# Therapeutic and medicinal uses of olive oil and importance of phenolic and volatile compounds

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**Abstract:**

This mini review gives an overview of the importance of olive fruit, oil and leaves. It also provides a general view of the phenolic and volatile compounds in the olive, explaining the extraction procedures and the analytical tools used for determining these compounds. Therapeutic and medicinal uses were also investigated.

**Keywords:** Olive oil, Phenolic compounds, Therapeutic uses

## Introduction

Installations that recover olive oil produce three main residues: a solid cake known as olive pomace, and large amounts of two liquid phases: olive oil and an aqueous liquid known as olive-mill waste water (Francisca et al., 2015).Olive mill waste water is a C-rich organic waste with high contents of both toxic phenols and valuable nutrients, being rich in organic matter, nitrogen, phosphorus, potassium and magnesium. Olive mill pomace is a semi-solid to semi-liquid by product with phytotoxic and antimicrobial properties, low pH, relatively high salinity and organic load, and rich in phenolic constituent (José et al. 2014). Olive stones are recovered in the olive oil extraction process

after oil separation. According to several reports the main components of olive stones are cellulose, hemicelluloses and lignin. Olive stones represent approximately 10% by weight of the olive fruit.

Olive oil is the natural oil extracted from olives. Today, olive oil is the second most important oil crop worldwide after palm oil. Total olive oil world production for the last six recent seasons has been 2,951,800 tons. Mediterranean countries account for some 98% of world production (Nassima, 2016). About 14% of the oil is saturated fat, whereas 11% is polyunsaturated, such as omega-6 and omega-3 fatty acids. Important volatile compounds of quality Olive oil are aldehydes, alcohols, esters, aromatic and aliphatic hydrocarbons, ketones, and furans. The composition of these compounds differs depending on the enzyme activity (Cavalli et al., 2004). Other factors can influence the volatile composition such as cultivar, ripeness, climate, region, altitude, and technological factors (harvest, olive storage, washing, crushing, malaxing, extraction processes, andstorage) (Kiralan et al., 2012; Cecchi et al., 2013; Bayrak et al., 2013). Volatile compounds have a major role in the aroma of olive oils. While part of the volatile compounds in vegetable oil is comprised throughout the ripening of the fruit. A major proportion is made as results of protein and chemical reactions that occur throughout the oil processing. Protein reactions influence particularly within the formation of the compounds which are responsible for the oil aroma through lipogenase, wherase unpleasant odor compounds area unit usually formed by chemical reactions (oxidative rancidity) (Kalua et al., 2007).

Olive oil, one among the oldest identified oils, is usually made within the Mediterranean basin, contains essential fatty acids and fat-soluble vitamins, and has its own style and odor further as a high edibleness degree and calorie worth (Nas, 2001). The amount of volatile compounds in olive oil is also related to the sensory quality (Şişik, 2014).

The olive fruits contain a wide variety of phenolic compounds that are potent antioxidants, astyrosol, hydroxytyrosol, oleuropein and dialdehydic form of decarboxymethyl oleuropein and are present in all of the investigated olive tissues, including the pulp, leaves and stone.

1. **Extraction of volatile compounds from olive oils**

In (2018), changes in volatile compounds of olive oil were investigated in terms of variety, harvest year, and geographic regions (Mediterranean, Aegean, Southeastern peninsula, Marmara, and Black Sea) (Şeyma et al., 2018). Volatile compounds of olive oils were extracted by victimization solid-phase micro extraction (SPME) methodology and have been identified by gas chromatography-mass spectrographic analysis. Fifty-nine volatile compounds from seven totally different chemical teams including aldehydes, ketones, hydrocarbons, alcohols, esters, terpenes, and furans were known. Among aldehydes, trans-2-hexenal was found to be comparatively higher. Alcohols and esters were determined as different necessary compounds.

Principal element analysis showed that volatile compounds may play a crucial role within the separation of regions. In this context, a study has been realized, the olive fruits employed in the analysis were provided from 5 geographic regions (Table 1). The samples were taken in Gregorian calendar month 2010 and 2011. In total, fifty samples and five cultivars from every region were collected in 2 harvest years and processed to vegetable oil within the agricultural facilities placed within the regions, where the samples had been taken from, through the three-phase extraction methodology. Five hundred cubic centimeters was taken from every vegetable oil sample, place into brown glass bottles, and unbroken in dark until the analysis.

The extraction of volatile compounds was done by exploitation solid-phase microextraction (SPME) technique according to the tactic delineate (Ines et al. 2017). Gas chromatography–mass qualitative analysis (GC/MS) was used to analyze the volatile compounds of oil samples. To do that, oil sample was placed into a forty mil SPME bottle (Supelco, Bellefonte, PA, USA) sealed with a polytetrafluoroethylene-faced silicone polymerseptum (Supelco, Bellefonte, PA, USA). The bottle was left at 45°C during a thermoblock (Supelco, Bellefonte, PA, USA) throughout ninety min with magnetic stirring. The DVB/CAR/PDMS fiber (50/30 μm, Supelco) that was absorbed by the volatile compounds was thermally desorbed into the injection port of the gas chromatography for six min at

250°C. The appliance port was within the splitless mode. The volatile compounds were seperated on a HP-1 (Agilent, 50 m, 0.2 mm i.d., 0.55 μm film) column below the following conditions: atomic number 2 rate, one mL/min; kitchen appliance temperature programs, one min at 45°C, from 45°C to 230°C with a rate of 3°C min, control for five min at 230°C; detector and GC-MS interface temperatures, 250 and 280°C, severally. Lepton impact mass spectra were recorded at seventy energy unit, and data were no inheritable across the mass vary 30–400 amu. Identification of volatile compounds was based mostly on a comparison of the results with mass spectra from a info developed by office and WILEY or standards molecules (for scheming Kovats index, Supelco 44585-U, Bellefonte PA, USA) (Şeyma et al., 2018).

Consequently, it has been determined that aldehydes play an important role within the volatile compound profile in all the regions and trans-2-hexenal is a major compound. The alcohols and esters follow aldehydes are not affected by the cultivar factor. As another important result, it is found that cultivar factor on the volatile profile is more effective than the harvest year (Şeyma et al., 2018). The use of activity, storage (in order to decant) associated filtration in an industrial olive mill have to scrub and to clarify olive oils (Vidal et al., 2019). The vegetable oil class wasn't modified once the activity, storage and filtration processes with slight changes within the fruitiness, bitterness and pungency. However, activity, storage and filtration made some important changes found within the quality parameters and minor composition.

A relevant result was however the content of phenolic resin compounds was full of activity. A discount within the concentration of those compounds was ascertained once the vertical process, this can be most likely the results of the transfer of hydrophilic phenols from the oil to the water part. Similarly, the content of volatile compounds from the LOX pathway exhibited a decrease once laundry. The most relevant results from the oil samples kept for twenty five days before filtration were a big increase within the peroxide index around 30% and a seventy eight decrease within the inhibitor capability. A little range of variations was detected once oil filtration, with no variations within the

sensory characteristics. The full quantity of phenolic resin compounds and volatile compounds from the LOX pathway was similar in each filtered and unfiltered samples; the antioxidant capability exhibited the same trend to the phenolic resin compound content. On the contrary, the photosynthetic pigment content faded once the filtration method.

From these results, it's ended that the water addition within the vertical activity and therefore the time of storage of olive oils ought to be reduced so as to avoid the decrease of the inhibitor capability and phenolics compounds (Vidal et al., 2019). Olive preprocessing storage could be a crisis of management that indicated that storage of olives in inadequate conditions injury to the standard of the oil. The employment of boxes for the storage of olives may represent a significant improvement within the quality of the ultimate product.

The aromatic profile is considerably altered throughout the olive preservation. Limonene and (Z)-3-hexenyl acetate were gift solely within the sample processed in real time once harvest and will be thought of by the means as markers of freshness whereas HS-SPME-GC-MS results together with PCA analysis make sure the actual fact that at the top of the storage period there was a development of hydrocarbons like three, 7- decadiene and 2 isomers of 3-ethyl-1, 5-octadiene that the role within the definition of oil flavor isn't clear and will play a crucial role within the fragrance of this valuable product (Vidal et al., 2019). The suitable temperature conditions, the high humidness promote the microorganism organization of the olive tissues by all the microorganisms present within the setting and chiefly fungi. By examination both vegetable oil volatile profile and functions of plant volatile organic compounds hexanal, nonanal, (E)-2-decenal, phenyl-ethyl alcohol, styrene, n-dodecane, ntetradecane, limonene, and b-selinene may have a plant origin. Overall, it looks that the contribution of the olive fruit microflora to the biogenesis of volatiles could be a advanced topic and is perhaps involving the enzymatic arsenal of the strains gift throughout the assorted phases of the vegetable oil production. Therefore, utilization of the microflora to improve the vegetable oil quality by up its aroma characteristics should be performed in a very lot of controlled manner. Application of a

number of the microflora members or perhaps application of the enzymes that these microorganisms manufacture which contribute to volatile biogenesis may have abundant to supply in vegetable oil quality. From the other hand, biological antifungal treatments may be wont to avoid the olive fruit deterioration throughout storage (Ines et al. 2017).

Olive oil contained novel volatile compounds that would enhance its flavor, however additionally contained some off-flavor compounds that may cut back its organoleptic characteristics and so its quality. Results show that olive microflora will contribute to the biogenesis of oil volatiles may doubtless be accustomed enhance oil aroma (Ines et al. 2017). The identification of microorganisms capable of manufacturing volatile compounds would have a good impact; the various functions of plant volatile organic compounds (FVOCs) can be developed to be used in potential biotechnological applications (biofuel, biocontrol, etc.) with greater value. This study has applied a brand new sampling system supported SPE–GC–MS for deciding the volatile compounds generated throughout the heating of 2 oils with totally different smoking points. Twenty-three totally different compounds, happiness to distinct chemical families, were known at room conditions. Heating from temperature to eighty on top of their smoking point, each oils was found to own a unique level of stability in relevancy temperature. Solely the alkane series family had an analogous behavior with each kinds of oil (no important variation with temperature), though they were a lot of concentrated within the oil fumes. The quantity of acids and aldehydes with double unsaturation wasn't considerably different between the categories of oil. This didn't occur with unsaturated or saturated aldehydes; the latter were produced in larger amount within the sunflower-seed oil. It was possible to relate the content of fatty acids of every of the oils to the proportion of aldehydes generated in every case. Also, the sensory study has shown that there's a synergistic effect between the various aldehydes, some of which are answerable for the characteristic odor of the frying method, mainly the unsaturated aldehydes. These are gift in lower quantities within the further virgin olive oil than within the high-oleic sunflower-seed oil, when these

oils are heated to temperatures employed in cooking processes (Ignacio et al., 2013), Supported solid-phase extraction–gas chromatography–mass spectroscopic analysis were used for characterizing volatile compounds generated throughout the heating of oils. The system has been applied to helianthus and extra virgin oil at room conditions, heating from temperature to eighty higher than their smoking point. Twenty-three compounds, mainly saturated and unsaturated aldehydes, and alkanes; chemical group acids were gift in lower concentrations. During heating, the steadiness of every oils was found to diverge.

The alkanes were made in larger quantities within the sunflower oil. Alkanes were found in higher concentration in the oil and showed no vital variation in either of the oils because the temperature modified. A relationship between the amount of aldehydes discharged and temperature was found and the importance of the unsaturated aldehydes within the fried odor was conjointly exposed (Ignacio et al., 2013).

The volatile profile needs additional analysis taking into account different characteristics of fruits, equivalent to the ripening index, oil and water mass fraction (Bayrak et al., 2013). Since organic chemistry synthesis and transformation of those compounds throughout upon the activity of endogenous enzymes, that area unit partly influenced by genetic factors, mixtures of different cultivars might have either a synergistic or antagonistic result on synthetic resin and volatile compounds within the ensuing oil. In this context, 2 specific cultivars from the Istrian peninsula, Leccino (L) and Istarska bjelica (B), were chosen. 2 monovarietal fruit samples

(LlOO and BlOO) and 4 mixtiares within the following mass ratios: L/B=80:20, L/B=60:40,

L/B=40:60 and L/B=20:80 were ready. The mass fraction of total phenols determined calorimetrically. Mass fraction of total phenols within the oil samples from fruit mixtures modified linearly from (199.5±7.2) in Leccino to (642.0±61.7) mg/kg in Istarska bjelica, in a very strict correlation with fruit mass quantitative relation of the 2 cultivars. Results suggest that fruit mixtures of two chosen cultivars in olive process supply attention-grabbing

possibilities for targeted modulation of synthetic resin and volatile compounds in virgin olive oil, and consequently, their sensory and organic process characteristics (Olivera et al., 2012).

## *2. Therapeutic and medicinal benefits*

### 2.1 Olive oil

Olive oil is the natural oil extracted from olives, about 14% of the oil is considered as saturated fat, whereas 11% is polyunsaturated, such as omega-6 and omega-3 fatty acids. But the predominant fatty acid in olive oil is a monounsaturated fat called oleic acid, Olive oil has antioxidant properties and contains several essential fatty acids required for the production of phospholipids, being the case of alpha-linolenic acid and gamma-linolenic acid (Touseef et al., 2018). The health promoting properties are associated with the presence of monounsaturated fatty acids, and functional bioactive compounds like tocopherols, carotenoids, phospholipids and phenolics. Monounsaturated fatty acids present in olive oil can prevent atherosclerosis by interfering various inflammatory responses. A combination of Hydroxytyrosol, oleic acid, and omega 3 fatty acids imparts potential therapeutic effects against active colitis (Vijay et al. 2016). Oleic acid inhibits tumor necrosis factor (TNF)–α–induced expression of cyclooxygenase protein expression, and prostaglandins (PG) secretion in human glioblastoma cell. As such, oleic acid is a cancer preventive fatty acid that inhibits chronic inflammatory biomarkers (Lamy et al., 2016).

Regarding fatty acids profile, due to the high content of monounsaturated ones, olive by-products could be a new promising ingredient for cosmetics and pharmaceutical products. Fats are indispensable to life not only as an energy source but also for their structural role in the skin, retina, nervous system, lipoproteins, and biologic membrane.

On the other hand, olive oil phenolic compounds are broadly divided into major and minor phenols depending on their composition (Cicerale et al., 2008). The most commonly reported minor phenolic compounds in olive oil are Hydroxytyrosol, tyrosol, oleocanthal, luteolin, apigenin, vanillin, vanillic

acid, oleuropein and p–coumaric acid. Olive oil phenolic extract modifies the antioxidant gene expression of healthy human adults thereby improving the antioxidant enzymes including catalase, superoxide dismutase, and glutathione peroxidise.

*2.2 Olive leaves*

Olive leaves fully grown in wild Mediterranean region and America contain higher concentrations of active ingredients appreciate such as Oleuropein and Astrul and Allecin. it's used as oil that contains seventy fifth of monounsaturated fatty acid. The degree of toxicity of the olive leave is non-existent. Utilization of pure Oleuropein or in a very crude extract has its own therapeutic price in treating polygenic disease, kills a broad vary of microorganism, viruses, parasites, molds and additionally found it regulates the force per unit area level thereby reducing the likelihood of stroke and cardiopulmonary arrest.

There are five groups of phenolic compounds predominantly present in olive leaves: oleuropeosides (oleuropein and verbascoside); flavones (luteolin-7-glucoside, apigenin-7-glucoside, diosmetin-7-glucoside, luteolin, and diosmetin); flavonols (rutin); flavan-3-ols(catechin),and substituted phenols (tyrosol,hydroxytyrosol, vanillin, vanillic acid, and caffeic acid). The most abundant compound in olive leaves is oleuropein, followed by hydroxytyrosol, the flavone-7-glucosides of luteolin and apigenin, and verbascoside. Hydroxytyrosol is a precursor of oleuropein, and verbascoside is a conjugated glucoside of hydroxytyrosol and caffeic acid. Regarding cosmetic applications oleuropein presents very interesting pharmacological activities such as antioxidant, antiviral, antimicrobial and anti-inflammatory, skin protecting and anti aging properties.

Leaves are considered by-products of olive farming, representing a significant material arriving to the olive mill (Xynos et al., 2012). For many centuries olive leaf or their extracts have been associated with health and preservation, indeed it have been used to treat diabetes, hypertension or even hypercholesterolemia. Olive leaves also gather the interest of the scientific community and the

industries worldwide, as their health promoting benefits are constantly being shown by a never-increasing number of scientific data.

Leaves present high amounts of oleuropein, although it has also been found in other parts of the fruit such as peel, pulp and seed (Servili et al., 1998).

Olive leaves have the highest antioxidant and scavenging power among the different parts of the olive tree. Olive leaf essential oil also has antioxidant capacity almost two times higher than green tea extract and 400% higher than vitamin C.

*2.3 Olive fruit*

Bioactive compounds such as polyphenols, carotenoids and anthocyanins present in fruits with their potential antioxidant activity offer health benefits including protection against cardiovascular diseases and cancer.

Also The olive fruits contain a wide variety of phenolic compounds that are potent antioxidants such as astyrosol, hydroxytyrosol, oleuropein and dialdehydic form of decarboxymethyl oleuropein, and are present in all of the investigated olive tissues, including the pulp, leaves and stone.

**Conclusion**

Olive oil is the natural oil extracted from olives. A part from its beneficial fatty acids, it contains modest amounts of vitamin E and K. Olive oil is also loaded with powerful antioxidants. These antioxidants are biologically active and may reduce the risk of chronic diseases. There are various techniques that can be used for the extraction from olives.

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**Table1** Olive cultivars from different geographic regions (Şeyma et al. 2018)

| Geographic region | | | | | |
|---|---|---|---|---|---|
| Cultivar | Mediterranean | Aegean | Southeastern Anatolia | Marmara | Black Sea |
| | Gemlik (MG) | Memecik (AM) | Nizip Yağlık(SNY) | Gemlik (MRG) | Butko (BSB) |
| | Ayvalık (MA) | Domat (AD) | Ayvalık (SA) | Ayvalık (MRA) | Otur (BSO) |
| | Saurani (MS) | Uslu (AU) | Kilis Yağlık(SKY) | Çelebi (MRÇ) | Görvele (BSG) |
| | Haşebi (MH) | Gemlik (AG) | Halhalı (SH) | Domat (MRD) | Satı (BSS) |
| | Sarı Ulak(MSU) | Erkence (AE) | Karamani (SK) | Memecik (MRM) | Kızıl Satı (BSK) |