Classification of olive oils based on their acidity percentage, their adulteration and their designation of origin using LIBS with Machine Learning techniques

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ABSTRACT

One of the societal challenges is the assurance of food quality, a purpose supported by both national and international organizations (as e.g. IOC). The European Commission has set the limits of allowed concentration of the different food ingredients and also enacted laws in order to preserve the designation of origin (Protected Designation of Origin, PDO) and the geographic indication (Protected Geographical Indication, PGI) of food[1]. According to these laws, food's categorization, which is based on their variety and designation of origin, is set as a criterion of their authenticity and quality.

Laser Induced Breakdown Spectroscopy (LIBS) is a rapid laser based analytical technique based on plasma formation on the examined sample's surface, due to the interaction of an intense laser beam with the sample. The analysis of materials, which may be of any physical state (i.e. gas, liquid or solid), is performed rapidly and in real time, with no need for sample preparation. Measurements can be carried out in-situ, on-line and remotely, even in hazardous and inaccessible environments (as e.g. nuclear wastelands). Moreover, LIBS technique provides the ability of simultaneous multielement analysis of the sample.

LIBS application on organic materials was limited in the past due to the similarities presented of their plasma emission spectra, because of the abundancy of the elements C, O, H and N that constitute most of them, and therefore the extraction of qualitative and quantitative information was extremely difficult. For this reason, machine learning techniques, both supervised and unsupervised ones, have been applied on LIBS spectra, in order to extract valuable information, otherwise impossible to obtain.

In the present study, LIBS is combined with machine learning techniques, such as Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) to ensure Cretan olive oil's quality, via their categorization based on their designation of origin, their acidity[2] and their adulteration with pomace oil. The obtained classification results of olive oils are spectacular, and therefore the combination of LIBS with machine learning techniques seems that it can be a powerful and useful tool for food analysis.

REFERENCES

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