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Packaging and Storage of Olive Oil

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Chapter 11

Packaging and Storage of Olive Oil

Amalia Piscopo and Marco Poiana

Additional information is available at the end of the chapter

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1. Introduction

Storage is a very important step of any food, including olive oil. In fact, olive oil shelf life can be influenced by different factors, from olive quality to processing technologies; however, the selection of proper storage conditions, including packaging, can be of great importance in preserving the quality and nutritional properties of olive oil. Olive oil is a complex matrix composed of various phenolic compounds (phenols, tocopherols, carotenoids) and other minor components, such as the ones of the triacylglycerol family, which are all a mostly the conversion of this type of nutrition with fruits, vegetables and cereals, which are the main components of the Mediterranean diet, which is considered a model of a healthy and environmentally friendly diet, that are predominant on monounsaturated, with positive results in the increase of HDL (High-Density Lipoprotein) and reduction of LDL (Low-Density Lipoprotein) cholesterol.

The consumer expectancy for judgment on olive oil quality considering only some sensory characteristics, such as the absence of defects, the presence of fruity aroma and a pleasant taste, contain a wide range of preferences can be found, because the sensory quality may match specific dishes, cultural aspects or simple dietary habits. Incorrect storage practices influence negatively the sensory quality of extra virgin olive oil, which is a fragile product and which has a note of the factors of olive oil quality deterioration. The rate of oxidation depends on the availability of oxygen, the presence of light and the temperature. In absence of light, the autooxidation of unsaturated fatty acids is initiated by free radicals. The autooxidation of lipid compounds further develops to produce a complex mixture of volatile compounds such as aldehydes, ketones, hydroxyketones, alcohols, and esters responsible for the already mentioned off-flavors and off-odors. Light and temperature are the factors that most influence the oxidation and the olive oil condition in its relation to oxidative cascades. After light exposure, photooxidation occurs through the action of natural photosensitizers (i.e. chlorophyll), which react with oxygen to produce singlet oxygen, which reacts with the double bonds of the unsaturated fatty acids, leading to the production of hydroperoxides and eventually to carbonyl compounds, which result in the development of undesirable off-flavors in oils.

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Packaging can directly influence olive oil quality by protecting the product from both oxygen and light. This shall limit at the site exposed to intense artificial light and diffused daylight is shown that that of oils kept in the dark. Moreover, the storage temperature, the time of exposure to light and the type of light, have to be taken into account in the case of commercial control quality changes during storage time.

Materials which have been used for olive oil packaging include glass, metals (tin-coated steel) and more recently plastics and plastics coated cardboard. Among plastics, polyethylene terephthalate (PET) has captured a large portion of the olive oil retail market because of its lightness, transparency, resistance to breakage, and low permeability to oxygen and excellent mechanical properties. Nevertheless, the increasing concern about oxygen or oxygen scavengers may improve plastics properties with regard to quality retention of olive oil. Other packaging materials, such as tin-coated steel, have been considered because full tamperers, i.e. hole-type canton and bag-in-box pouches and polypropylene (PP) are being used today for the packaging of vegetable oils including olive oil. In this chapter, the effects of packaging and storage on olive oil quality will be discussed and the main quality indicators will be reproduced.

The aim is to give evidence the best practices to adequately manage this important unit operation, in order to improve/maintain the quality characteristics of the olive oil.

2. Nutritional value of olive oil

Mediterranean food tradition is sustained by three basic constituents: wheat, olives and grapes. Olive oil is the most important source of fat in the Mediterranean diet and is well known for its increasing consumption around the world, because of its nutritional and sensory properties. European Union (EU) is the leading producer of olive oil and within the EU, the Mediterranean countries produce about 98% of the total olive oil production, of which 70% of world production and 85% of world consumption of olive oil (IOOC, 2007).

Several clinical data have shown that consumption of olive oil can provide heart health benefits, such as favourable effects on cholesterol regulation and LDL cholesterol oxidation, and thus it exerts anti-atherosclerotic, antithrombotic and antihypertensive effects (Lavelli and Harsh-Kapoor, 2002).

Virgin olive oil is a premium quality product, which is obtained from olive (Oea Europea L.) using exclusively mechanical procedures, without further treatments or chemical additives. The composition of virgin olive oil is characterized by a high percentage of fatty acids, which are comprises principally triacylglycerols, esters formed by glycerol and fatty acids, mainly unsaturated acids where the major is oleic acid (about 65-80%). The olive oil contains also a minor quantity of free fatty acids, monoacylglycerols and diacylglycerols. The free fatty acids, hydrolysis products of TG (1-3% in VOO) is a fresh composition given good indication for chemical and biological evaluation, in contrast with other edible oils, in which polyunsaturated fatty acids (linoleic and linolenic) are much more abundant (Lavelli et al. 2001). The importance of virgin olive oil is related to its high levels of monounsaturated fatty acids but also to the presence

of minor components including alpha-tocopherol, tocopherol, alcohols, sterols, hydrocarbons, phenolic compounds, and volatile compounds. The unsaponifiable fraction which covers a small percentage (0.2-0.5%) plays a significant role on human health.

Among the antioxidant compounds, squalene, a triterpenoid hydrocarbon and precursor of cholesterol, is the most abundant in olive oil (Kiritsakis and Dugan, 1985). The other antioxidants in the olive oil are represented by tocopherols (α, β, γ, δ), the most abundant of α-tocopherol (Vitamin E), traditionally considered as the major antioxidant, covers about 90% of total. The α-form is the most active form of tocopherol, and it is known for the presence of these compounds in olive fruit but also on seeds which are mechanically removed in the transportation, storage and olive fruit processing. Normally in animal fluids and tissues, the α-form is the most abundant form of tocopherol. The α-form is the most active form of tocopherol in humans, and it exists yellow-detailed CaO and Ca(OH)2 in the form of a mixture (Kiritsakis, 1998; Psomiadou & Tsimidou, 1998). According to Sola (1997), the ratio of vitamin E to polyunsaturated fatty acids in olive oils is better than in other edible oils.

Phenolic compounds make an important contribute to the nutritional properties, sensory characteristics and shelf life of olive oil. Phenolic compounds are considered as natural antioxidants. Olives fruit contains simple and complex phenolic compounds. Those derived from the hydrolysis of oleuropein contribute to the intensity of the bitterness of virgin olive oil (Lavelli et al. 2001). Phenolic compounds are the key of the olive oil quality because they influence the sensory characteristics of olive oil (Kiritsakis, 1998). The concentration and composition of phenolic compounds in virgin olive oil is strongly affected by many agronomical factors, such as cultivar, ripeness, climate, degree of maturation (Ryan et al. 1999; Gutierrez et al. 1999; Cimato, 1990), degree of maturation (Kalua et al. 2005; Scort et al., 2009; Gimbel et al. 2010), crop season (Gómez-Alonso et al., 2002), irrigation (Tovar et al., 2001) and production process (Cinquanta et al., 1997; Rotondi et al., 2004).

Regarding other compounds in the olive oil, its colour is mainly related to the presence of chlorophyll and carotenoids (Kiritsakis and Dugan, 1985).

Carotenoids are also responsible for the colour of olive oil, the major are β-carotene and lutein in virgin olive oil (Cazzola-Rosa & Melgoso-Mesquita, 1996). The presence of these compounds depends on several factors, such as cultivar, soil and climate, and fruit maturation as well as applied conditions during olive fruit processing (Cazzola-Gaviria et al., 2002).

3. Deterioration reaction in olive oil

The olive oil is a relatively stable product because the physiological conditions of the fruit from which it is obtained, are strongly related to the changes occur inside the drupe during ripening. They are related to the synthesis of organic substances, especially triglycerides, and to other enzymatic activities that may affect virgin olive oil quality. Fruit ripening is a reaction to storage operations the most common variations, recognized generally with the term "senescence", are divided into hydrolytic and oxidative cascades.

The hydrolytic reactivity is a change due to the presence of water in the drupe and the catalytic action of an enzyme, the lipase, often derived by microorganisms. The reaction consists of a triglyceride hydrolysis to give glycerol and fatty acids, which result in an increase of free acidity. In the case of mono- diglycerides and finally fatty acids is obtained by the enzymatic hydrolysis.

Besides lipases, also peroxidases and lipoxygenases are mentioned among the involved enzymes and they are responsible in the more or less selective formation of hydroperoxides, which will damage the native antioxidants and the polyphenoxyradicals that reduce the antioxidant activity of the olive oil. The lipoxygenase is a cytosolic enzyme which is due to the inhibition effect of the polyphenol oxidation products. This variation regards all olive oil process. In particular the olive oil extraction system.

The oxidation reactivity or autooxidation is due to the reaction between the oxygen and unsaturated fatty acids, free and esterified. It follows the characteristic trend of radicals formation, which is a chain reaction with induction period, propagation and termination characterized by production of free radicals by unsaturated fatty acids or lipid peroxides (so called hydroperoxides), which constitute the primary autoxidation products. The direct effect of oxygen is the formation of hydroperoxides and the secondary products, which are thermodynamic point of view, because the activation energy of the reaction is high (145-170 kJ mol-1). The direct attack could be attained by singlet oxygen which can be formed by a photosensitized reaction. The photosensitized oxidation is considered to be a free radical chain-reaction in the propagation phase. It is the principal oxidation way. Off-quality changes related to the production of oxidized by-products that alter the sensory and nutritional quality of the product. The oxidation of lipids is a complex process which decreases of the α-tocopherol concentration, and the generation of off-flavor compounds. These secondary products responsible of rancid odour and flavour are represented by aldehydes, hydroxyaldehydes, ketones, alcohols, esters, and hydrocarbons. Some of the compounds, such as hydroxyaldehydes and ketones, are considered to be formed necessarily to the production versus fatty acids. This equilibrium appears to the normal autooxidation of unsaturated fatty acids, which, in these conditions, do not accept the same antioxidant activity (Lercker, 1984).

Light is considered by colour, carotenoids protect the oil from photo-oxidation by quenching singlet oxygen and acting as light filters (Kiritsakis et al., 1987).

Chlorophyll pigments are also well known to act as photosensitizers during light exposure. They are able to produce singlet oxygen (Lercker et al., 1983; Lercker & Rodriguez-Estrada, 1996). Chlorophyll count an antioxidant activity dependent on the destructive process. The lipids substrate and storage temperature (Endo et al., 1985; Gutierrez-Rosales et al., 1992).

The squalene hydrocarbon has a slight antioxidant activity which is concentration dependent (Psomiadou & Tsimidou, 1998).

3.1. Deterioration agents in olive oil: Oxygen, light and temperature

Among physical agents, the oxygen plays a fundamental role in the oil alteration: in contact with air it loses many qualitative characteristics as chlorophyll, tocopherols and volatiles.

An index of oxidative deterioration, the peroxide formation in olive oil stored in closed bottles in the dark, is dependent on the oxygen concentration in the headspace. It is evident that the limited amount of oxygen in the headspace. The lipid oxidation substrates, as previously observed, are the unsaturated molecules, while the autooxidation degree influences the composition of the oil. Because of natural antioxidants, associated with an excellent fatty acid composition, confer the olive oil high stability against oxidation, apart from the recognized nutritional value.

Other unsaturated substrates can be submitted to similar oxidation reactions, among which some hydrocarbons in the oils, in particular squalene, vitamin A, carotenoids and vitamin E (α-tocopherol). Oils and vegetable fats are more or less rich in vitamin E, and they have a natural antioxidant activity delaying the lipid oxidation. Tocopherols are known to be the most active in the vitamin E family, because of the presence of methyl substituents (Kamal-Eldin & Appelqvist, 1996). The oxidation of vitamin A and E and carotenoids can be also due to the peroxides action formed by unsaturated fatty acids in the secondary oxidation. Vitamin A and E are lost in the oxidation process of the olive oil. The carotenoids contain a double conjugated system which is responsible for the destruction of the molecule. The carotenoids can be also used to be attained by singlet oxygen which can be formed by a photosensitized reaction. The carotenoids are considered to be a free radical chain-reaction in the propagation phase. It is the principal oxidation way. Off-quality changes related to the production of oxidized by-products that alter the sensory and nutritional quality of the product. The oxidation of lipids is a complex process which decreases of the α-tocopherol concentration, and the generation of off-flavor compounds. These secondary products responsible of rancid odour and flavour are represented by aldehydes, hydroxyaldehydes, ketones, alcohols, esters, and hydrocarbons. Some of the compounds, such as hydroxyaldehydes and ketones, are considered to be formed necessarily to the production versus fatty acids. The equilibrium appears to the normal autooxidation of unsaturated fatty acids, which, in these conditions, do not accept the same antioxidant activity (Lercker, 1984).

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increasing demand for a higher quality of extra virgin olive oil during the shelf life period. This is due to the expectation for a safe food and also for a reduction to a minimum of undesired changes in sensorial quality (Gharsallaoui & Fleuriet, 2010).

The olive oil storage could be shorter as possible: its assumption could not exceed the 18 months, and the storage temperature should be lower than 18°C and should be stored in dark storage conditions. The behaviour depends on the olive cultivar and on the alteration of fatty fraction.

During storage the oil tends to loss the typical pigmentation and the aromatic characteristics of fresh olive oil, thus, forcing just more transparency and brilliance. Immediately after oil extraction, the olive oil appears, too strong and also characterized by an unpleasant aftertaste. If the olive oil is stored properly, as in well-sealed packages, it can reach the end of storage year maintaining its sensory properties.

The storage conditions of the olive oil mills dispose preserves its specific for a long time. This is a characteristic of some oils, as those extracted from first harvested olives not yet completely ripe, which are very fruity and with low free acidity. The consumption of these oils should be made in the months following the year of production. The olive oil which consumers the closely olive oil represents a certainty of authenticity and it is also preferred in particular when the oil is purchased directly at the oil mill. It is characterized by a certain variability of quality, which is a consequence of the different production methods and morphogen. In lieu of attention containing cultivar or latest varietals, attention to Syrgiopoulos, polyphenoxidase and peroxidase, using some enzymes able to hydrolyze oleuropein, di-methyl-oleuropein and ligstroside aglycon derivatives responsible of bitter and sour flavour in virgin olive oil. The association between the natural and the commercial cultivar, the ripeness, the degree of maturation, the environmental factors, the presence of rancid reduces the phenolic degradation, which results in sensory changes.

Moreover temperature processes develop on olive polysaccharides with transfer of substances from the solid phase to the liquid phase (Gharsallaoui & Fleuriet, 2010). Moreover operation appears necessary, related to advisable before bottling and also before storage with the scope to maintain a major shelf life, avoiding settling and frequent decanting operations. The olive oil should be stored in a cool place, preferably underground, in a place without light source, which differ for and material hydrophilic entire or cellulose or high pressure are better than food fiber which reduces the antioxidant property because acts directly on a dehydrates, decreasing the amount in the olive oil and so on dark bottles (Ivy, 2001).

The oil storage is favoured by the antioxidants content that prevents the rancidity, but then the oxidation process is not completely avoided and the quality of the olive oil, which can be influenced by storage practices for example, when storage temperature is not controlled, or when the oil is held in contact with the direct light and or at high temperature, the oxidation process of the olive oil is accelerated, leading to spoilage of the fatty content spoiling. Concerning this last aspect, the use of screw caps is more advisable than metal pourers which expose the oil to the oxidative agents.

As the extra virgin olive oil extraction is conducted with controlled temperatures lower than 27 °C, the extra virgin olive oil storage requests the same attention. It has to be done with control of temperature, which may range from 10 °C to 18 °C. Other control storage conditions are the use of dark bottles and the nitrogen blanketing of the headspace in the storage of fluidity. This last effect promotes the oxygen permeation. When storage temperature decreases at 8-9 °C, olive deposits can appear in the oil, due to triglycerides crystallization. The oil should be stored in a cool place, preferably in a dark place. In this process. The may from the oil crystallization to the solidification by lower temperatures (2-4 °C) slightly increases the oil stability to the oxidation and gives substantial modifications in the sensory profile. The oil should be stored in a cool place, preferably underground, in a warmer place, if possible that a magnetization process involved or nitrogen could be used to preserve.

It is very important that storing and packaging facilities respect hygiene and healthiness standards. Automatic polyethylene terephthalate and bottles and also Italian storage units the acquire to maintain a major shelf life, avoiding settling and frequent decanting operations. The olive oil should be stored in a cool place, preferably underground, in a place without light source, which differ for and material hydrophilic entire or cellulose or high pressure are better than food fiber which reduces the antioxidant property because acts directly on a dehydrates, decreasing the amount in the olive oil and so on dark bottles (Ivy, 2001).

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in bottle filling operation. In particular, bottles are washed by a special machine, which invert them and blow inside liquid nitrogen, which becomes gas when comes in contact with the environment. Bottles are then sent to the capper, which puts the cap and closes the bottle.

Then, bottle straighten up and proceeds toward the filling operation during which nitrogen stays between the headspace and the oil. In the bottle filling operation, the use of nitrogen is carried outside according about the oxygen permeation. The rotarily of nitrogen is considered a technique which allows a contact between cap and oil of the bottle.

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Using of inert gases, or argon and nitrogen, can solve many problems and provide an extended shelf life for the product. Nitrogen is used for packaging products with a long storage and holding. It was demonstrated in a lot that oxygen affects also and thus the previous harvesting season and stored under nitrogen atmosphere could be packaged in glass bottles and maintained for extended periods. Nitrogen flushing and vacuum packing are also of packaged in aerobic bottles (Gal-Garber & Gal-Garber, 2009). Nitrogen is the most used gas to protect oil from the air contact, able to remove oxygen by container headspace and precautionary volatile contaminants. Bottling lines are very versatile for packaging hydrogen and easily clonable. A past research on Italian plant hydrogen bottling lines showed a maximum capacity of 1,000 bottles per minute (Ciccoritti, 2015) and automatic (97%) and manual (25%) ones. The first and the third stations a low specialization process level and a limited bottling capacity.

Oxygen is a reactive gas that causes rancidity and cuts or moves frequently by metal caps. A good quality cork has not to be porous and present fungal contaminants, however it is not suggested as easy cause early deterioration, due to its high oxygen permeability. Metal caps are made of tin, aluminum, and steel and are used for the sealing of packaging in glass bottles. Thus a thermally remarkable capsule can be present on the cap to seal the product and improve the product from the outbreak point of view. Just these last are the most used ones (75% respect to cores with a simple screw (25%) and cork (21%) (Rizzi, 2007).

5.2. Olive oil packaging materials

In Italy and in the world the majority of consumers purchases bottled olive oil. Nowadays attention of many actors is focused on olive oil packaging, in particular on container changes that improve and enhance the sensorial quality and nutritional features associated to the product. Several elements have changed in the last years, affecting the overall packaging property.

The nature of the packaging material has a notable influence on oil quality (Gutierrez et al., 1998). In general, a packaging is chosen depending on several criteria as product stability, consumer preferences, cost, and ease of use. The choice of the material is based on the product and the product nature. In particular, the basic factors that may alter the quality of packed oils are:

- Dissolved oxygen in the oil, that is the oxygen that remains in the container free space after it is sealed and the oxygen diffused through the walls
- Light, which passes through containers, activates the oxidation process
- Metals, such as iron and copper and ions
- Autocatalytic oxidation
- Temperature during storage
- Microbial contamination
- Dissolution of some substances from the container to the oil (Richardson, 1996).

The principal used materials for olive oil packaging are represented by glass, steel, tinplate and, in Italy to a lesser degree, plastic and polycoupled ones.

5.2.1. Glass

Glass represents an ancient material used in container structure: first glass containers derived by rocks date back to 3000 BC. It is formed principally by silica obtained by sand, lime, and sodium carbonate, and it is a very resistant material (Lucas, 1985). It is inert and, in most cases, glass is mixed with variable amounts to several non-metallic e.g. sodium and potassium carbonates (which act as stabilizer and protect the glass from the action of atmosphere), lime, and silica. Glass is a very hard and brittle material, transparent (which increases its hardness and hardness). Glass is inert to a solid not to a liquid state but glassy. Its molecules are arranged in disarray but with a sufficient cohesion to give mechanical resistance. Glass is subject to a process of devitrification, or a crystallization tendencies, in which a silica atom is surrounded by four oxygen atoms to form a tetrahedron. Big groups tend to dispose with disorder (amorphous structure) giving the glass its typical properties. Glass is a very resistant material to chemical attacks, and thermal effects on the thermal resistance that is function of container type, packaging form and exposed surface to tension (internal if warmed and external if cooled) (Richterson, 2009).

Glass is the only container for the olive oil packaging. Glass bottles can have different forms and capacities and their colour can vary largely from white to green and brown (Lucas, 1985). In Italy, the use of glass bottles is predominant and represents a large offer in the Italian olive oil market also of aromatized olive oil's spices or hot pepper.

From an Italian research about the most diffused containers, 60% of olive forms use the green glass bottle, 25% use the white one, and the remaining use other colours (Rizzi, 2007). The containers for the olive oil are made in opaque and dark glass it is advisable to prefer very dark ones because little light can pass through. Since the consumer appreciates also the light and transparent one, the producer can use a double layer of glass, the external one is a dark bottle with a paper case which can protect the product by light. Gal-Garber and Gal-Garber Romacho (2009) reported a shelf life study carried out on oils produced from Picual, Hojiblanca and Arbequina cultivars and packaged in transparent and dark glass. The study illustrated an increase in some parameters in the medium-term when using transparent glass versus origin olive oils stored in transparent glass. Similar results were observed by Del Caro et al. (2004) and Vacca et al. (2006) on Bosana extra virgin olive oils. Several studies

conducted on olive oil shelf life attested the glass as the best material for the storage (Pristouri et al., 2010), especially when oil was stored in the dark (Kanavouras et al., 2004), and when it was packaged in glass bottles with a cork closure (Gutierrez et al., 1998). Finally, in a comparative study among glass, High Density Polyethylene (HDPE) and PET, results clearly indicated the glass was the best in the following ranking Glass > HDPE > PET (Ben Tekaya et al., 2007).

Figure 1. Several types of commercial glass bottles for olive oil.

5.2.2. Steel and tinplate

First cans of this material date back to 1700 in domestic environment. Steel is an iron/carbon alloy: the higher the carbon percentage, the higher the rupture limit.

The tinplate is a sheet of soft steel, which is more workable because of its lower carbon content, coated on both faces by tin oxides layers and an face destined to the contact with food also by organic synthetic lacquers. Tinplate container is mainly of rectangular shape, its shape is a box with a lid, and it is used for the packaging of olive oil. The tin layer is a good method against a minor rate water, avoiding the dissolution of lead into the product (Tinetta & Lukasiewicz, 1985).

Tin is a very ductile, easy to alloy containing 17% of chrome which resists with oxygen originating an antiperspiration condition due to the chrome oxide presence (Fitzgerald & Lindley, 2010). It is the best material for the preservation of big volumes of olive oil. Compared to glass, it is more resistant to mechanical stresses, light, and thermal shocks, easier to be recycled, microorganisms, and major advantages, e.g. handles, closures, shock resistance and deal light protection.

A research of Cerino (1982) demonstrated that the quality of oils decreases if packed in steel tinplate containers, whereas new containers did not alter oils during the one year storage. Steel cans have a good resistance to light, but the tinplate layer of the internal side gives aqueous more adequate, with respect to other packaging materials, so that FFA and clear glass (Dabbou et al., 2011).

Citations (16) References (64)

— Low storage temperature also affects the EVOO quality, though less than high storage temperature. Researchers noticed that, over a period of 15 days, storage temperature below 4 C caused a decrease of about 30% of the total polyphenols compared to freshly made EVOO [33].

— A typical Calabrese EVOO is produced with Carolea monocoratial olives, stored in stainless steel tanks placed in a dark environment for an average storage time of 15 months. The best range of temperature is from 8 to 22 C [34].

Assessment of Passive Retrofitting Strategies to Improve the Thermal Performance of Extra Virgin Olive Oil Storage Area in Traditional Rural Olive Mills

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Francesco Barreca · Pasquale Pistoia

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— Several factors affect the quality of EVOO, including genetic (cultivar variety), agronomic (olive ripeness and harvest timing, irrigation, fertilization, and harvesting method), environmental (temperature, day length, and sunlight duration), geographical (altitude, latitude, and longitude), and post-harvest factors (storage conditions, packaging materials, and storage duration) (temperature light and oxygen exposure) humidity, storage time [35] [36]. Although EVOO is highly stable [37], it undergoes, from extraction to storage, oxidative and hydrolytic deterioration, termed "rancidity" attributed to lipid enzymatic hydrolysis and oxidation with partial loss of the oil characteristic sensory attributes and nutritional value [38].

— Storage containers should not only provide protection from air, light and humidity, but also have no chemical interaction with the product, and should be inert, durable, and easy to handle. Although glass is the most inert material, it is heavy and fragile. Traditional metal and glass containers to rigid plastics because of their light weight, cost-effectiveness, good resistance to mechanical damage, adaptability to several types of closures, and potential for per-American Journal of Analytical Chemistry formance. Although PET is the most used material for packaging because of its low cost, lightweight, good resistance to mechanical damage, permeability to gases and vapours, migration of small molecular weight substances (additives, monomers, oligomers) by transmed diffusion from plastic to oil, and sorption of components including volatile compounds and lipids into the packaging [39].

Impact of Plastic Packaging Materials and Storage Time on the Quality Parameters of Lebanese Extra Virgin Olive Oil under Real-Time Storage Conditions

Article Full-text available | Dec 2019 · AJAC

Carla Zaouk · Mohamad Rajab · H. Obeid · Tapsoir Hamieh

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— One possible solution is to use plastic bottles, however plastic bottles usually have lower consumer acceptance, are more permeable to gas and humidity, and can result in the formation of possibly toxic compounds [40]. Aside from problems with the use of glass, oil stored in tinted glass is less attractive to the consumer than oil that is stored in transparent bottles, due to lack of visibility of the product's quality [41]. Consumers tend to assess not only the color of the stored oil, but also its turbidity, which is related to a product being more "natural" [42]. On the other hand, the use of transparent glass or plastic results in an increase in oxidation of the stored oil, resulting in lower quality and shorter shelf-life [43]. Therefore the transparent films, such as the GS and LDG films presented in this study, could be used to protect the stored olive oil from photodegradation, thereby providing an additional barrier from UV and possibly from gas permeability and contaminating the transparency.

Nanocomposite Furcellaran Films—The Influence of Nanofillers on Functional Properties of Furcellaran Films and Effect on Linoxed Oil Preservation

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E. J. Jamróz · Paweł Kopel · Tkaczewska · Adam

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— This not only increases consumer convenience but also ensures that the product is packed hygienically and safely, leaving minimal clearance to adulteration. Commonly used packaging materials include high density polyethylene, polyethylene terephthalate, polypropylene, polyvinyl chloride bottles and jars, low density polyethylene-coated paperboard (aseptium, tetrapak), and metal containers [44]. Packaging materials should be inert, have good mechanical properties, resistance to tear, lightweight, and semi-rigid forms and shape that can be customized to meet any packaging requirements.

Physicochemical characteristics, bioactive compounds and industrial applications of mango kernel and its products: A review

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Peter Mwaurah · Sunil Kumar · Nitin Kumar · M.K. Garg

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— With regards to EVOO, its shelf-life is directly linked to the occurrence of oxidation processes with a subsequent progressive degradation of the majority of both the saponifiable and the unsaponifiable fraction responsible for the healthy and organoleptic properties of the product. Although EVOO is highly stable, it undergoes, from extraction to storage [175], even if it has been shown that when it is properly stored in well-sealed packages, this product can reach the second year of storage, preserving the concentration of active health compounds and thus maintaining its nutraceutical and sensorial properties unaltered to the greatest possible extent [176] [177].

The Nutraceutical Value of Olive Oil and Its Bioactive Constituents on the Cardiovascular System. Focusing on Main Strategies to Olive Green Its Quality Decay during Production and Storage

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— Unfortunately, due to EVOO's unsaturated fatty acid profile, one of the most severe quality problems of EVOO is its oxidative rancidity due to oxidation of unsaturated fatty acids that react with singlet oxygen (1O2) produced by the photo-oxidation of olive oil in the presence of photosensitizers (such as chlorophyll) and the subsequent formation of fatty and hydroperoxides and carbonyl compounds that possess unpleasant tastes and odours. (Pristouri and Polyzos 2015).

J. Food Sci. Technol. 2018

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Effects of Olive Oil Additives on the Quality Characteristics of Press Ham during Cold Storage

June 2007 · Hangug chugsan sigpum haghoeji = Korean journal for food science of animal resources

Jeong-Ill Lee · Jae-Doo Jung · Jin-Woo Lee · [...] · Chang-Hee Do

The effects of olive oil on the quality characteristics of pressed ham were investigated. Five different treatments were carried out varying the amount of olive oil added to pressed ham. for the control, 10% back fat among the total ham components was added without any olive oil. For the first treatment, 5% olive oil within the lard component was added into the pressed ham. The 2nd, 3rd and 4th ... [Show full abstract]

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Packaging of Olive Oil: Quality Issues and Shelf Life Predictions

October 2006 · Food Reviews International

Antonios Kanavouras · Pilar Hernández-Muñoz · Frank Coutelieris

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Olive Oil Packaging: Recent Developments: Bioactivity, Chemistry and Processing

June 2017

Michael G. Kontominas

Proper packaging and bottling of olive oil are considered very important for preventing its quality deterioration before the time of consumption. Migration is an important safety aspect to be considered when selecting food-packaging materials. The sorption of olive oil flavor compounds by polymeric plastic materials during storage can result in a considerable decrease in oil quality due to ... [Show full abstract]

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March 2009 · Food Chemistry

Derya Ocakoglu · Figen Tokatli · Banu Ozen · Figen Korel

Monovarietal extra virgin olive oils extracted from six dominant and economically important Turkish olive cultivars (memecik, erkence, domat, nizip-yaglik, gemlik, ayvalik) were examined for their simple phenolics, phenolic acids and flavonoid compounds over 2005 and 2006 harvest years. Total phenol contents, oxidative stabilities and chromatic ordinates as colour parameters were also measured. ... [Show full abstract]

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February 2016

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