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Editorial

What olive oil for healthy ageing?

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The olive tree originated in Asia Minor around 6000 years ago and then spread to all the Mediterranean basin. Olive oil is extracted from the pulp of its fruits [1–3]. Many studies show that the nutritional pattern of the so-called Mediterranean Diet is associated with a lower incidence of age-related diseases related to inflammation and oxidative stress, such as cardiovascular disease, Parkinson's disease, Alzheimer's disease and cancer [4–7]. It is now clear that olive oil, as a main source of fat, must play a key role in explaining the health benefits of the Mediterranean Diet.

So what is in olive oil? It is a complex mixture of over 200 compounds. The composition depends on many factors which include geographical origin, weather and irrigation, ripening and processing after harvesting. Thus all olive oils are not all the same. The main constituents of olive oil are triglycerides, the so-called the saponifiable fraction (98–99%). The three main fatty acids in the triglyceride fraction are a monounsaturated fatty acid (oleic acid), a saturated fatty acid (palmitic acid) and a polyunsaturated fatty acid (linoleic acid) [1–3]. The remaining unsaponifiable fraction (1–2%) contains about 230 components. These include: (i) lipophilic phenols (tocopherols) whose levels fall as olives mature; (ii) sterols the main sterol being beta-sitosterol; (iii) colour pigments, mainly chlorophylls and carotenoids (the most important is beta-carotene); (iv) alcohols; (v) waxes, aldehydes, esters, ketones; and (vi) phenolic compounds (hydrophilic phenols). The phenolic fraction of olive oil are polyphenols of which there are 7 different subfamilies: anthocyanins, flavonoids, flavones, phenolic acids, phenolic alcohols, acids and secoiridoids. Their amount is strongly influenced by the variety and the geographical origin of the olives. Greek Koroneiki olives have a very high level of polyphenols, while the polyphenol content of the Spanish Arbequina variety is low and the polyphenol content of Sicilian Nocellara is medium-high. In addition oil produced from green olives contains more polyphenols than that obtained from more mature fruit. Furthermore heating, method of extraction, or long processing times and inappropriate storage and packaging can result in polyphenol loss.

This variation in composition has led to an EU directive 2568/91 classifying olive oil (OO) according to quality and purity criteria:

(i) virgin olive oil (extra virgin olive oil -EVOO-, virgin olive oil -VOO- and lampante olive oil -LOO-), (ii) refined olive oil -ROO- and (iii) olive oil -OO- (4,5). EVOO (free acidity, expressed as oleic acid, not more than 0.8%) is obtained by mechanical processing, or “cold pressing”, that preserves polyphenols. VOO (free acidity, expressed as oleic acid, not more than 0.2%) is also obtained by processes that include washing olives with water, milling, cold pressing and centrifugation. VOO maintains relatively high amounts of unsaponifiable compounds and a large amount of phenolic fractions or tocopherols, but during refining, the majority of polyphenols are subsequently lost [5]. LOO is the virgin olive oil which has a free acidity, expressed as oleic acid, more than 2%. However it is not suitable as food because of its high acidity, poor flavour and unpleasant smell unless it is refined. It is a poor quality oil. ROO (free acidity, expressed as oleic acid, not more than 0.3%) is obtained from virgin olive oils by refining methods such as filtering with charcoal or other chemical or physical filters. This leads to a reduction in polyphenols [5]. OO is a mix of refined and virgin oil (other than lampante olive oil; free acidity, expressed as oleic acid, not more than 0.1%). The term indicates an OO obtained by blending refined olive oil and virgin olive oil other than lampante olive oil.

But, what olive oil is recommended for healthy ageing? As discussed below, the positive effects mostly depend on polyphenols, and EVOO should represent the best choice for healthy ageing. Many studies now support this idea.

Oleic acid represents the topmost monounsaturated fatty acid (MUFA) provided in the diet (~90% of all MUFA) and is the main monounsaturated fatty acid of olive oil. In South-Europe it is mostly provided by olive oil, whereas in the other Western countries it is provided by meat and meat products, added fats, and dairy products [8]. Oleic acid is claimed to increase the resistance of low-density lipoprotein (LDL) to oxidation and, consequently, reduces the risk of atherosclerosis. It has also been suggested that MUFA offers protection from age-related cognitive decline and might be responsible for the hypotensive effects of OO [4,6–8]. However the source of MUFA seems to be important as shown by a recent meta-analysis. It found an overall risk reduction of all-cause mortality (11%), cardiovascular mortality (12%), cardiovascular events (9%), and stroke (17%) when comparing the top versus bottom third of MUFA, olive oil, oleic acid, and MUFA: saturated fatty acid ratio. MUFA of mixed animal and vegetable sources *per se* did not yield any significant effects on these outcome parameters. However, only olive oil seems to be associated with reduced risk. When focusing on virgin olive

oil consumption, the inverse correlation between olive oil and CVD risk found in the meta-analysis is consistent with the fact that olive oil is not just a source of MUFA but also of other biologically active components [8].

OO also contains phenolic compounds (hydroxytyrosol, oleuropein) which have antioxidant, anti-inflammatory and antimicrobial properties. [4,9]. These are thought to reduce atherosclerotic plaque formation and to be neuroprotective [10–12]. There is a European Food Safety Authority (EFSA) approved health claim on olive oil polyphenols (Commission Regulation (EU) 432/2012): ‘Olive oil polyphenols contribute to the protection of blood lipids from oxidative stress. The claim may be used only for olive oil, containing at least 5 mg of hydroxytyrosol and its derivatives (e.g. oleuropein complex and tyrosol) per 20 g of olive oil. In order to bear the claim information shall be given to the consumer that the beneficial effect is obtained with a daily intake of 20 g of olive oil.’

Identification of the best olive oil for healthy aging remains a complex issue dependent not only on the polyphenol content but also on the amount consumed. Extra virgin oil with the highest polyphenol content seems to offer the most benefits.

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All authors contributed to the writing of the manuscript and have seen and approved the final version.

Competing interest

The authors declare no conflict of interest.

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[13].

References

- [1] Servili M, Esposito S, Lodolini E, Selvaggini R, Taticchi A, Urbani S, et al. Irrigation effects on quality, phenolic composition and selected volatiles of virgin olive oils Cv. Leccino. *J Agric Food Chem* 2007;55:6609–18.
- [2] Servili M, Esposito S, Lodolini E, Selvaggini R, Taticchi A, Urbani S, et al. Effect of olive stoning on the volatile and phenolic composition of virgin olive oil. *J Agric Food Chem* 2007;55:7028–35.
- [3] Servili M, Selvaggini R, Esposito S, Taticchi A, Montedoro GF, Morozzi G. Health and sensory properties of virgin olive oil hydrophilic phenols: agronomic and

technological aspects of production that affect their occurrence in the oil. *J Chromatogr* 2004;1054:113–27.

- [4] Virruso C, Accardi G, Colonna-Romano G, Candore G, Vasto S, Caruso C. Nutraceutical properties of extra-virgin olive oil: a natural remedy for age-related disease? *Rejuvenation Res* 2014;17:217–20.
- [5] Regulation (EEC) 2568/91 (http://faolex.fao.org/cgi-bin/faolex.exe?rec_id=032212&database=FAOLEX&search_type=link&table=result&lang=eng&format_name=@ERALL) accessed 29.10.14.
- [6] Vasto S, Buscemi S, Barera A, Di Carlo M, Accardi G, Caruso C. Mediterranean diet and healthy ageing: a sicilian perspective. *Gerontology* 2014;60:508–18.
- [7] Vasto S, Barera A, Rizzo C, Di Carlo M, Caruso C, Panotopoulos G. Mediterranean diet and longevity: an example of nutraceuticals? *Curr Vasc Pharmacol* 2014;12:735–8.
- [8] Schwingshackl L, Hoffmann G. Monounsaturated fatty acids, olive oil and health status: a systematic review and meta-analysis of cohort studies. *Lipids Health Dis* 2014;13:154.
- [9] Ciceralo S, Lucas LJ, Keast RS. Antimicrobial, antioxidant and anti-inflammatory phenolic activities in extra virgin olive oil. *Curr Opin Biotechnol* 2012;23:129–35.
- [10] Castañer O, Fitó M, López-Sabater MC, Poulsen HE, Nyyssönen K, Schröder H, et al. The effect of olive oil polyphenols on antibodies against oxidized LDL. A randomized clinical trial. *Clin Nutr* 2011;30:490–3.
- [11] Helal O, Berrougui H, Loued S, Khalil A. Extra-virgin olive oil consumption improves the capacity of HDL to mediate cholesterol efflux and increases ABCA1 and ABCG1 expression in human macrophages. *Br J Nutr* 2013;109:1844–55.
- [12] Vauzour D. Dietary polyphenols as modulators of brain functions: biological actions and molecular mechanisms underpinning their beneficial effects. *Oxid Med Cell Longev* 2012;2012:914273.
- [13] EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). Scientific Opinion on the substantiation of health claims related to polyphenols in olive and protection of LDL particles from oxidative damage (ID 1333, 1638, 1639, 1696, 2865), maintenance of normal blood HDL-cholesterol concentrations (ID 1639), maintenance of normal blood pressure (ID 3781), “anti-inflammatory properties” (ID 1882), “contributes to the upper respiratory tract health” (ID 3468), “can help to maintain a normal function of gastrointestinal tract” (3779), and “contributes to body defences against external agents” (ID 3467) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA J* 2011;9(4), 2033 [25 pp.]. doi:10.2903/j.efsa.2011.2033. Available online: www.efsa.europa.eu/efsajournal

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