

Development of a novel method for direct analysis of extra virgin olive oils using HR ICP-AES

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The olive tree is an evergreen tree cultivated for thousands of years throughout the Mediterranean basin, which represents the largest international olive growing area. The European Union holds the record in terms of olives and olive oils production, consumption, and exportation. Extra virgin olive oils are particularly important for the national agroindustrial sector, for the aspects related to the production territory (authenticity), and for the link with the Mediterranean Diet. However, at the same time, because of economical purposes, it is also one of the products most subjected to adulteration.

The determination of the multi-elemental profile of extra-virgin olive oils has aroused increasing interest in the scientific community due to its possible application in geographical traceability studies.

The determination of the multi-elemental profile in extra-virgin olive oil is, however, one of the most difficult analytical challenges, due to the high viscosity of the matrix, high organic load increasing the matrix effect and the possibility of interferences. Furthermore, the extremely low concentration of elements makes it extremely susceptible to contamination during pre-treatment of the sample. Analysis of existing literature has revealed that microwave digestion (with HNO₃ and sometimes with the addition of H₂O₂) and ultrasound-assisted extraction are the sample pre-treatment procedures most widely used. However, some authors highlighted that the elemental content variability in different samples, even with the same geographical origin, can also be influenced by the different pre-treatment techniques.

To overcome these difficulties, a method for the analysis of the multielemental profile of extra virgin olive oils was developed using HR ICP-AES PlasmaQuant 9100 equipped with an organic kit sample introduction system. This new method allows to directly analyse the extra virgin olive oil without the need for mineralization or extraction. Extra virgin olive oils, in fact, are only diluted in solvents with low viscosity before direct aspiration. This "dilute and shoot" approach offers the advantage of less sample preparation and handling, significantly reducing the risk of sample handling errors.

Keywords: Extra virgin olive oil; elemental analysis; trace element profile; ICP-AES.

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References:

- [1] Pucci, E., Palumbo, D., Puiu, A., Lai, A., Fiorani, L., & Zoani, C. (2022). Characterization and Discrimination of Italian Olive (*Olea europaea sativa*) Cultivars by Production Area Using Different Analytical Methods Combined with Chemometric Analysis. *Foods*, 11(8), 1085. doi: <https://doi.org/10.3390/foods11081085>
- [2] ISO 21033, First Edition 2016/05/1, Animal and vegetable fats and oils – determination of trace elements by inductively coupled plasma optical emission spectroscopy (ICP-OES).
- [3] AOCS. American Oil chemist Society, AOCS Recommended Practice Ca 17-01, approved 2001.