Editorial

An Up-Date of Olive Oil and Bioactive Constituents in Health: Molecular Mechanisms and Clinical Implications

Currently, nutrition therapy, in addition to their dietary support, can exert therapeutic effects without the undesirable effects that accompany the classical pharmacotherapy. In the last years, it has been highlighted that consumption of some foods as well as a nutritive function, has a profound influence on health outcomes. Importantly, recent research has suggested that dietary patterns such as the traditional Mediterranean diet of countries that surround the Mediterranean Sea, may confer protection from certain chronic diseases related to oxidative stress, inflammation and the immune system. Mediterranean diet is characterised by large amounts of foods naturally derived, such as vegetables, fruits, nuts, fish and grains and, in opposition to all other healthy diets, has a high content of total fat as its most distinctive feature. This is because of the usual high intake of olive oil, from olive tree, *Olea europaea*, the characteristic culinary fat of the Mediterranean area.

In this respect, recent epidemiological studies have confirmed that habitual consumption of olive oil is effective in the prevention and treatment of certain pathologies especially, cardiovascular, neurodegeneration and aging, obesity, metabolic syndrome and diabetes, and diverse types of cancer principally breast colorectal cancer, lung, stomach, but also endometrium, ovary, and prostate [1-3].

The monounsaturated oleic acid, the more ubiquitous monounsaturated fat, is the main component of olive oil, accounting up to 80% of the total lipidic composition. The other major fatty acids present are the polyunsaturated linoleic acid (2.5–20%) and the saturated palmitic acid (10–20%). Olive oil also contains multiple minor components, present in a small amount (about 2 % of oil weight) with important biological properties. They are classified into two types: the unsaponifiable fraction, defined as the fraction extracted with solvents after the saponification of the oil and the soluble fraction. Together contain more than 230 chemical compounds such as aliphatic and triterpenic alcohols, sterols, hydrocarbons, vitamins such as α- and γ-tocopherols (around 200 ppm) and β-carotene, phytosterols and pigments, volatile compounds and polyphenols including, simple phenols (hydroxytyrosol, tyrosol), aldehydic secoiridoids, flavonoids and lignans (acetoxypinoresinol, pinoresinol) among others. In fact, the phenolic fraction is in part, responsible for olive oil oxidative stability and sensory attributes, and it is considered an important parameter in the evaluation of virgin olive oil quality [4]

The content of the minor components of an olive oil varies, depending on the cultivar, climate, ripeness of the olives at harvesting, and the processing system employed to produce the types of olive oil currently present on the market: extra-virgin, virgin, olive oil or pomace. Virgin olive oil (VOO) is that one obtained from the fruit of the olive tree solely by mechanical or other physical means under conditions that do not lead to alteration in the oil. It has not undergone any treatment other than washing, decantation, centrifugation or filtration. Extra-VOOs are VOOs with a free acidity, expressed as g of oleic acid/100 g of olive oil, less than 0.8 g. Certain VOOs in agreement with the International Olive Oil Council Regulation are submitted to a refining process in which some components, mainly phenolic compounds, and to a lesser degree squalene, are lost. By mixing virgin and refined olive oil an ordinary olive oil (olive oil) is produced and marketed. After VOO production, the rest of the olive drupe and seed is processed and submitted to a refining process, resulting in pomace olive oil, to which a certain quantity of VOO is added before marketing [5].

Traditionally the beneficial effects of VOO have been attributed to its high monounsaturated fatty acid (MUFA) content (oleic acid) as it protects lipoproteins and cellular membranes, from oxidative damage. There is likewise good evidence that the high proportion of oleic acid plays a protective role in cardiovascular diseases [6]. Besides, in most case-control and cohort studies have shown that oleic acid is associated with a reduction in the risk of cancer (mainly breast as it prevents the overexpression of *HER2* (Her-2/*neu*, *er*B-2), a well-characterized oncogene that plays a key role in etiology, progression and response to chemotherapy and endocrine therapy, in approximately 20% of breast carcinomas [7] but also colorectal and prostate cancer [8,9].

In addition to MUFA evidences have accumulated on the favourable properties of minor though highly bioactive components of VOOs, particularly the phenolic compounds, which have shown a broad spectrum of bioactive properties, including anti-inflammatory, antioxidant, antimicrobial, antiproliferative, antiarrhythmic, platelet antiaggregant and vasodilatory effects [10-13].

Nevertheless, dietary intervention trials, observational studies or *in vitro* and *in vivo* experiments have shown that the health benefit of VOO is attributable to the combined properties of all its constituents, namely MUFA and minor polar and non-polar compounds. Actually, it has been shown significant effects on the lipid profile with a decrease in LDL-cholesterol, and higher HDL/total cholesterol ratio versus saturated fatty acids and a reduction of LDL oxidizability. In the same way, it has been confirmed olive oil consumption is accompanied by a recovery of endothelial function and blood pressure control in addition to a promotion a reduction in thrombogenesis, both by a decrease of coagulation factors and platelet aggregation [14]

In normal subjects and patients with type-2 diabetes it has been observed an improvement of glucose metabolism. Also there is experimental evidence concerning the favourable influence of olive oil on chronic inflammatory diseases such as gastric ulcer and inflammatory bowel disease [15,16]. Besides, studies in human cell lines and experimental models suggest a potential protective effect of VOO on the initiation, promotion and progression of carcinogenesis. Such protective action on cancer may be mediated through several

mechanisms, mainly, changes in the composition and structure of tumour cells membranes, changes in eicosanoid biosynthesis or intracellular signaling pathways, modulation of gene expression, reduced cellular oxidative stress and DNA damage, and modulation of the immune system and hormonal balance in hormone-dependent cancers, such as breast and prostate [12]. Furthermore, recent studies have brought new insights of the favourable effects olive oil effects on obesity enhancing fat oxidation and optimizing energy metabolism in obesity conditions. On the other hand, recent reports suggest that VOO diets protects in age-related cognitive decline and Alzheimer's disease [9,12].

The purpose of this issue is intended to provide the reader an up-date of the beneficial activity of olive oil its bioactive constituents and the plausible molecular mechanisms of action.

REFERENCES

[1] Covas MI, Konstantinidou V, Fitó M. Olive oil and cardiovascular health. J Cardiovasc Pharmacol 2009; 54: 477-82.
[2] Pelucchi C, Bosetti C, Rossi M, Negri E, La Vecchia C. Selected aspects of Mediterranean diet and cancer risk. Nutr Cancer 2009; 61(6): 756-66.
[3] La Vecchia C. Association between Mediterranean dietary patterns and cancer risk. Nutr Rev 2009; 67 (Suppl 1): S126-9.
[4] Alarcón de la Lastra C, Barranco MD, Motilva V, Herrerías JM. Mediterranean diet and health: biological importance of olive oil. Curr Pharm Des 2001; 7: 933-50.
[5] Fitó M, de la Torre R, Covas MI. Olive oil and oxidative stress. Mol Nutr Food Res 2007; 51: 1215-24.
[6] Pérez-Jiménez F, Ruano J, Perez-Martinez P, Lopez-Segura F, Lopez-Miranda J. The influence of olive oil on human health: not a question of fat alone. Mol Nutr Food Res 2007; 51: 1199-208.
[7] Menendez JA, Vellon L, Colomer R, Lupu R. Oleic acid, the main monounsaturated fatty acid of olive oil, suppresses Her-2/*neu* (*erb*B-2) expression and synergistically enhances the growth inhibitory effects of trastuzumab (HerceptinTM) in breast cancer cells with Her-2/neu oncogene amplification, Ann Oncol 2005; 16: 359–371.
[8] Escrich E, Moral R, Grau L, Costa I, Solanas M.Molecular mechanisms of the effects of olive oil and other dietary lipids on cancer. Mol Nutr Food Res 2007; 51: 1279-92.
[9] Waterman E, Lockwood B. Active components and clinical applications of olive oil. Altern Med Rev 2007; 12: 331-42.
[10] Tripoli E, Giammanco M, Tabacchi G, Di Majo D, Giammanco S, La Guardia M. The phenolic compounds of olive oil: structure, biological activity and beneficial effects on human health. Nutr Res Rev 2005; 18: 98-112.
[11] Visioli F, Poli A, Gall C. Antioxidant and other biological activities of phenols from olivesand olive oil. Med Res Rev 2002; 22: 65-75.
[12] López-Miranda J, Pérez-Jiménez F, Ros E, De Caterina R, Badimón L, Covas MI, Escrich E, Ordovás JM, Soriguer F, Abiá R, de la Lastra CA, Battino M, Corella D, Chamorro-Quirós J, Delgado-Lista J, Giugliano D, Esposito K, Estruch R, Fernandez-Real JM, Gaforio JJ, La Vecchia C, Lairon D, López-Segura F, Mata P, Menéndez JA, Muriana FJ, Osada J, Panagiotakos DB, Paniagua JA, Pérez-Martinez P, Perona J, Peinado MA, Pineda-Priego M, Poulsen HE, Quiles JL, Ramírez-Tortosa MC, Ruano J, Serra-Majem L, Solá R, Solanas M, Solfrizzi V, de la Torre-Fornell R, Trichopoulou A, Uceda M, Villalba-Montoro JM, Villar-Ortiz JR, Visioli F, Yiannakouris N. Olive oil and health: summary of the II international conference on olive oil and health consensus report, Jaén and Córdoba (Spain) 2008. Nutr Metab Cardiovasc Dis 2010; 20: 284-94.
[13] Granados-Principal S, Quiles JL, Ramirez-Tortosa CL, Sanchez-Rovira P, Ramirez-Tortosa MC.Hydroxytyrosol: from laboratory investigations to future clinical trials. Nutr Rev 2010; 68(4): 191-206
[14] Pérez-Jiménez F, Lista JD, Pérez-Martínez P, López-Segura F, Fuentes F, Cortés B, Lozano A, López-Miranda J. Olive oil and haemostasis: a review on its healthy effects Public Health Nutr 2006; 9: 1083-8.
[15] Alarcón de la Lastra C, Barranco MD, Martín MJ, Herrerías J, Motilva V. Extra-virgin olive oil-enriched diets reduce indomethacin-induced gastric oxidative damage in rats.Dig Dis Sci 2002; 47(12): 2783-90.
[16] Sánchez-Fidalgo S, Villegas I, Cárdeno A, Talero E, Sánchez-Hidalgo M, Motilva V, Alarcón de la Lastra C. Extra-virgin olive oil-enriched diet modulates DSS-colitis-associated colon carcinogenesis in mice Clin Nutr 2010; 29: 663-73.

Catalina Alarcón de la Lastra Romero Ph.D.

Department of Pharmacology,
School of Pharmacy
University of Seville, Spain
Profesor García González
Seville 41012
Tel: +34 954 55 9877
Fax: + 34 954556074
E-mail: calarcon@us.es