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Positive Health Effects of Olive Oil

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Olive oil is the main source of fat in the Mediterranean diet. Although the use of olive oil has a long history, in recent decades it has experienced a full bloom all over the world. The consumption of olive oil in Croatia, as a Mediterranean country, is modest (2L per capita). This paper discusses basic characteristics of olive oil, with special emphasis on its health effects. Olive oil is rich in chlorophyll, carotenoids, and vitamin E, all of which serve as natural antioxidants, whereas its phenolic components, oleuropein and hydroxytyrosol, impact health positively in several ways. In addition to being powerful antioxidants, phenols in olive oil have anti-inflammatory, antiangiogenic, and anticancer properties. They modulate the immune system by affecting white blood cell proliferation and producing cytokine. The oil's anticancer properties are of particular importance.
Mono-unsaturated fatty acids raise the level of "good cholesterol," thus preventing the atherosclerosis process. Oleic acid in olive oil is less sensitive to oxidation, which is why it reduces the risk of harmful oxidation products. It has a high biological value and is easily digestible. Its antioxidant components slow down the ageing process and prevent the formation of cancer cells by neutralizing free radicals. It is important to preserve as many biologically active substances of olive oil as possible by properly storing and preparing the oil in order to maximize its effectiveness.

Keywords: Olive oil; mono-unsaturated fatty acids; phenols; health.

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1. INTRODUCTION

Olives are considered to be the oldest cultivated species. Their cultivation process began more than 6000 years ago in Mesopotamia and continued spreading towards Mediterranean countries. Oil can be considered olive oil only when it originates from the domesticated olive species called Olea Europea Sativa and such oil represents the most valuable type of fat in the human diet. The oil's properties are conditioned by many factors: soil type, species, agro-technical measures, fruit maturity, harvesting method and fruit storage methods [1]. Olive oil was especially valued by the ancient Greeks and Romans. The Romans classified olive oil into five categories: *oleum exalbis ulivis,* obtained by grinding green olives, *oleum viride,* produced from more mature olives, *oleum maturum,* made from fully ripe fruits, *oleum caducum,* obtained from fruits which fall on the ground naturally, and *oleum cibarium*, coming from the so-called almost *podriadas* olives, which were intended as slave food. According to some of our authors [2]. subspecies of some wild olive trees, such as *mastrinka* (*olea europea oleaster*), as well as some domesticated olive trees (*olea europea sativa*), grow naturally in our region and have nothing to do with Greeks and Romans arriving in it. In addition to being used in cooking, olive oil was used in cosmetics and for the treatment of various diseases (it is often mentioned by Hippocrates in his writings) [3]. Olive oil is an essential component of the Mediterraean diet and it's consumption is assosiated with many health benefit. According to Alarcon de la Lastra et al. plenty of date show a strong correlation between the adherence to the Mediterraean diet and virgin olive on mortality and morbidity. Extra virgin olive oil has beneficial effects such as inflammation,oxidative stress,platellet aggregation, coagulation, endothelial function, lipids and fibrinolysis according Riuz-Canela et al, 2011. There are many other bioactive componens such as squalene,sitosterole,pigments and triterpenes that have beneficial properties.

2. CHEMICAL COMPOSITION OF OLIVE OIL

2.1 Composition of Olive Oil

Olive oil consists of the glycerol fraction, i.e., the saponifiable fraction (90-99%) and the non-glycerol fraction, i.e. the non-saponifiable part (0.4-5%) [4]. Triglycerides and free fatty acids make up the saponifiable fraction, whereas the unsaponifiable fraction is made up of over two hundred compounds of different structures, such as aliphatic and triterpene alcohols, hydrocarbons, sterols, volatile compounds, carotenoids, phenolic compounds, etc. The content and type of compounds are what makes olive oil different from other edible oils, and some of the compounds contribute to the unique character and biological effect of the oil [4].

2.2 Saponifiable fraction of olive oil

Fatty acids present in olive oil are generally, up to 95%, attached to glycerol in the form of triglycerides. The composition of triglycerides in olive oil varies depending on the origin of the oil. Hydrolysis (lipolysis) of triglycerides releases fatty acids, increases acidity and such oil is of poorer quality . The amount of free fatty acids in the oil (acidity) is a direct indicator of the oil quality, and it also reflects how well the olive (starting from its flower phase to the point in which it turns to some fruit) is cultivated, processed, and stored; all of this affects the oil's sale and consumption [4]. Olive oil contains fatty acids which have 12 to 24 carbon atoms. Most of these acids, however, contain 16 and 18 carbon atoms, which can be saturated or of varying degrees of unsaturation in the cis configuration [5]. Oleic acid is the most abundant unsaturated fatty acid (55-83%). It is easily digestible and has a high biological value. In addition to oleic, monounsaturated fatty acids that can also be found in glycerides are palmitoleic and eicosenoic acid.

Essential fatty acids, linoleic (polyunsaturated, two double bonds, n-6) and α-linolenic (polyunsaturated, three double bonds, n-3) contribute to better oil quality [5]. Although olive oil contains the same fatty acids as other oils and fats, it is the ratio of different fatty acids that makes it unique and more valuable than others (Table 1). The ratio of linoleic and linolenic acid in olive oil corresponds to the ratio of these acids in breast milk, which is why the usage of olive oil is recommended in the nutrition of infants . The content of monounsaturated fatty acids is higher than polyunsaturated, which makes the oil more resistant to oxidation [5].

2.3 Unsaponifiable Fraction of Olive Oil

The unsaponifiable portion of olive oil may be lipophilic (meaning its components are soluble in oil fraction obtained during the processing procedure) or hydrophilic (meaning its

components are soluble in vegetable wastewater obtained during the processing procedure) [6].

2.4 Lipophilic Compounds

Hydrocarbons make up almost 60% of the saponifiable fraction of olive oil. Among these, squalene and carotenoids (pigments) are the most common, whereas others consisted in the fraction are saturated aliphatic hydrocarbons and neoformation products originating from sterols (diene hydrocarbons), diterpenes and triterpenes, isoprenoids ten-paraffins. Squalene is thought to have a chemoprotective effect on some cancers, and its content depends on the extraction process and is significantly reduced by the oil refining process [6]. Aliphatic alcohols in olive oil can be free or esterified . They are long-chain, saturated alcohols with 18 to 30 carbon atoms, and their content depends on the cultivar, vegetation year, fruit maturity and processing procedure . The fraction of aliphatic alcohols also contains two acyclic diterpenoids, phytol and geranyl, geraniol, and triterpene alcohols, such as erythrodiol and uvaol [6]. Hydroxy pentacyclic triterpenic acids, such as oleanolic and olive acid, although present only in traces, are important constituents of olive oil [6].

Sterols, as an integral part of the unsaponifiable fraction of olive oil, belong to tetracyclic compounds formed by biosynthesis from squalene. Sterols play the role of natural antioxidants and inhibit the process of oil spoilage. Their content is reduced by storage [7]. The chlorophyll and carotenoid pigments are responsible for olive oil's characteristic colour. The number of pigments, and thus the colour of the oil, is influenced by the species of the olive used for it, its degree of maturation, the production process, as well as its storage conditions. The most important lipophilic phenols in olive oil are tocopherols and tocotrienols. Tocopherols have a natural antioxidant effect and inhibit autooxidative oil spoilage (the process of oxygen from air binding to unsaturated bonds in the fatty acid chain). The tocopherol content in olive oil equals 150-330 mg/kg [7]. The most common tocopherol in olive oil is α-tocopherol, i.e., vitamin E (90% of all tocopherols), and it exists in α, δ and ω forms . Just one tablespoon of olive oil contains 8% of the recommended daily amounts of vitamin E [7].

2.5 Hydrophilic Compounds

Hydrophilic phenolic compounds from olive oil are a mixture of compounds of diverse chemical structure (phenolic acids, phenolic alcohols, hydroxyisochromans, flavonoids, etc.) responsible for most of olive oil's antioxidant properties [7]. The synergistic effect of hydrophilic phenols and α-tocopherols on the stability of virgin olive oil has also been confirmed. During the oil processing procedure, up to 80% of phenolic compounds are irreversibly lost together with vegetable wastewater. Phenolic compounds are mostly ambiphilic; they are distributed between the lipid (olive oil) and the aqueous phase (vegetable waste water) [8]. The presence of phenols in extra virgin olive oil and their content (0.02-1000 mg/kg) depends on a number of factors: olive species, geographical region, agro-technical measures, maturity of fruit during the harvest, olive oil extraction and processing, storage and usage (consumption) [9]. Phenolic acids, as aromatic secondary metabolites, are present in all plants. When it comes to olive oil, we distinguish between two types of phenolic acids: benzoic acid derivatives and cinnamic acid derivatives. In addition to these derivatives, other phenolic acids, such as phenylacetic acid derivatives, may be found in olive oil.

The most common phenolic alcohols in olive oil are tyrosol (4-hydroxyphenylethanol, p-HPEA) and hydroxytyrosol (3,4-dihydroxyphenylethanol, 3,4-DHPEA) [9]. Tyrosol and hydroxytyrosol may be present in free or esterified form. They are most esterified with elenolic acid (EA) to which glucose can bind to form a glycoside, i.e., compounds called secoiridoids [9]. Oleuropein is a tyrosol, that is, hydroxytyrosol, esterified with elenolic acid, to which glucose is bound. Ligstroside or oleuropein aglycones are formed during glucose cleavage. The most abundant secoiridoids in extra virgin olive oil are oleocanthal (p-HPEA-EDA, tyrosol bound to the dialdehyde form of elenolic acid) and 3,4-DHPEA-EDA (hydroxytyrosol bound to the dialdehyde form of elenolic acid) as well as 3,4-DHPEA-EA (oleuropein aglycone) [9]. Tyrosol and hydroxytyrosol, together with their secoiridoid derivatives, make up almost 90% of all phenols in extra virgin olive oil, but, due to their polar groups, almost 80% of that is lost during the refining process. The aglycone part of the structure is released when the fruit is crushed and ground under the influence of endogenous beta-glucosidase. During oil storage, due to hydrolysis the concentration of released tyrosol and hydroxytyrosol increases [10]. Phenolic compounds, in particular decarboxymethyl oleuropein aglycone, contribute to the

characteristic pungent and bitter taste of the oil [10]. Regarding other olive oil compounds, hydroxyisochromans, flavonoids (flavones, flavonols, anthocyanins) and lignans are also present in phenolic compounds, which can serve as a marker for the type of olive from which the oil was obtained [11]. Olive oil also contains about 280 volatile compounds (carbonyl compounds, alcohols, esters, hydrocarbons, etc.), only about 70% of which contribute to the smell of olive oil, whereas 20% of it contributes to its flavour. Other compounds have such a low concentration that they are imperceptible to our senses.

2.6 Bioavailability of Phenolic Compounds from Extra Virgin Olive Oil

Bioavailability refers to the ratio between the amount of olive oil ingested into the body and the amount that is actually digested, absorbed and metabolized by normal biochemical processes. The information on the absorption and availability of phenolic compounds from extra virgin olive oil is essential for determining its potential positive health effects [12]. Most studies on the bioavailability of phenols from olive oil have focused mainly on tyrosol, hydroxytyrosol and oleuropein. Tyrosol and hydroxytyrosol are absorbed about 10 minutes after the ingestion, and their serum concentration is dose-dependent: in humans, it can vary from 55 to 66% [12]. The bioavailability of tyrosol and hydroxytyrazole is higher when they taken as an integral part of olive oil, rather than as an aqueous solution. It is assumed that antioxidants in extra virgin olive oils may prevent the breakdown of phenolic compounds in the digestive system prior to absorption [13]. Tyrosol and hydroxytyrosol are small polar molecules and are thought to be absorbed by passive diffusion. Oleuropein is a larger polar molecule which contains glucose in its structure; thus, it probably uses glucose transporters to pass through the epithelial cells of the intestinal tract [13]. Even when moderate doses of olive oil (25 mL per day) are ingested, 37 to 98% of phenols are present in plasma and urine in the form of conjugates, mainly glucuronides, indicating extensive first-pass metabolism [13]. An important step in the metabolism of oleuropein, oleuropein aglycone and ligstroside is the release of tyrosol or hydroxytyrosol from their structures. Hydroxytyrosol is rapidly eliminated from plasma and excreted in the urine in free form (approximately 15%) or bound to glucuronic acid, and to a lesser extent (5%) it is excreted through the faeces. In addition to glucuronides, a significant increase in homovanillic alcohol and homovanillic acid produced by hydroxytyrosol metabolism with the help of catechol-O-methyltransferase enzyme was observed in the urine of healthy volunteers [13]. To fully explain the mechanism of absorption and metabolism of phenolic compounds from extra virgin olive oil, further research is certainly needed. Biological activity of phenolic compounds from extra virgin olive oil. The results of research of phenolic compounds in extra virgin olive oil have pointed to their important biological effects, which can not only have a beneficial effect on health, but also a preventive effect on the development of chronic degenerative diseases. It depicts some biological activities of important phenolic compounds of oleuropein and its derivatives [13].

Table 1. Fatty acid content in olive oil

Fatty Acid Name		***Content (%)***
Myristic	C14:0	<0.05
Palmitic	C16:0	7.5-20.0
Palmitoleic	C16:1	0.3-3.5
Heptadecanoic	C17:0	<0.3
Steraic	C18:0	0.5-5.0
Oleic	C18:1	55.0-83.0
Linoleic	C18:2	3.5-21.0
Alpha-linolenic	C18:3	<1.0
Arachic	C20:0	<0.6
Eicosenoic	C20:01	<0.4
Behenic	C22:0	<0.2
Lignoceric	C24:0	<0.2

The ratio of different fatty acids that makes it unique and more valuable than others

3. OLIVE OIL SENSORY CHARACTERISTICS AND CLASSIFICATION

Olive oil is the first agri-food product whose sensory analysis is based on the PANEL test (a special standardized analytical method performed by a group of selected, educated and trained evaluators) and serves as a criterion for market classification of products. According to EU Regulation No. 2568/91, it is determined that the oil must be subjected to sensory analysis in order to be classified in the appropriate quality category on the market. The analysis examines specific properties, desirable for extra virgin olive oil: bitterness, pungency, smell and taste [14]. Olive oil categories are classified on the basis of quality parameters relating to: physical and chemical properties, such as acidity level, peroxide value, fatty acid content and sterol composition, as well as organoleptic sensory characteristics, such as fruitiness, and the absence of organoleptic defects [14].

4. OLIVE OIL CLASSIFICATION

The Ordinance on Olive and Olive-Pomace Oils (*Pravilnik o uljima od ploda i komine maslina*, *Official Gazette, 7/2009*) contains the categorization of olive oils in the following categories: virgin olive oils, refined olive oils, olive oils produced by mixing refined olive oil, crude olive-pomace oil and olive-pomace oil. Extra virgin olive oil is the best and purest form of olive oil, has the finest, but also a complex taste. It is produced only by mechanical, physical methods of pressing and has the lowest level of acids. Its acidity level does not exceed 0.8% (0.8 g of free fatty acids, expressed as oleic acid per 100 g of product), its aroma is fruity and has no organoleptic defects. It is rich in chlorophyll and carotenoids that serve as natural antioxidants and prevent oil from turning rancid. It contains vitamin E in its best form – as tocopherol – and phenolic components. The acidity of virgin olive oil must not surpass 2% and may have slight organoleptic defects. The virgin olive oil of the worst quality is the lampante virgin olive oil: its acidity surpasses 2%, it has no fruit properties and has significant organoleptic defects. Olive oil composed of refined olive oil and virgin olive oils is produced by mixing refined olive oil and virgin olive oils (excluding lampante olive oil) and does not contain more than 1 g of free fatty acids. Olive-pomace oil is obtained by mixing refined olive-pomace oil and olive oils other than lampante oil, and its content of fatty acids is maximum 1% [14,15].

5. STORAGE AND USE OF OLIVE OIL

If stored properly, olive oil can reach second year of aging – antioxidants protect it from rancidity. It needs to be protected from direct light and heat and stored in dark glass bottles. Once exposed to air, it should be consumed as soon as possible and the bottle in which it is stored needs to be closed regularly [16]. Saturated and monounsaturated fatty acids are quite resistant to cooking, whereas polyunsaturated fatty acids are sensitive to heat. Extra virgin olive oil is rich in thermostable oleic acid, antioxidants, vitamin E and phenolic compounds. This composition makes it stable even at high temperatures. The smoke point of olive oil is significantly higher than standard household cooking temperatures. Extra virgin olive oil does not undergo significant structural changes at temperatures below the smoke point, and it retains its nutritional value better than other vegetable oils [16,17]. Research by Australian authors De Alze et al (2018), published in the *Acta Scientific Nutritional Health* journal, has shown that extra virgin olive oil is the safest and most stable type of oil, even when processed at high temperatures. However, it is worth mentioning that it loses biologically valuable compounds such as phenols, vitamin E and volatile substances, which affects the changes in the flavour and smell of the oil.

6. OLIVE OIL AND HEALTH

As a Mediterranean country, Croatia consumes a Mediterranean diet. Among the main features of the diet are: high consumption of fruits, vegetables, legumes, nuts, seeds and grains. Fish is consumed moderately, meat slightly less and the most common type of meat consumed is chicken. The cheese and yoghurt are also popular. An important characteristic of the Mediterranean diet is the consumption of olive oil and various Mediterranean herbs in the form of spices, and moderate consumption of wine, usually with meals. The main source of fat in the Mediterranean diet is olive oil. According to the recommendations of the World Health Organization, 15-20% of total caloric intake should be consisted of fats. Fats are not just a source of energy, they have a manifold role: they are an integral part of cell membranes, they protect internal organs from injuries and extreme temperatures, they participate in hormone metabolism, and they dissolve vitamins A, D, E

and K. Eicosanoids, substances that control all hormonal systems and vital physiological functions, are synthesized from fats. The first more systematic study that confirmed the beneficial effects of the Mediterranean diet on human health was conducted by Americans after World War II. The *Rockefeller Foundation* research team came to the Greek island of Crete in 1948 to investigate the demographic, social, economic, nutritional and health characteristics of the population. The Greek government hired this team with the aim of improving the economic, social and health status of its citizens. The results of the study came as a surprise. They demonstrated that the incidence of heart diseases in the Greek population was 90% lower than in the United States. In the same way the incidence of some other chronic diseases was also reduced, and the life expectancy of Greek women was the longest in the world. The first definition of the Mediterranean diet was introduced by the American doctor Ancel Keys. He spent half of his life in the Mediterranean region. In the 1960s, he led a study of "seven countries" which included the former Yugoslavia. The study found a causal link between fat intake and mortality. He proved that there was a beneficial effect of unsaturated fatty acids on blood cholesterol levels. Mortality from coronary heart disease in Finland was as much as thirty times higher than in Greece, which was attributed to a diet containing more saturated fatty acids. The study also proved the benefits of consuming olive oil in reducing "bad LDL cholesterol", which is due to monounsaturated fatty acids and antioxidants, and the raise in the levels of "good HDL cholesterol". The levels of LDL and HDL cholesterol are responsible for the damage to the walls of blood vessels, as well as the development of atherosclerosis, which in turn can lead to a stroke or a heart attack [18].

6.1 Health Effects of Phenolic Components of Olive Oil

Phenolic compounds occur in the form of phenolic acids, alcohols, oleuropein derivatives, lignans and flavonoids. Phenolic acids in olive oil are derivatives of benzoic and cinnamic acid. The most abundant alcohols in olive oil are tyrazole and hydroxytyrazole [19]. The polyphenol content of olive oil depends on the maturity of the olives, agronomic factors, extraction technology, as well as storage and packaging processes. Virgin olive oil contains about 500 mg/L of polyphenols. Phenolic components are responsible for the bitter taste of olive oil. The positive effect of phenolic components depends on their bioavailability. Studies have shown that tyrazole and hydroxytyrazole are absorbed as early as ten minutes after ingestion. Olueropein is a larger molecule that contains glucose and it is thought to use glucose transporters to pass through the intestinal epithelial cell membrane [20].

6.2 Antioxidant Effect Of Phenols In Olive Oil

The antioxidant effect of phenols is related to their structure. During the metabolic processes in the body, free radicals that contain unpaired reactive electrons in the outer shell are formed. These radicals cause cell damage. Excessive production of free radicals or their impact from the environment leads to oxidative stress which is the cause of carcinogenesis, atherosclerosis, diabetes, and other degenerative and autoimmune diseases. Hydroxytyrazole has an antioxidant effect, as it removes free radicals and activates endogenous antioxidant systems in the body. Hydroxytyrazole is thought to increase the mitochondrial biosynthesis pathway through increased regulation of PCG-1α. Hydrixytyrazole protects mitochondria from reduced mitochondrial DNA synthesis and modulates the activity of critical transcription factors. Hydroxytyrazole and oleuropein have been shown to act synergistically with lesser known phenolic components [21,22,23,24].

6.3 Anti-Inflammatory Effects

Studies have demonstrated that daily consumption of olive oil reduces the risk of chronic inflammatory diseases, such as arthritis, cardiovascular disease neurodegenerative diseases and cancer. A few hours after the consumption of olive oil, the inflammatory markers TXB_2 and TLB_4 decrease in size. Oleocanthal from olive oil has a profile similar to the non-steroidal anti-inflammatory drug ibuprofen. It inhibits cyclooxygenase enzymes 1 and 2 involved in prostaglandin synthesis. The phenolic components of extra virgin olive oil reduce the concentration of the cytokine interleukin 6 (IL-6) and C reactive protein (CRP) in patients with coronary heart disease. A positive effect of oleocanthal has been observed in patients with osteoarthritis where it reduces the expression of the NO synthases (and NOS) in the patient's cartilage. The unique lipid composition of olive oil with a high content of monounsaturated fatty acids affects the reduction

of the inflammatory response in autoimmune diseases [25,26,27,28,29].

6.4 Impact On Cardiovascular Diseases

The antioxidant properties of hydroxytyrazole and oleuropen are associated with the prevention of atherosclerosis and the development of cardiovascular diseases [30]. *In vitro* and *in vivo* studies have demonstrated that the consumption of olive oil reduces the level of total cholesterol, triglycerides, low-density lipoprotein (LDL), reduces the activity of HMG-CoA (3-hydroxy-3-methylglutaryl coenzyme A) reductase, and increases the concentration of high-density lipoprotein (HDL). Hydroxytyrazole has an effect similar to acetylsalicylic acid, inhibiting platelet activity and aggregation. The consumption of extra virgin olive oil leads to a decrease in the levels of plasminogen activator inhibitor 1 (PAI-1) and factor VII (FVII), which are procoagulant factors that influence the development of thrombosis and coronary heart diseases. They also reduce the concentration of homocysteine, which increases endothelial adhesion [30,31].

6.5 Antitumor Activity

Olive oil polyphenols, in particular oleuropein and hydroxytyrazole, reduce the incidence of cancer in Mediterranean countries with significant olive oil consumption [32]. It has been proven that the consumption of olive oil reduces the incidence of colorectal cancer, skin cancer, and breast cancer [33]. Polyphenols protect cell membranes from oxidative damage, and hydroxytyrazole inhibits lipoxygenase, an enzyme responsible for leukotriene synthesis, which thus modulates the inflammatory response. Lignans from olive oil also have an effect on changing hormonal status due to their anti-estrogenic effect. Oleic acid in olive oil is less sensitive to oxidation and thus reduces the risk of harmful oxidation products. In colon cancer cells, hydroxytyrazole reduces the level of the epidermal growth factor receptor (EGFR) by promoting its degradation. EGFR is an important factor that triggers colon carcinogenesis because it regulates the proliferation, apoptosis, angiogenesis, and invasion of cancer cells. Oleuropein has antiproliferative, proapoptotic activity and it induces apoptosis in breast cancer cells by regulating the Bax and Bel2 genes. It has been shown to inhibit aromatase, a cytochrome P450 enzyme that is an important pharmacological target in the treatment of breast cancer. It is thought to alleviate the harmful effects during chemotherapy [34,35].

6.6 Antimicrobial Effect

Phenolic compounds can act on the membrane of microorganisms by increasing surface activity. They stimulate phagocytosis and affect the production of certain amino acids. Triazole has an antibacterial effect on Moraxella catarrhalis and Haemophilus influenzae. Hydroxytyrazole and oleuropein have a bacteriostatic and bactericidal effect on Staphylococcus aureus, Salmonella enteritidis. Oleuropein acts antivirally by stimulating phagocytosis and inhibiting reproduction [36,37].

6.7 Neuroprotective Action

Olive oil phenols protect against dementia and reduce the incidence of Alzheimer's disease. With aging, changes occur on mitochondrial membranes that are sensitive to free radicals due to the presence of double bonds in phospholipids. Oleocanthal inhibits the accumulation of Tau protein and protects the hippocampus from synaptopathological effects. Some research has shown that oleuropein can reduce the accumulation of Abeta (beta amyloid) in the brain, which binds at postsynapses, causing loss of synaptic function and neuronal damage [38].

6.8 Impact on Digestion

Consumption of olive oil affects the level of intestinal peptides; cholecystokinin, gastrin, secretin, somatostatin and peptide YY [39]. Olives are grown in all Mediterranean countries. The largest producers are Italy, Spain and Greece. Croatian olive growing has flourished in the last decade thanks to a number of objective circumstances, such as state incentives, the high price of olive oil, the introduction of new technologies, as well as positive attitudes about the health value of olive oil. Olive oils vary in taste and colour depending on the region they come from. Tuscan oils are strong in taste and green in colour, oils from Catalonia have a mild almond aroma, Greek oils have a very strong taste, and those from North Africa are sweet. The link between certain flavouring properties and chemical compounds from olive oil that have a beneficial effect on health are known facts. Phenolic compounds are the carriers of bitter taste and pungency, and they are found in extra virgin olive oil [40].

7. CONCLUSION

With its unique composition, olive oil has a beneficial impact on our health: it has a protective effect on the health of the heart and vasculary system. It is a powerful antioxidant and anti-inflammatory drug. Over the recent years the production of olive oil in Croatia has been increasing. Varieties are grown from which the highest quality extra virgin olive oils are obtained. The green colour and pungent taste indicate that it is an olive oil rich in chlorophyll and polyphenolic compounds that provide strong antioxidant protection. It is necessary to inform the public about the importance of the Mediterranean diet and olive oil as a source of the best fats in our diet.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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