The use of stable isotopes of hydrogen, carbon and oxygen in oil and carbon in individual fatty acids is presented. A study was performed on olive oil samples from different regions (Brda, Slovenia, Istria, Croatia, and Montenegro). In addition, sensory and chemical analyses were obtained and all the samples were classified in accordance with Regulation EEC/2568/91 and related annexes (the last No.1989/2003) as extra virgin olive oils. All measurements performed on genuine olive oils were used to upgrade the database in 2006, 2007 and 2008.

Materials and methods

- Samples from different varieties including Istrška belica, Leccino, Maurino, Frantoio from 2006-2008
- Sensory and chemical analysis (stearins)
- Hydrogen, carbon and oxygen isotope analysis on bulk samples – EA-IRMS, H/TEA pyrolysis IRMS
- Chemical characterization of individual fatty acids: GC-MS
- Carbon isotope analysis of individual fatty acids: GC-C-IRMS

Results

The bulk olive oil samples all have isotopic compositions between ~31.6‰ and ~29.1‰ and a similar range of δ¹³C values in individual fatty acids. Oils from Istria, Slovenian and Montenegro had slightly lower δ¹³C values and showed greater variability. We also observed an increased variability in fatty acid composition in oils from different cultivars from Montenegro.

In the case of the δ¹⁸O values, these increased from Brda in Slovenia (23.2 ± 0.3‰) to Montenegro (25.4 ± 0.5‰), while δ²H values decreased from −150 ± 5‰ in Brda to −153 ± 3‰ Montenegro.

Discussion

Authenticity

The δ¹³C values also depend not only on geographical origin but also on the year of production. In all three sampling periods the ratio of δ¹³C₁₈:₀–δ¹³C₁₆:₀ deviations from 1:1, which unfortunately means that this ratio cannot be used as an indicator of adulteration that had been anticipated in previous studies.

Measurements of isotopic composition of genuine olive oils and fatty acids in combination with δ¹⁸O and δ²H values were further used to determine the geographical origin of olive oil. The most significant variables were δ¹³C₁₈:₀, δ¹³C of oil and δ¹³C₁₆:₀ with the overall variability of 83%.