12
Culinary Applications

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Domestic and Other Uses

Olive oil, a food staple in the warmer regions around the Mediterranean Sea, is now becoming popular throughout Europe and in the United States, Canada, and other countries. This is due to its highly characteristic flavor but also to the promotion of the health benefits of Mediterranean dietary patterns.

Olive oil has a remarkable stability and can be stored for 18 months or more. The resistance to development of rancidity is combined with a vast array of flavor and color hues and distinct features depending on the cultivar of olives from which the oil is extracted. These virtues offer opportunities for a variety of culinary applications with very little or no processing. Anyone coming from the Mediterranean region of the world could tell about the flavor of a good dose of olive oil on salads, fish, vegetables, and almost everything else.

Olive oil contributes complex flavors that are reflected throughout the whole dish and adds body and depth to food. A good quality olive oil blends perfectly with the greens. Traditional vegetable dishes are prepared with seasonal vegetables, pulses, and grains. Although very old, these recipes contain wisely balanced ingredients and meet health criteria as defined by modern science.

In vegetarian dishes olive oils with herbal hues are usually preferred. For salad, a pronounced hint of apple is suitable, while for grilled meats a peppery flavor is desirable. Other dishes such as pies, mayonnaise, fried eggs, etc require different hues for those who can go deep into sensorial characteristics like mouthful, bouquet, taste, aftertaste, etc., and have developed their own personal preferences. “Freshly cut grass flavor,” “flowery aroma,” “pepperiness,” and other such comments are very likely to be heard not only in oil-tasting parties but even in common discussions of consumers with a sophisticated palate. One has to stress also that differences in soil, climate, cultivar, year, maturity of the fruit, and processing conditions hardly allow for two identical olive oils. The chefs have already understood that, as with wine, each extra virgin olive oil has its very own identity.

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The taste of olive oil is very often complemented by the sharp taste of vinegar, lemon, or tomato. Olive oil serves as a buffer against high acidity from fruit juices such as lemon, vinegar, and tomatoes. A simple traditional salad dressing is an instantly beaten mixture of olive oil and lemon juice, a source of both lipid-soluble and water soluble vitamins (α-tocopherol, carotenoids, ascorbic acid) and biophenols (hydoxytyrosol derivatives and other o-diphenols). In a recent report Paraskevopoulou et al. (2005) demonstrated how a stable olive oil-lemon juice salad dressing can be developed with the use of xanthan gum as a stabilizer and arabic gum or propylene glycol alginate as emulsifier. Samples of the prepared dressing were found to have a remarkable stability against oil droplet coalescence.

In salads or in cooking, olive oil is often mixed with herbs and spices, which are also an important element of the Mediterranean diet. Herbs like oregano, rosemary, thyme, or other herbs from the plants of the *Lamiaceae* family are rich sources of phenolic compounds with strong antioxidant activity (Nakatami, 1994, Tsimidou, and Boskou, 1997, Exarchou et al., 2001, Exarchou et al., 2002). These herbs maintain the nutritional value of the food and enhance the shelf life of the product.

Antoun and Tsimidou (1997) prepared gourmet olive oils which contained dry oregano and rosemary. Such oils, containing small amounts of the herbs, not only satisfied sensory requirements, even among non olive oil consumers, but also had improved resistance to auto-oxidation. This is obviously due to the contribution of antioxidants present in the herbs, like rosmarinic acid, caffeic acid, carnosol, carnosic acid, carvacrol, thymol, and others (Nakatami, 1994, Tsimidou and Boskou, 1994, Exarchou et al. 2001, Exarchou et al., 2002). In retail outlets it is now possible to purchase olive oil flavored with a variety of herbs and spices. These specialty oils, containing the additional antioxidants from the herbs, should be stored carefully in dark places because of the presence of increased levels of chlorophylls transferred from the plant material. It is known that chlorophylls promote photosensitized oxidation. Thus, total chlorophyll content may be a critical factor for the shelf life of these preparations. Damechki et al. (2001) proposed a suitable labelling for oregano and rosemary gourmet olive oils suggesting careful avoidance of light for a safe domestic use.

In addition to salads and cooking, olive oil is also used in marinades, pasta sauces, for preserving fish, cheese, sausage, and vegetables, for the preparation of breakfast toasts (tostada con aceite), as a dip for bread and in sweets, savory dishes, and home bread.

Due to the biological importance of olive oil, new attempts are continuously made to extend its uses in a variety of fatty products (e.g. margarines, cholesterol lowering spreads, reduced fat mayonnaise, butter creams, chocolate products or pastes made of almonds, hazelnuts and other nuts). The replacement of other fats by olive oil in such products is not well known since most of these applications are patented. Recently, Ansorena and Astiazaran (2004) suggested a new application for olive oil.

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They conducted a study to obtain better oxidative stability in dry fermented sausages. Pork backfat was partially substituted with olive oil and antioxidants (BHA, BHT) were added to the product. The substitution resulted in lower rates of lipid oxidation during storage and better monounsaturated plus polyunsaturated to saturated fatty acid ratios. Kayaardi and Gok (2004) also suggest replacement of animal fat in meat products to reduce cholesterol levels.

Positive and Negative Attributes

The International Olive Oil Council in its Trade Standards (COI/T.15/NC no 3-25,2003) defined 3 positive attributes: bitter, fruity, and pungent and 11 negative attributes: fusty, musty, muddy, sediment winey-vinegary, rancid, heated or burnt, hay or woody, greasy, vegetable water, brine, and earthy (for the definitions see glossary at the end of the book).

Some of these properties are processing defects, (e.g. fusty, burnt, excessively bitter), others are due to storage and packaging. Ethyl acetate and acetic acid produced by acetic acid bacteria, which grow during the storage of olives, are responsible for the vinegary defect (Garcia-Gonzalez and Aparicio, 2002).

In addition to the three positive attributes defined by the IOOC, there are many other characterizations encountered when the flavor of olive oil is judged by experts. These may be: apple, artichoke, astringent, sweet, banana, buttery, fresh, grass, green, melon, peppery, flat, rough, impersonal, harmonious, and others.

Some of the positive attributes can be declared in the label of the packaged olive oil according to regulation EC 1019/02. This, however, has to wait till July 2006, when the IOOC finalizes the sensory evaluation methods (Regulation EC 1750/200 4,OJEU,L312/7,9.10.2004).

Olive Oil in Frying

Olive oil has a remarkable stability during domestic deep-frying or in other uses that require frying temperatures (Boskou, 1999). In comparison to sunflower, cottonseed, corn, and soybean oil, olive oil has a significantly lower rate of alteration. This increased stability to thermal oxidation explains why the oil can be used for repeated frying. The resistance of olive oil to rapid deterioration at elevated temperatures is attributed to its fatty acid composition and the presence of natural antioxidants such as squalene, alpha-tocopherol, and Delta-5- avenasterol (Boskou, 1999, Blekas and Boskou, 1999). The above properties are well known to people who traditionally use olive oil in cooking and prefer olive oil as a means of shallow frying.

According to Varela (1992), deep frying in olive oil offers a means to improve the profile of lipid intake. During the frying process, changes occur in the fat composition since the oil penetrates into the fried food. Western diets using vegetable oils and animal fats are very often rich in saturated fatty acids and also n-6 fatty acids. When

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meat is cooked in olive oil there is a favorable change in saturated to polyunsaturated fatty acids ratio. A better combination is to fry fish. In sardine, for example, the nutritional benefits of the oil are combined with those of the n-3 fatty acids from the fish (Cuesta et al.1998).

Heating and Phenolic Compounds

In the last decade, researchers have focused on the level of phenolic compounds such as hydroxytyrosol in heated olive oil, since these compounds contribute to the stability of the oil against auto-oxidation but they are also considered components with an important biological role. Most of the published reports indicate that phenolics in virgin olive oil deteriorate relatively rapidly. Andrikopoulos et al. (2002) determined total phenols during successive pan-fryings and deep-fryings of virgin olive oil under conditions applied in domestic cooking. The loss of polar phenols and tocopherols was significant. Brenes et al. (2002) investigated the changes occurring in virgin olive oil subjected to simulated domestic frying, microwave heating, and boiling with water in a pressure cooker. Heating at 180°C caused a significant loss of tocopherols and hydroxytyrosol derivatives, but lignans (pinoresinol and 1-acetoxypinoresinol) were relatively stable. Microwave heating caused lower losses of phenolic compounds. Boiling in the pressure cooker caused rapid hydrolysis of the secoiridoid aglycons. The hydrolysis products were diffused in the water phase.

Pellegrini and coworkers (2001) used the ABTS decolorization assay of antioxidant activity to study the effect of heating on the total antioxidant activity (TAA) of extra virgin olive oil and alpha-tocopherol content, in the presence of 14 polar phenolic compounds occurring in the oil. Their results indicate that heating causes a significant loss of olive polyphenols, which act as stabilizers of alpha-tocopherol during olive oil heating. Similar results for a stabilizing effect of polar phenols on alpha-tocopherol were also reported by Valavanidis et al. (2004). Gomez-Alonso et al. (2003) found that the antioxidant activity of the phenolic extract, measured with the DPPH radical test, diminishes during the first six frying processes (each frying process: 10 min at 180°C). A rapid loss was observed mainly in the concentration of hydroxytyrosol and its secoiridoid derivatives (aldehydic forms).

A loss of the antioxidant capacity of olive oil and other vegetable oils due to heating at frying temperatures was also reported by Quiles et al. (2002) who used electron spin resonance and also by Carlos-Espin (2000) and his coworkers who studied the kinetics for the disappearance of total free radical scavenging capacity (RSC) using the DPPH test. Kalantzakis and others (2003) examined the loss of antioxidant capacity (evaluated by the DPPH test) and the polar transformation products formed from various vegetable oils heated at 180°C for 10 hours. It was observed that olive oil lost its radical scavenging capacity at a shorter time of heating in relation to soybean, sunflower, cottonseed oil, and a commercial frying oil. However, olive oil reached the level of 25% Total Polar Compounds (rejection point) after prolonged heating, while

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all the other oils reached this upper limit in shorter periods (10 hours of heating). It can be concluded that olive oil as a frying medium has a remarkable stability and a resistance to oxidative polymerization due to frying. When, however, health effects are expected from the presence of natural antioxidants, the number of heating operations should be restricted to a minimum.

Another important aspect of frying in olive oil was examined by Persson and his coworkers (2003) who fried beefburgers in various oils. The burgers were analyzed for the levels of 12 different heterocyclic amines(HA), such as 2-amino-3,8-dimethylylimidazol(4,5-*f*) quinoxaline, and 2-amino-1-methyl-6-phenyl-imidazol(4,5-*b*)pyridine. The intake HA amines has been associated to the development of cancer in some epidemiological studies. During cooking of animal tissue these amines are formed at low levels via the Maillard reactions and a free radical mechanism. Frying in virgin olive oil reduced the formation of heterocyclic amines and this was related to the presence of secoiridoid phenols. Loss of these phenols by storage or heating caused a decrease in the HA-reducing capacity of the oil.

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