Green approach for estimation of iodine value in olive oil

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Abstract

This work proposes a new and environment friendly method for the quantitative analysis of iodine value (Iv) in olive oil. By applying Attenuated total reflectance-Fourier transform mid-infrared Spectroscopy (ATR-FTMIR) associated with chemometric techniques of Principle Component Regression (PCR) and Partial Least Squares (PLS). Spectral data were first analyzed by Principal Component Analysis. Then, PCR and PLSR were used to establish calibration models. Either PCR or PLSR model revealed the best calibration models for predicting the content of Iv in olive oil samples with coefficient of determination (R^2) > 0.9. Finally, another predictive model with multiple linear regression (MLR) was built up by chosen wavenumbers. It was six FTMIR wavenumbers 726.068; 1160. 94; 1457. 94; 1740. 44; 2942. 84 and 3471. 24cm^{-1}.

Excellent correlation between chosen wavenumbers and Iv was obtained (R^2v = 0.967). The value obtained for root mean square error of prediction (RMSEP) was 2.28. The method developed was very suitable for the determination of Iv in olive oil. It is a green chemical technique furnishing a reliable, non-polluting and rapid quantification tool that does not require chemical analysis for determining Iv in olive oil.

Keywords: ATR-FTIR spectroscopy, Chemometric tools, Iodine value, Olive oil.

Introduction

The olive tree is quoted as a blessed tree, a symbol of universal man and olive oil is a source of divine light to guide people. The origin of the olive tree is lost in the mists of time, its history merges with civilizations that have emerged around the Mediterranean basin and have for a long time governed the destinies of humanity and marked their footprint[1]. The real oil would have existed in Algeria since the 12th millennium BC. From this point of departure to the Phoenicians (4000 to 3000 years BC), no indication can understand the evolution.

From the Phoenician period, the olive oil trade has enabled the development of olive growing throughout the Mediterranean basin. Since then, the history of the olive tree merges with the history of Algeria and the various invasions have had a definite impact on the geographical distribution of the olive tree that we inherited at the country's independence.

Today, 95% of the world's olive oil is produced in the Mediterranean. The techniques and customs continue to intersect around the cultivation of the olive tree. Overall, the production of olive oil has a decisive role for the economies and employment as well as for the biodiversity of the Mediterranean regions. In Algeria, the areas occupied by the olive tree are of the order of 315 000 hectares with 35 million olive trees and an average annual production of 35000 tons[2]. The Algerian olive oil sector is one of the least competitive in the Mediterranean, even though the country is ranked 7th world producer by the International Olive Oil Council (IOOC)[3]. It has benefited from few modernization initiatives; irrigation, mechanization and fertilization are thus sparsely distributed.

On the other hand, Algerian olive oil has some assets that can be beneficial if they are valued within the framework of a geographical indication: orchards that extend mainly (80%) in mountain terroirs (large and small Kabylie, the region of Jijel and part of eastern Algeria), differentiated and quality product, varietal diversity, good image at the national level, oil from an extensive and environmentally friendly culture and high price of product that can provide a comfortable income for rural families[4].

In fact, olive oil is an interesting product from a nutritional point of view for its composition in fatty acids. Indeed, it is largely unsaturated and contains a small part of essential fatty acids. In addition to this particular composition of fatty acids, olive oil is especially interesting for its minor compounds such as polyphenols. The nutritional value of these phenolic compounds lies in their strong antioxidant capacity which could prevent or slow the onset of certain degenerative diseases as well as cardiovascular diseases. Therefore, optimizing their content in olive oil presents a real public health interest[5].

Additionally, the quality of virgin olive oil, the only food oil that qualifies as "natural", is a major asset because it is closely linked to the nutritional, biological and organoleptic values of oil. The quality of olive oil varies not only in terms of soil variety and climatic conditions but also with many