Olive trees (Olea europaea L.) are among the oldest historically important fruit trees. References to olives within the western civilized world date back to Biblical and Roman times and to Greek mythology. Extra virgin olive oil proved itself indispensable in the ancient world, and was called “liquid gold” by Homer and “the great healer” by Hippocrates, placing olive oil at the top of the food and medicine list (Clodoveo et al., 2014). Kings were anointed with olive oil as a sign that they were chosen by God to rule (1 Samuel 16:1). Olive oil was considered by the Egyptian and Minoan civilizations to be of vital importance, and it was sometimes used as a form of currency (Arte Legno, 2016).

The oil, fruit, and leaves of the olive tree have an ancient history of nutritional, medicinal, and traditional uses. Olives and olive leaves are the first botanicals prominently noted in the Bible, in Ezekiel 47:12, “The fruit thereof shall be for meat, and the leaf thereof for medicine” – thus its nickname, “Tree of Life.” The Spartans rubbed olive oil on their bodies as a moisturizer and to emphasize their physique, while Greek athletes received olive-oil massages. Early Roman emperors gave olive oil as gifts during celebrations. The Romans developed the screw press to extract the oil, a technology that is still used today. In the Eastern world, the first Japanese known to have eaten olive fruits was Toyotomi Hideyoshi, an Imperial Regent of Japan. He received a barrel of salted olives from Spanish King Felipe II in 1594. In the early 1860s, the shogun’s physician, Hayashi Doukai, who studied Dutch medicine in Nagasaki, developed the first trial orchard in Japan to produce olive oil for medical use (Takeuchi and Shibata, 2012).

Olive tree culture was an important agricultural activity and a symbol of wealth and security in ancient civilizations (Rick, 2016). “The olive tree is surely the richest gift of heaven” said Thomas Jefferson (Firenze, 2011).

History of olive cultivation and use

The use of olives has been recorded on ancient tablets and in ancient documents, and signs of olives have been found during archeological digs and within tombs (International Olive Council, 2016, The Big Olive, 2016, Vossen, 2007). These have provided evidence of the history of the use of olives and the spread of olive cultivation to different locations.

Taking the area that extends from the southern Caucasus to the Iranian plateau and the Mediterranean coasts of Syria and Palestine (Acerbo) to be the original home of the olive tree, its cultivation developed considerably in these last two regions, spreading from there to Cyprus and from Crete towards Egypt.

8,000-6,000 BC. Olive was first domesticated in the eastern Mediterranean region.
6,000-3,000 BC. Olives were being grown and used in southern Turkey, Syria, Israel, Lebanon, Cyprus, Greece and North Africa.
2,000 BC. The value of olive oil was five times that of wine. Oil was used for food, lamp fuel and for anointing people in the temples.
1,700 BC. The olive tree was introduced to Egypt around this time. Tutankhamen wore a garland of olive branches.
1,500 BC. Olive oil became a major commodity in the trade of Crete. Many artifacts, such as milling stones, storage vessels, and frescos showing the use of olives were found in Greece, Egypt, and western Turkey archeological sites.

1,000 BC. Olive tree cultivation moved westward over this period, including to Italy, France, Spain, Portugal, Morocco, Algeria and Tunisia. The expansion of the Roman Empire contributed to the spread of olive cultivation and olive oil production across the Mediterranean region.

400 BC. The Greeks, Spanish and Portuguese were major exporters of olive oil to other Mediterranean countries including Italy, France, England and Germany.

300 AD. The Romans were expert at producing processed olives and many different types of olive oil.

325 AD. Constantine the Great established the Byzantine Empire, and the many uses of olive oil continued to increase.

400-1000 AD. Olive tree plantings increased significantly during the Middle Ages, particularly in Spain, Italy and Greece, to supply the growing urban populations, and its economic importance continued.

1503-1600 AD. Spanish explorers brought olives to South America. Olive trees were grown in Chile, Peru, Argentina and Mexico.

1800-1900 AD. Olives were planted in Australia, New Zealand, California and Japan. The development of low-cost extraction of oil from seeds, and the development of other sources of oil, caused a drop in demand for olive oil. This resulted in a glut in the world market, and a focus on higher production rather than quality.

1946-1947. Olive plantations were established in Azerbaijan.

1958. The International Olive Oil Council was established in Madrid, Spain, under the auspices of the United Nations, to create standards for the different types of olive oil so that fraud could be reduced.

1978-1987. The FAO played a significant role in sponsoring an olive development project in China.

1990s. There was a major increase in interest and investment in olives as an industry by new (World) producers, such as those in Australia, New Zealand, United States, South Africa, Argentina, Brazil, Chile, Uruguay, Peru, and Japan.


2006. The International Olive Oil Council changed its name to the International Olive Council (IOC), to encompass sustainable growing of olive trees for all forms of use.

2007. Olive plantations were established in India.

2010. UNESCO recognized the Mediterranean diet as an Intangible Cultural Heritage of Humanity, in which extra virgin olive oil has a key role.

2016. The IOC celebrated the olive tree, the “universal symbol of peace and harmony”, which is now growing on five continents and contributes to sustainable economic and social development.

World olive production

In 2014, olive trees were cultivated on approximately 10 million ha across the world. Between 2014 and 2016, the land occupied by olive trees increased by 10%, to 11 million ha, of which more than 8 million ha were not irrigated. During the 25 years between the 1990/91 and 2015/16 seasons, world consumption of table olives increased 2.8 times. In 2015/16, the world’s top ten consumer countries were Egypt, Turkey, Algeria, the United States, Spain, Syria, Italy, Brazil, Iran, France and Russia (International Olive Council, 2016). Spain is the world’s leading producer and exporter of olive oil and table olives.

In 2014, the ten largest producing countries were located in the Mediterranean region and produced around 15 million t of olives, representing around 98% of the world’s only Mediterranean basin countries, but also Argentina, Chile and the United States, while the top ten preserved olive exporters include similar Mediterranean basin countries, but also Argentina, Peru and Belgium (Figure 2). Some countries that export olive products do not grow the fruit, but manufacture products after importation of raw materials, e.g. Belgium.

Australia is an exporter and also an importer of both olive oil and processed olives. Olive trees have been grown in Australia since European settlement. There has been a renaissance in the Australian olive industry since the early 1990s, primarily due to the increased popularity of Mediterranean cuisine and the opportunity to replace imported olive products (Sergeeva, 2012). Australia is one of the smaller olive producing countries, although it is in the top 20 for cultivated area, production quantity, and virgin olive oil exported (Figures 1 and 2). The current area planted covers more than 43,000 ha (FAO, 2016), extending over more than 2000 plantations (Ravetti and Edwards, 2014). Compared with Aus...
Australia's 20,000 t production, Spain produces approximately 11 million t of olive oil per annum (225,000 t exported), Italy 623,000 t (208,000 t exported) and Greece 261,000 t (10,000 t exported). Total world production is approximately 3 million t (International Olive Council, 2016).

According to the Australian Olive Association (AOA), between April 2015 and March 2016, Australia exported 6,686 t of olive products to Spain, Italy, China, New Zealand and the United States (AOA, 2017). Victoria was the leading export state, accounting for 74% of export volume. Olive exports from Western Australia lifted from 30 t in July-March 2015 to 565 t in July-March 2016. Western Australia now accounts for 11% of national exports by volume. There are more than 100 known cultivars of olives in Australia, both classic Mediterranean cultivars and recent hybrids. Italy is one of the richest countries in terms of olive cultivars, with more than 600 cultivars, including 'Frantoio', 'Leccino', 'Pendolino', 'Carolea', 'Coratina' and 'Moraiolo'. Major Spanish cultivars include 'Picual', 'Alberquina', 'Hojiblanca', 'Cornicabra', 'Manzanilla de Sevilla' and 'Manzanilla de Jaén'. In Greece, cultivars include 'Kalamata', 'Koroneiki' and 'Consevolia'; in Tunisia, 'Chetoui', 'Meski' and 'Chemlali Sfax'; in France, 'Picholine'; in California, 'Mission'; and in Portugal, 'Galega'.

**Olive oil**

Olive oil has long been used in Mediterranean cuisine but it has become globally popular in recent years because consumers have become more aware of its health benefits (Alemán et al., 2016, Sofi et al., 2014). The health benefits of olive oil are extensive, with new positive attributes continuing to be discovered. Extra virgin olive oil is traditionally used in the Mediterranean cuisine, a diet that promotes good health and longevity. Olives and olive oil are good sources of monounsaturated fat. Extra virgin olive oil has more than 70% monounsaturated fat, the highest percentage of any edible oil. It contains high concentrations of antioxidants, anti-inflammatory substances, and fat-soluble vitamins, E, A, D, and K. Research has shown that the compounds found in extra virgin olive oil have positive effects in preventing many diseases, such as cancer, diabetes, atherosclerosis, heart disease, oxidative stress, blood pressure, obesity, rheumatoid arthritis, osteoporosis, and Alzheimer's (Covas et al., 2006; Alonso et al., 2006; Martínez-González et al., 2008; Salas-Salvadó et al., 2008; Salas-Salvadó et al., 2013).

Extra virgin and virgin olive oils have aroma and flavor characteristics that vary depending on the country of origin, soil conditions, rainfall, climate, cultivar, ripeness, and processing methods (Vossen, 2007). For example, oil from the Catalan cultivar 'Arbequina' is typically very aromatic with a fresh, herbal olive flavor, and a very light pungency and bitterness. In contrast, 'Frantoio' grown in Tuscany, is harvested fairly green and has a strong aromatic, grassy and fruity flavor with a strong pungency, whereas in Umbria the olives tend to be harvested a bit later and 'Frantoio' is blended with olives from other cultivars, resulting in an oil that has a riper fruitiness flavour, medium bitterness
The color of extra virgin olive oil varies from light gold to rich green but it is not an indication of quality. Perhaps the most important factor determining the color of olive oil is the time of harvesting of the olives, which affects the amount of chlorophyll and carotenoids present in the fruit. Olive oil, especially extra virgin, contains tyrosol phenolic compounds such as oleuropein and oleocanthal. These compounds are responsible for its bitter and pungent taste and are antioxidants.

Olive oil is produced by the pressing or crushing of olive fruit. For high quality olive oil to be produced, the olives must have unbroken skin. The process to produce oil must be started within 24 h of harvest. First, olives are washed and the leaves are removed. Then the olives are crushed using a mill, which was traditionally made of stone. More modern methods use a hammer mill made of steel. This lyses the cells of the olive fruit and releases the oil. The next step is called malaxation, which involves mixing the olive slurry into a paste to prepare for separation of the oil. The paste is stirred for 30 to 60 min at a temperature between 26.6 and 30°C. Preferably oxygen is not present. Finally, the oil is extracted from the solids and the fruit-water. Traditionally, this is done using a press, however, it can also be performed using a selective filtration process or by using a vertical centrifuge. After processing, the oil is left to settle at 7 to 18°C for up to 3 months to allow for any further separation before bottling.

The trade standards for different types of olive oil have been defined by the International Olive Council (2016). The main differences between the different oil classifications are the acidity percentages and the production methods. The details are as follows. The acidity concentrations for the different classifications are: extra virgin olive oil 0.8% (0.8 g 100 g⁻¹), virgin olive oil 2%, and ordinary virgin olive oil, which is virgin olive oil that has no more than 3.3% acidity.

Extra virgin is the highest quality and most expensive olive oil classification. It should have no defects and a flavor of fresh olives. Extra virgin olive oil is made using a process called “first cold-pressed.” The word “first” refers to the olives being pressed on the first round of extraction. “Cold” refers to the olives being kept at a temperature no higher than 27.7°C, and “pressed” refers to the method of extraction. This method indicates that no heat or chemical additives were used to extract the oil from the olives, which can alter and destroy the flavors and aromas of the olive oil. Without adding heat to the processing, the olive oil also retains its full nutritional value. Virgin olive oil production involves producing oils from the olive fruit by physical means under conditions that do not lead to alterations within the oil. Virgin olive oil is produced from the first and second pressings of the olive fruit by the cold-pressing method (where no chemicals and only a small amount of heat are applied).

### Table olives

The most common cultivars of processed olives are ‘Kalamata,’ ‘Manzanillo,’ ‘Mission,’ ‘Green Spanish Queen,’ ‘Jumbo Green Kalamata,’ and ‘Leccino’. Green olives, which are picked before they mature completely, tend to be higher in polyphenols. Black olives, which are allowed to mature on the tree, generally have higher oil content and lower concentrations of bitter compounds than green olives. All table olives are a good source of iron, copper, and vitamin E. Raw olives are hard and very bitter when eaten straight off the tree as they contain very high quantities of oleuropein. They are not usually eaten fresh, but are fermented or cured with lye, brine or packed in salt to remove the oleuropein. However, there are a few cultivars that don’t need processing and can be consumed when fully ripe. The method of “curing” the olives affects the flavour and texture of the finished product.

### Methods of curing table olives

Olives are harvested at different stages of ripeness: green-ripe, turning color, and naturally black ripe. The most common curing processes use brine, water, lye treatments or dry salt. During these curing processes, the water-soluble compound, oleuropein, is leached out of the olive flesh.
**Water curing.** To prepare olives for water curing, each olive is first individually cut or cracked, so that the bitter oleuropein can more easily leach out. Water cured olives are soaked in fresh water (i.e. no salt added) for a month. The water is changed daily. Water curing doesn’t change the taste of the olive as much as other methods such as brining, but the olives won’t store for as long afterwards. Water-cured olives typically remain slightly bitter because water-curing removes less oleuropein from the olives than other curing methods. After curing, the olives are placed in a brine, which is a vinegar-salt solution, containing garlic and herbs that add the characteristic flavors.

**Brine-curing.** Olives can be cured by placing them directly into brine (a concentrated salt solution) where they undergo a natural fermentation. As the olives ferment, they create lactic acid, which results in a typical sour taste. The olives end up with shiny, smooth surfaces. The brining not only removes bitterness but seasons the olives as well. The process takes at least three months and may take six months, depending on the cultivar and maturity, as well as the temperature, salt concentration, and acidity (pH level) of the brine. Green-ripe olives take longer to cure in brine than naturally black ripe olives.

**Lye-curing.** “Artificial ripening” is applied to green and semi-ripe olives. Olives are soaked in lye from 2 to 3.5% sodium hydroxide solution, depending on the ripeness of the olives, cultivar, temperature and water quality. The fermentation process produces lactic acid, which lowers the acidity of the brine and therefore stabilizes the product. The olives remain in this solution until the lye has penetrated two thirds of the way through the flesh. The lye is then replaced by water, which removes any remaining residue and the process is repeated. Once olives are fermented, fully oxidised or “become black”, they are placed in fresh brine and packed in bottles. Green olives are processed in two principal ways: with fermentation (Spanish type) and without fermentation (Picholine or American type).

**Dry-salt curing.** Dry-salt cured olives are prepared from fully ripe, mature fruit that are dark red to black. Once picked, the olives are washed thoroughly and packed in bottles. Green olives are processed in two principal ways: with fermentation (Spanish type) and without fermentation (Picholine or American type).

**Oil curing.** Salt-cured ripe olives are plunged briefly into boiling water to remove the salt, then dried and stored in olive oil. The oil is sometimes flavored with spices and herbs, which add other layers of flavor. These olives come out salty and are chewier and meatier than other olives. Dry-cured olives retain more of their bitterness than brine cured olives. Though these olives still have a telltale prune-like exterior that comes from salt-curing, the oil rehydrates them, making them slightly plumper and meatier.

**Smoked**

To get the olives ready for the smoker, the brine is drained, then the olives are placed in a disposable pan. The smoker is set at 95-105°C, and the olives are smoked for 1-2 h. The longer they are smoked, the more pronounced the smoky flavor will be. A small quantity of virgin olive oil, infused with rosemary and basil or other herbs, is poured onto the olives. Poached sliced garlic cloves are often added to the pan and all the ingredients are tossed together.

**Olive wood**

Olive wood has a dense grain giving a long burning time and creating a smokey flavour, which is light and aromatic but punchy enough for red meats without overpowering fish and poultry. Since ancient Greek times, grill masters in the Mediterranean have used the fragrant wood of the olive tree for grilling lamb, pork, poultry and seafood.

**Difference between olive oil, olives, and leaves**

Olive oil, fruit and leaves have been used as medicine throughout recorded history. The olive tree produces oleuropein abundantly in its leaves as well as in the olive fruit itself, and special processing techniques now allow for the extraction of a stable, standardized form of oleuropein from leaves.

There are several significant differences between the nutritional composition of olive oil and whole olives. Olive oil is 100% fat, while whole olives are only about 20% fat. A tablespoon of olive oil contains 120 calories, while olive fruit (about 10 medium) have only 40 calories. Olives, which have to be cured or pickled to be edible, usually contain a lot of sodium, while olive oil is sodium-free. The curing process removes a lot of the polyphenols in olives, whereas these are largely preserved in extra virgin olive oil. Polyphenols, such as oleuropein, are phytonutrients, which play an important role in maintaining human health and wellness. The concentration of phenols in extra virgin olive oil varies from 50 to 800 mg kg⁻¹. The phenol concentration in olive oil depends on cultivar, climate, region, latitude, and ripeness of the olive.
Olive fruit provide some fiber, whereas olive oil does not. Some olives are processed with natural fermentation, meaning that they would be a source of beneficial bacteria, but olive oil is not. Unfortunately, the different processing methods of olives have, as their main goal, to reduce the very bitter oleuropein. The final flavour of the olive depends on the cultivar, fermentation, processing solution and the final soaking solution (that is, salt, vinegar, marinades, herbs and spices).

Oleuropein content correlates well with the pungency of oil and fruit-based olive products, although leaf extracts tend to be quantitatively standardized for oleuropein and have more powerful antioxidant activity.

Olive leaves are available throughout the year. Olive leaves can be ingested in the human diet as an extract – liquid concentrate, herbal tea (fresh or dried leaf), powder, or in capsules. Olive leaf products can also be used as an ingredient in some food dishes. Olive leaf powder can be added in smoothies, pastas, pancake, salad, ice cream and other products.

Olive oil and table olives are an important part of the healthy Mediterranean diet.

Health benefits of olive oil and olive leaves

The three most powerful phytochemicals in olive oil and olive leaf are oleuropein, oleocanthal, and hydroxytyrosol (Bulotta et al., 2014; Abaza et al., 2015). Oleuropein, one of the best known active constituents of olive leaf, has been endowed with many health promoting properties. Furthermore, this herbal extract is a potent antioxidant. Researchers determined that olive leaf extract has twice the antioxidant capacity of green tea and 400% the antioxidant capacity of vitamin C. Besides its antioxidant effect, oleuropein can also stimulate the immune system and promote fat-burning (Poudyal et al., 2010).

Research suggests that the immune system can reduce the effect of viruses, such as the ones responsible for common cold and influenza, by this process (Walker, 1997, Fredrickson, 2000). Olive leaf extract has been shown to increase recovery from the influenza virus. Additional anti-inflammatory and antioxidant properties offer promise in fighting liver, colon, prostate, breast and skin cancers, atherosclerosis, arthritis and neurodegenerative disease (Visioli et al., 2002; Menendez et al., 2008; Goulas et al., 2009; Barbaro et al., 2014). A study showed that a Mediterranean style diet rich in olive oil reduced the risk of type II diabetes by almost 50% compared to a low fat diet (Paravantes, 2011, Guasch-Ferre et al., 2015). Olive oil and leaf extracts and their oleuropein constituents are best known for their blood pressure-lowering effects, preventing the clogging of blood vessels and reducing the risk of stroke, and it can help maintain the blood-brain barrier (Alonso et al., 2006, Perrinjaquet-Moccetti et al., 2008, Bowden, 2009).

Olive leaves are traditionally used in herbal medicine for the relief of coughs, colds, flu, and sore throats, to help reduce fevers (Walker, 1997, Bowden, 2009, Barbaro et al., 2014) and to treat gout in Mediterranean regions.

Benefits of extra virgin olive oil and leaves for skin

Extra virgin olive oil is being used externally for the skin, hair, and face in cosmetics or as a natural remedy (Rodrigues et al., 2015). There are suggestions olive oil may be helpful in healing burned skin lesions based on trials with rats (Hangan et al., 2016), and in lowering the risk of dermatitis in premature babies (Kiechl-Kohlendorfer et al., 2008). It is also being used as a substitute for shaving cream, shampoo, soap, hand and body cream, lip balm, and as make-up remover. Olive leaf extract also provides some unique medicinal benefits in the treatment of many problem skin conditions such as eczema, acne, psoriasis and shingles. Olive leaf extract can protect the skin by its antioxidant, antimicrobial and anti-inflammatory effects (Ancora et al., 2004). Oleuropein extract of olive leaf reduced reddening of the skin, dehydration, and blood flow to the skin better than vitamin E (Bowden, 2009). Kimura and Sumiyoshi (2009) suggested that olive leaf extracts and oleuropein have preventative effects on chronic UVB-induced skin damage. Wounds heal faster with olive leaf extract, according to Koca et al. (2013). Olive leaf extract is a common ingredient in botanical soaps and creams.

Conclusion

The Mediterranean diet has consistently been demonstrated to have a beneficial influence on human health and longevity. The benefit is due to its constituent foods, amongst which virgin olive oil, especially extra virgin, is considered to be the most important. Its benefits include its antioxidant, anti-inflammatory, anti-atherogenic and lipid-lowering capacity, which are chiefly a result of its chemical composition, particularly its high content of oleic acid, polyphenols, sterols, and tocopherols, which sets it apart from other oils. Studies on extra virgin olive oil and olive leaf extracts have been published in scientific journals such as Phytomedicine, Sci Pham, Phytother Res, Nutr Biochem, Clin Chem, Clin Nutr, Med Food, J Ethnopharma-col, Int J Antimicrob Agents, Int J Cancer, Cancer Res Clin Oncol, Int J Cosmet Sci, Plant Foods Hum Nutr, Agric Food Chem, Mol Nutr Food Res, Diabetes Care, Plant Foods Hum Nutr and other journals. Abundant published medical studies have shown that the olive tree is an important medicinal plant, with health benefits used for the treatment of many diseases and skin problems (Poudyal et al., 2010; Visioli et al., 2002, Menendez et al., 2008; Goulas et al., 2009; Barbaro et al., 2014, Bowden, 2009, Ancora et al., 2004, Kiechl-Kohlendorfer et al., 2008). Extra virgin olive oil is a major component and the "gold elixir" of the Mediterranean diet.

Acknowledgments

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References


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