Photonic devices and monitoring techniques for the wine industry

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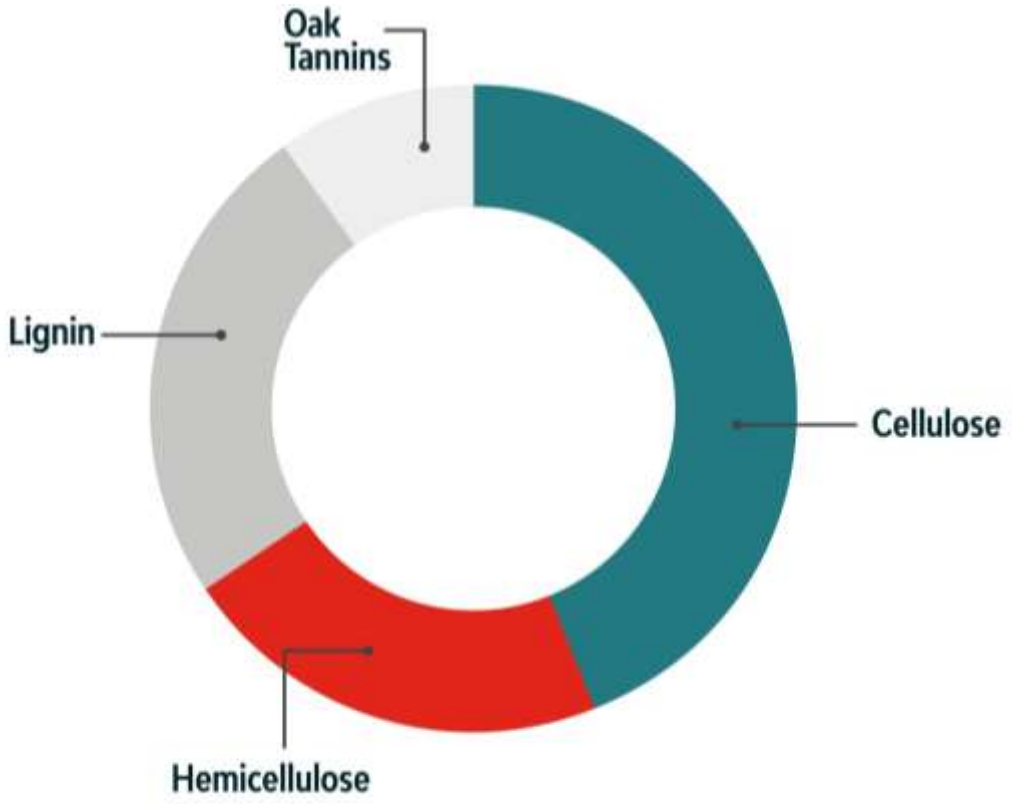
Indy Magnus

Oak chemical constituents



https://www.worldcooperage.com/oak-constituents/

LIGNIN ~25%

- color
- increase in blended complexity
- production of vanilla
- removal of off-notes,
- subtraction (e.g. vegetal)

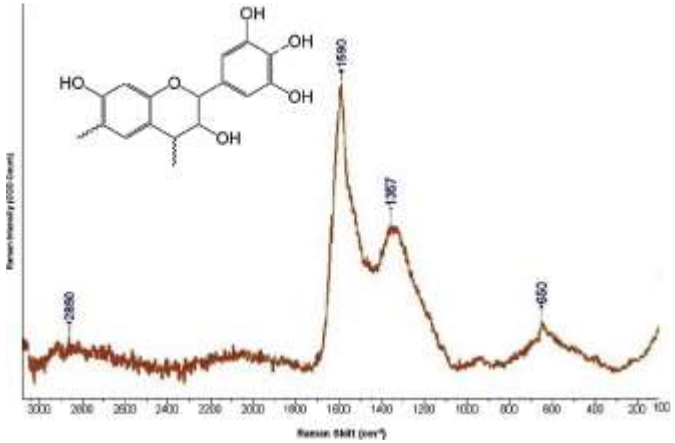
TANNIN ~.8-10%

- removal of off-notes,
- subtraction (e.g. vegetal)
- production of astringency
- promotion of oxidation products
- color

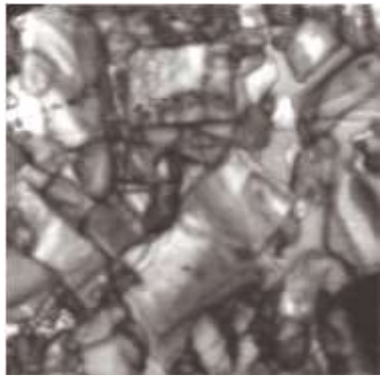
Spectroscopic studies of oak wood compounds

Raman spectroscopy for detection of tannin changes in pomegranate fruits during maturity

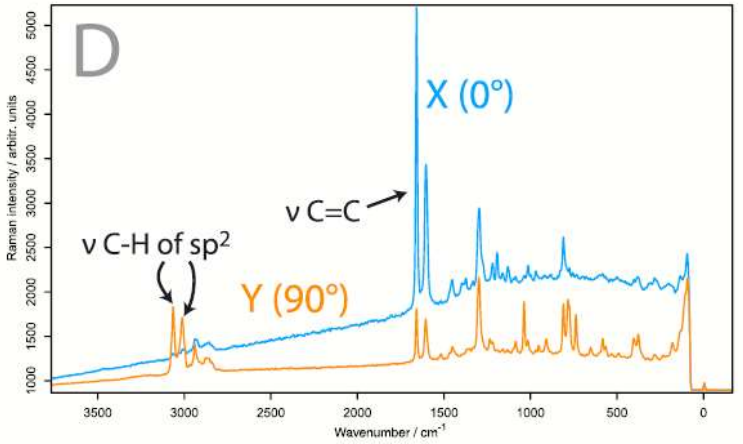
https://doi.org/10.1016/j.scienta.2019.108670



Raman spectroscopy of Lignin

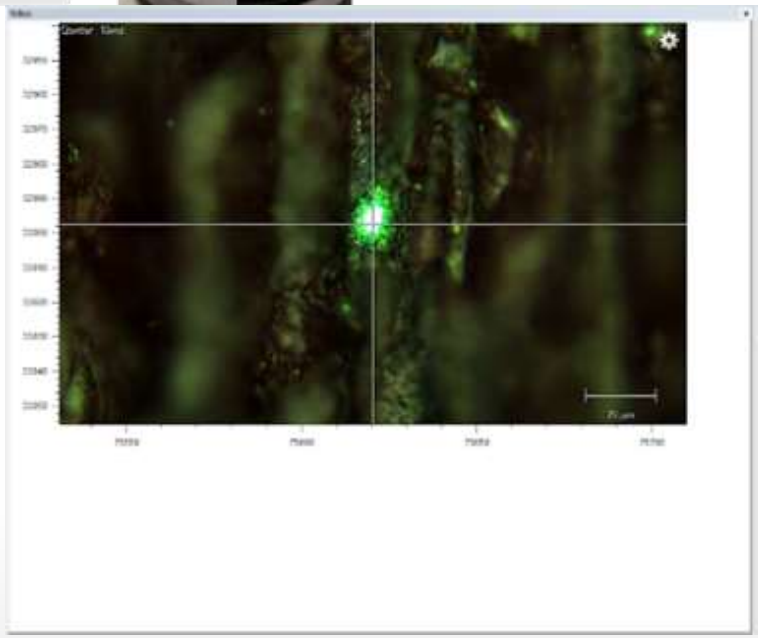


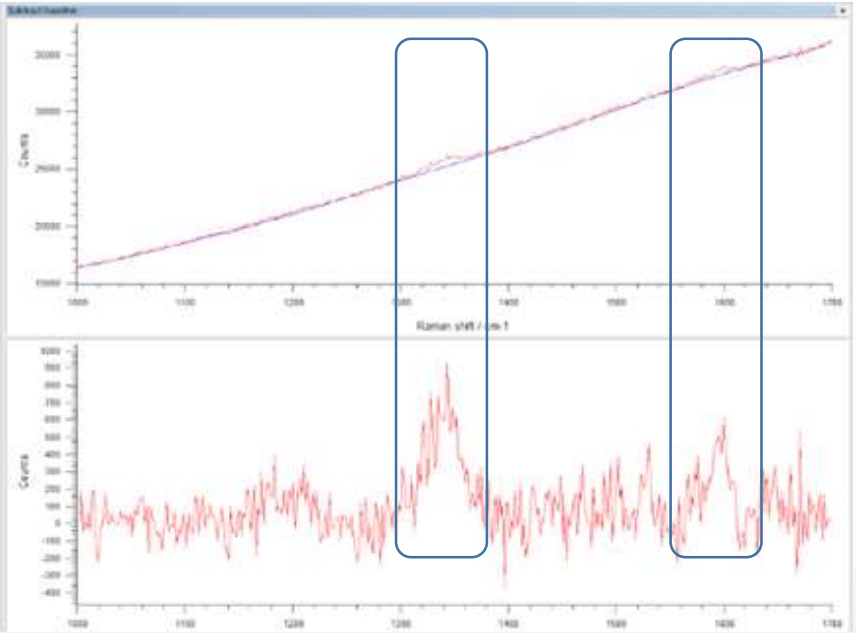
DOI: 10.1002/jrs.5588



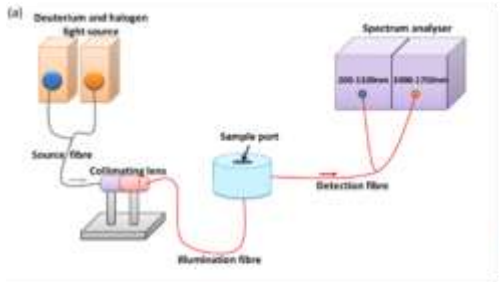
Raman Spectroscopy of oak samples

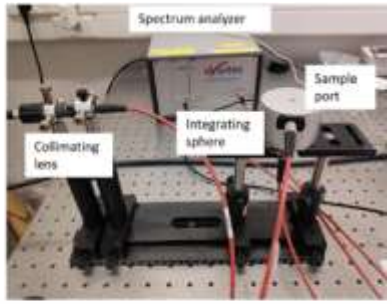
Laser wavelength- 532 nm
Raman spectra with tannin lines at 1340 cm^{-1} and 1594 cm^{-1}



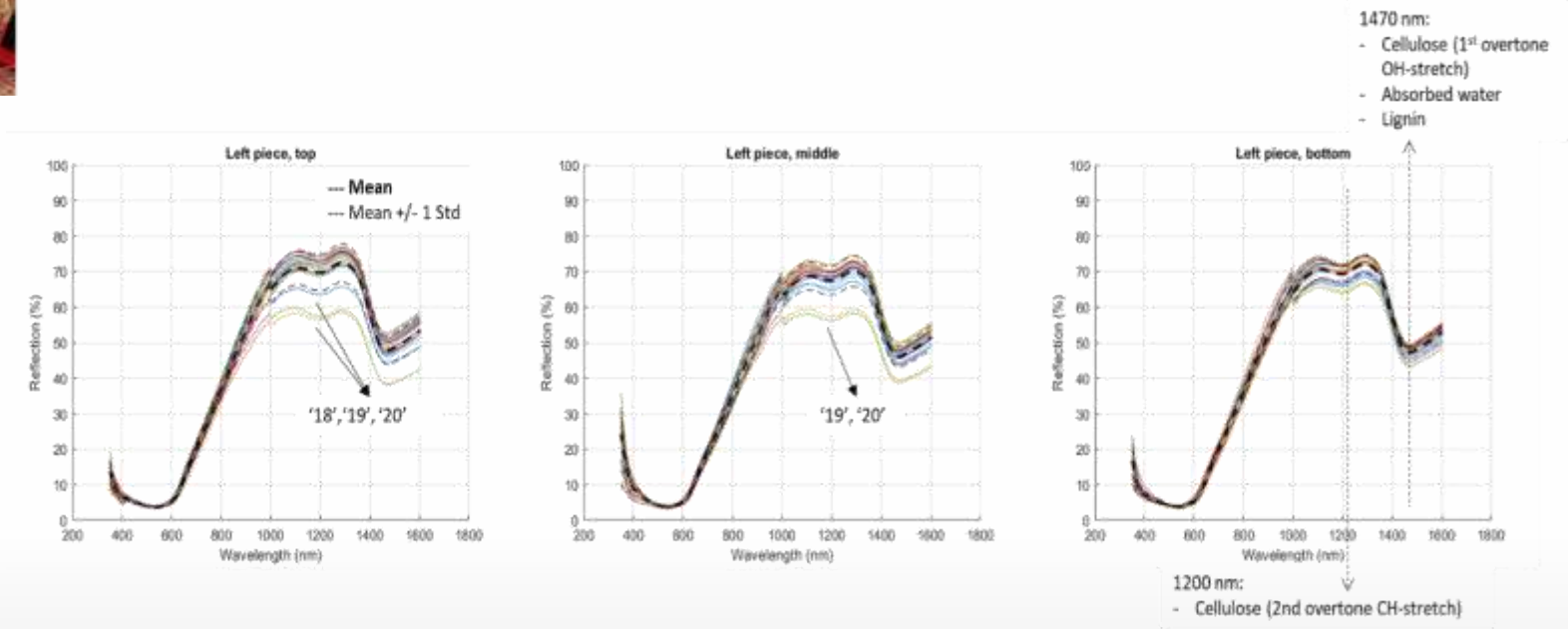


Reflection spectroscopy of oak samples

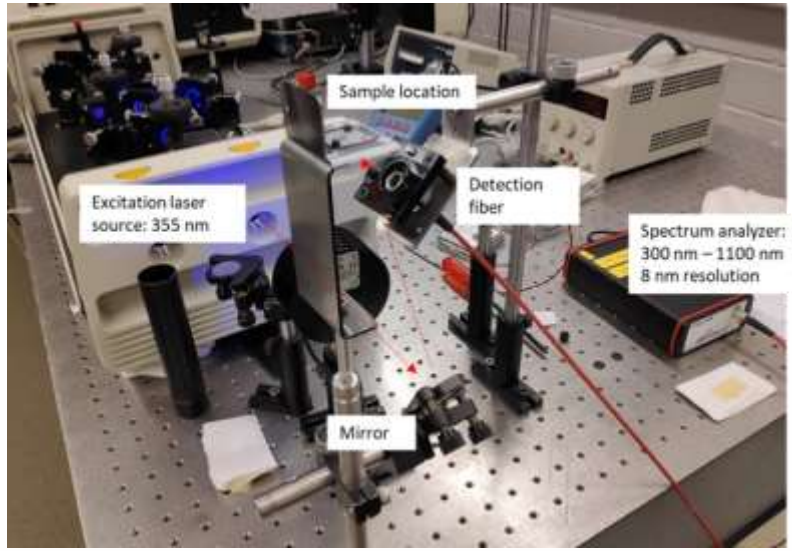




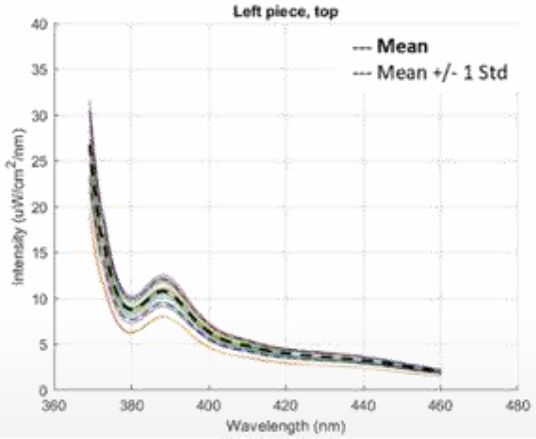
Broadband light source
Reflectance spectra with lignin peak at 1470 nm

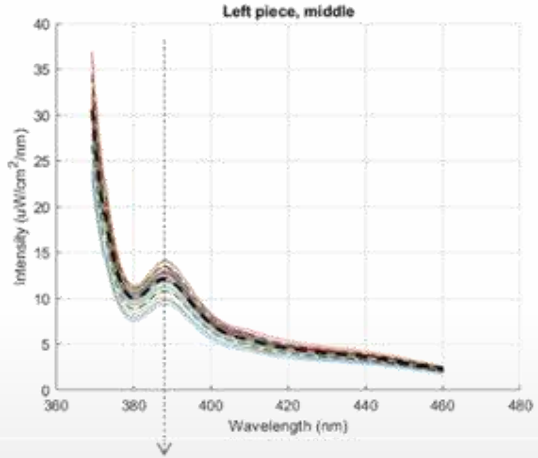


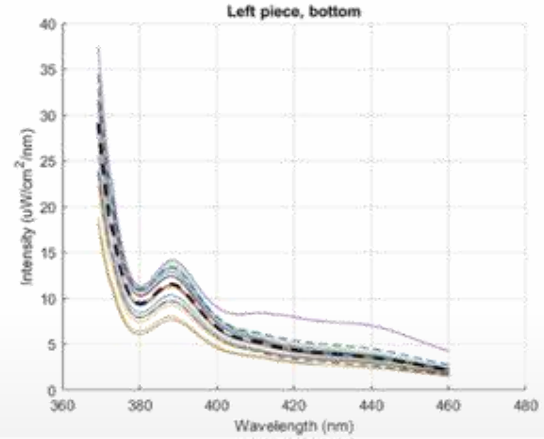
Fluorescence spectroscopy of oak samples



Laser wavelength- 355 nm
Auto fluorescence spectra of lignin with a peak at 390 nm

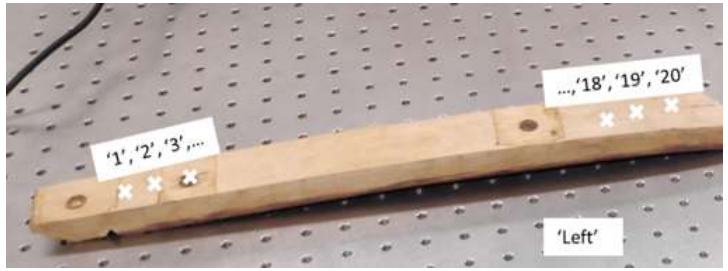


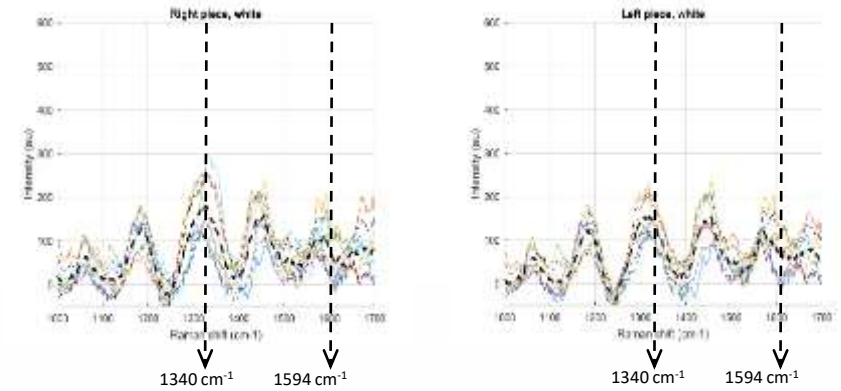




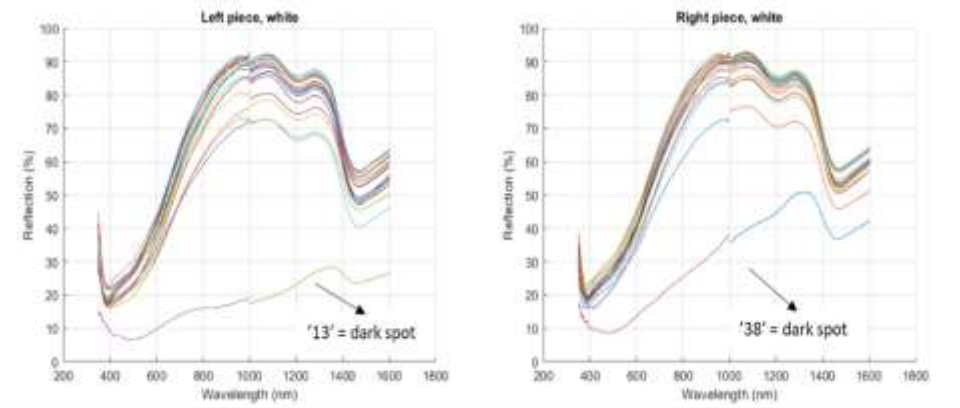
390 nm:
- Lignin

Spectra of oak external walls

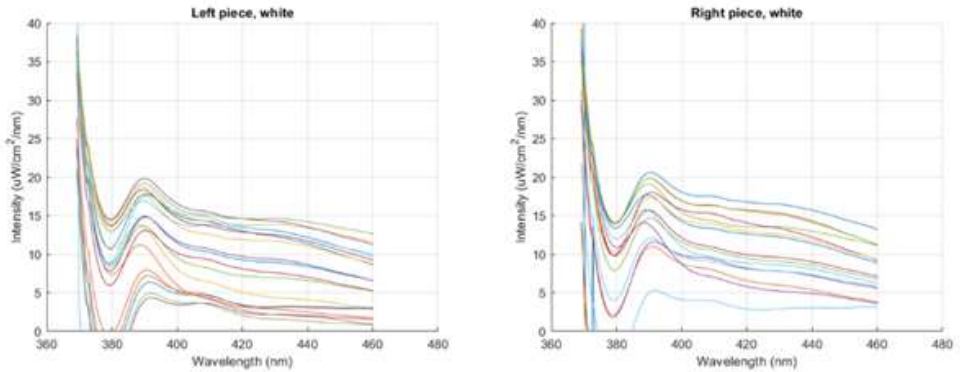




Raman spectra



Reflectance spectra

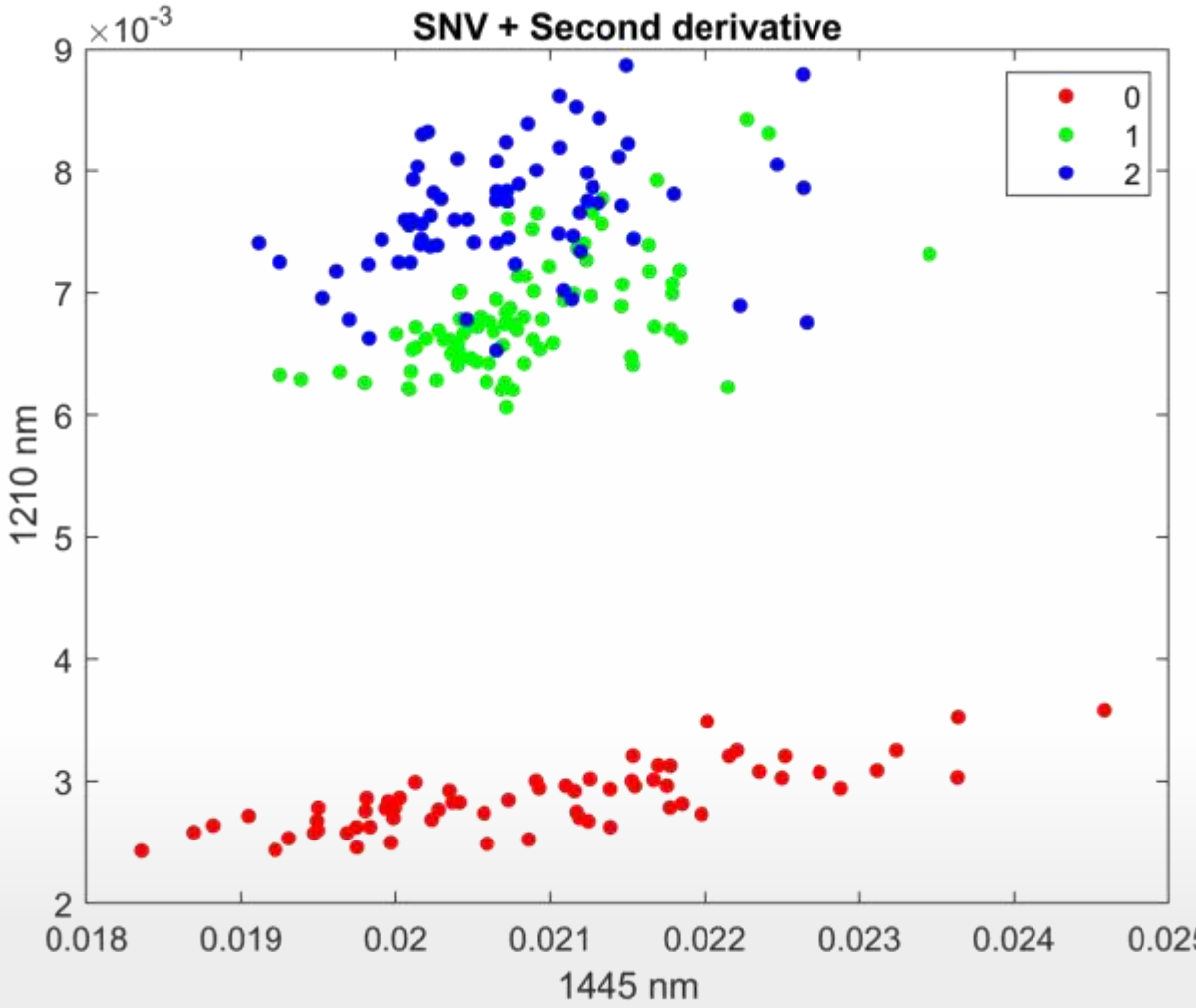


Fluorescence spectra

Study of barrel reusability

Standard normal variate transformation on reflectance spectra

SVN shows clear clustering in 1 dimension (1470 nm or 1200 nm)



Conclusions

- Spectroscopic techniques, such as Raman, reflectance and fluorescence spectroscopy can be applied to perform non-invasive barrel monitoring;
- By applying machine learning algorithms it is possible to distinguish barrels reusability;
- Reflectance spectroscopy gives the most reliable results for oak barrel monitoring for wine aging purposes.

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