Year:**2013**, Volume: **1**, Issue:**1**
First page: (**28**) Last page: (**41**)
ISSN: **2321-2187**
Online Available at **www.florajournal.com**

International Journal of Herbal Medicine

Biological Significance of Seed Oil and Polyphenolic of *Olea europaea*

Mohammad Asif[1*]

1. Department of Pharmacy, Guru Ram Das (PG) Institute of Management and Technology, Dehradun, (Uttarakhand), 248901, India.
[E-mail: aasif321@gmail.com; Tele: +9198997088910]

The olive tree *Olea europaea* have beneficial properties. Mainly used parts of the olive tree are fruits and seeds. Seeds oil of olive is used as a major component of the "diet." Chief active components of olive oil include oleic acid, a monounsaturated fatty acid, polyphenolics and squalene. These main phenolic components are hydroxytyrosol, tyrosol, and oleuropein, which occur in highest amounts in virgin olive oil and have antioxidant properties. Olive oil has shown activity in against cancer, mainly in colon and breast cancer prevention, while individual component of olive oil, oleic acid and squalene has also been identified as anticancer agent. The olive oil has effects on coronary heart disease, due to its ability to reduce blood pressure and low-density lipoprotein level. Some components (such as hydroxytyrosol, tyrosol, and oleuropein) of olive oil exhibited antimicrobial activity against pathogenic microorganism in intestinal and respiratory infections. The oleic acid, polyphenolics, squqlenes are dependable for a number of biological activities as well as whole olive plant also gives health benefits.

Keyword: *Acorus calamus*, Ash value, Extractive value, Alcohol extract, Aqueous Extract.

1. Introduction

Olive oil ranges in colour from green to golden and also in flavour from very mild to very strong. The differences in the types of oils depend on the type of olive, the region in which they were cultivated and also the time of harvesting. The olives must be picked at exactly the right time otherwise the extracted oil could either be too bitter or too rancid. Although olive oil is a fat, and we are told to stay away from fats, as they are bad for our health, in the case of olive oil, nothing could be further from the truth. Not all fats are bad for us if consumed in moderation, and the truth is that olive oil is actually very good for us. Olive oil has been used as a medicine and beauty treatment for hundreds of years. Nowadays it is a staple of the Mediterranean diet, which recent research has proven to be one of the healthiest diets in the world. The olive tree *Olea europaea*, produces the olive fruit. Traditionally, the olive products have been used as nutritive, aphrodisiacs, emollients, laxatives, sedatives, tonics, colic, alopecia, paralysis, rheumatic pain, sciatica, and hypertension[1]. The olive fruits can be consumed whole as either the entirely ripe black fruit or as the unripe green fruit. Olive oil, the major source of dietary fat in some the countries, particularly in those countries where olive plants are grown such as Mediterranean countries[2,3]. Consumption of olive have a tendency to low incidence of chronic degenerative disease[4]. While there are dietary variations, a common feature is

the consumption of olive oil, either uncooked or as the primary cooking fat[4]. The olive oil containing diet is linked to a reduced incidence of degenerative diseases, particularly coronary heart disease (CHD) and breast, skin, and colon cancers [5,6]. In addition to olive oil, the Mediterranean diet (MD) is rich in fiber, fruits, and vegetables also. Since olive oil is the major energy source in the MD. In comparison to other countries diets, the MD has a relatively high fat content; however, as the diet is associated with a low incidence of cancer and CHD, despite the high fat intake, it suggested that the type of fat is very essential than the amount of fat consumed[6]. The first seeds oil extracted are the high quality extra virgin olive oil. Further extraction with organic solvents can be to produce low quality refined husk oil[7]. Olive oil exert their biological benefits mainly through antioxidant constituents. Though the composition of olive oil is complex, the major groups of compounds to contribute to its health benefits such as oleic acid, phenolics, and squalene[7], and have been found to inhibit oxidative stress. These olive antioxidants protect them from oxidation by the high temperatures and ultraviolet (U.V) rays. The olive oil preserve many of its antioxidant compounds. This is not seen with other vegetable oils, which tend to be more refined. The environmental conditions of growing olives alter the components of the oil, including its properties[8].

1.1 Types of olive oil

As mentioned previously, extra virgin olive oil is the most expensive, most natural and purest form of olive oil. It comes from the first cold pressing of the olives and is less than 1% acidic.

As this is the oil that is the least handled, it contains the highest amounts of Vitamin E and other antioxidants, making it the healthiest type of olive oil. Extra virgin olive oil is too good to be used for frying foods and should be reserved for drizzling on salads and breads or for making sauces and soups. If the oil that is extracted is too acidic, then it must be refined in order to make it palatable, which means that it will have to undergo heat and chemical treatment. The heat and chemicals alter the state of the olive oil and some of the vitamins, minerals and goodness are lost during the procedure.

The quality of virgin olive oil is not as good as the extra virgin, however, it still has a fine taste and is less than 2% acidic. Pure olive oil can be slightly misleading, as it is in fact a mixture of virgin olive oil and refined olive oil, as is the oil termed "olive oil".

1.1.1 Cancer: The phytonutrient in olive oil, oleocanthal, mimics the effect of ibuprofen in reducing inflammation, which can decrease the risk of breast cancer and its recurrence. Squalene and lignans are among the other olive oil components being studied for their possible effects on cancer.

1.1.2 Heart Disease: Olive oil helps lower levels of blood cholesterol leading to heart disease.

1.1.3 Oxidative Stress: Olive oil is rich in antioxidants, especially vitamin E, long thought to minimize cancer risk. Among plant oils, olive oil is the highest in monounsaturated fat, which doesn't oxidize in the body, and it's low in polyunsaturated fat, the kind that does oxidize.

1.1.4 Blood Pressure: Recent studies indicate that regular consumption of olive oil can help decrease both systolic and diastolic blood pressure.

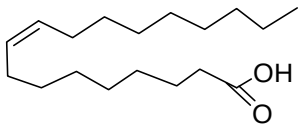
1.1.5 Diabetes: It has been demonstrated that a diet that is rich in olive oil, low in saturated fats, moderately rich in carbohydrates and soluble fiber from fruit, vegetables, pulses and grains is the most effective approach for diabetics. It helps lower "bad" low-density lipoproteins while improving blood sugar control and enhances insulin sensitivity.

1.1.6 Obesity: Although high in calories, olive oil has shown to help reduce levels of obesity.

1.1.7 Rheumatoid Arthritis: Although the reasons are still not fully clear, recent studies have proved that people with diets containing high levels of olive oil are less likely to develop rheumatiod arthritis.

1.1.8 Osteoporosis: A high consumption of olive oil appears to improve bone mineralization and calcification. It helps calcium absorption and so plays an important role in aiding sufferers and in preventing the onset of Osteoporosis.

1.1.9 Oleic Acid: Olive oil contains mainly oleic acid, a monounsaturated fatty acid (MUFAs)[9]. Olive oil is unique with respect to the high oleic acid content (approximately 72%) because the mostly seed oils are composed primarily of polyunsaturated fatty acids (PUFAs), including the ω-fatty acids, linoleic acid. Compared to PUFAs, oleic acid is MUFAs, it has only one double bond, making it much less susceptible to oxidation and contributing to the antioxidant action, high stability, and long shelf life of olive oil[10]. The health benefits of oleic acid are conflicting because that oleic acid plays an important role in cancer prevention. Whether a secondary effect of the fatty oil stability (preventing oxidative stress) or anticancer effect remains debatable[8]. Although oleic acid is found in high concentration in olive oil[11,12], than beef and poultry (30- to 45 %) oleic acid, while palm, peanut, soybean, and sunflower oil contain (25 to 49%) oleic acid[9]. Several *in vitro* and *in vivo* studies have examined the effect of oleic acid on cancer. I*n vitro* experiments, effect of olive oil or oleic acid on colorectal neoplasia. They concluded olive oil induces apoptosis and cell differentiation and down-regulates the expression of cyclooxygenase-2 (COX-2) and Bcl-2. The COX-2 is believed to play an important role in colorectal cancer development, while Bcl-2 is an intracellular protein that inhibits apoptosis. Oleic acid alone exhibited cell-line specific apoptotic induction, since HT-29 cells were affected but not Caco-2 cells. Oleic acid had no effect on the down-regulation of COX-2 and Bcl-2. Olive oil was found to have no effect on cell proliferation. The researchers concluded oleic acid plays a minor role, if any, in colorectal chemoprotection and that other components of olive oil are involved in this protective process[13]. *In vitro* studies conducted the effect of oleic acid on breast cancer cell lines. The results are encouraging and support that oleic acid is important in chemoprotection[11].



Oleic acid

1.1.10 Phenolic Constituents: A range of phenols in olive oil provides some of its health benefits. The total phenolic content has been reported to be in the range of 196-500 mg/kg[7]. Although the phenolic compounds in olive oil vary widely, extra virgin olive oil has a higher phenolic content than refined virgin olive oil[7,15] this difference was reflected in the levels of individual phenols as well as the total quantity of phenols in the oil[10]. The

concentration of phenols depends on a number of factors, like environmental growth conditions, method of oil production, and storage conditions[3]. Olive oil phenols can be divided into three categories: simple phenols, secoiridoids, and lignans, all of which are antioxidants. Major phenolic compounds include hydroxytyrosol, tyrosol, oleuropein[16] and ligstroside[7]. Hydroxytyrosol and tyrosol are simple phenols and oleuropein is a secoiridoid (Figure 1). The simple phenols hydroxytyrosol and tyrosol are formed from the hydrolysis of the secoiridoid aglycones of oleuropein and ligstroside. Hydrolysis of oleuropein, which occurs during olive oil storage[17], results in the formation of hydroxytyrosol, tyrosol, and ethanol[18]. As well as being present in olive oil, hydroxytyrosol is endogenous to the brain as a catabolite of neurotransmitter breakdown[8]. The phenolic content of the olive fruit changes as it grows and develops. After six months of growth, the major phenols are the glucosides of ligstroside and oleuropein[7]. As the olive matures these compounds are deglycosylated by glucosidase enzymes to free secoiridoids[7]. Unlike the glucosides, free secoiridoids can be detected in olive oil. Because the free secoiridoids are able to cross the oil/water barrier, these compounds partition into the oil[7]. Black olive pericarp extract has a higher concentration of phenolic compounds and a higher antioxidant capacity than green olive pericarp extract[6].

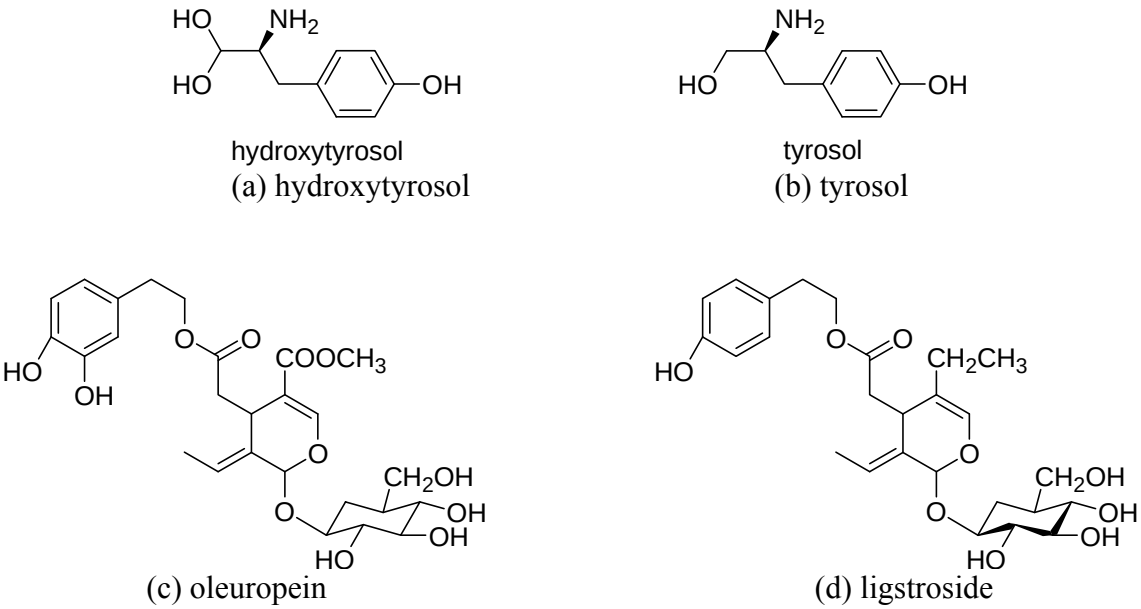


Fig 1: Olive Oil Phenols

It has been known for many years that compounds with a catechol group exhibit antioxidant activity[3]. The catechol group is able to stabilize free radicals through the formation of intramolecular hydrogen bonds. Of the three main phenols in olive oil, hydroxytyrosol and oleuropein are catechols and tyrosol is a mono-phenol. It has been suggested that, of all the phenols present in olive oil, only the catechols are important[3]. Hydroxytyrosol and oleuropein scavenge free radicals and inhibit low density lipoprotein (LDL) oxidation[3,7]. These two phenols show dose-dependent activity and are considered potent antioxidants, demonstrating activity in the

micro-molar range. Both are more potent free radical scavenger than the endogenous antioxidant vitamin E and the exogenous antioxidants dimethyl sulfoxide (DMSO) and butylated hydroxytoluene (BHT)[3,7]. These two catechols have been shown to scavenge a variety of endogenous and exogenous free radicals and oxidants, including those generated by hydrogen peroxide,7 hypochlorous acid, and xanthine/xanthine oxidase[3]. Higher concentrations of tyrosol are needed to exert an antioxidant effect. Using hydroxyl radical scavenging as a measure of antioxidant capacity, olive oil has a higher antioxidant capacity than seed oils and extra virgin olive oil is more potent than refined virgin olive oil10 due to its higher concentration of antioxidants. Similar results were obtained when xanthine oxidase[10] and hypochlorous acid[3] were used. Olive oil phenols are capable of scavenging free radicals produced in the fecal matrix, which is thought to explain the epidemiological data suggesting a colonic chemoprotective effect of olive oil[7]. One mechanism associated with the anticancer effects of hydroxytyrosol and oleuropein is prevention of DNA damage, which can prevent mutagenesis and carcinogenesis[3]. Hydroxytyrosol, however, has biological activity beyond its antioxidant capacity, as it can affect a range of enzymes, including COX and NAD(P)H oxidase[3], and reduce platelet aggregation[3,19]. Recently a secoiridoid derivative, oleocanthal (Figure 2), having an extreme irritant effect on the throat, has inhibition of COX enzymes and anti-inflammatory activity[20].

1.1.11 Squalene: Squalene, is a triterpene hydrocarbon (Figure 3) and a major intermediate in the biosynthesis of cholesterol. Although found in both plants and animals, in vastly different amounts[9]. While olive oil is composed of approximately 0.7% squalene,9 other foods and oils typically have squalene levels in the range of 0.002-0.03%. Only a slight difference between the level of squalene in extra virgin and refined virgin olive oils (extra virgin having higher levels)[7]. Although squalene is widely distributed throughout the body, the majority is transported to the skin.9 Sebum has high levels (12%); whereas, adipose tissue has much lower levels (0.001-0.04%).9 Due to squalene's structure, it is more likely to scavenge singlet oxygen species than hydroxyl radicals[9]. Exposure to high levels of ultraviolet radiation causes the formation of carcinogenic singlet oxygen species within the skin, where a high concentration of squalene may provide a chemoprotective effect[9]. Studies have shown topical squalene has an inhibitory action on chemically-induced skin carcinomas[9]. Squalene added to the diet of rats resulted in an 80% increase in serum squalene levels and inhibition of the hepatic enzyme HMG-CoA reductase[9].

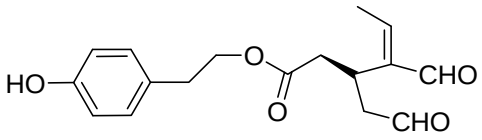
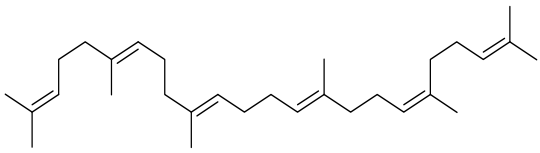


Fig 2: The Structure of Oleocanthal

The enzyme inhibition may be due to squalene or its metabolites. HMG-CoA reductase, the rate-limiting enzyme in the biosynthesis of cholesterol, results in decreased production of cholesterol and intermediates by its biosynthesis. These intermediates are commonly needed to activate oncogenes[9]. One important intermediate is the compound farnesyl pyrophosphate (FPP), which is involved in the prenylation of several oncoproteins. Because other dietary substances that cause a reduction in FPP levels cause a reduction in tumor growth, squalene is hypothesized to

work in the same manner[9]. Administration of squalene, the rate of cholesterol synthesis increased[21]. Whereas, chronic long-term administration results in reduced HMG CoA reductase activity and increased fecal elimination of cholesterol[21]. Studies have shown increased dietary squalene, while increasing serum squalene levels, does not cause an increase in serum cholesterol or atherosclerosis[22].

1.1.12 Cooking with Olive Oil: Olive oil is consumed cold in salads. Therefore, it is important to determine the stability of the identified active components when subjected to heat. The major process contributing to the instability of olive oil when stored or heated is fat oxidation[4]. Sufficient exposure and degradation can lead to significant changes in the composition of olive oil, and these changes affect its biological properties. Due to the reduction in polyphenol content during heating, cooking with olive oil produces a number of degradation products[23], with lipid peroxidation occurring to a limited extent. The heating method also affects degradation. In traditional cooking, olive oil is boiled or heated conventionally. In recent times, the introduction of the microwave oven has added another method to heat olive oil[23,24]. For conventional heating, a time-dependent effect is observed, with the phenolic content being reduced as heating time increases[23]. Individual phenols react differently to conventional heating; for example, hydroxytyrosol levels decrease rapidly, as do lignans, but at a slower rate[23]. With respect to microwave heating, changes in polyphenol content and degradation products than conventional heating[23,24]. The length of time the oil is heated in a microwave appears to have a dramatic effect on degradation of the oil[23,24]. The effects of boiling olive oil in a pressure cooker and concluded that water of pH 4-5 (acidic) was a major contributing factor to the level of degradation.



squalene

Fig 3: The Structure of Squalene

Lipid peroxidation products have been linked to cancer and cardiovascular disease[4]. Compared with other oils used for cooking, olive oil has a high concentration of MUFAs and a low concentration of PUFAs. This means fewer targets for reactive oxygen species (ROS), making olive oil more stable and less likely to undergo peroxidation. In addition, olive oil contains many antioxidants that reduce lipid peroxidation.4 Although antioxidants protect olive oil from thermal degradation[25], frying reduces the oil's antioxidative capacity[26], a particularly important fact when the same oil is used repeatedly. The low oxygen exposure of the oil and a short cooking time reduce the potential for lipid peroxidation[4]. However, because the oil is more likely to be re-used, accumulation of polymeric compounds occurs as the antioxidant capacity is being reduced[4,27]. Compared to other oils, olive oil has a relatively long deep-fat frying "shelf-life" and is more stable than other oils for repeated frying[4,27,28]. Because exchange between lipids in the food and the oil occurs during cooking, the type of food fried also plays a role. For example, frying fish increases the oil's instability because the oil becomes enriched with PUFAs, which are more susceptible to oxidative degradation than MUFAs[4]. Although frying foods with a high protein content such as meat, fish, and eggs can potentially produce carcinogenic heterocyclic amines (HCAs), the

antioxidants present in olive oil limit the formation of HCAs [28,29].

2. The Effect of Olive Oil on Specific Conditions

2.1 Coronary Heart Disease:

Epidemiological studies demonstrate the olive oil reduces the incidence of CHD [30,31]. The antioxidant effects of olive oil may contribute to these protective effects. To understand how olive oil might help prevent atherosclerosis, a review of atherosclerotic plaque formation is in order. Oxidation of LDL cholesterol has been identified as one of the first steps in the development of atherosclerotic lesions by promoting injury to the arterial wall through several mechanisms, including growth factor and chemotactic protein expression, inflammation, and increased local macrophages. Macrophages bind to and engulf oxidized LDL-an innate immune response to tissue damage. This engulfment produces a fatty foam cell, which, when combined with other cells, produces a fatty streak in the blood vessel[32]. Oxidized LDL can also be taken up directly by endothelial and smooth muscles cells, leading to formation of fatty streaks, which is the first sign of atherosclerosis. The lesions forming atherosclerotic plaques are made up of lipids, endothelial and smooth muscle cells, and extracellular matrix. The plaque environment is proinflammatory[4]. Inflammation occurring prior to the formation of fatty streaks and atherosclerotic lesions causes alterations to the endothelial cell wall, which increases the adhesion of leukocytes, LDL cholesterol, and platelets. This contributes to the development of atherosclerosis and cardiovascular disease [32]. *In vitro* studies have demonstrated hydroxytyrosol and oleuropein are capable of inhibiting production of isoprostanes, a marker of LDL oxidation[33]. It has been suggested that phenols present in olive oil may act synergistically with these constituents to prevent LDL oxidation.

2.2 Hypertension:

As with other aspects of cardiovascular diseases, there is a reduced incidence of hypertension in populations that consume the unsaturated fatty acid containing diet [16,34,35] Several studies have demonstrated the antihypertensive properties of olive oil [1,5,36-38]. The intravenous administration of olive oil extract reduced systolic, diastolic, and mean arterial blood pressures in normotensive rats[1]. The protective effect of diet rich in PUFAS with high in MUFAs (olive oil) in patients taking antihypertensive medications[37,38] and found individuals who consumed an olive oil-rich diet were able to reduce the dosage of antihypertensive medication. Olive oil's precise mechanism of action for B.P reduction is unknown, although several theories have been proposed. Such as olive oil is a Ca^{+2} channel antagonist, closely mimicking the effects of the Ca^{+2} channel blocker drug verapamil.1 Another suggested mechanism is via improved endothelial function[16,37,39]. Phenols and oleic acid may contribute to improved endothelial function by reducing ROS[16]. Other potential mechanisms have been suggested, including decreasing vascular tone and changes to the fatty acid and phospholipid composition of the aorta [38].

2.3 Cancer:

Because strong epidemiological evidence suggests people who consume the Mediterranean diet have a lower incidence of certain cancers, including breast, skin, and colon[4,7], research has focused on possible mechanisms to explain this phenomenon. Oxidation of proteins, DNA, and lipids has been shown to contribute to cancer development, and consumption of antioxidants is believed to reduce the risk of

mutagenesis and carcinogenesis[12]. Antioxidants are present in olive oil, fruits, and vegetables that makes to the apparent dietary chemoprotection. *In vitro* studies have found olive oil phenols are potent antioxidants, which may provide potential chemoprotective properties, although *in vivo* data are lacking. Research examining phenolic compounds has found hydroxytyrosol is capable of protecting cells from hydrogen peroxide damage and DNA from peroxynitrite-induced damage, blocking cell cycle progression at the G1 phase, and inducing apoptosis[19]. *In vivo* and *in vitro* studies on the activity of oleuropein have found, in addition to antioxidant properties, it has antiangiogenic action and inhibits cell growth, motility, and invasiveness[40]. Oleuropein has also been found to cause cell rounding, which disrupts the cell actin cytoskeleton. Oleuropein also affects and disrupts purified actin filaments, providing direct antitumor effects due to cell disruption[40]. In *in vivo* animal studies, rapid tumor regression was observed when mice were given one-percent oleuropein in drinking water[40]. SFAs and PUFAs in the diet have been implicated in colon, breast, prostate, and ovarian cancers[41]. The substitution of olive oil may explain its apparent cancer-protective effect and accentuate the importance of the type, rather than the amount, of fat consumed.

2.4 Colon Cancer: The carcinogenic heterocyclic amines (HCAs) produced when protein-containing food is fried have been found to induce breast, colon, and pancreatic cancer in rats[28].Based on this evidence, the relationship between fried foods and colorectal cancer[28]. When olive oil was compared to other oils, it was found that fried olive oil has a protective effect against colon cancer. This agrees with data that unheated olive oil is beneficial in protecting against colon cancer[28]. As described previously, when olive oil is used for frying, fewer HCAs are produced than when oils high in PUFAs are used. Later, the *in- vitro* study showed the effect of virgin olive oil phenols on colorectal carcinogenesis[42]. Using specific cell lines, they investigated processes involved in cancer initiation, promotion, and metastasis–the three main stages in cancer development–and concluded olive oil phenols exert beneficial effects in all three stages. The oil extract was shown to reduce DNA damage (initiation), increase barrier function (promotion), and reduce cell invasion of surrounding tissue (metastasis)[42].

2.5 Breast Cancer: Most of the active compounds in olive oil are lipid soluble; however, even though the phenolic glycosides are less so, they are likely to be stored in fat tissue. This may explain the chemoprotective effect against breast cancer and the low incidence of breast cancer in Mediterranean countries. In addition, oleic acid is incorporated into the phospholipid membrane of breast tissue cells, resulting in a reduction in lipid peroxidation[42,43,5,7].
Case control studies that looked at women have shown an inverse correlation between olive oil consumption and the incidence of breast cancer[43,44]. The relationship between MUFAs intake, the storage of MUFAs in breast tissue, and postmenopausal breast cancer[41,42]. Animal studies using dimethyl benz(α)anthracene-induced cancer have shown a diet rich in olive oil has a non-promoting effect on carcinogenesis. This effect is backed up by histopathological and morphological features[45,46].

2.6 Antimicrobial Activity: *In vitro* studies have demonstrated the antimicrobial activity of hydroxytyrosol, tyrosol, and oleuropein against several strains of bacteria implicated in intestinal and respiratory infections. Hydroxytyrosol and oleuropein have

antimicrobial action. It has been proposed that this action is due to the two ortho-positioned phenolic groups in their structure (Figure 1)[15]. A recent study found virgin olive oil has bactericidal action against *Helicobacter pylori*[17], the primary cause of gastric ulcers and linked to gastric cancers.

In recent years some strains have shown resistance to the typical antibiotics used to eradicate the infection and aid ulcer healing. Because phenolic compounds have been identified as having antibacterial properties, olive oil, with its high phenolic content, has been studied for *H. pylori*. Phenols inhibited bacterial growth at low concentration and were stable for several hours in the highly acidic environment of the stomach. They found the secoiridoid aglycones, particularly the dialdehydic form of decarboxymethyl ligstroside, have the greatest anti-*H. pylori* activity and are not hydrolyzed in the stomach[17]; hydrolysis, if it occurs, produces the less active hydroxytyrosol and tyrosol. As the concentration of phenolics needed to kill *H. pylori* cells is higher than that for antibiotics, the researchers suggest virgin olive oil should be considered as preventive rather than a treatment agent. The mechanism by which phenolic compounds affect *H. pylori* is unknown at present[17].

2.7 Rheumatoid Arthritis: Rheumatoid arthritis (RA) is an autoimmune disease characterized by chronic joint inflammation and damage. The initial autoimmune stimulus is unknown; however, joint and tissue damage occurs by a variety of mechanisms, many of which involve reactive oxygen species. ROS can cause destruction of hyaluronic acid and disruption to collagen, proteoglycans, protease inhibitors, and membrane function, the latter via oxidation of membrane fatty acids[47]. The initiation of RA is believed to result in an increase in the concentration of macrophages and neutrophils in the synovial fluid and free-radical-producing enzymes. This leads to high levels of ROS in the joints, which increases and prolongs inflammation and damage[47]. The antioxidant effect of olive oil has been found to reduce inflammation. In addition, dietary omega-9 MUFAs, such as oleic acid, have been found to replace omega-6 PUFAs in several aspects of cell metabolism. Reducing the competition between omega-6 and omega-3-PUFAs can lead to an increased use and incorporation of omega-3-PUFAs[47]. A number of studies that examined the benefits of fish oils in RA used an olive oil placebo for the control groups[48-50]. Although results highlighted the benefits of fish oils, unexpected significant improvements were also seen in the control groups. Benefits including pain reduction, reduced morning stiffness, and improved patient evaluation of global disease were reported by patients receiving olive oil only[50]. As a result, olive oil improved RA symptoms in patients already receiving fish oil[51]. Olive oil appears to act synergistically with omega-3 fish oils to improve the symptoms of RA; the benefits are thought to be exerted through the oleic acid component. Oleic acid is converted to eicosatrienoic acid (ETA) and then leukotriene A3 (LTA3). LTA3 is a potent inhibitor of proinflammatory leukotriene B4 synthesis[51]. It has also been shown that olive oil consumption decreases the risk of developing RA[52].

2.8 Olive Oil Diet Reduces Risk of Type 2 Diabetes

Traditionally a low fat diet has been prescribed to prevent various diseases such as heart disease and diabetes. While studies have shown that high fat diets may increase the risk of certain diseases such as cancer and diabetes, it appears that it is the *type* of fat that counts rather than the amount of fat. We now know that a diet rich in

monounsaturated fats such as the ones found in olive oil, nuts and seeds actually protects from many of these chronic diseases.

A recent Spanish study published in the scientific journal Diabetes Care showed that a Mediterranean style diet rich in olive oil reduces the risk of type II diabetes by almost 50 percent compared to a low fat diet. Type II diabetes is the most common and preventable form of diabetes.

2.8 Olive Oil Fights Osteoporosis

The results of a study announced this week into the possible treatment methods for osteoporosis have found that olive oil could play a role in both the future development of drugs as well as in the dietary requirements of patients. Osteoporosis is a disease characterized by a decrease in bone mass, which in turn causes the architecture of bone tissue to become fragile. This can then increase the possibly of fractures, making even the slightest of knocks potentially fatal for sufferers. The disease is recognized as being particularly prevalent among postmenopausal women for whom a decrease in the production of estrogen then weakens bone structures and most commonly affects the ribs, wrists, and hips. For this study, scientists were particularly interested in how a supplementation of olive oil could be used to help women in this category. Tests were carried out on rats showing comparable conditions to female human menopause, with one group being treated orally with olive oil. At the end of the experiment, blood samples were collected and tested for levels of calcium, phosphorus, alkaline phosphatase (ALP), malondialdehyde (MDA), and nitrates. The results found that that rats not treated with olive oil showed a significant decrease in calcium levels and a significant increase in plasma ALP, MDA, and nitrates levels. Olive oil supplementation proved to be beneficial and was found to both attenuate these changes and to positively affect the thickness of bones.

2.9 Olive Oil May Protect from Depression

It is common knowledge that olive oil and the Mediterranean diet confer a multitude of health benefits. But what about emotional health benefits? A diet rich in olive oil can protect from mental illness. The study included 12,059 volunteers who were part of the SUN Project, a prospective study among Spanish university alumni, aimed to identify the dietary determinants of stroke, coronary disease and other disorders. The researchers followed these volunteers for over 6 years and gathered data on lifestyle factors such as diet as well as medical history. At the beginning of the study none of the volunteers suffered from depression, and by the end of the study, 657 new cases were detected. In addition, the researchers discovered that a higher intake of olive oil and polyunsaturated fats found in fatty fish and vegetable oils was associated with a lower risk of depression. According to the researchers these findings suggest that cardiovascular disease and depression may share some common mechanisms related to diet.

2.10 A Good Beauty Treatment

Olive oil is rich in a number of vitamins, particularly vitamins E and K. Vitamin E is a powerful antioxidant, which destroys free radicals in the body and protects against cancer. Vitamin E keeps the skin supple, smooth and fresh looking and is said to delay the ageing process, which is why it is often added to skin creams. Olive oil is also said to give shine and bounce to dull hair and strength to brittle nails. All in all, olive oil is an excellent tonic for both inside and outside the body. One tablespoon of olive oil a day mixed together with fresh orange or lemon juice is thought to maintain a healthy

and supple body with shiny hair and smooth skin.

2.11 Uses of Olive Oil

- Drizzle over salad with cider vinegar, salt and pepper
- Make other types of salad dressings
- Use to make homemade mayonnaise
- Brush onto meat, fish or poultry before grilling or roasting
- Use to make pasta sauce bases and add herbs, chillies and garlic
- Use to make homemade soups and stews
- Drizzle over rice salads or couscous
- Drizzle over potatoes and other vegetables for roasting
- Drizzle over toasted French bread, rubbed with garlic and sprinkle with salt

3. Conclusion

Considerable evidence indicates the monounsaturated fatty diet is linked to a decreased incidence of cardiovascular disease and certain cancer types. An important component of this diet is the main source of fat–olive oil. Since research concludes fat intake has a positive correlation with the risk of CHD and cancer, and the MUFAs diet is high in fat. Saturated fatty acids have been linked to unfavorable health outcomes; whereas, MUFAs have been found to be beneficial, even though olive oil contains no essential omega-3 or omega-6 PUFAs. The high level of the MUFA oleic acid in olive oil is therefore believed to contribute to the low incidence of chronic diseases. Recent studies compare a diet rich in olive oil to one low in olive oil. These studies provide good evidence olive oil may be beneficial for reducing high blood pressure and preventing breast and colon cancer. The antioxidant capacity of olive oil contributes to many of its health benefits. Oleuropein and its hydrolysis product hydroxytyrosol are the most potent antioxidants. The antioxidant action of olive oil *in vitro* has been linked to such benefits as chemoprotection, anti-inflammatory action, and prevention of atherosclerotic plaque formation.

However, evidence that the active compounds in olive oil are capable of distribution throughout the body. It has been estimated that[55-66] percent of olive oil phenols are absorbed after ingestion, the majority in the small intestine[53]. Phenols are believed to act in the blood vessels to prevent LDL oxidation and in tissues to protect against DNA damage. In addition, olive oil phenols retain antioxidant activity *in vivo* when given orally[3]. Research has focused on the effects of olive oil rather than whole olives. However, it seems safe to assume the benefits of olive oil also apply to consumption of whole olives because the therapeutic components of the oil are also found in the whole olive. The extra virgin olive oil contains significantly more antioxidants than refined virgin olive oil and husk oil. Because *in vitro* studies have shown the antioxidant activity of hydroxytyrosol and oleuropein is dose dependent, the amount of olive oil consumed is likely to affect its chemoprotective and cardioprotective effects[54].

The amount of olive oil or length of consumption needed to achieve health benefits[7]. Regarding breast cancer, the highest protective effect of olive oil was seen in women who consumed ≥30.5 g/day[44]. With respect to B.P reduction, an effect was seen with dietary supplementation of 40 g/day for men and 30 g/day for women,38 which equates to approximately 15 kg/year and 11 kg/year, respectively. Olive diet reduced incidences of CHD and certain type of cancers. Olive oil is also not the only component of the diet that has been found to have biological

benefits. The evidence indicates, however, that olive oil and its components contribute significantly to the health benefits, with more of an effect on prevention than treatment.

4. References

1. Gilani AH, Khan AU. Shah AJ, et al. Blood pressure lowering effect of olive is mediated through calcium channel blockade. Int J Food Sci Nutr 2005;56:613-620.
2. Wahrburg U, Kratz M, Cullen P. Mediterranean diet, olive oil and health. Eur J Lipid Sci Technol 2002;104:698-705.
3. 3. Visioli F, Poli A, Gall C. Antioxidant and other biological activities of phenols from olives and olive oil. Med Res Rev 2002;22:65-75.
4. Harwood JL, Yaqoob P. Nutritional and health aspects of olive oil. Eur J Lipid Sci Technol 2002;104:685-697.
5. Keys A, Menotti A, Karvonen MJ, et al. The diet and 15-year death rate in the Seven Countries Study. Am J Epidemiol 1986;124:903-915.
6. Owen RW, Haubner R, Wurtele G, et al. Olives and olive oil in cancer prevention. Eur J Cancer Prev 2004;13:319-326.
7. Owen RW, Giacosa A, Hull WE, et al. Oliveoil consumption and health: the possible role of antioxidants. Lancet Oncol 2000;1:107-112.
8. Visioli F, Galli C, Galli G, Caruso D. Biological activities and metabolic fate of olive oil phenols. Eur J Lipid Sci Technol 2002;104:677-684.
9. Newmark HL. Squalene, olive oil, and cancer risk: a review and hypothesis. Cancer Epidemiol Biomarkers Prev 1997;6:1101-1103.
10. Owen RW, Mier W, Giacosa A, et al. Phenolic compounds and squalene in olive oils: the concentration and antioxidant potential of total phenols, simple phenols, secoiridoids, lignans and squalene. Food Chem Toxicol 2000;38:647-659.
11. Menendez JA, Vellon L, Colomer R, Lupu R. Oleic acid, the main monounsaturated fatty acid of olive oil, suppresses Her-2/*neu* (erbB-2) expression and synergistically enhances the growth inhibitory effects of trastuzumab (Herceptin) in breast cancer cells with Her-2/*neu* oncogene amplification. Ann Oncol 2005;16:359-371.
12. Visioli F, Grande S, Bogani P, Galli C. The role of antioxidants in the Mediterranean diets: focus on cancer. Eur J Cancer Prev 2004;13:337-343.
13. Llor X, Pons E, Roca A, et al. The effects of fish oil, olive oil, oleic acid and linoleic acid on colorectal neoplastic processes. Clin Nutr 2003;22:71-79.
14. Menendez JA, Papadimitropoulou A, Vellon L, Lupu R. A genomic explanation connecting "Mediterranean diet," olive oil and cancer: oleic acid, the main monounsaturated fatty acid of olive oil, induces formation of inhibitory "PEA3 transcription factor-PEA3 DNA binding site" complexes at the Her-2/*neu* (erbB-2) oncogene promoter in breast, ovarian and stomach cancer cells. Eur J Cancer 2006;42:2425-2432.
15. Tuck KL, Hayball PJ. Major phenolic compounds in olive oil: metabolism and health effects. J Nutr Biochem 2002;13:636-644.
16. Perona JS, Cabello-Moruno R, Ruiz-Gutierrez V. The role of virgin olive oil components in the modulation of endothelial function. J Nutr Biochem 2006;17:429-445.
17. Romero C, Medina E, Vargas J, et al. *In vitro* activity of olive oil polyphenols against *Helicobacter pylori*. J Agric Food Chem 2007;55:680-686.
18. Martinez-Dominguez E, De la Puerta R, Ruiz-Gutierrez V. Protective effects upon experimental inflammation models of a polyphenol-supplemented virgin olive oil diet. *Inflamm Res* 2001;50:102-106.
19. Fabiani R, De Bartolomeo A, Rosignoli P, et al. Cancer chemoprevention by hydroxytyrosol isolated from virgin olive oil through G1 cell cycle arrest and apoptosis. Eur J Cancer Prev 2002;11:351-358.
20. Beauchamp GK, Keast RS, Morel D, et al. Phytochemistry: Ibuprofen-like activity in extravirgin olive oil. *Nature* 2005;437:45-46.
21. Relas H, Gylling H, Miettinen TA. Dietary squalene increases cholesterol synthesis measured with serum non-cholesterol sterols after a single oral dose in humans. Atherosclerosis 2000;152:377-383.
22. Strandberg TE, Tilvis RS, Miettinen TA. Metabolic variables of cholesterol during squalene feeding in humans: comparison with cholestyramine treatment. J Lipid Res *1*990;31:1637-1643.
23. Brenes M, Garcia A, Dobarganes MC, et al. Influence of thermal treatments simulating

cooking processes on the polyphenol content in virgin olive oil. J Agric Food Chem 2002;50:5962-5967.
24. Caponio F, Pasqualone A, Gomes T. Effects of conventional and microwave heating on the degradation of olive oil. Eur Food Res Technol 2002;215:114-117.
25. Gennaro L, Bocca AP, Modesti D, et al. Effect of biophenols on olive oil stability evaluated by thermogravimetric analysis. J Agric Food Chem 1998;6:4465-4469.
26. Quiles JL, Ramirez-Tortosa MC, Gomez JA, et al. Role of vitamin E and phenolic compounds in the antioxidant capacity, measured by ESR, of virgin olive, olive and sunflower oils after frying. Food Chem 2002;76:461-468.
27. Galeone C, Talamini R, Levi F, et al. Fried foods, olive oil and colorectal cancer. Ann Oncol 2007;18:36-39.
28. Bastida S, Sanchez-Muniz FJ. Thermal oxidation of olive oil, sunflower oil and a mix of both oils during forty discontinuous domestic fryings of different foods. Food Sci Technol Int 2001;7:15-21.
29. Monti SM, Ritieni A, Sacchi R, et al. Characterization of phenolic compounds in virgin olive oil and their effect on the formation of carcinogenic/mutagenic heterocyclic amines in a model system. J Agric Food Chem 2001;49:3969-3975.
30. de Lorgeril M, Salen P. The Mediterranean diet in secondary prevention of coronary heart disease. Clin Invest Med 2006;29:154-158.
31. de Lorgeril M, Salen P. The Mediterranean-style diet for the prevention of cardiovascular diseases. *Public Health Nutr* 2006;9:118-123.
32. Patrick L, Uzick M. Cardiovascular disease: C-reactive protein and the inflammatory disease paradigm: HMG-CoA reductase inhibitors, alphatocopherol, red yeast rice, and olive oil polyphenols. A review of the literature. Altern Med Rev 2001;6:248-271.
33. Salami M, Galli C, De Angelis L, Visioli F. Formation of F2-isoprostanes in oxidized low density lipoprotein: inhibitory effect of hydroxytyrosol. Pharmacol Res 1995;31:275-279.
34. Carollo C, Presti RL, Caimi G. Wine, diet, and arterial hypertension. Angiology 2007;58:92-96.
35. Psaltopoulou T, Naska A, Orfanos P, et al. Olive oil, the Mediterranean diet, and arterial blood pressure: the Greek European Prospective Investigation into Cancer and Nutrition (EPIC) study. Am J Clin Nutr 2004;80:1012-1018.
36. Ruiz-Gutierrez V, Muriana FJ, Guerrero A, et al. Role of dietary oleic acid from different sources on fatty acid composition of erythrocyte membrane and blood pressure in healthy subjects. J Nutr Biochem 1997;8:689-695.
37. Alonso A, Ruiz-Gutierrez V, Martinez-Gonzalez MA. Monounsaturated fatty acids, olive oil and blood pressure: epidemiological, clinical and experimental evidence. Public Health Nutr 2006;9:251-257.
38. Ferrara LA, Raimondi AS, d'Episcopo L, et al. Olive oil and reduced need for antihypertensive medications. Arch Intern Med 2000;160:837-842.
39. Herrera MD, Perez-Guerrero C, Marhuenda E, Ruiz-Gutierrez V. Effects of dietary oleic-rich oils (virgin olive and high-oleic-acid sunflower) on vascular reactivity in Wistar-Kyoto and spontaneously hypertensive rats. Br J Nutr 2001;86:349-357.
40. Hamdi HK, Castellon R. Oleuropein, a nontoxic olive iridoid, is an anti-tumor agent and cytoskeleton disruptor. Biochem Biophys Res Commun 2005;334:769-778.
41. Simonsen NR, Fernandez-Crehuet Navajas J, Martin-Moreno JM, et al. Tissue stores of individual monounsaturated fatty acids and breast cancer: the EURAMIC study. European Community Multicenter Study on Antioxidants, Myocardial Infarction, and Breast Cancer. Am J Clin Nutr 1998;68:134-141.
42. Gill CI, Boyd A, McDermott E, et al. Potential anti-cancer effects of virgin olive oil phenols on colorectal carcinogenesis models *in vitro*. Int J Cancer 2005;117:1-7.
43. Sieri S, Krogh V, Pala V, et al. Dietary patterns and risk of breast cancer in the ORDET cohort. Cancer Epidemiol Biomarkers Prev 2004;13:567-572.
44. Masala G, Ambrogetti D, Assedi M, et al. Dietary and lifestyle determinants of mammographic breast density. A longitudinal study in a Mediterranean population. Int J Cancer 2006;118:1782-1789.
45. Solanas M, Hurtado A, Costa I, et al. Effects of a high olive oil diet on the clinical behavior and histopathological features of rat DMBA-induced mammary tumors compared with a high corn oil diet. Int J Oncol 2002;21:745-753.
46. Costa I, Moral R , Solanas M, Escrich E. High-fat corn oil diet promotes the development of high histologic grade rat DMBA-induced

mammary adenocarcinomas, while high olive oil diet does not. Breast Cancer Res Treat 2004;86:225-235.
47. Darlington LG, Stone TW. Antioxidants and fatty acids in the amelioration of rheumatoid arthritis and related disorders. Br J Nutr 2001;85:251-269.
48. Soeken KL, Miller SA, Ernst E. Herbal medicines for the treatment of rheumatoid arthritis: a systematic review. Rheumatology (Oxford) 2003;42:652-659.
49. Jantti J, Seppala E, Vapaatalo H, Isomaki H. Evening primrose oil and olive oil in treatment of rheumatoid arthritis. Clin Rheumatol 1989;8:238-244.
50. Kremer JM, Lawrence DA, Jubiz W, et al. Dietary fish oil and olive oil supplementation in patients with rheumatoid arthritis. Clinical and immunologic effects. Arthritis Rheum 1990;33:810-820.
51. Berbert AA, Kondo CR, Almendra CL, et al. Supplementation of fish oil and olive oil in patients with rheumatoid arthritis. Nutrition 2005;21:131-136.
52. Linos A, Kaklamani VG, Kaklamani E, et al. Dietary factors in relation to rheumatoid arthritis: a role for olive oil and cooked vegetables? Am J Clin Nutr 1999;70:1077-1082.
53. Vissers MN, Zock PL, Roodenburg AJ, et al. Olive oil phenols are absorbed in humans. *J Nutr* 2002;132:409-417.
54. Waterman E, Lockwood B. Active Components and Clinical Applications of Olive Oil. Altern Med Rev 2007;12(4):331-342.