

Jozef Miloš
Editor

Phenolic Compounds, Production and Health Benefits

Food Science
and Technology

Handbook of

Olive Oil

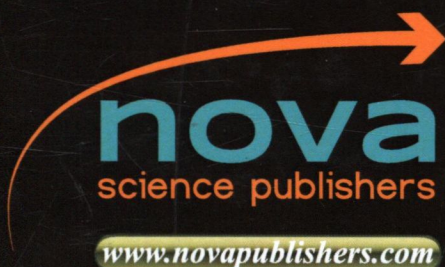
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Olive Oil



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FOOD SCIENCE AND TECHNOLOGY

HANDBOOK OF OLIVE OIL
PHENOLIC COMPOUNDS, PRODUCTION
AND HEALTH BENEFITS

JOZEF MILOŠ
EDITOR



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PREFACE

This book examines the latest research in olive oil. Topics included in this book include biomedical activities of olive oil phenolic compounds, including antioxidant, anti-inflammatory, antimicrobial, cardiovascular, endocrine, anticancer and central nervous system effects. Also, some insights related to bioavailability and synergistic activities are presented; a summary and critical analysis of the available information about phenolic compounds in VOO; the beneficial effects of phenolic compounds, contained in extra virgin olive oil, which have been reported in the last few years; an overview of different analytical approaches, including the most recent advances, and the difficulties regarding phenolic compounds determination in olive oil; olive oil wastes (OMW) characteristics, bio-valorization potentialities and treatment options with regard to the economic feasibility, environmental regulations and challenges of existing waste disposal practices in olive-growing countries are discussed; the health effects of olive oil, including for the liver; a summary of the knowledge of the *in vitro* and *in vivo* effects of oleocanthal comparing, where available; the determinant factors that affect Japan's olive oil imports; research on oleocanthal and its promising applications as a preventive and/or therapeutic agent for several diseases; and an examination of the organic olive oil sector, demonstrating its importance in terms of wealth and economic impact.

Chapter 1 - Olive oil and especially EVOO (Extra Virgin Olive Oil), in addition to being a basic food component of the Mediterranean Diet, plays an essential role in human health due to its polyphenols, sterols and antioxidants composition.

The alarming growth in the rates of obesity and diabetes is a problem in Western civilization child health. One of the causes of these pathologies is without a doubt the inadequate high-fat diet, in which components that include fats of animal origin and tropical vegetable origin are used. Currently, this causes the use of hydrogenated fats and others resistant to rancidity. This situation leads to the aforementioned pathologies and therefore makes it absolutely necessary to incorporate organoleptically pleasant EVOO in infant food.

This is why the objective of this chapter is to know the composition of compounds which play an important health role, such as sterols, tocopherols and polyphenols, all of them present in the main varieties of EVOO.

The study was conducted during five consecutive harvests of the composition of the oils, the production and yields of Western Mediterranean varieties. The biometric study of the different varieties has also been carried out, as well as its relationship pulp/stone and the relationships between these parameters are studied in order to establish a broader biochemical characterization of these olive varieties.

It is known that the type of crop, rainfed (with the sole contribution of precipitation) and different irrigation doses influence acidic composition, this is why the samples of the main varieties were studied in both conditions, and in trees located in two different areas of cultivation. Thus, the authors were able to establish a characterization and modeling of the composition of EVOO.

It is therefore established a better knowledge in light of the current focus on varietal oils and as a basis for formulated bi or polivarietals, to suit consumer demands and in particular to know the role of minority components in EVOO. All materials have been previously characterized by CPVO-TP/099/1.

Chapter 2 - The olive stage of ripeness influences in the olive composition i.e., phenolic compounds and concentration vary along ripeness process. Phenolic compounds are key in the oil quality as they are natural antioxidants that contribute to protecting the oil stability against oxidation. Phenols are present in the olive oil in a percentage from 0.1% to 0.3% depending on the olives state of ripeness from which olive oil was extracted. Olives and olive oil contain polyphenols such as oleuropein, hydroxy-tyrosol, tyrosol, rutin, and quercetin, as well as caffeic, vanillic, and o- and p-coumaric acids. Hydroxy-tyrosol significantly inhibits the lipid oxidation of olive oil and has a positive effect on human health. Previous studies have suggested that polyphenols present in the olive oil could improve the oxidative stability of canned products and reduce the concentration of carcinogenic compounds such as heterocyclic amines in fry processes. In fact, diets rich in natural foods and food-derived components such as phenolic compounds receive a great deal of attention because they are perceived as 'safe' and 'non-medicinal' which some are known to function as chemopreventive agents against oxidative damage, cerebrovascular disease, and aging. The phenolic composition and concentration are different for each olive variety, being the variety "Picual" the one of the highest phenolic concentration. The most abundant polyphenol among the varieties studied was hydroxy-tyrosol, with concentrations of 1.4–12 mg L⁻¹. In general, reduction in polyphenols content along ripeness process was observed. This reduction has been noted in the hydroxy-tyrosol concentration over the ripeness process and varied according to the olive variety, by 10, 2.8, and 1.6 mg L⁻¹ for the varieties 'Hojiblanca', 'Picual', and 'Arbequina', respectively. The evaluation of the influence of the degree of ripeness on oxidative stability of olive oils is important for decisions on producing oils

with a certain overall quality. The practice of harvesting ripe olives as soon as possible to produce oils of high phenolic contents and thus high oxidative stability implies bitter and piquant oils, this being admissible for oils of some varieties but detrimental to others appreciated in the market for being more fruity and sweeter.

Chapter 3 - Olive oil is a basic component of the Mediterranean diet. Mediterranean populations experience reduced incidence of cardiovascular disease, atherosclerosis, diabetes mellitus, metabolic syndrome, neurodegenerative diseases, certain types of cancer and higher life expectancy. Following impressive number of various biomedical studies related to the phenomena that accumulate for decades, these health benefits could be at least partially attributed to the olive oil, and more specifically the phenolic compounds naturally present in olive oil. While a number of reports have linked the health benefits of olive oil with its phenolic content, there is a great number of *in vitro* and *in vivo* studies that have demonstrated positive effects of olive oil phenolic compounds following analysis of certain physiological parameters. Thus, the phenolic compounds are deemed to be of central importance for beneficial antioxidant, antiatherogenic and anti-inflammatory, antimicrobial, cardiovascular, anticancer, and neuroprotective effects that can be ascribed to the consumption of extra virgin olive oils. The aim of this chapter is to review the biomedical activities of olive oil phenolic compounds, including antioxidant, anti-inflammatory, antimicrobial, cardiovascular, endocrine, anticancer and central nervous system effects. Also, some insights related to bioavailability and synergistic activities are presented.

Chapter 4 - The increasing popularity of olive oil is mainly attributed to its high content in phenolic compounds, which corresponds with the minor components fraction. Some polar olive oil phenols are not generally present in other fats, and this is one of the reasons that make this product unique. Phenolic compounds comprise a large family of secondary metabolites of plants and present a wide variety of health benefits. These compounds act as natural antioxidants and play an important role in the prevention of human diseases. Due to the chemical diversity of phenolic compounds, and to the fact that some of them are found at very low concentrations, their analysis is relatively complex.

Briefly, assays for phenols in olive oil can be classified as those determining the total content of polyphenols, and those allowing the determination of the individual phenolic profile. Most of the analytical methods used for the quantitative determination of total phenols in olive oil are based on colorimetric assays. The analysis of *o*-diphenolic compounds is also carried out by this type of determination. Qualitative and quantitative composition of phenols in olive oil varies because of the strong dependence on variety and ripeness of the fruit, agronomic factors, and the processing system used for its extraction. Therefore, the identification and quantification of the individual components of olive oil are of great interest. Extraction, chromatographic separation, and characterization are the three basic steps involved in the analysis of the phenolic profile

of olive oil. The extraction procedures are mainly based on liquid-liquid extraction (LLE) and solid-phase extraction (SPE) using, in most cases, methanol as solvent. Regarding the analytical separation, it can be accomplished by capillary gas chromatography (GC) and, mainly, reverse phase high-performance liquid chromatography (RP-HPLC) with different detectors. Capillary electrophoresis (CE) has also been used for this purpose, achieving the same aims than HPLC but higher resolution, and reducing sample volume and analysis time. Nevertheless, nowadays liquid chromatography coupled to mass spectrometry (HPLC-MS) is widely accepted as the main tool in identification, structural characterization, and quantitative analysis of phenolic compounds in olive oil. Nuclear magnetic resonance (NMR) spectroscopy is also a powerful complementary technique for structural assignment in the cases where mass spectral data are insufficient to establish a definitive structure for phenolic compounds. In recent years, the hyphenation of HPLC with the most information-rich spectroscopic technique NMR has been proposed for structure elucidation of phenolic compounds in olive oil. Several studies have been carried out regarding the development of efficient and accurate analytical methods for the qualitative and quantitative analysis of phenolic compounds in olive oil. This chapter pretends to show an overview of different analytical approaches, including the most recent advances, and the difficulties regarding phenolic compounds determination in olive oil.

Chapter 5 - Different scientific evidences suggest that the long term dietary consumption of virgin olive oil (VOO) seems to be related to an attenuation of the inflammatory response and reduction of the associated risk of chronic inflammatory disease states. VOO phenolic compounds are claimed to be the main responsible for these positive health benefits. They are mainly synthesized from phenolic glucosides present in the olive fruit by the action of glucosidases occurring when they come together once the olive fruit is crushed during olive oil extraction. The genetic variability of the major phenolic compounds was studied in a representative sample of olive cultivars (*Olea europaea* L.) from the World Olive Germplasm Collection established at IFAPA Centre "Alameda del Obispo" in Cordoba, Spain. The most abundant phenolic components found in VOO are the secoiridoid derivatives resulting from the enzymatic hydrolysis of oleuropein, ligstroside and demethyloleuropein present in the fruit, which showed to be on average the main phenolic glucosides. The mean content of phenolic compounds in the oils was 494.51 $\mu\text{g/g}$ oil, displaying a variability range of 63.74-1432.04 $\mu\text{g/g}$ oil. The mean content of phenolic compounds in the fruits was 12384.23 $\mu\text{g/g}$ fruit with a range of 3754.13-30696.39 $\mu\text{g/g}$ fruit. Total phenolic compounds in the fruits and the oils were significantly correlated ($r = 0.66$). Thus, the composition and biochemical status of the olive fruit seem to be the most important variables determining the synthesis of the VOO phenolic compounds during the oil extraction process. On the other hand, the content of oleuropein and derivatives in the oils and fruits showed a correlation coefficient ($r = 0.64$) lower than that observed for ligstroside and derivatives ($r = 0.73$). These findings

might be related to the higher oxidation rates of the former due to the action of oxidative enzymes during the oil extraction process as a consequence of the orthodiphenolic structure they possess. Data on phenolic composition would be of interest for the selection of optimal parents in olive breeding programs with the aim of obtaining new cultivars with improved nutritional quality.

Chapter 6 - Hydroxytyrosol (HT) and tyrosol (TY) are two phenols present in virgin olive oil (VOO), the principal fat used in Mediterranean countries. It is well known the benefits of Mediterranean diet in the prevention and development of certain illness as cancer or cardiovascular diseases as well as the natural protection exerted by VOO in these same diseases. When there is an injury in the body, inflammation is one of the early response to the damage; immune cells drive the immunologic response to clean and heal the damage. An uncontrolled response of the immune system could derive in the appearance of several illness. Macrophages are the main cells that control this process and their appearance and activity is the key of the development of cancer or Crohn's diseases, among others. In this chapter, the effects in macrophages of two natural compounds (HT and TY) present in VOO are studied. Results showed that both compounds are able to manage M1 macrophage response into an anti-inflammatory state, which could be very useful in the treatment of several diseases as Crohn's or inflammatory bowel diseases. Even more, there could be able to prevent chronic inflammation, which in turn is one of the reason of certain disease appearances.

Chapter 7 - Traditionally, the healthy properties of extra virgin olive oil have been attributed to its monounsaturated fatty acid high content. However, increasing evidence points out the participation of different minor antioxidant components, such as phenolic compounds. For the last decade, increasing research efforts have been made to explore the beneficial effects of these phenolic compounds on several physiological and physiopathological processes. Depending on the grade of bioavailability of each phenolic compound, they seem to carry antioxidant, anti-inflammatory and antimicrobial properties. One of the newest phenolic compounds discovered in the extra virgin olive oil food matrix is oleocanthal. The discovery of this molecule opens new perspectives on the biomedical applications of this natural compound with similar properties to those of so-called nonsteroidal anti-inflammatory drugs (NSAIDs). Oleocanthal has also exhibited antitumor properties on several tumor cell lines via different molecular mechanisms. Moreover, it has been proposed as an effective agent for the treatment of Alzheimer's disease. Therefore, it is necessary to increase research efforts about oleocanthal and its promising applications as a preventive and/or therapeutic agent for several diseases.

Chapter 8 - It has been known for decades that olive oil has beneficial health effects. However, only recently the biological properties of its constituents have been investigated. Recent studies confirmed that phenolic compounds of olive oil have several beneficial effects on human health. Olive oil is a source of at least thirty six phenolic compounds. The major phenolic compounds in olive oil are hydroxytyrosol, tyrosol and

oleuropein and their derivatives. The olive oil phenols includes numerous classes, such as phenolic acids like caffeic, gallic, vanillic and coumaric acids, phenolic alcohols including tyrosol and hydroxytyrosol and more complex compounds such as secoiridoids (oleuropein, ligstroside...), lignans (acetoxypinoresinol and pinoresinol), flavonoids and finally hydroxyl-isochromans. All these classes of phenols have potent antioxidant, anti-inflammatory, antimicrobial and antiviral activities. High consumption of extra virgin olive oils, which are particularly rich in these phenolic antioxidants should afford considerable protection against ageing, cardiovascular, cerebrovascular and neurodegenerative diseases, diabetes mellitus, metabolic syndrome and several cancers by inhibiting oxidative stress. A reduction in total mortality has also been confirmed after consumption of olive oil phenols. Some phenolic compounds of olive oil have also been demonstrated that they act as anti-allergic and an infertility treatment agents. This work summarizes the beneficial effects of phenolic compounds, contained in extra virgin olive oil, which have been reported in the last few years.

Chapter 9 - The liver plays a vital role in the body; performs metabolic, digestive, immunological, reservoir and homeostatic functions. However, is an organ susceptible to multitude injuries, which can be caused by viruses, drugs, toxic substances, alcohol and by obesity. Extra virgin olive oil (EVOO) is considered the gold standard of edible oils, has a composition rich in monounsaturated fatty acids and other minor components, including many phenolic compounds which may have beneficial effects on human health. EVOO has positive impact on different stages of liver damage, including hepatic steatosis (reducing the number and size of fat globules and the accumulation of triglycerides), non-alcoholic steatohepatitis (reducing inflammation and oxidative stress), cirrhosis (inducing less formation of fibrous tissue), hepatocellular carcinoma (due to its antioxidant properties reduces ROS production, decreasing DNA damage and promotes cellular apoptosis) and ischemia-reperfusion injury (reducing the liver damage and ROS levels).

EVOO in liver is involved in the activation of various metabolic pathways in order to prevent inflammation, oxidative stress, endoplasmic reticulum stress, mitochondrial dysfunction and insulin resistance, key situations in the onset and progression of hepatic tissue damage. Among the most important molecular effects of EVOO in the prevention of liver damage are: *i*) activation of nuclear transcription factor Nrf2, inducing a cellular antioxidant response by the positive regulation of gene expression of antioxidant enzymes and/or of enzymes involved in cell detoxification; *ii*) inactivation of nuclear transcription factor NF- κ B, preventing the cellular inflammatory response and; *iii*) inhibition of the PERK pathway, preventing reticulum stress and autophagy. The present chapter reviews the main scientific evidence about the hepatoprotective action of EVOO, discussing the molecular mechanisms involved in this protection.

Chapter 10 - Different phenolic compounds are present in extra-virgin olive oil (EVOO). The biological effects of the more characterizing for EVOO, i.e., secoiridoids,

have been studied since their discovery and their health beneficial properties, that go beyond merely antioxidant activities, are becoming more and more recognized.

Oleocanthal is the secoridoid responsible for the oral irritation induced by EVOO and perceptually it gives an oropharyngeal sensation similar to that produced by ibuprofene. Oleocanthal similarity with ibuprofene is also at the pharmacological level since it induces a dose dependent inhibition of COX enzymes even greater than the drug. Furthermore, oleocanthal is able to inhibit *in vivo* the formation of neurofibrillary aggregates responsible for Alzheimer's disease.

This review summarizes the knowledge of the *in vitro* and *in vivo* effects of oleocanthal comparing, where available, data with related EVOO phenols, and focusing on its anti-inflammatory, chemotherapeutic, neuroprotective and antimicrobial activities, discussing also bioavailability and experimental concentration issues.

Chapter 11 - Agriculture not only responds to meet food needs, but it must also respond to the needs and institutional context. The agricultural sector supports and creates employment opportunities and also the economic viability of rural areas with low settlement. In this scenario, organic olive oil area is one of the most important of the agricultural sector because olive oil is the link between health and nutrition.

The aim of the paper is to investigate organic olive oil sector, thus to demonstrate it's importance in terms of wealth and economic impact.

Chapter 12 - Mediterranean diet (MD) represents the gold standard in preventive medicine due to its association with lower overall mortality patterns. Its role in human nutrition is one of the most important areas of investigation, therefore a wide range of epidemiological studies found an inverse correlation between the MD consumption and the incidence of certain cancers in populations living in the Mediterranean area, compared with populations living in Northern Europe or the USA, probably because of the harmonic combination of many elements with antioxidant and anti-inflammatory properties. Extra virgin olive oil (EVOO) stands for the main source of fat in MD, characterized by bioactive components particularly phenolic compounds, it has a potential preventive and functional action on Cancer disease, liver, breast, colon which present the second cause of death after cardiovascular diseases worldwide.

The beneficial effects of EVOO have been attributed mostly to its phenolic fraction and its anti-proliferative properties causing apoptosis of human cancer cells. In this regard, this chapter presents an overview of benefits of olive oil against cancer, assessing and discussing the mechanism of action undersigning these effects as well as case studies.

Chapter 13 - Hydroxytyrosol (HT) and tyrosol (TY) are two of the main phenolic compounds present in several plants of the vegetable kingdom, but with major presence in the product of olive trees. These two compounds appear from the secoiridoid hydrolysis of virgin olive oils during storage. While the concentration of TY is always higher than HT, the quantity of both depend on the olive tree variety, climatic and agronomic conditions. Multiple health claims are attributed to these two compounds (as

cardioprotectives, antioxidants, protection against DNA...). Therefore, recent studies show us that they may play a key role in the development and prevention of different kind of cancers, among them breast cancer. This chapter explain and describe the more notably beneficial effects of these two compounds in the prevention, appearance and development of breast cancer. *In vivo* and *in vitro* studies demonstrate that these two phenols could aid in chemotherapies against breast cancer and in the prevention of it. Nevertheless, although they are natural compounds, special attention should be paid to the concentration administrated, this is the main reason why more deeply studies are needed for asseverate their preventive and antitumoral activities.

Chapter 14 - Chronic-degenerative diseases are currently a public health problem worldwide, including dyslipidemias, alterations in glucose metabolism, arterial hypertension and abdominal obesity, which together characterize the so-called metabolic syndrome. The risk of developing cardiovascular disease is estimated to be approximately double in subjects with metabolic syndrome and three times the risk of developing type 2 diabetes, which represent the main causes of death in the population. Although metabolic syndrome is a complex and multifactorial entity, the alarming increase in the components of metabolic syndrome is mainly associated with two etiological factors, the decrease in physical activity and the dietary pattern in the population, particularly the high consumption of energy from simple carbohydrates and fats. The authors know that maintaining a healthy diet is essential to prevent metabolic alterations, not only in terms of total caloric intake, but also the “quality” of fats consumed, i.e., the type of fatty acids that characterize the individual’s diet is determinant for the development of the disease. The Mediterranean diet has become in recent decades a reference icon for healthy eating, and its beneficial effects have been recognized by scientists, doctors, nutritionists and international organizations such as the World Health Organization (WHO), the organization of the United Nations for Food and Agriculture (FAO), among others. It is now known that extra virgin olive oil is one of the fundamental components of the Mediterranean diet, and that it is characterized by a high content of essential fatty acids and phenolic components, whose biological effect on the body gives it preventive properties and/or the ability to reduce the incidence of chronic-degenerative diseases associated with metabolic syndrome. The results summarized in this chapter have been obtained from population studies, as well as experimental animal models, which demonstrate some of the mechanisms of action of the main components of extra virgin olive oil, on metabolic processes related to the pathophysiology of metabolic syndrome, that confer the beneficial effects to this oil. The above highlights the importance of the Mediterranean diet on the prevention and/or control of metabolic syndrome.

Chapter 15 - The phenolic content and profile of virgin olive oil is determined by the composition and biochemical status of the olive fruit. In this sense, the presence of phenolic compounds in virgin olive oil is directly related to the content of phenolic glycosides initially present in the olive fruit tissues and the activity of hydrolytic and

oxidative enzymes acting on these glycosides during olive fruit processing. Recently, the first olive fruit genes and enzymes involved in the biosynthesis and transformation of the phenolic compounds primarily detected in the olive fruit mesocarp have been characterized. In the present review the authors will focus on the effect of environmental factors which can alter the phenolic composition of virgin olive oil, such as temperature, light, water deficit, salinity, and olive fly infestation. In addition, the regulation of the mentioned genes and enzymes in response to those environmental factors is also discussed. These recent studies represent an important step towards the understanding of the molecular mechanisms that regulate the phenolic composition of virgin olive oil.

Chapter 16 - Networking entrepreneurs stimulate the growth of the group through the reinforcement of the relations among the firms involved. The opportunity to work in clusters is particularly necessary for SMEs, which always have a low power, especially for those who work in a low technological sector.

Italy is characterized by a massive presence of small and medium enterprises, organized in districts or networks. Despite the economic crisis, some of these groups are able to survive and score positive performances both locally and abroad.

In this work the authors investigate the olive-oil biological sector, which is able to tow the Apulian economy based on its vocation. This sector shows a trend in network formation. Moreover, from an entrepreneurial point of view, such a strategy brings advantages both for the single unit and the group. This study aims at investigating the effect of the network on firm performances, considering the identity of the network and its social interactions. The authors believe that the entrepreneur's ability to innovate and the locational advantages in supporting network necessity are relevant factors for a network identity. The common factors are the entrepreneurial culture and social contacts of the team.

Chapter 17 - As the size of the global olive oil market has been rapidly growing, new markets emerged outside Europe, particularly in the Asia-Pacific region. Japan, as an export destination, is an emerging market for olive oil in East Asia. This chapter investigates the determinant factors that affect Japan's olive oil imports. Based on unbalanced panel data of Japan's olive oil imports from 15 trade partners from 1988 to 2013, the commodity-specific gravity model is estimated. The results suggest that an increase in the GDP of Japan and its trade partners has a positive effect and the distance between them is a resistance factor. The difference in factor endowments has a negative impact on olive oil imports, whereas increasing domestic production has a positive effect on the flow of imports. Together with the fact that Japan increased its olive oil exports, these results indicate the development of an intra-industry olive oil trade and support the concept of a new trade theory rather than the traditional Heckscher-Ohlin discussion. These findings imply that promotion of the export of varieties of olive oil through product differentiation would be more relevant to explore Japan's emerging market, rather than producing a large quantity sold at a lower price.

Chapter 18 - Virgin olive oil (VOO) has excellent nutritional, technological and sensory characteristics that make it a unique and basic ingredient of the Mediterranean diet and accumulating evidence suggests that it may have health benefits which include reduction of risk factors of coronary heart disease, prevention of several types of cancers, and modification of immune and inflammatory responses. VOO can be considered as example of a functional food, with a variety of components that may contribute to its overall therapeutic characteristics. The importance of VOO is mainly attributed both to its high content of oleic acid, a balanced contribution quantity of polyunsaturated fatty acids, and its richness in phenolic compounds, which act as natural antioxidants and may contribute to the prevention of several human diseases. The main classes of phenols in virgin olive oil are phenolic acids, phenolic alcohols, hydroxy-isocromans, flavonoids, secoiridoids and lignans. The concentration and composition of phenolic compounds in virgin olive oil is strongly affected by many agronomical and technological factors, such as olive cultivar, place of cultivation, climate, degree of maturation, irrigation, crop season and production process. The aim of this review paper is to summarize and critically analyze the available information about phenolic compounds in VOO.

Chapter 19 - The olive oil industry has experienced *continuous* growth mainly due to its nutritious and economic importance, particularly in Mediterranean countries. This is accompanied by the disposal of large amounts of wastes produced by different phases of olive oil extraction technologies (traditional pressing or centrifugation). The composition of olive mill wastes (OMW) varies considerably, owing to geographical and climatic conditions, *olive tree variety and age*, agricultural practices, olive type, extraction technology, use of pesticides and fertilizers, harvest time and stages of maturity. OMW are difficult to treat due to their high organic load composed of sugars, tannins, phenols, polyalcohols, pectins, proteins, oil emulsion, etc. For this reason, several management strategies have been investigated for the treatment and valorization of OMW, including physical, chemical and biological processes as well as combination of thereof. On the other hand, OMW can be used in a wide range of biotechnological applications which could enhance the economic viability of the various systems used for OMW treatment. In this chapter, OMW characteristics, bio-valorization potentialities and treatment options with regard to the economic feasibility, environmental regulations and challenges of existing waste disposal practices in olive-growing countries are discussed.

Chapter 20 - Olive oil industry is actually one of the main engines of the economy of the Mediterranean Basin countries, of which Spain, Italy and Greece cope with the highest total production worldwide, but neither should be disregarded the rapid widespread of this industry in other countries such as Syria, Argelia, Turkey, Morocco, Tunisia, Portugal, France, Libya, Lebanon, Serbia and Montenegro, Macedonia, Cyprus, Egypt, Israel, Jordan, as well as in the USA, Argentina, Australia and China, the last country incorporated to this industrial sector and with an enormous growth potential.