

Abstract

Evaluation of near infrared spectroscopy as an analytical tool for wine production and bottling

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Introduction

The use of fast, robust and automatable analytical methods are of growing importance for wine production and/or bottling. In this study we evaluated the capability of near infrared (NIR) spectroscopy to replace several conventional methods. Objective was the quantitative analysis of several parameters in red, white/rose wines and musts at different stages of the production process as well as the monitoring of the varietal identity.

Materials and Methods

The spectra were recorded using a Büchi Nirvis FT-NIR spectrometer (Büchi, Flawil, Switzerland) measuring in transfection mode with a path length of 0.5 mm. All measurements were performed using light fibre optics to be able to implement an online monitoring system in a further step. 53 white and rose wines, 43 red wines and 55 musts were analysed. Further spectra of mixtures with different grape variety content [%_{vol.}] were recorded. Multivariate data analysis was performed using The Unscrambler X (Camo, Oslo, Norway) and NirCal 4.21 (Büchi, Flawil, Switzerland) software packages. The spectra were pretreated using different methods and the wavenumber range was individually selected for each PLS calibration. While the wines and musts were validated with a test-set, full cross validation was used for the mixtures.

Results and Discussion

Satisfactory calibrations could be achieved for the following parameters: density, ethanol content, reducing sugar content, glucose content, fructose content, acidity, lactic acid content, tartaric acid content and glycerol content. The fact that one near infrared spectrum contains all these information the question how these parameters correlate with each other raised and the correlations were calculated. In binary mixtures of similar tasting but different priced wines (e.g. Pinot Blanc and Müller Thurgau) PLS calibrations to predict the grape variety content quantitatively could be established. Regression coefficients of the calibrations between 0.90 and 0.95 and SEP's of approximately 10% could be achieved.

Conclusion

It could be shown that NIR spectroscopy in combination with multivariate data analysis shows high potential for routine analysis in wine production as well as in bottling. Comparing to established spectroscopic wine analysis (mid infrared spectroscopy) near infrared spectroscopy can do the same but even more. Several quality parameters and the grape variety content can be quantified simultaneously. In a further step we use our findings to establish a system to monitor the fermentation process online, direct inside the wine barrel.