

AUTHENTICATION OF *CAMELLIA OLEIFERA* ABEL OIL BY NEAR INFRARED FOURIER TRANSFORM RAMAN SPECTROSCOPY

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Abstract: FT-Raman was employed to determine the authenticity of *Camellia Oleifera* Abel oil. Raman intensity at 1266, 1302, and 1655 cm^{-1} changed concomitantly with the magnitude of double-bond in oil. A linear correlation ($R^2 = 0.9910$) between the Raman ratio (v_{1655}/v_{1444}) and iodine value in oils was obtained which was then used to analyse the authenticity of *Camellia Oleifera* Abel oils from local markets.

FT-Raman has been used for the analysis of edible oils.⁽¹⁻⁴⁾ The advantages of FT-Raman spectroscopy in oil analysis include the following: (1) it is free from fluorescence interference, (2) it has less photodecomposition compared to classical dispersive Raman measurement, (3) it allows direct sample measurement with no sample destruction, and (4) there is no use of unfriendly reagents. We report here the authentication of *Camellia Oleifera* Abel oil by FT-Raman spectroscopy. *Camellia Oleifera* Abel oil is popular in Taiwan because of its unique therapeutical property such as scar curing and stomach-ache relieving. The price of *Camellia Oleifera* Abel oil is much higher than other edible oils. Adulteration of *Camellia Oleifera* Abel oil with other cheaper oils is a long-term problem. Usually, chemical and sensory analyses are used to solve this problem. However, classical method for oil analysis is relatively tedious and inaccurate. We reported that FT-Raman is a simple and rapid technique for oil analysis.⁽⁴⁾ In this report, we further affirm the high efficiency of FT-Raman in solving the adulteration problem of *Camellia Oleifera* Abel oil.

Fresh soybean oil and *Camellia Oleifera* Abel oil were prepared directly from soybean and *Camellia Oleifera* Abel, respectively, in our laboratory. Blend oils were prepared from both oils at different ratio (0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0 in *Camellia Oleifera* Abel oil). All sample oils were deposited in brown glass vials, sealed with a cap, and stored at -18 °C pending for analysis. The determination of Iodine Value (IV) for each sample was analysed in triplicate by the Wijs⁽⁵⁾ method, which is used to evaluating oil quaoity. The FT-Raman measurement was accomplished by using a Bruker RFS-100 FT-spectrophotometer (Bruker Optik GmbH, Lubeck, Germany). Continuous wave near-infrared excitation at 1064 nm was provided by a diode laser pumped Nd:YAG laser (Coherent Lubeck GmbH, Lubeck, Germany). An aliquot (~0.5mL) of each sample was introduced into a capillary quartz tube, which was fixed onto a stainless steel holder, and the laser light with power of 100 mW was focused on the sample. The scattered radiation was collected at 180° with an ellipsoidal mirror and was filtered, modulated and reflected back into the highly sensitive GaAs detector which was cooled by liquid nitrogen. Raman spectra were produced over the Raman shift 0 - 3500 cm^{-1} . Typically, 100 interferograms were coadded at 4 cm^{-1} resolution with a sampling time about 3 minutes.

Fig.1 is a representative Raman spectrum of soybean oil, blend oils, and *Camellia Oleifera* Abel oil. The vibrational bands at 1742, 1655, 1444, 1302, 1266, and 1076 cm^{-1} were assigned to the C=O stretching, C=C stretching (*cis* form), CH₂ scissoring, CH₂ twisting, =C-H in-plane bending, and C-C stretching modes, respectively.⁽⁶⁾ Apparently, Raman intensity at 1266, 1302, and 1655 cm^{-1} changed concomitantly with the change of double-bond content in oils. So, FT-Raman is a prospective tool for evaluating the quality of *Camellia Oleifera* Abel oil. Fig. 2 shows the plot of Raman intensity ratio (v_{1655}/v_{1444}) vs. IV of blend oils. A linear correlation with high consistency ($R^2 = 0.9910$) between the Raman intensity ratio and the IV in oil was obtained. The agreement between FT-Raman and classical titration method indicates that the application of FT-Raman in

determining the authenticity of *Camellia Oleifera* Abel oil is quite convincible. Analysis of various *Camellia Oleifera* Abel oil collected from local markets is then carried out. FT-Raman spectroscopy further proves itself a powerful technique for the authentication of *Camellia Oleifera* Abel oil since each measurement can be directly completed in 3 min without any sample modifications.

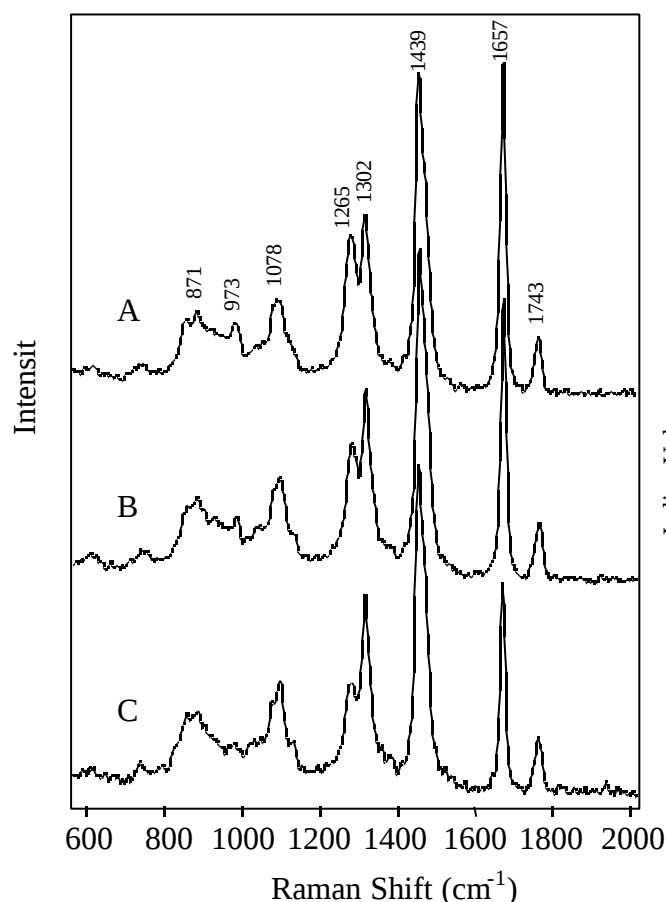


Figure 1: FT-Raman spectra of 100% soybean oil (A), 50% soybean oil + 50% *Camellia Oleifera* Abel oil (B), and 100% *Camellia Oleifera* Abel oil (C).

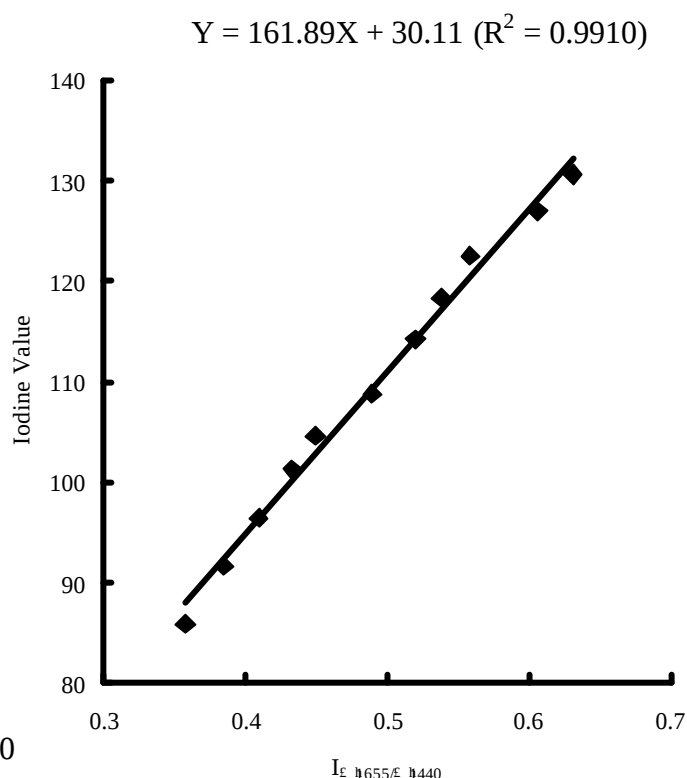


Figure 2: Correlation of Raman intensity ratio (v_{1655}/v_{1440}) to the iodine value on the blend oils prepared from soybean oil and *Camellia Oleifera* Abel oil at different ratio.

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