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MEETING ABSTRACT OP

Integration of Raman spectroscopy and chemometrics for reliable authentication of olive oil

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Abstract: Extra virgin olive oil (EVOO) is highly valued for its rich composition of bioactive compounds and high oleic acid content, which contribute to its nutritional quality and oxidative stability; however, its high market value has led to increasing adulteration with cheaper vegetable oils, raising concerns for consumer safety and product authenticity. To address this issue, international organizations such as the International Olive Council (IOC), FAO, and OLAF have established standards to ensure quality and traceability, although natural variations in fatty acid composition (typically 55–85% oleic acid) due to cultivar, origin, and processing conditions complicate authentication. In this context, Raman spectroscopy has emerged as a rapid, non-destructive, and reliable analytical technique capable of providing detailed molecular information without extensive sample preparation (Ryoo et al., 2017; Li et al., 2018). When combined with chemometric methods such as PLS, PLS-DA, and DD-SIMCA, Raman spectroscopy can detect adulteration at low levels, often below 5%, while advanced approaches including surface-enhanced Raman spectroscopy (SERS), temperature-modulated analysis, and interval-based methods (iPLS and siPLS) further improve sensitivity and accuracy, achieving detection limits as low as 0.5% (Farley et al., 2016; Hashem et al., 2020). The use of optimized preprocessing techniques such as standard normal variate (SNV), along with careful selection of instrumental parameters, enhances model performance, and the integration of machine learning algorithms enables classification accuracies exceeding 90%. Portable Raman systems allow for real-time, in situ analysis, making this technique highly suitable for routine quality control and authentication in the olive oil industry.

Keywords: Extra virgin olive oil, adulteration, Raman spectroscopy, chemometrics, food authenticity

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