A data fusion model of NIR and RAMAN techniques for the geographical screening of Italian extra virgin olive oil.

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Due to climate changes and *Xylella fastidiosa* infection the production of Italian extra virgin olive oil (EVO) recentely decreased. Italy now imports oils from other countries to meet the needs of the consumers and the food industry. As a consequence, an increase of frauds based on the mixture of the Italian EVO oil with those produced by other countries in Europe or outside Europe has been reported. The aim of the study is the set-up of a simple and efficient analytical approach able to discriminate Italian EVO oils from those produced by other countries. The EVO oils were analyzed by two non-destructive spectroscopic techniques RAMAN and NIR. The spectra obtained by both analytical methods were pre-processed, normalized and then statistically analyzed by Mid-Level Data Fusion. A classification model, able to discriminate Italian EVO oils, was obtained.

Forty-one oils were analyzed (7 Greek oils and 34 Italian oils). The spectra were obtained by using the RAMAN spectrophotometer BRAVO (Bruker) and the NIR instrument named MPA (Bruker).

The fusion of the principal components obtained by the two techniques enhanced the efficiency of the classification model. In fact, no good geographical discrimination of the oils was obtained by the principal components analysis (PCA) of the data obtained by each technique. Instead, an efficient classification by PLS-DA of the *training* *set* with accuracy more than 90% was obtained after Mid-Level Data Fusion, whereas the accuracy of the PLS-DA classification was more than 83% on a *validation-set* of new samples .

Geographical discrimination of EVO oils can be successfully obtained by the fusion of NIR and RAMAN data. New samples will be added in the future to this preliminary study in order to improve the accuracy of the approach.

**Keywords:** Mid-Level Data Fusion, NIR, RAMAN, geographical origin, Virgin Olive Oil, PCA, PLS-DA

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