

Non-invasive fingerprint studies for wine bottle authentication

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Introduction

Precision oenology is crucial for creating high-quality wines that meet customer expectations (Merkyte, Longo et al. 2020). However, concerns about wine authenticity persist due to adulteration, mislabeling, and counterfeiting, leading to financial losses and undermining consumer trust (Popović, Krčo et al. 2021). This research focuses on studying non-invasive methods for fingerprinting wine bottles using SWNIR spectrometry for wine bottle identification.

Materials and Methods

Wine bottles from the same batch and production date were chosen for the analysis marked with the reference points for spectrum reading.

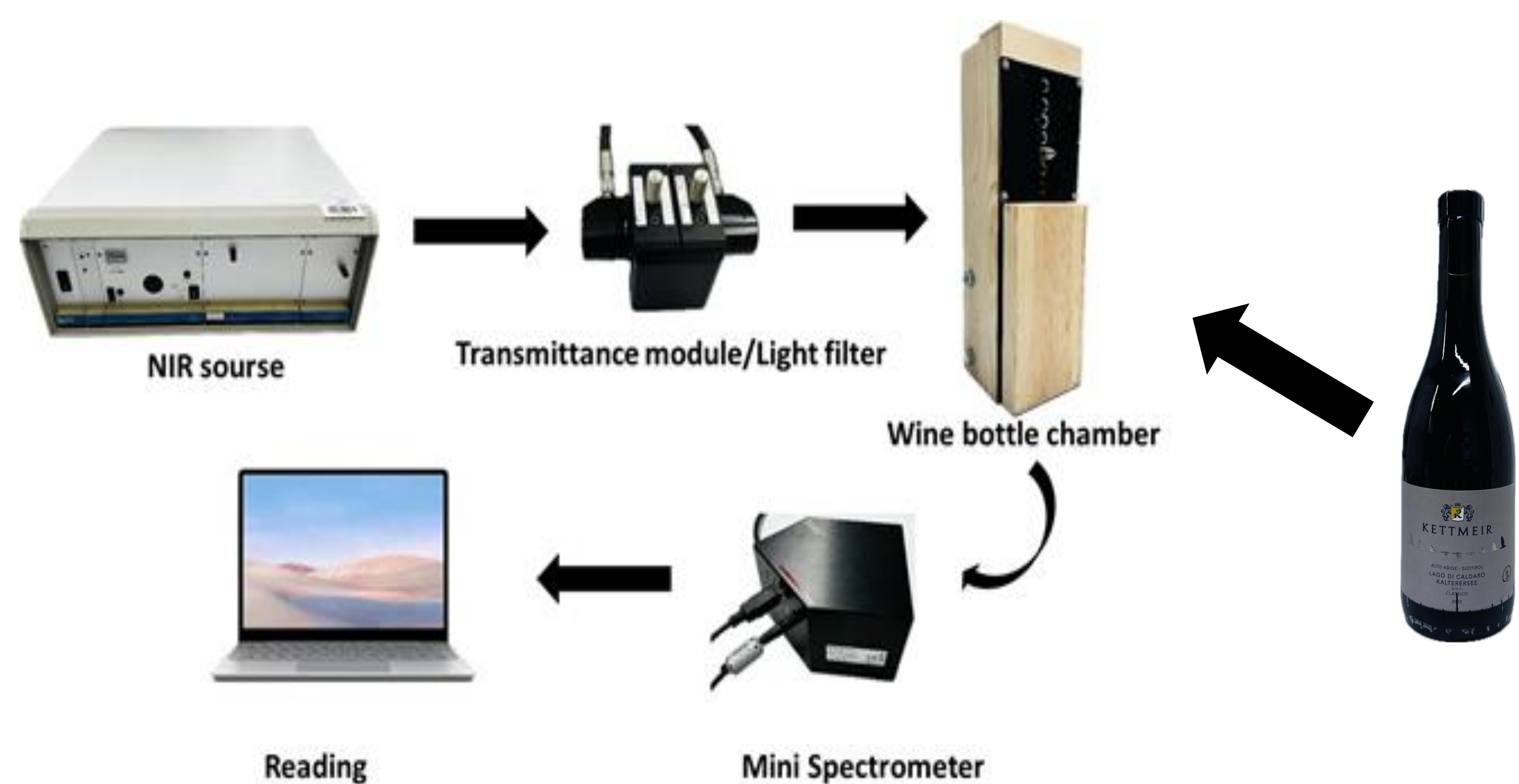


Figure 1. Schematic representation of the analysis

Results and Discussions

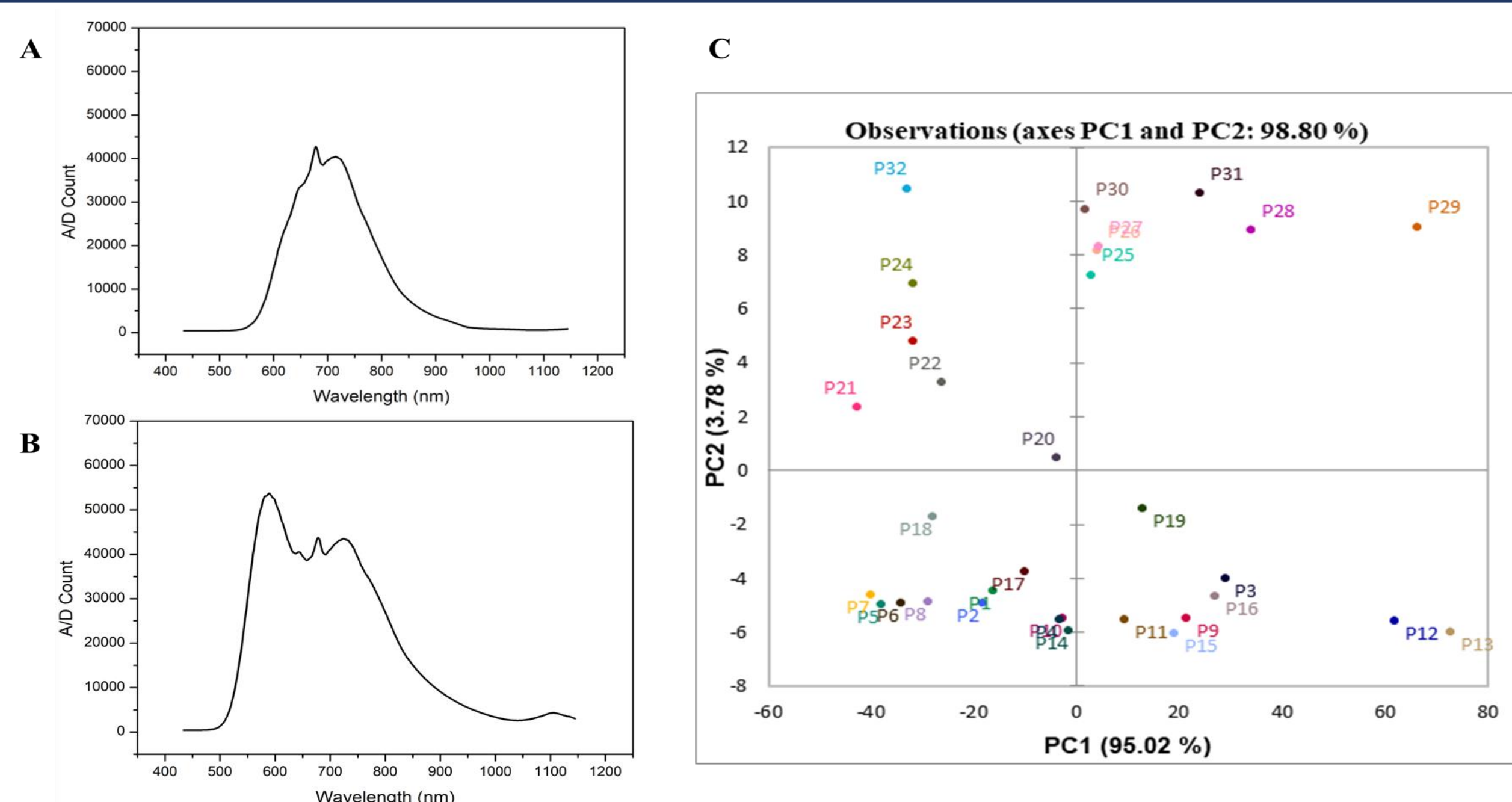


Figure 2. shows portable spectrometry spectral data of wine bottles at the bottleneck position. Figure 1.A and B spectrum shows distinct peaks indicating unique spectral characteristics at the bottleneck of two different wine bottles, demonstrating a different set of spectral features at the same position. C. PCA score plot for spectral data of 32 positions (from P1 to P32) on a wine bottle.

Using portable spectrometry, unique fingerprints of wine bottles can be obtained which is due to the diffraction and reflections of the light by the glass.

Where reproducibility analysis confirms that the authenticity of the wine bottle can be confirmed by measuring its unique spectral fingerprint.

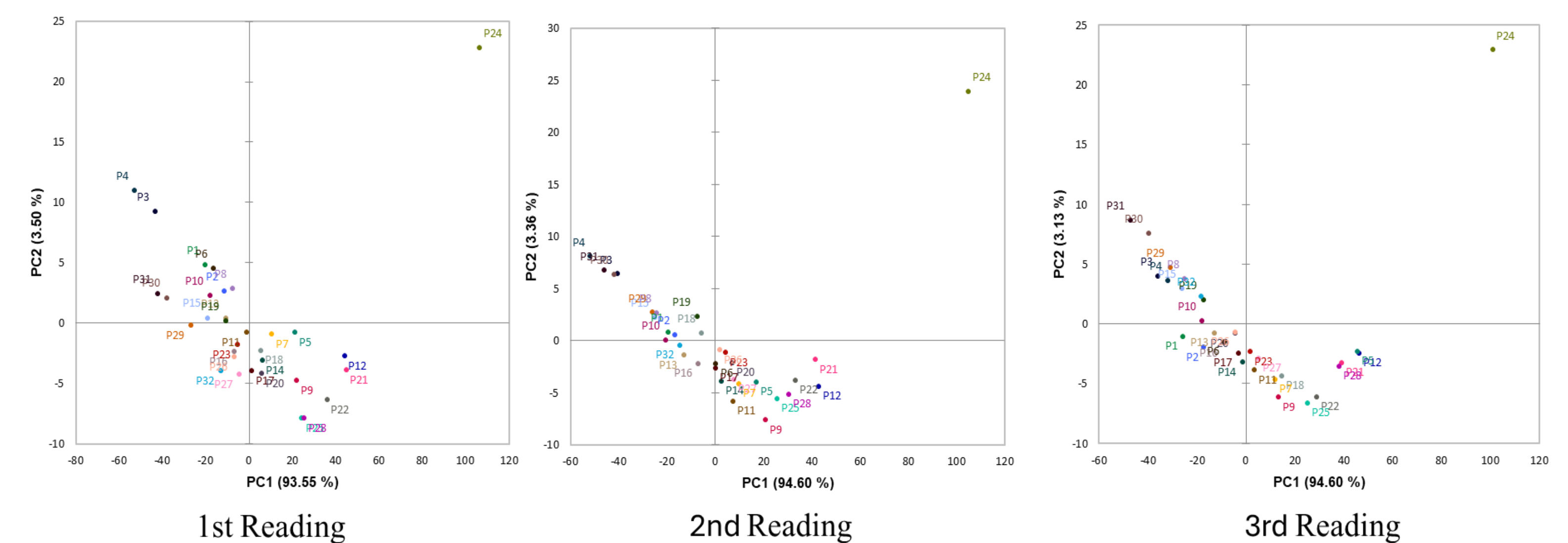


Figure 3. Illustrates the three readings of the same wine bottle performed over a week of intervals for reproducibility analysis.

Conclusion

To combat wine counterfeiting, portable spectrometry seems a promising and reliable technique to differentiate bottles.

The approach uses the distinctive spectral fingerprints of glass and wine to authenticate wine bottles, although it needs further research and improvements in the device.

References

- Merkyte, V., E. Longo, M. I. Jourdes, A. Jouin, P.-L. Teissedre and E. Boselli (2020). "High-performance liquid chromatography–hydrogen/deuterium exchange–high-resolution mass spectrometry partial identification of a series of tetra- and pentameric cyclic procyanidins and prodelphinidins in wine extracts." *Journal of agricultural and food chemistry* **68**(11): 3312-3321.
- Popović, T., S. Krčo, V. Maraš, L. Hakola, S. Radonjić, R. Van Kranenburg and S. Šandi (2021). "A novel solution for counterfeit prevention in the wine industry based on IoT, smart tags, and crowd-sourced information." *Internet of Things* **14**: 100375.