July
02-03
2025
RamanFest
Frankfurt | GERMANY

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Wine Analysis by HPLC-SERS

[Background] We have been attempting to apply surface enhanced Raman spectroscopy (SERS) to food sciences. The aim of this study is to combine HPLC and SERS to enable precise analysis of HPLC-separated compounds using SERS. The study began with the detection of SERS spectra of components contained in wine. Subsequently, for the wine component that was successfully detected (caffeic acid) [1], HPLC was used to attempt further detection and analysis.

[Experiment] The HPLC was the *Kotori* system (Uniflows Co., Ltd.) used with a *PEGASL ODS SP100-7* column [2]. The flow rate was 1 mL/min, UV detection was at 265 nm, and the mobile phase consisted of 5 mM phosphate buffer (pH 2.5) and methanol in a 70:30 ratio. Caffeic acid was first injected into the HPLC to confirm its retention time. Then, the caffeic acid to be fractionated was run through, and HPLC pretreatment was carried out. The SERS substrate was subjected to artifact removal and then immersed in the fractionated solution for 10 minutes. The Raman spectrometer used was the *DXR3* by Thermo Fisher Scientific, and the measurement conditions were as follows: laser wavelength 785 nm, laser power 0.5 mW, and 16 accumulations.

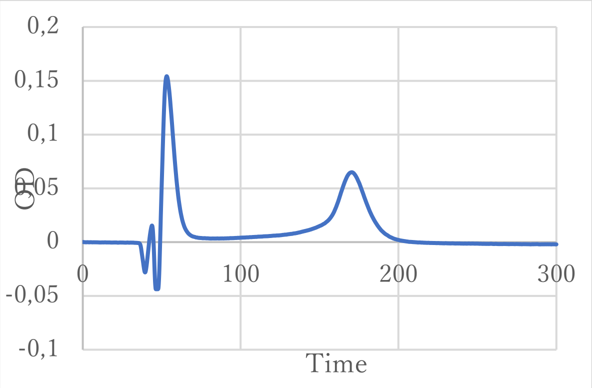
[Results and Discussion] Figure 1 shows a chromatogram of 1 mM caffeic acid. Figure 2 shows the SERS spectrum of the fractionated caffeic acid solution collected over the entire peak width after injection. Three measurements were taken using a single substrate, and in all three instances, SERS spectra that appear to originate from caffeic acid were obtained. When detecting stably HPLC-treated 1 mM caffeic acid, the quality of the substrate is crucial, and artifact removal from the substrate is necessary. Under the present conditions, HPLC-treated caffeic acid at 1 mM is detectable by SERS, and caffeic acid detection from wine under similar conditions will be conducted.

References

[1] Iris Aguilar-Hernándeza, etc., Vibrational Spectrocopy 89 (2017) 113-121

[2] U. Yamaguchi, H. Honda, S. Kumagai, H. Takei, Analytical Sciences (2025) https://doi.org/10.1007/S44211-025-00761-5

Figures



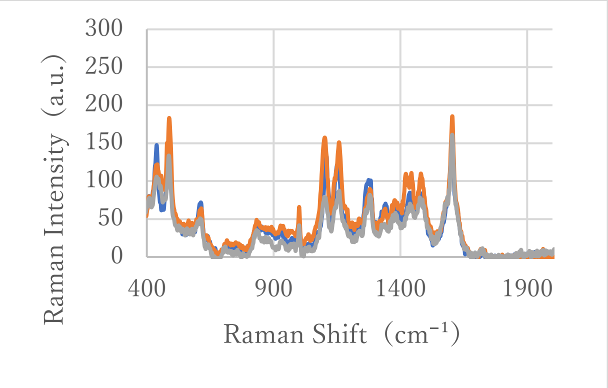


Figure 1: Chromatograph of 1 mM caffeic acid

Figure 2: SERS spectra of fractionations