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THE MOST ANCIENT FUNCTIONAL FOOD IN HISTORY

The following article is based on the Chevreul Medal Lecture presented by Valentina Ruiz-Gutiérrez on the occasion of her accepting the award at the 4th Euro Fed Lipid Congress held in Madrid, Spain, October 1–4, 2006.

Valentina Ruiz-Gutiérrez and Javier S. Perona

INTRODUCTION

Extensive epidemiological, clinical, and laboratory tests have indicated that diet influences the development of a wide range of organic illnesses with cardiovascular disease being the most important, but also including hypertension. Most of the illnesses in which nutritional factors play an important role have decisive genetic and environmental determinants. But, at present, not all the environmental risk factors are clearly characterized, and most of the susceptible genotypes have not yet been identified. Furthermore, possible relationships between the genetic and the nutritional mechanisms in the development of illnesses are still not well known. It is evident that nutritional factors are important in the etiology of several organic illnesses and that dietary modifications can reduce the risk of their occurrence. However, for most illnesses, it is still not possible to estimate quantitatively, not only the total risks, but also the benefits.

In earlier studies we attributed the known beneficial effects of the Mediterranean diet on the cardiovascular system to the high consumption of olive oil and its particular lipid profile. More recently we have demonstrated that the presence of specific minor components in this oil play an important role in the prevention of inflammatory processes.

But before going on to the health and nutritional properties, we should describe the different olive oils to clarify what the consumer buys when going to the supermarket and purchasing a “bottle of olive oil.”

OLIVE OIL TYPES

Olive oil is obtained traditionally from mechanical pressing of the harvested, cleaned fruit. Purification of the extracted oil is minimal, involving a preliminary water washing, milling, and shaking followed by either a 3-phase centrifugation (traditional) method or a 2-phase procedure (ecological). Various grades of olive oil are produced (Figure 1).

Virgin olive oils. These oils are obtained from the fruit of the olive tree (olives) solely using mechanical or other physical means under mild conditions of washing, decantation, centrifugation, or filtration that do not lead to deterioration of the oil. Depending on the characteristics of the oil obtained, we speak of a natural, fresh, and fragrant juice that possesses different ranges of flavors reflecting annual weather conditions, region of origin, olive variety, and treatment and technical care applied in the cultivation of the olives and the preparation of the oil. Within this group we include those virgin oils that declare on the bottle the olive variety from which it has been obtained (oils of Hojiblanca, Picual, Verdial, Arbequina, Cornicabra, etc.) or of the area in which the olives have been harvested (Aguadulce, Antequera, Baena, Sierra de Segura, etc.). Within virgin olive oils, however, we need to recognize:

- Extra virgin olive oil—organoleptic grading (scent and flavor) equal to or greater than 6.5 and a maximum oil acidity of 1° (1 g per 100 g); a lower-grade product known as virgin

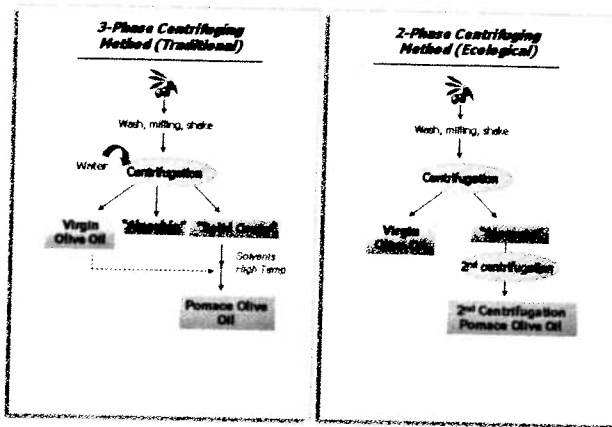


FIG. 1. Olive oil extraction.

olive oil (the term "fine" may be used in production and marketing) has organoleptic grading equal to or greater than 5.5 and a maximum acidity of 2° (2 g per 100 g).

- Normal virgin olive oil—organoleptic grading equal to or greater than 3.5 and a maximum acidity of 3.3° (3.3 g per 100 g).
- Virgin lampante olive oil—organoleptic graduation lower than 3.5 and/or an acidity greater than 3.3° (3.3 g per 100 g); it is not edible and is destined for refining.

Refined olive oil is a grade of olive oil obtained from low quality virgin olive oils that have undergone the appropriate refinement processes to eliminate their adverse characteristics.

Olive oil is a mixture of edible virgin olive oils and refined olive oil, with a maximum acidity of 1.5° (1.5 g per 100 g).

Orujo oil is obtained from the residuals of stones and skins of the olive.

Orujo olive oil is constituted from a mixture of refined orujo olive oil and edible virgin olive oils with a maximum acidity of 1.5° (1.5 g for 100 g).

These retail grades have no legal meaning in the United States, which is not a member of the International Olive Oil Council (IOOC).

Olive oil is the archetypal monounsaturated vegetable oil. It is also characterized by having a low content of unsaponifiable matter (0.8–2.0% of the oil) consisting of hydrocarbons, sterols, tocopherols, phenols, triterpenoids, and other minor components (Table 1). These unsaponifiable components are retained in the oil and are not lost due to refining processes such as deodorization commonly used in the refining of other vegetable oils.

HEALTH BENEFITING PROPERTIES

Our group was the first to study the benefits of a virgin olive oil-enriched diet in a high cardiovascular risk (hypertensive and hypercholesterolemic) human population. Comparisons were made with another vegetable oil (high-oleic sunflower oil) possessing the same quantity of monounsaturated fatty acids but a different content of minor components. Two new factors of pathogenic significance associated with essential human hypertension were discovered, namely, the asymmetric distribution and trans-membrane movement of cholesterol and the fact that both parameters are selectively and favorably modified by virgin olive oil. Intake

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A brief history of olive oil

Olive oil has been recognized as a food since 6,000 B.C. A yellowish, transparent, aromatic liquid extracted by simple pressing of the fruit of the olive tree, it can be used to dress, cook, and preserve food. The oil obtained in this way was considered a food and a "revitalizing" liquid by the Phoenicians, Carthaginians, and other Mediterranean peoples who, in their collective wisdom, were able to transmit their knowledge to later generations inhabiting the region around the Mare Nostrum (the Roman name for the Mediterranean Sea). Olive oil is now regarded as an unusual luxury by cardiologists and nutritional specialists, being the only vegetable fat, other than palm oil, that is obtained from fruit (juice of the olive): The others are obtained from seeds.

Documents written in Mycenaean Greece (XVIII to the XIII century B.C.) are relatively scarce, but large numbers of tablets have been found in Knossos and Pylos. These tablets contain inscriptions of different foods among which significant quantities of olives and olive oil are frequently—if not always—represented. Some documents register the names of the olive- and grain-producing cities and possibly reflect the practices that persist in Greece today, of sowing grain in olive groves.

The Romans are credited with the expansion of olive tree cultivation throughout their Empire, and are consequently responsible from the 1st century B.C. for the recorded data of olive oil usage in the Mediterranean basin. We inherited the word "olive" from the Latin "oliva" and Greek "elaiwa." The writings of the time relate that the Andalusian capital of Seville was surrounded by olive trees and that the production (then the most important for the Roman Empire) was harvested in the whole Guadalquivir River valley along the then-navigable Guadalimar and Genil rivers to Écija. The 200 km stretch of waterways favored the transport of oil in two-handled jars, which meant that olive oil had optimal taste for Roman, Arab, and later, Christian palates. The best plants for the new vineyards came from Aljarafe, the town situated to the west of Seville. ■

Minor Components of Virgin Olive Oil

HYDROCARBONS	Squalene	2000 ppm
	β -carotene	0,3-3,0 ppm
STEROLS	Phytosterol	1500 ppm (95%)
TOCOPHEROLS	α -Tocopherol	200 ppm (92%)
PHENOLS	Tyrosol, Hydroxytyrosol	50-350 ppm

Minor Components of Pomace Olive Oil

TRITERPENOIDS	Oleathic acid	60-400 ppm
	Maslinic acid	100-300 ppm
	Erythrocol and Uvaol	500 ppm

TABLE 1. Unsaponifiable matter in olive oil.

of olive oil also normalizes the activity of the Na^+ - Li^+ counter-transport and the lipid composition of the erythrocyte membrane, as well as the arterial pressure (systolic and diastolic) of hypertensive patients.

Until our 1996 study, oleic acid was regarded as the component of virgin olive oil responsible for the anti-atherogenic activity associated with the "Mediterranean Diet." However, our studies demonstrate that other fatty acids, their positional distribution in triglycerides, the polyphenols, and the saponifiable fraction of virgin olive oil can have the same or greater importance than oleic acid itself in reducing or preventing cardiovascular incidence.

Our group also has demonstrated the marked antioxidant effect of the polyphenols present in virgin olive oil, which have been demonstrated to have as much capturing capacity of oxygen-derived free radicals and of nitrogen as the inhibitory activity associated with the formation of proinflammatory eicosanoids, both *in vitro* and in experimental animals. Virgin olive oil contains not only polyphenols but also tocopherols, which possess relevant antioxidant properties and may improve endothelial function by reducing levels of reactive oxygen species in the endothelium. Endothelial activation is one of the earliest stages in the development of the atherosclerotic process and may be inhibited by minor components present in virgin olive oil as revealed by reduced release of proinflammatory mediators, such as adhesion molecules and cytokines.

There are, however, other less well-studied compounds that exert important effects on the endothelial function. Phytosterols and triterpenoids have anti-atherogenic, anti-inflammatory, and vasorelaxant effects, but their roles in the endothelium need to be further studied. The increasing number of investigations on the properties of these minor compounds are not only helping to explain some of the classical beneficial effects of the Mediterranean diet and virgin olive oil itself, but also contributing to the emergence of other olive-derived oils, such as orujo olive oil, which being more enriched in these minor components, might be helpful for the prevention of cardiovascular disease. The concentration of these minor components is greatly increased in orujo olive oil, as they come from the skin and stones of the olive fruit, as well as from the leaves. Our group has reported for the first time the anti-atherogenic anti-inflammatory, vasorelaxant, and anticarcinogenic effects of orujo olive oil and its minor components, which

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suggest that this edible oil may be regarded as a functional olive oil of the future.

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