

Identification of Extra Virgin Olive Oil using the Alpha UV-Vis Spectrophotometer



Summary

In this study, based on the International Olive Council (IOC) UV spectrophotometric method, the specific extinction coefficients K_{232} , K_{270} , and ΔK of two commercially available extra virgin olive oils (EVOO), blended olive oil, and sunflower oil samples were measured using the K LAB Alpha UV-Vis spectrophotometer.

The UV absorbance of stock solutions and 1:5 diluted solutions prepared in cyclohexane was measured in the ultraviolet region and converted into K_{λ} values according to the International Olive Council (IOC) calculation formula. The converted results were then compared with the IOC criteria for extra virgin olive oil to evaluate grade compliance.

As a result, both extra virgin olive oil samples met all acceptance limits, whereas the blended olive oil and sunflower oil exceeded the IOC thresholds and were therefore not classified as extra virgin olive oil. These results demonstrate that the Alpha UV-Vis spectrophotometer can be effectively used for evaluating oxidation and refining levels and for olive oil grade classification based on IOC UV indices.

K LAB Co., Ltd., a leading company in the domestic analytical instrument industry, is the only specialized research and manufacturing enterprise in Korea that manages the entire process—from R&D to production—under one roof.

Website
www.klab.im

Tel
+82-042-932-7586

Contact
info@klab.im

Overview

Globally, the consumption of olive oil is increasing as a source of healthy fats, with the demand for extra virgin olive oil (EVOO) expanding most rapidly among all categories.

Accordingly, cases have been reported in which the actual quality of olive oil differs from label declarations due to the adulteration with low-cost oils or oxidative degradation. As a result, the need for internationally standardized quality verification methods has been increasingly emphasized.

The International Olive Council (IOC) has established a UV spectrophotometric method that uses the specific extinction coefficients K_{232} , K_{270} , and ΔK for olive oil grade classification. Absorption characteristics in the ultraviolet region reflect the presence of conjugated diene and triene oxidation products, and are therefore used as key quality indicators for evaluating the degree of oxidation and refining of olive oil.

In this application note, the K_{232} , K_{270} , and ΔK values of two commercial extra virgin olive oils and other edible oils were measured using K LAB's Alpha UV-Vis spectrophotometer following the IOC test method. The obtained values were compared with the IOC extra virgin criteria to evaluate the grade suitability of each sample.



[Figure 1]. Alpha UV-Vis spectrophotometer - A double-beam UV-Vis spectrophotometer developed by K LAB, supporting a wavelength range of 190-1,100 nm and providing stable ultraviolet data required for calculating the K_s and ΔK values of olive oil.

Experimental Conditions

Sample Preparation

In this experiment, two commercially available extra virgin olive oils (EVOO-1 and EVOO-2), a blended olive oil (OO-1), and a sunflower oil (SO-1) were used as samples. Approximately 0.25-0.30g of each sample was weighed into a 25 mL volumetric flask and diluted to volume with cyclohexane to prepare the stock solution.

To ensure that the absorbance for the K_{232} measurement fell within the recommended range of 0.1-0.8, the same stock solution was further diluted 1/5 with cyclohexane to prepare the diluted solutions. The sample information and the concentrations of the prepared solutions are summarized in [Table 1].

[Table 1]. Sample information and prepared solution concentrations

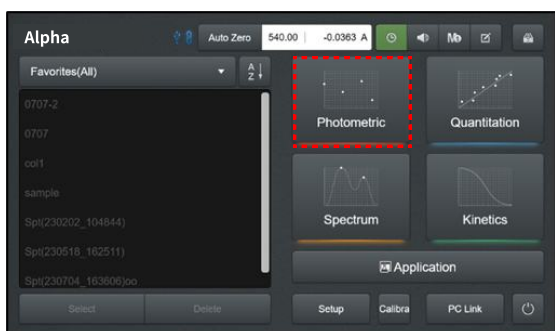
Sample ID	Ingredients on label	Stock conc. (g/100 mL)	Diluted conc. (g/100 mL)
EVOO-1	Extra virgin olive oil	1.13	0.23
EVOO-2	Extra virgin olive oil	1.13	0.23
OO-1	Refined olive oil and virgin olive oil	1.07	0.21
SO-1	Sunflower oil	1.01	0.20



[Figure 2]. Samples used in this experiment (from left: EVOO-1, EVOO-2, OO-1, SO-1)

Measurement and Data Processing

Measurements were performed using the K LAB Alpha UV-Vis spectrophotometer with 10 mm quartz cuvettes. The measurement wavelengths were set to 232, 266, 270, and 274 nm in accordance with the IOC test method, and zero adjustment was carried out using cyclohexane as the blank. Prior to sample analysis, each cuvette was rinsed several times with the same sample to prevent cross-contamination and to ensure a clean measurement surface.



[Figure 3]. Main UI screen of the Alpha UV-Vis spectrophotometer - Using the Multi-Wavelength function in Photometric mode, the absorbance of each sample was measured simultaneously at 232, 266, 270, and 274 nm.

The absorbance A_λ obtained at each wavelength was converted to the specific extinction coefficient K_λ according to the calculation formula specified by the IOC. When the cell path length is s and the sample concentration is c (g/100 mL), K_λ is defined as follows. Since a 10 mm quartz cuvette was used in this experiment, $s = 1$ cm was applied.

$$K_\lambda = \frac{A_\lambda}{c \times s}$$

[Equation 1]. Calculation formula for the specific extinction coefficient K_λ

The ΔK value was calculated using the K_λ values at 266, 270, and 274 nm according to the following equation.

$$\Delta K = K_{270} - \frac{K_{266} + K_{274}}{2}$$

[Equation 2]. Calculation formula for the change in specific extinction coefficient (ΔK)

The K_{232} , K_{270} , and ΔK values obtained for each sample were then compared with the IOC UV standards for extra virgin olive oil and olive oil (refined + virgin blend) to evaluate compliance with the specified grade criteria.

[Table 2]. IOC UV standards for selected olive oil types

Oil type	K_{232}	K_{270}	ΔK
Extra virgin olive oil	≤ 2.50	≤ 0.22	≤ 0.01
Olive oil (refined olive oil + virgin oils)	-	≤ 1.15	≤ 0.15

Results and Discussion

Table 3 summarizes the K_{232} , K_{266} , K_{270} , K_{274} , and ΔK values calculated for each sample using the Alpha UV-Vis spectrophotometer, along with the determination results based on the IOC extra virgin criteria ([Table 2]). The K_{232} value was calculated using the absorbance at 232 nm from the 1/5 diluted sample.

The K_{232} values of EVOO-1 and EVOO-2 were below 2.50, and their K_{270} and ΔK values were within the limits of 0.22 and 0.01, respectively, meeting the IOC criteria for extra virgin olive oil.

In contrast, OO-1 and SO-1 exhibited K_{232} , K_{270} , and ΔK values higher than the acceptable limits for the extra virgin grade, and therefore did not comply with the IOC extra virgin classification.

[Table 3]. K_{λ} values and extra virgin criteria evaluation results by sample

Sample ID	K_{232}	K_{266}	K_{270}	K_{274}	ΔK	Extra virgin Determination
EVOO-1	2.457	0.165	0.153	0.148	-0.003	PASS
EVOO-2	2.357	0.197	0.194	0.191	0.000	PASS
OO-1	2.853	0.480	0.489	0.437	0.031	FAIL
SO-1	3.162	2.743	3.166	2.875	0.357	FAIL

Conclusion

In this experiment, the ultraviolet spectrophotometric method proposed by the IOC was referenced to calculate the K_{232} , K_{270} , and ΔK values of commercial extra virgin olive oil and other edible oil samples using the Alpha UV-Vis spectrophotometer, and the results were compared with the IOC extra virgin criteria.

Both extra virgin samples satisfied the allowable limits for all three indicators, whereas the blended olive oil and sunflower oil samples exceeded the standard values for every parameter, confirming that they do not meet the extra virgin classification.

These findings demonstrate that the Alpha UV-Vis spectrophotometer is suitable for evaluating the oxidation and refining levels of olive oil using the IOC UV indicators (K_{232} , K_{270} , ΔK), and that it can be effectively applied in practical quality control and grade verification workflows.

* References

1. International Olive Council. Spectrophotometric investigation in the ultraviolet (COI/T.20/Doc. No 19/Rev.5). Madrid: International Olive Council; 2019.
2. International Olive Council. Trade standard applying to olive oils and olive pomace oils (COI/T.15/NC No 3/Rev. 13). Madrid: International Olive Council; 2019