

Evaluating the Purity of Olive Oil using the Shimadzu UV-1800 Spectrophotometer

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■ Introduction

Olive oil has become a major component of the human diet. The United States is the largest importer of olive oil and demand for this product will continue to increase with an increased awareness of the health benefits that olive oil offers¹. Controversy has always surrounded the purity of olive oil based on its classification as "Extra Virgin", "Virgin", and "Olive Oil". The International Olive Council (IOC) and the United States Department of Agriculture (USDA)² identify extra virgin as the top grade of olive oil. Chemistry standards have been established for the evaluation of olive oils and the purpose of this application news is to demonstrate the use of the Shimadzu UV-1800 spectrophotometer for such analysis. COI/T20/Doc. no. 19 released by the IOC outlines the method of analysis for using a spectrophotometer based on the absorption characteristics of olive oil in the ultraviolet region of the energy spectrum.

Ultraviolet spectroscopy can provide information on the degree of oxidation of the olive oil. More specifically, the quality of olive oil is analyzed based on the absorption bands between 200 and 300 nm. Peaks that are present in this region are due to the presence of conjugated diene and triene systems. The analysis method is based on the principle that conjugated double bonds are formed in oils upon oxidation. An elevated level of UV absorbance indicates oxidized oil³. This is demonstrated in Figure 1 which shows the ultraviolet spectra of Extra Virgin Olive Oil compared to that of Olive Oil diluted in solvent.

The Shimadzu UV-1800 spectrophotometer is a compact, double-beam UV-Vis spectrophotometer that uses a Czerny-Turner monochromator in a compact design. The instrument can be operated as a stand-alone system or with UVProbe software. The UV-1800 is USB-memory ready, which enables users to save measurement data to USB memory for data analysis and printing on a PC.



Shimadzu UV-1800 Spectrophotometer

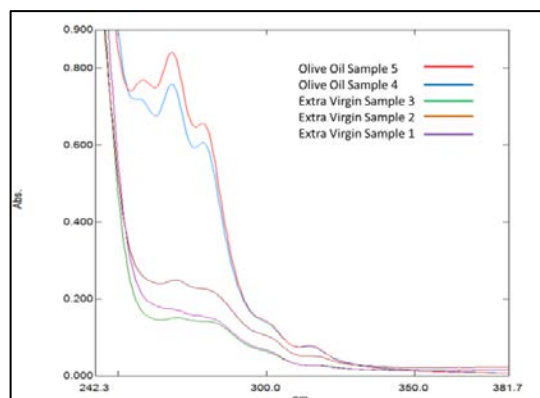


Figure 1: Ultraviolet spectra of Extra Virgin Olive Oil and Olive Oil diluted in iso-octane using COI/T20/Doc. no. 19 as a guideline.

■ Experimental Conditions

Olive oil samples were diluted in iso-octane (2,2,4-Trimethylpentane) using the methods outlined in COI/T20/Doc. no. 19 as a guideline. Samples were measured on the Shimadzu UV-1800 using 1 cm path length quartz cuvettes with solvent as a reference. Spectrophotometric analysis of olive oil in accordance with the official method in the EC regulations involves determination of the specific extinction (extinction coefficient) in iso-octane at wavelengths of 232, 264, 268, 272 nm, and determination of the variation of the specific extinction (ΔK), as outlined in equations 1 and 2:

$$(1) \quad K_{\lambda} = \frac{E_{\lambda}}{c \cdot s}$$

where K_{λ} is the specific extinction at wavelength λ , E_{λ} is the extinction measured at wavelength λ , c is the concentration of the solution in g/100 mL, s is the thickness of the cuvette in cm.

■ Results

Table 1 summarizes the results obtained on the UV-1800 by analyzing multiple olive oil samples and

(2)

$$\Delta K = K_m - \frac{K_{m-4} + K_{m+4}}{2}$$

where K_m is the specific extinction at wavelength m (268). The Shimadzu UV-1800 was used to measure the extinction coefficients of 5 different oil samples labelled either as "Extra Virgin Olive Oil" and "Olive Oil" purchased from local grocery stores.

their correlation to the criteria outlined by the IOC standards.

Table 1: Specific extinction coefficients measured on the Shimadzu UV-1800 for Extra Virgin Olive Oil and Olive Oil samples.

Measured K Values					
Olive Oil Sample Type	K232	K264	K268	K272	ΔK
Extra Virgin Sample 1	2.379	0.179	0.173	0.165	0.001
Extra Virgin Sample 2	1.911	0.207	0.214	0.209	0.006
Extra Virgin Sample 3	2.085	0.130	0.135	0.134	0.003
Olive Oil Sample 4	2.373	0.686	0.759	0.663	0.085
Olive Oil Sample 5	2.180	0.701	0.772	0.675	0.084
Criteria K Values					
Extra Virgin Olive Oil	≤ 2.50		≤ 0.22		≤ 0.01
Olive Oil	—		≤ 0.90		≤ 0.15

Shimadzu's UVProbe software offers the ability to create customized methods and pass/fail criteria that can be saved and recalled for future use in-line with

the standards established by the IOC as shown in Figure 2.

Custom Equations & Pass/Fail Criteria

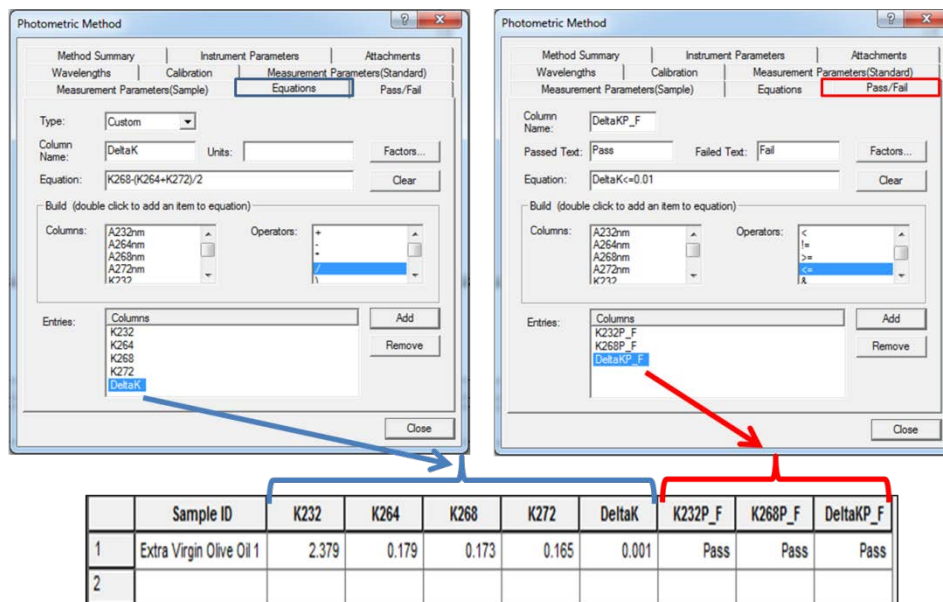


Figure 2: Create custom equations for calculating the specific extinction coefficients and establish Pass/Fail criteria based on outlined IOC standards.

■ Summary

The Shimadzu UV-1800 spectrophotometer demonstrates the ability to analyze the purity of olive oil samples allowing for distinction between Extra Virgin Olive Oil and Olive Oil as outlined by the

International Olive Council. The UVProbe software allows for efficient data analysis and interpretation of results for comparison with defined standard values.

■ References

1. Frankel, E.N.; Mailer, R.J.; Wang, S.C.; Shoemaker, C.F.; Guinard, J.-X.; Flynn, J.D.; Sturzenberger, N.D. "Evaluation of Extra-Virgin Olive Oil Sold in California". Report. UC Davis Olive Center at the Robert Mondavi Institute.
2. United States Standards for Grades of Olive Oil and Olive-Pomace Oil. October 25, 2010.
3. International Olive Council. COI/T20/Doc. no. 19/Rev3 2010. Method of Analysis: Spectrophotometric Investigation in the Ultraviolet. 2010.



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