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Composition and Nutritional Properties of Mediterranean Extra-virgin Olive Oils

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Abstract

Olive oil plays an important role in diet, economy and culture of Mediterranean people. Epidemiological studies have shown a lower incidence of some chronic and degenerative diseases in this area. The purpose of this paper was to compare the nutritional properties of Sicilian and Cretan extra-virgin olive oils. Forty Cretan (cultivar: Koroneiki) and forty-six Sicilian olive oil (cultivar: Nocellara del Belice) samples are collected in the crop seasons 2003/04 and 2004/05. We estimate free acidity, peroxide value, UV absorption characteristics, fatty acid composition, total tocopherols and polyphenols amounts. The results of statistical analysis showed extra-virgin olive oils from Cretan cultivar have an higher oleic acid and tocopherols content. The total polyphenols amounts in the two different cultivar are similar. These data provided evidence that both genetic factors (cultivar) and geographic factors (olive- growing zone) may influence composition and nutritional properties and high quality of extra-virgin olive oils.

Introduction

Olive (*Olea europaea* L.) trees are widely cultivated in southern Europe especially in Spain, Italy and Greece. In Italy and Greece there is an ancient tradition of olive trees cultivation and although the cultivation of this tree has been extended to many other regions of the world, olive fruits remain a typical Mediterranean crop. Olive oil plays an important role in diet, economy and culture of people who live there. For all these reasons, methodologies of olive trees cultivation and the olive oil potential health benefits have been studied for many years. Epidemiological studies have shown a lower incidence of atherosclerosis, cardiovascular diseases and certain kinds of cancer in the Mediterranean area than in other areas. The results of these studies have been in part attributed to the characteristic kind of diet of the local population. It is known that increased consumption of mono-unsaturated fatty acids instead of poly-unsaturated fatty acids, reduces the risk of atherosclerosis, reducing the peroxidation of circulating lipoprotein (Moreno and Mitjavilab, 2003). Recent studies have shown that other constituents of certain characteristic Mediterranean diet foods have beneficial biological effects on health, for example polyphenols and flavonoids. Olive oil is the main source of fat and the Mediterranean diet's healthy effects can be attributed not only to the high relationship between unsaturated and saturated fatty acids in olive oil, but also to the antioxidant property of its phenolic compounds (Tripoli *et al.*, 2005).
As a continuation of these studies, the present investigation was undertaken to make a comparison in quality and nutritional characteristics between Italian and Greek extra-virgin olive oils.

Materials and Methods

2.1. Samples

Forty monovarietal olive oils (*cultivar: Koroneiki*) coming from different zones of Crete are collected in the crop seasons 2004/05. The Italian samples of the commercial *Nocellara del Belice* olive oils are coming from "Valle del Belice" zone (Castelvetrano-Trapani: western Sicily), thirty samples are collected in the crop season 2003/04, while other sixteen samples in the crop season 2004/05. We have chosen *Nocellara del Belice* olive oils because it has been shown that this typical western *cultivar* gives high quality extra virgin olive oil, especially rich in antioxidant compounds (Tripoli *et al.*, 2004). Greek and Italian extra virgin olive oils were obtained form industrial mills. Oils were obtained using standard processing conditions. Samples of commercial *Nocellara del Belice* extra virgin olive oil were collected from industrial mills in the province of Trapani (Sicily) during the two crop seasons in November. The samples of *Koroneiki* extra virgin olive oil were collected in January 2005. All samples were stored at 4 ° C

in darkness using amber glass bottles without headspace until analysis. All the analysis were performed in the shortest time.

2.2. Determination of chemical and nutritional Parameters of olive oil samples

Free acidity, peroxide value and UV absorption characteristics, and fatty acid composition were carried out following the analytical methods described in Regulations EEC/2568/91 and subsequent modifications and integration of the Commission of the European Union (regulation 2568/91, 1991).

2.3. Determination of Total Phenols

Total phenols were measured by Extraction SPE-Spectrophotometric Assay (C 18) (Favati *et al.*, 1994) and the determination was based on Folin-Ciocalteu method. For calibration purposes the standard of caffeic acid (Sigma chemical Co., St. Louis, MO, USA) was dissolved in methanol with concentrations range 1.0 – 7 mg/kg. The absorptions of the solution at 725 nm was measured. Results were expressed as mg kg^{-1} caffeic acid equivalents.

2.4. HPLC Analysis of Tocopherols

Tocopherols were determinated by HPLC according to the method of Rovellini *et al.*(1997). The isocratic HPLC system (Surveyor-UV/VIS) consisted of an HPLC pump LC (Surveyor), an autosampler (AS Surveyor), a UV detector, and a fraction collector, and data were recorded and analysed by using ChromQuest 4.1 software. Elution was performed at a flow rate of 3.5 mL/min, using as the mobile phase a mixture of methanol/acetonitrile (50:50 v/v) (solvent A) and water/phosphoric acid (99.5:0.5 v/v) (solvent B). The solvent gradient was maintained for 5 min, and the run was ended. Quantification of tocopherols was carried out at 292 nm. The injection volume was 20 µL. Quantification of µ-Tocopherols content was calculated by a calibration curve obtained with a commercial standard (Fluka). Triplicate determinations were made.
All the reagents and solvents are Merck.

2.5. Statistical Analysis

One-way analysis of variance (ANOVA) was used to evaluate differences between the variables considered. Significant result were considered at $P \leq 0.05$. Data were analysed by the Epilnfo software (ver.6.0, Centers of Disease Control and Prevention, Atlanta, GA).

Results and Discussion

The chemical parameters founded according to Reg. CE n° 1983/2003 of the 06/11/2003 (acidity, peroxide number, spectrophotometric values and composition in fatty acids), perfectly allow to classify all the oils like extra virgin olive oil. Results of these quality indices for *Koroneiki* (n=40) and *Nocellara del Belice* (n=46) extra virgin olive oils from two crop seasons (2003/04 to 2004/05) are shown in Fig. 1, and in Table 1, respectively. The comparison between the values obtained from the chemical analysis of *Nocellara del Belice* and *Koroneiki* oils of season crop 2004/05, has a remarkable importance, since in this season both the *cultivars* has been infested with *Dacus oleae* G, now called *Bactrocera oleae*. Actually, the free acidity in the crop season 2004 is higher than in the crop season 2003. For example, the range of free acidity 0.1 - 0.4 % for *Nocellara del Belice* 2003/04, while for *Koroneiki* the range is 0.2 - 0.6 %. The oleic acid quantity is significantly higher in the Greek *cultivar* in both crop seasons (2003/04 $P = 0.00001$; 2004/05 $P = 0.00001$), consequently, the percentage of other fatty acids is smaller ($P = 0.0002$; $P = 0.0002$) (Table 1 and Fig. 1 A). In particular, the stearic acid amount is less in *Koroneiki* than *Nocellara del Belice* ($P = 0.0001$; $P = 0.0001$) (Fig. 1B). This datum could have an important nutritional meaning; it has been demonstrated that this fatty acid is strongly aterogenic, because it is able to reduce the plasmatic levels of HDL – cholesterol (Khor, 2004). Also the linoleic acid amount is less in *Koroneiki* than *Nocellara del Belice* ($P = 0,00001$; $P = 0,00001$) (Fig. 1B). It could be an important datum, since according to some studies, prostaglandin of series 2, which are formed from arachidonic acid, derived from acid linoleic, promote the onset of hormone-dependent tumours (breast and prostate cancer) (Stoll, 1998). It has been shown that the ratio between saturated and

	Crop season	Oleic acid %	Palmitic acid %	Stearic acid %	Linoleic acid %	Total Polyphenols (mg/kg)	Total Tocopherols (mg/kg)
Nocellara Belice	3-apr	71.55 ± 2.8	12.97 ± 1.32	3.51 ± 0.59	9.04 ± 1.03	286.03 ± 115.35	265.10 ± 73.50
Nocellara Belice	4-mag	73.64 ± 1.77	12.69 ± 0.78	3.09 ± 0.32	7.86 ± 1.09	89.00 ± 22.26	234.63 ± 24.50
Koroneiki	4-mag	77.15 ± 1.52	11.80 ± 0.72	2.66 ± 0.21	6.15 ± 0.88	91.85 ± 20.18	299.60 ± 69.02

Table 1 - Chemical and Nutritional values (mean ± standard deviation) of Sicilian and Cretan extra-virgin olive oils

unsaturated fatty acids can contribute to *cultivar* characterization, since it is known that the acidic profile of virgin olive oils is mainly affected by the fruit variety (Aranda *et al.*, 2004). Nevertheless, other major factors, such as climatic conditions, *cultivar*, irrigation and the stage of ripeness of the fruit, can affect the triglyceride and fatty acid composition (Aparicio and Luna, 2002). It is possible to observe that the total polyphenols amounts in the two different *cultivars* of the same vintage year is similar, but they are less in the *Nocellara of the Belice* oils of the crop year 2003/04 ($P = 0.00001$) (Fig. 1A). It could be to the infestation of *Dacus olea* G. in both *cultivars* in the crop season 2004/05. The polyphenols are used by the plants as defence against of the parasites; therefore, the infested plants have a smaller content. Changes in the phenolic compounds amounts of this resulting oils are considerable and affect the organoleptic properties and their stability negatively (Angerosa, 2002). The total tocopherols content is higher in *Koroneiki* than in *Nocellara del Belice cultivar* of the crop year of 2004/05 ($P < 0.0006$), while the significance is less in the crop season of 2003/04 ($P < 0.0481$) (Fig. 1B). The differences in the composition between oils of the 2003/04 and the 2004/05 emphasize the importance of the vintage year, of the nutritional properties and the genuineness of an oil.

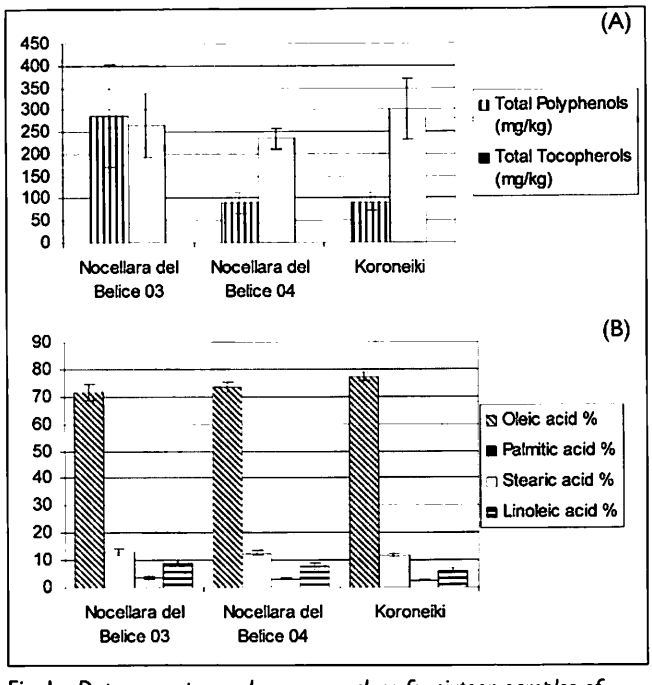

Fig. 1 - *Data are expressed as mean values for sixteen samples of Nocellara del Belice 2003/04, forty samples of Nocellara del Belice 2004/05 and forty samples of Koroneiki 2004/05. The standard errors of the mean is represented by vertical bars. (A) Mean values of fatty acids % with standard errors; (B) mean values of total polyphenols (mg/kg) and total tocopherols (mg/kg) with standard errors.*

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