



Homebrewing and portable NIR instruments: monitoring the fermentation of readymade malt extract using the SCiO sensor

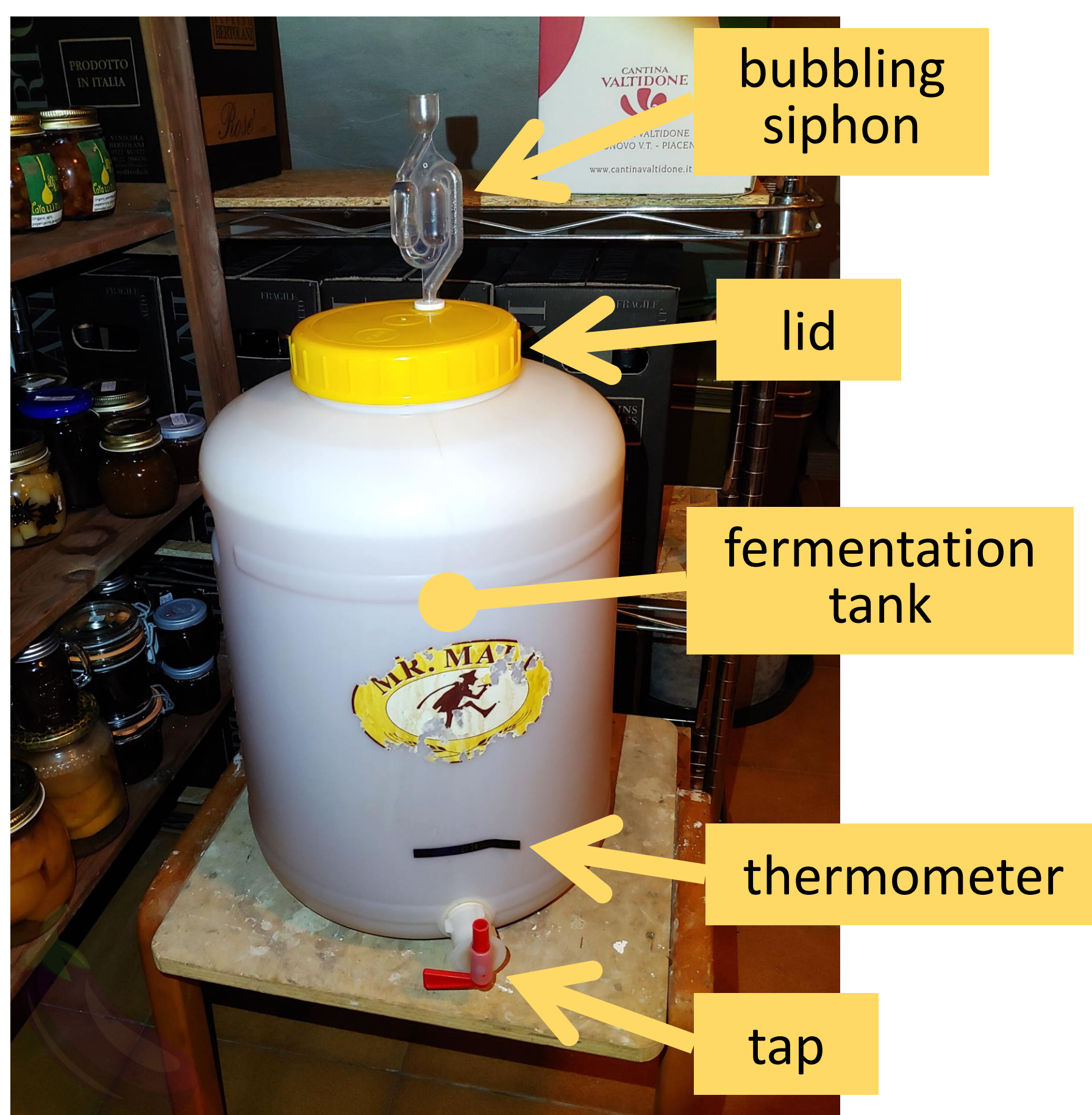


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Introduction: What do homebrewing and miniaturized NIR spectrometers have in common? From a conceptual point of view, the *do-it-yourself motto*. In practice? Homebrewing can be followed analytically with an NIR spectrometer and chemometrics!

Materials and methods



1) **The first idea:** "It's Summer, it's vacation time, let's brew a beer, dad!"

2) **The second idea:** "Wait, I have here my research group's SCiO sensor (↓), we could use it for following the brewing process!"

*Cavallini senior rolls his eyes in disbelief *

3) **The experimental setup:**

- one week of measures, ×2/day + T0 = 13 time points
- small amounts of brewing liquid were carefully taken from the fermentation tank (to avoid contaminations)
- 6 acquisitions of 5 spectra* each were recorded with the SCiO at each sampled time point (*spectra then averaged)

SCiO + liquid accessory

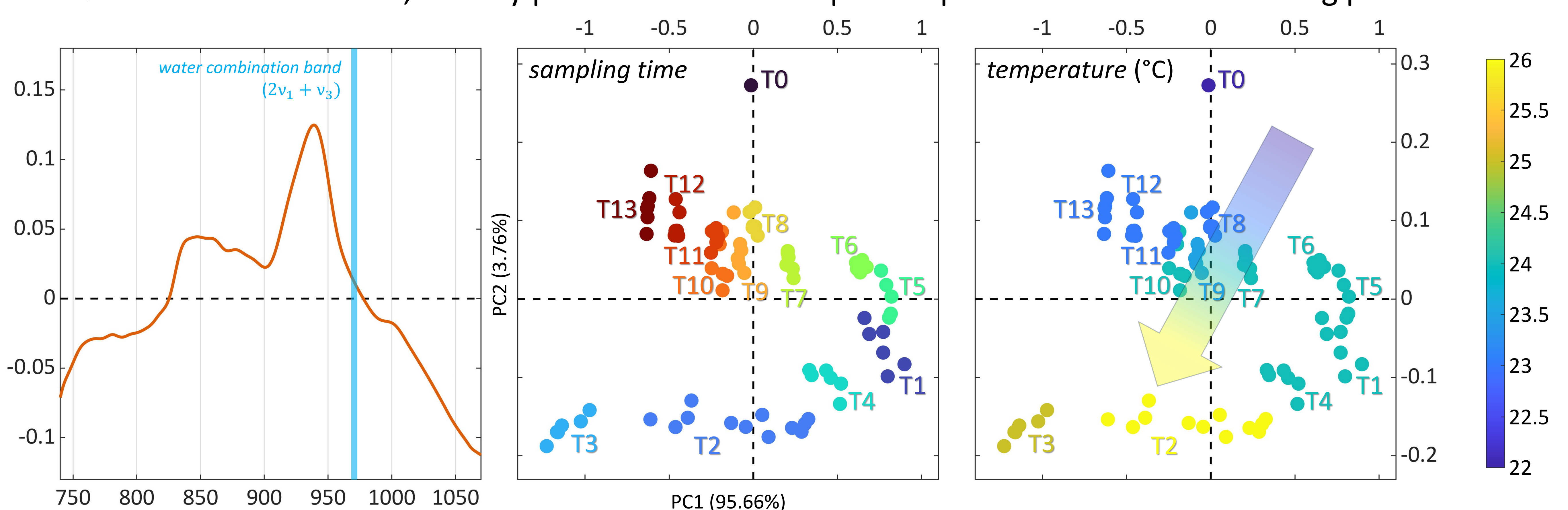
(Consumer Physics)
740 – 1070 nm



4) **Data analysis:** the most famous exploratory data analysis method, her majesty **PCA!**

Results

A simple PCA model was fitted on the spectral data, preprocessed with SNV and mean center. PC1 and PC2 already explain 99.42 % of the total variance, so they provide a rather complete representation of the brewing process.

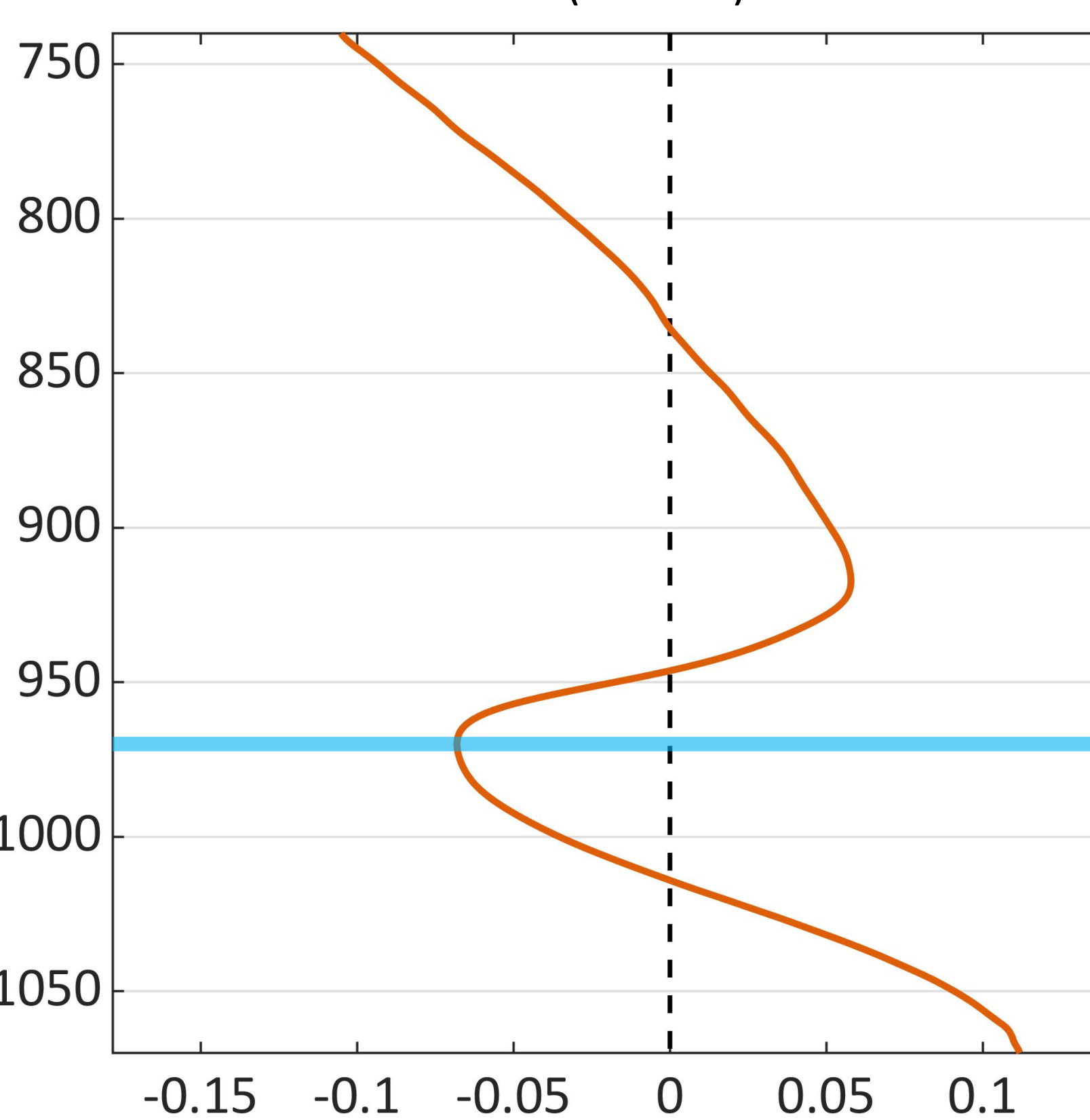


Time trend

- The time evolution is non-linear, as movements along both PC1 and PC2 occur. T0 can be viewed as a "reference" time point, being far away from all other measurements.
- Interpretation of the results according to the signals is rather difficult, since not many univocally assigned signals are present within this spectral range.
- However, the different time points appear well grouped, suggesting that it could be possible to identify stages of maturation of the beer.

Temperature trend

- T0 corresponds to the lowest temperature (brewing broth cooled to room temperature) and T2-3 correspond to the maximum temperature: this is the transition between days 1 and 2, after which the temperature becomes stable between 23-25 °C. This spike can be linked to the yeast activity ramping up, and continuously changing the liquid's composition.
- Two temperature levels seem present diagonally (1st-4th quadrants).



Conclusions

- Simple and portable NIR instruments can be used for tackling everyday "problems", at least from a qualitative point of view.
→ This is the premise of the do-it-yourself motto!
- The SCiO sensor proved to be reliable and easy to use, providing nice and clear signals.
- Further interpretation according to the signals (especially the sharper bands described by PC2) will be done and possibly matched with what is known* about beer maturation during the brewing process...suggestions?

(*the presenting author just took a trip to Ireland, where he did extensive field research)