

Rapid Extra Virgin Olive Oil Classification and Blend Quantitation

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A-TEEM™ molecular fingerprint and multivariate (PARAFAC and PLS) analysis

Introduction

The resurgence of interest in the Mediterranean Diet and its associated health benefits have directed focus on the role that Extra Virgin Olive Oil plays. The increasing awareness is leading to increasing product demand, but also opportunities to compromise quality. Hence the need for rapid analytical methods to perform Quality Analysis of various product samples.

A-TEEM molecular fingerprinting, a technique based on simultaneous acquisition of Fluorescence Excitation Matrices and Absorbance is shown to easily distinguish between Extra Virgin Olive Oil brands, varieties, and provides a quantitative evaluation of blends.

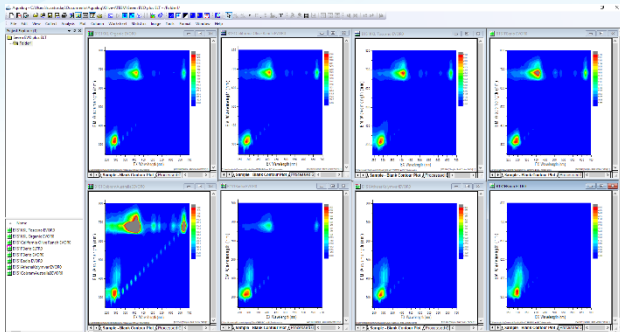


Figure 1. A-TEEM fluorescence fingerprints of 7 Extra Virgin Olive Oils of different brands and one Extra Light Tasting purified product within brand "B".

Measurements were conducted using Aqualog™, a CCD-based fluorimeter with built-in absorbance detection for real-time inner filter effect correction that is needed to acquire traceable and reproducible, concentration-independent A-TEEM fingerprints. Olive oil samples were prepared by dissolving them in hexane and measuring the IFE-corrected fluorescence EEM and absorbance contemporaneously in a 1 cm quartz cuvette with 5 nm excitation and emission band pass.

Each A-TEEM fingerprint was collected in less than a minute. Olive oil brands were coded with single letters of the alphabet. Multivariate Analysis (3-D PARAFAC and PLS) was performed using Eigenvector Inc. Solo software.

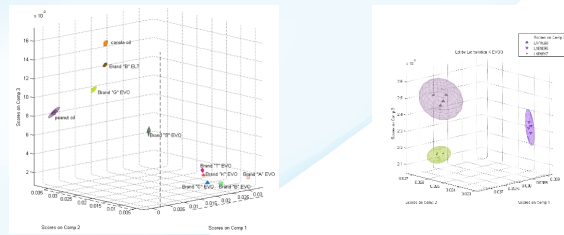


Figure 2. 3-D score plot of PARAFAC analysis of different brand Extra Virgin Olive Oils and vegetable oils. (A). Lot-to-lot variation of the same EVOO product of brand "K" is demonstrated in panel (B).

3-D PARAFAC (Parallel Factor) Analysis can classify these products based on their A-TEEM molecular fingerprints acquired with Aqualog. Extra Virgin olive Oil and Extra Light Tasting Olive Oil within the same brand are clearly distinguished as are the others. More-over, classification of different lots within the same EVOO product of a brand is possible.

A-TEEM spectroscopy is also successful at distinguishing between individual varieties of Extra Virgin Olive Oil as shown in Figure 3, which features a 3-D scoreplot of PARAFAC Analysis of six different Mediterranean varieties of the same brand obtained from a local specialty store. The ellipses border the 95% confidence interval.

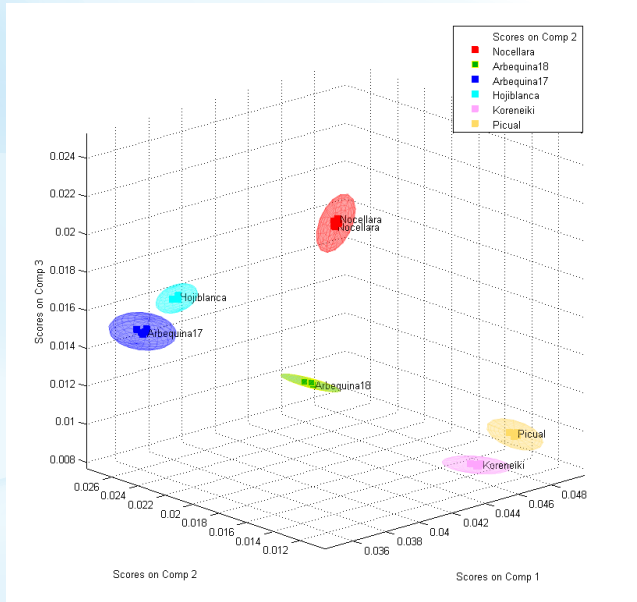


Figure 3. 3-D scoreplot of PARAFAC analysis of Mediterranean varieties.

The model correctly predicted the blend to have a 45% Nocellara (NOC45), with the R2 values of Calibration and Cross Validation being both 0.999

Conclusion

A-TEEM molecular fingerprints acquired with the Aqualog and coupled with multivariate analysis allow rapid classification and quantitation of extra virgin olive oil varieties and their blends.

Partial Least Squares analysis (PLS) of a progressive blend of two varieties, Nocellara and Arbequina, was carried out to demonstrate the capability to quantitate the mixture of different varieties.

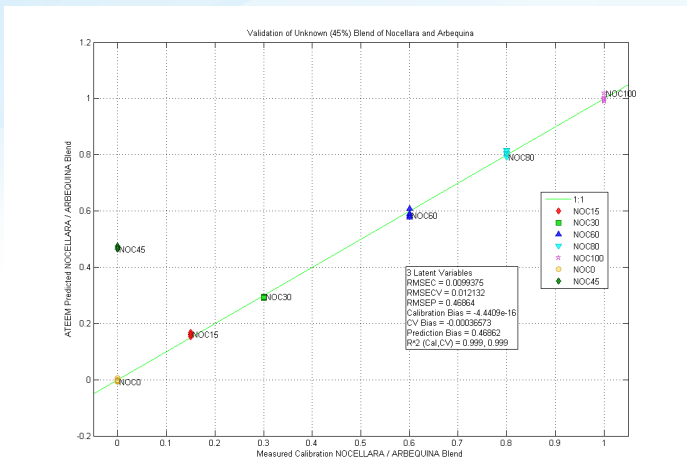


Figure 4

Figure 4 shows the validation of a 45% blend of Nocellara and 55% Arbequina EVOO's when it was presented to the PLS model as an unknown with 0% measured value.



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