Fatty acid and sterolic profile as possible indicators for origin discrimination of mono-cultivar extra virgin olive oils, cultivated in the coastline part of north-western Greece

V. Skiada [1,2], S. Agriopoulou [1*], P. Tsarouhas [3], Y. Manousopoulos [4], P. Katsaris [2], E. Stamatelopoulou [1] and T. Varzakas[*]

[1]Department of Food Science and Technology, University of the Peloponnese, Antikalamos, 24100 Kalamata, Greece; vpskiada@yahoo.gr (V.S.); sagriopoulou@gmail.com (S.A); estamatel@gmail.com (E.S.); t.varzakas@us.uop.gr (T.V.)

[2]Department of Olive and Horticultural Plants, Hellenic Agricultural Organization-DEMETER, 24100 Kalamata, Greece; vpskiada@yahoo.gr (V.S.); pankatsaris@yahoo.gr (P.K.)

[3]Department of Supply Chain Management (Logistics), International Hellenic University, Kanellopoulou 2, 60100 Katerini, Greece; ptsarouhas@ihu.gr (P.T.)

[4]Plant Protection Division of Patras, Hellenic Agricultural Organization-DEMETER, NEO & Amerikis, Patra, Greece; inminz@gmail.com (Y.M.)

Correspondence: t.varzakas@us.uop.gr (T.V.); sagriopoulou@gmail.com (S.A.)

Introduction

Extra virgin olive oil quality and authenticity is an important issue in order to assure consumer's protection, prevent unfair competition and disrupt the national economy by a false declaration of origin. As a result, the authenticity efforts are focused on identifying their botanical origin as well as their adulteration with lower quality or less costly cultivars of lower commercial value [1,2]. Up to now, extended scientific attempts have been carried out on the examination of one or more constituents present in the olive oils (major and minor components) able to provide useful information on olive cultivars and differentiate among their botanical origin [2,3].

AIM OF THE STUDY

The objective of this study was to evaluate and characterize monovarietal extra virgin olive oils of cv. Lianolia Kerkyras produced in the coastline part of Western Greece and compare them with olive oils of Koroneiki variety produced in the same area.

Materials and Methods

Geographical distribution and sampling: A total of one hundred and four (N=104) virgin olive oil samples were collected during the harvesting period 2019-2020 from the coastline part of Western Greece. In particular, sixty (60) samples of cv Lianolia Kerkyras and forty four (44) olive oil samples of Koroneiki cultivar were originated from the following regional units: Preveza, Parga and Thesprotia. All regions are characterized by similar climatic conditions. Olive samples were transferred to local oil mills for olive oil extraction under the same post-harvest conditions. The obtained olive oil samples were stored at 4°C until further analysis. All the examined chemical parameters were determined in duplicate.

Determination of the quality and chemical parameters: Free fatty acid, peroxide value and spectroscopic indices (K_{232} and K_{268}) were carried out, following the analytical methods described in the Regulation EEC/2568/91 of the European Commission and later amendments. The individual sterols, total sterols and triterpene dialcohols were determined according to the method adopted by EEC/2568/91 regulation, Annexes V. In accordance, fatty acid composition was determined according to the official method of the Regulation EEC/2568/91, Annex IV [4]. Results were expressed as mean values ± standard deviation (SD). Data were evaluated using MINITAB 18 software. Differences between means were tested for statistical significance using analysis of variance (ANOVA).

Results

Table 1. Qualitative parameters from the examined Koroneiki and Lianolia Kekryras olive oils from the coastline region of North-Western Greece. Results are expressed as means ± standard deviation (SD). N=104 [1].

Parameter	cv. Koroneiki (N=44)		cv. Lianolia Kerkyras (N=60)		EEC limit for EVOO category
	Mean ±SD	Min - Max	Mean ±SD	Min - Max	
Free acidity (%)	0.24 ± 0.10	0.13 - 0.55	0.27 ± 0.12	0.12 - 0.75	≤ 0.80
Peroxide value ($meqO_2/kg$)	6.64 ± 1.26	3.81 - 9.66	5.21 ± 1,12	3.41 - 8.64	≤ 20
K_{232}	1.56 ± 0.14	1.39 - 2.04	1.61 ± 0.15	1.25 – 1.95	≤ 2.50
K_{268}	0.14 ± 0.01	0.11 - 0.19	0.14 ± 0.02	0.11 – 0.21	≤ 0.22

Table 2. Fatty acid profile of the examined mono-cultivars olive oils from the coastline region of Western Greece. Results are expressed as means ± standard deviation (SD). N=104 [1].

Parameter	cv. Koroneiki (N=44)		cv. Lianolia Kerkyras (N=60)		Calculated P-value	EEC limit for EVOO category
	Mean ±SD	Min-Max	Mean ±SD	Min-Max		
Myristic C14:0 (%)	0.009 ± 0.002	0.006–0.018	0,008±0.004	0.003–0.04	n.s	≤ 0,03
Palmitic C16:0 (%)	13.17 ± 1.01	11.16–17.59	14.76±0.91	12.97–16.71	0.000	7.50-20.00
Palmitoleic C16:1 (%)	1.07 ± 0.17	0.83–1.69	1,47±0.19	0.97–1.91	0.000	0.30-3.50
Heptadecanoic C17:0 (%)	0.04 ± 0.01	0.02–0.06	0.04±0.01	0.02–0.07	n.s	≤ 0.40
Heptadecenoic C17:1 (%)	0.07 ± 0.01	0.05–0.12	0.08±0.01	0.05–0.13	0.003	≤ 0.60
Stearic C18:0 (%)	2.51 ± 0.24	2.03–2.98	2.04±0.15	1.78–2.64	0.000	0.50-5.00
Oleic C18:1 (%)	75.07 ± 1.71	69.76–77.96	69.55±1.71	65.39–73.00	0.000	55.00-83.00
Linoleic C18:2 (%)	6.43 ± 1.27	4.21–9.55	10.40±0.91	8.30–12.80	0.000	2.50-21.00
Linolenic C18:3 (%)	0.72 ± 0.07	0.63–0.88	0.79±0.08	0.60–0.99	0.000	≤ 1.00
Arachidic C20:0 (%)	0.45 ± 0.03	0.34–0.53	0.40±0.02	0.30–0.49	0.000	≤ 0.60
Eicosenoic C20:1 (%)	0.29 ± 0.04	0.23–0.37	0.28±0.03	0.20–0.33	n.s	≤ 0.50
Behenic C22:0 (%)	0.13 ± 0.02	0.09–0.18	0.13±0.02	0.09–0.18	n.s	≤ 0.20
Lignoceric C24:0 (%)	0.05 ± 0.02	0.01–0.10	0.05±0.01	0.03–0.09	0.009	≤ 0.20

Table 3. Sterol profile of the examined mono-cultivar olive oils from the coastline region of Western Greece. Results are expressed as means ± standard deviation (SD). N=104 [1].

Sterols and triterpene diols	cv. Koroneiki (N=44)	cv. Lianolia Kerkyras (N=60)	Calculating P-value	EEC limit for EVOO category
	Mean ±SD	Mean ±SD		
Cholesterol (%)	0.10 ±0.08	0.12±0.06	n.s	≤ 0.5
24-methylene-cholesterol %	0.23±0.09	0.08±0.04	0.00	
Campesterol %	3.82±0.35	3.42±0.17	0.00	≤ 4.0
Campestanol %	0.07±0.03	0.04±0.02	0.00	< campesterol
Stigmasterol %	0.63±0.18	0.49±0.15	0.00	
Chlerosterol %	0.81±0.20	0.81±0.16	n.s	
β-Sitosterol %	85.95±2.68	89.21±1.27	0.00	
Sitostanol %	0.48±0.24	0.69±0.17	0.00	
Δ-5-avenasterol %	6.93±2.38	4.31±1.27	0.001	
Δ-5, 24-stigm/dienol %	0.29± 0.14	0.22±0.11	0.002	
Δ-7-stigmastenol %	0.32±0.15	0.29±0.11	n.s	≤ 0.5
Δ-7-avenasterol %	0.25±0.16	0.26±0.11	n.s	
Apparent b-Sitosterol %	94.63±0.70	95.28±0.35	0.00	≥ 93.0
Total Erythrodiol %	2.76±1.07	1.43±0.45	0.00	≤ 4.5
Total sterols (mg/kg)	1020.8±120.7	1343.7±115.1	0.00	≥1000

Conclusions

- Both cultivars (cv. Koroneiki and Lianolia Kerkyras) in the coastline region of north-western Greece had an overall high quality profile.
- The fatty acid and sterolic profile data set can permit the discrimination of Koroneiki and Lianolia Kerkyras olive oil samples according to their botanical origin and can be suggested as efficient authenticity indicators.
- The obtained results can contribute in the future to the establishment of a possible "Greek Authentic Olive Network" of indigenous, local and less exploited monovarietal olive oils.

References

1. Skiada, V., Agriopoulou, S., Tsarouhas, P., Katsaris, P., Stamatelopoulou, E., Varzakas, T. Evaluation and origin discrimination of two monocultivar extra virgin olive oils, cultivated in the coastline part of north-western Greece. *Appl. Sci.* **2020**, *10*, 6733.
2. Montealegre, C., Alegre, M., García-Ruiz, C. Traceability markers to the botanical origin in olive oils. *J. Agric. Food Chem.* **2009**, *58*, 28–38.
3. Mohamed, M.B., Rocchetti, G., Montesano, D., Ali, S.B., Guasmi, F., Grati Kamoun, N., Lucini, L. Discrimination of Tunisian and Italian extra-virgin olive oils according to their phenolic and sterolic fingerprints, *Food Res. Int.* **2018**, *106*, 920–927
4. Commission Regulation (EEC). No. 2568/91 of 14 July 1991 on the characteristics of olive oil and olive residue oil and on the relevant methods of analysis. Off. J. Eur. Union 1991, L208, 1–8.

Funding: This research received funding under the project "Authentic Olive Net" in the framework of the European program "Interreg Greece Italy" MIS Code 5003145.