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Discrimination between European and extra-European olive oils using stable isotope ratio analysis

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Extra-virgin olive oil represents a key product in the EU market, with Europe being the main exporter and consumer worldwide, as around 98% of the world's olive trees are concentrated in the Mediterranean basin. It enjoys global recognition thanks to its nutritional value and beneficial effects on health, but has suffered a dramatic loss of consumer confidence due to increasing numbers of fraud cases. To protect consumers and fair producers, the European Union created the PDO and PGI systems to promote and protect foodstuffs of particular quality (Reg. 1151/2012/EU) and has established more restrictive regulations for olive oil (e.g. Reg. 1335/2013/EU), although at the moment there are no reliable methods for testing olive oil authenticity.

The stable isotope of bio-elements (H, C, N, O, S), determined using isotope ratio mass spectrometry (IRMS), may reflect local agricultural practices and geo-climatic characteristics, thus providing unique reliable and representative fingerprints for different extra-virgin olive oils.

The aim of this work was to test the ability of IRMS to distinguish European from non-European extra-virgin olive oils. Specifically, around 100 extra-virgin olive oils were collected worldwide in the 13 main olive oil producing countries (Argentina, Australia, France, Greece, Italy, Morocco, Peru, Portugal, Spain, Tunisia, Turkey, Uruguay and the USA). $^{2}H/^{1}H$, $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios were analysed in bulk oils. Furthermore, $^{13}C/^{12}C$ was determined in the four main fatty acids (linoleic, oleic, palmitic and stearic acids) obtained through trans-esterification of triglycerides from olive oils.

The results show that bulk-isotope analysis was able to discriminate between different countries on the basis of specific geo-climatic conditions, but not specifically between European and non-European samples. Surprisingly, much better results on the differentiation between EU and non-EU countries were obtained by adopting $^{13}C/^{12}C$ compound-specific isotope analysis of fatty acids.

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