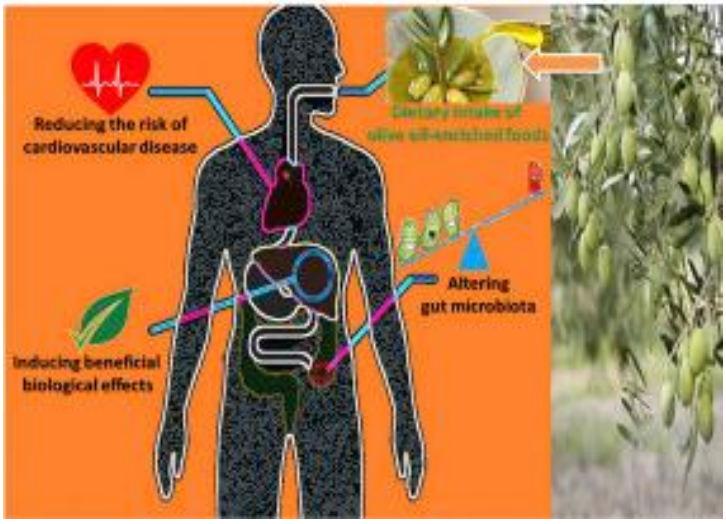

Fig 3: Health benefits that can be gained from olive oil (Mohsen *etal*., 2019)

VI. CARDIOVASCULAR DISEASES AND OLIVE OIL

According to Hohmann *etal*. (2016), consuming extra virgin olive oil serves as major preventive intervention for people that do not have CVD. Additionally, eating it could help those who are already ill as a secondary preventive measure because it might decrease the synthesis regarding LDL-c as well as increasing HDL-c production, which thus causes reverse transfer of cholesterol, which therefore slows onset of illness and lowers risks of future events which could lead to ear ailments. LDL-c is shielded from oxidation by the phenolic compounds that are found in extra virgin olive oil. According to Hernáez *etal*. (2017), oleic acid has the ability of reducing various types of oxidation, which would modify the flow of cholesterol and lower the LDL-c cholesterol amount in the blood. The purpose of the present research has been to assess impacts of Mediterranean dietary pattern that primarily consists of olive oil. A total of 68 people participated in the study, which lasted roughly a year. Researchers found that LDL was more resistant to oxidation. Additionally, a decrease in the oxidative damage-induced modification process was noted in conjunction with an increase in LDL particle size (Hernaez *etal*., 2017). The phenolic compounds included in the extra virgin olive oil function as anti-oxidants. Through blocking lipid peroxidation brought on by free radicals or heavy metals, it lessens the risk of CVD through decreasing HDL oxidation and stopping the effects of LDL. According to Katsarou et al. (2016), such phenols inhibit superoxide reactions and interfere with the oxidation chain reaction's propagation phase. Extra virgin olive oil usage controls hypertension. This has been noted in those who took olive oil for a full year. When compared to people who consumed butter, which contains 62.5% saturated fatty acids, the systolic as well as diastolic blood pressure in such people returned to normal (Hernáez et al. 2017).

Olive oil and T2D

Due in large part to its high content of polyphenols and monounsaturated fatty acids, olive oil has been shown to reduce rate of cardiometabolic diseases and type 2 diabetes (T2D). In the case when comparing those following a Mediterranean diet with extra virgin olive oil to those following a controlled diet (without olive oil), a noteworthy decrease in the risk of T2D was noted (Darshna et al., 2023). According to Hussein et al. (2020), antioxidant compounds, like polyphenols, flavonoids, and phenolic acids scavenge free radicals, like the peroxide, lipid peroxyl, and hydroperoxide, which inhibits oxidative pathways which contribute to degenerative diseases.

Health Benefits of Oleuropein as constituent of olive oil

Another compound with antioxidant qualities found in olive leaves and immature olive fruits (14% of the dry weight) is oleeuropein. Numerous inflammatory models have shown it to be beneficial in enhancing anti-inflammatory characteristics (Hohmann *etal*., 2016). Additionally, through causing the cancerous cells to undergo apoptosis, it has anti-proliferative and tumor-suppressive qualities (Hohmann et al. 2016). In a study using animal testing, individuals with colorectal cancer showed reductions of 64% and 16%, respectively, when fed 50 and 100mg/kg of oleuropein. At higher dose, there was a decrease in colonic inflammation, which protected the epithelial cells and inhibited the growth

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regarding new tumour cells (Giner *etal*., 2016). The aforementioned actions of oleuropein are facilitated by its capability to alter the expression of several genes as well as signaling proteins, which are essential for both cell apoptosis and proliferation (Shamshoum et al., 2017). A key component of a proprietary combination which inhibits proliferation regarding endothelial cells is oleeuropein. Oleuropein acts as a potent anti-angiogenic drug when taken orally (Cumaoglu et al., 2011) by inhibiting the formation of new blood vessels. Based on Cumaoglu *etal*. (2011), phenolic compounds found in extra virgin olive oil, like protocatechuic acid and oleuropein, could prevent macrophage-mediated LDLc oxidation. Extracts made from olive tree's leaves and fruits are rich in oleuropein, which shields the pancreatic β-cell line—which produces insulin—from the damaging effects of cytokines (Cumaoglu *etal*., 2011). Those results suggest that oleuropein enhances postprandial glycaemic performance by inhibiting oxidative stress produced from Nox2.

Antioxidant properties of olive oil

A diet high in fruits and vegetables is said to offer protection against a number of diseases. Ayla (2023) attributes this in part to the phenolic compounds' antioxidant properties. There is a growing interest in using anti-oxidants originating from herbal roots, despite the fact that synthetic antioxidants are utilized in various products due to their potential for mutagenesis and carcinogenic effects. Food-based natural polyphenols have antioxidant properties and might lessen or stop oxidative damage at the cellular level (fig 4). Because of their high phenolic content, their use in a variety of industries, including the dietary supplement, pharmaceutical, and cosmetics sectors, is growing in popularity. As a natural antioxidant, OLs are a substance that is often examined and highlighted. Through inhibiting or postponing the oxidation of oxidative substrates, it has demonstrated strong anti-oxidant activities. In comparison with other olive tree parts, OLs have the best antioxidant qualities due to their high oleuropein as well as hydroxytyrosol concentration (Ayla, 2023). Anti-oxidant effect is frequently influenced by the quantity and placement regarding hydroxyl groups with regard to functional group of the carboxyl (Ayla, 2023). Both the radical scavenging as well as metal chelating properties regarding phenolic compounds are significantly influenced by their structural features, including glycosylation site and the positions and quantities of groups of hydroxyl on carboxyl functional group, glycosidic moiety (Xie et al., 2015). According to research, the glycoside portion—aglycones coupled to glycones—has lower biological activity compared to aglycone portion (Oniszczuk et al., 2019). According to Ayla (2023), polyphenols found in olive products, such as hydroxytyrosol, along with their secoiridoid derivatives, such as oleuropein, reacting with free radicals, giving their own hydrogen to oxidants, neutralizing them, and scavenging the free radicals in order to generate forms of higher stability. According to Ayla (2023), they scavenge radicals like the DPPH, OH, ABTS·+, and O2· –. Through boosting antioxidant-acting enzymes' activity or the inhibiting enzyme activity which triggers pro-oxidant activities, they might lessen formation of ROS (i.e., reactive oxygen species). The location and number related to aromatic hydroxyl groups as well as the stability of the generated aroxyl radicals are critical factors for antioxidant action (Ayla, 2023). Electrons could be widely delocalized by the aroxyl radical. This is required to produce many mesomeric structures and stabilize radicals. hydrogen-donating as well as chelating metal ions Cu2+ and Fe3+, catalyze reactions which produce free radicals and are capable of blocking a number of the inflammatory enzymes, such as the lipoxygenases, without affecting the cyclo-oxygenase pathway, are linked to the antioxidant activity regarding hydroxytyrosol and oleuropein (Matthäus and Özcan, 2017). Additionally, it has been discovered that oleeuropein and hydroxytyrosol are scavengers regarding hypochlorous acid as well as superoxide anions, two potent oxidants generated at the inflammatory site and a crucial component of chlorine-based bleaches which come into contact with food often throughout production (Ayla, 2023).

Fig 4: Antioxidant activity of olive oil (Gamze *etal*., 2021)

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VII. OLIVE OIL AS ANTIOXIDANT IN FOOD APPLICATION

One of the most widely used utilization of OLs is an antioxidant in food. Lipids could become oxidized due to several factors like heat, light, metals, enzymes, free radicals, metalloproteins, and microorganisms activity throughout food storage and preparation. Maintaining oxidative balance is crucial for product quality, particularly for foods that include a lot of oil. Oxidative degradation in food products results in rancidity, oxidative compounds that may be toxic, sensory decay, color deterioration, a reduction in shell life, and loss of nutritional value. Since commercial chemical antioxidants are so affordable, efficient, and highly stable, they are majorly utilized in food business for stopping or slowing down oxidation. However, it is known that they may encourage the carcinogenesis process, and consumers have lately shown a preference for using natural additives rather than artificial ones (Borjan et al., 2020). As the importance of natural antioxidants has grown, OLs have garnered more attention because of their remarkable antioxidant capacity. Enriching food products with OLs may enhance nutritional value and offer health advantages in addition to their antioxidant effects. According to studies, olive leaves are typically added to food as a natural food additive for enriching it with bioactive as well as antioxidant compounds, enhancing shelf life by stabilizing oxidation, and creating useful products (Fig 5). OLE is believed to help preserve nutritious components and improve oxidation stability, therefore increasing the shelf life regarding vegetable oils. The phenolic profile of olive oil from Tunisian cultivars has been studied by Ammar et al. (2017). Prior to extraction procedure, olive leaves have been added to the oil. In the case when olive leaves (3%) are added to recovered oil from Chetoui cultivar which was treated with 3 Oueslati variety of the Tunisian olive oil, it was demonstrated that the oil contains higher polyphenols (44%), carotenoids (about 62%), and chlorophyll (about 67%) (Tarchoune et al., 2019). Following 18 months of storage, adding olive leaves to olive oil might improve its bioactive profile, claim Romani et al. (2019). The levels of phenolic contents, chlorophyll, alpha-tocopherols, and antioxidant activity were significantly higher in the oils treated with leaves. Due to the increased interest in high-phenol olive oils recently, studies were conducted to improve olive oils through adding phenolic compounds. Therefore, high phenol content as well as high oxidation stability olive oil that is rich in nutrients is produced. Particularly, research on adding phenolic compounds to olive oil that are extracted from olive leaves using various techniques has garnered interest (Arfaoui et al., 2022). According to the investigations, OLEs enrichment enhances virgin olive oil oxidation through reducing the extinction coefficients in addition to peroxide value during storage. Additionally, following six months, enhanced olive oil was shown to have superior flavor and odor to the control, along with good overall acceptability. In order to increase nutritional value and oxidative stability of extra virgin olive oil from the "Chetoui" type, Arfaoui *etal*. (2022) added OLE as natural antioxidant. Findings indicated that the enrichment didn't affect olive oil quality and upheld organic criteria.

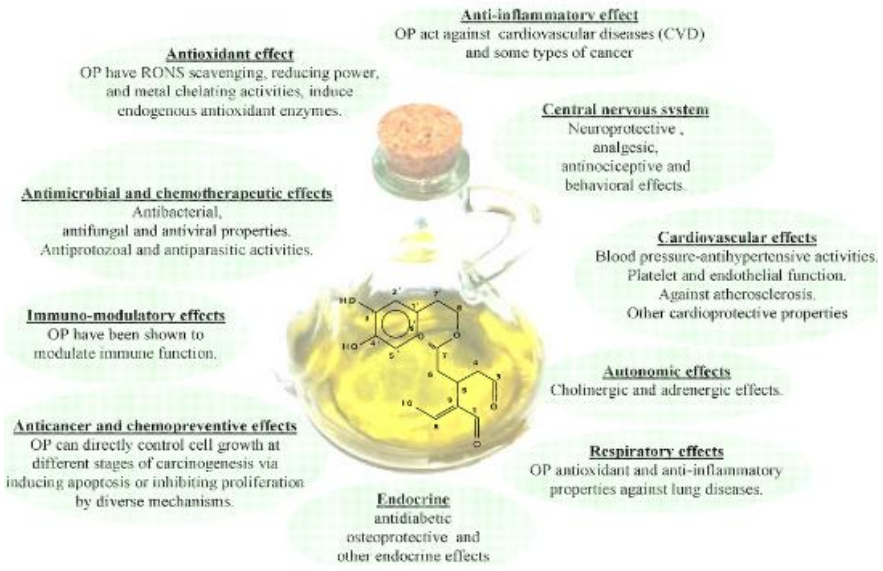

Fig 5: Antioxidant and biological activity of extra virgin olive oil (Maurizio *etal*., 2014)

VIII. CONCLUSION

It is claimed that consuming a Mediterranean diet enhances one's general quality of life. Consuming extra virgin olive oil has been shown to lower risks of CVDs, improve inflammation responses, increase the proliferation and growth of beneficial gut microbes, and other health benefits in both animal and human studies. Those benefits stem from extra virgin olive oil's superior nutritional value, which includes high concentrations of MUFAs (particularly oleic acid) and a few trace

elements, such as phenolics (oleuropein and hydroxytyrosol). OL possess important compounds that have numerous favorable effects on human health as well as food quality. For this reason, it could be employed to foods to increase food storage life and to make functional foods, and in cosmetic, pharmaceutical, and medical industries, rather of being thrown away as waste.

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