APPLICATION OF A FLUORESCENCE-BASED METHOD TO EVALUATE THE RIPENING PROCESS AND QUALITY OF PINOT BLANC GRAPE

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Abstract:

Context and purpose of the study - The chemical composition of grape berries at harvest is one of the most important factors that should be considered to produce high quality wines. Among the different chemical classes which characterize the grape juice, the polyphenolic compound, such as flavonoids, contribute to the final taste and color of wines. Recently, an innovative non-destructive method, based on chlorophyll fluorescence, was developed to estimate the phenolic maturity of red grape varieties through the evaluation of anthocyanins accumulated in the berry skin. To date, only few data are available about the application of this method on white grape varieties. The aim of the present study was to evaluate the quality and the ripening process of Pinot blanc grape by a non-destructive fluorescence-based sensor.

Material and methods - The study was performed on two vineyards of cv. Pinot blanc located in the Adige Valley (South Tyrol, Bolzano), in two consecutive vintages. The vineyard differed in the row orientation, east-west or north-south, and then on the sun light exposure of the grape-bunches. The grape phenolic maturity was assessed on intact berries by six measurements from bunch closure to harvest time. In each vineyard, 25 grape-bunches per row sides were flashed by Multiplex® 3.6 (Force-A, Orsay, France), for a total of 3 rows and 150 grape-bunches/measurement. The instrument indices of chlorophyll (SFR_R) and flavonols (FLAV_UV) were considered. Standard grape maturity tests were performed to assess total soluble solids (TSS) and total acidity content of the grape juice by spectroscopic method. At maturity the grapes were processed with a standard vinification protocol for white wines. Total polyphenolic content of wines was determined by a spectrophotometric analysis.

Results -A linear decrease of SFR_R index in the berry-skin during the grape ripening period was recorded. Interestingly, SFR_R values negative correlated with the TTS accumulation in Pinot blanc berries. On the other side, positive correlations between SFR_R and titratable acidity, malic acid and tartaric acid content, were observed. The FLAV_UV index showed an increasing linear trend during the grape ripening period. At harvest, significant difference in FLAV_UV index between the two vineyards was observed. Looking more deeply inside the data, the berry-skin FLAV_UV index significantly differed among the four sun-light expositions, with greater values recorded for the grape-bunches located in south and east sides of the vineyard rows. These results are in accordance with the available literature on the role flavonols as sun-burn protection compounds. Interestingly, the total polyphenolic content of the produced wines showed a positive correlation with the final FLAV_UV values measured in the berry-skin. In conclusion, the Multiplex® indices could improve precision viticulture strategies, such as the implementation of precision harvest practices. Indeed, SFR_R index could be used to indirectly evaluate the whole ripening process of white grapes in term of grape sugar content and acidity, while FLAV_UV could provide useful indications to winemakers about taste of final product. Future studies will be necessary to better correlate the berry-skin FLAV_UV values and the flavours of white wine.

Keywords: Chlorophyll, Flavonols, Grape, Multiplex®, Quality, Pinot blanc.

1. Introduction.

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Introduction – The grape berry quality depends on its chemical composition, which is related to the cultivar and vineyard's factors (Mattivi *et al.*, 2006). Among the different chemical classes that characterize the grape juice, flavonoids contribute to the final taste, stability and color of wines (Winkel-Shirly, 2002). Recently, an innovative portable optical sensor based on fluorescence non-destructive measurement has been developed to estimate maturity parameters of red grape varieties through the evaluation of berry skin anthocyanin content (Agati *et al.*, 2003). However, only few studies regarding the application of this method on white grape varieties are reported (Ferrandino *et al.*, 2017).
The aim of the present study was to assess the ripening process and berry quality of Pinot blanc grape by fluorescence-based sensor.

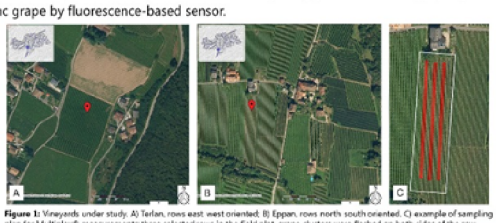


Figure 1: Vineyards under study. A) Terlan, rows east-west oriented; B) Eppan, rows north-south oriented; C) example of sampling plan for Multiplex® measurements: three selected rows in the field plot, grape clusters were flashed on both sides of the row.

Material and methods – The study included two vineyards of cv. Pinot blanc located in the Adige valley, Eppan and Terlan respectively (Fig. 1). The two vineyards differ in the grape-row orientation and sun-light exposure of the grape clusters. The trend of grape phenolic maturity was assessed on the skin of intact berries using the commercial optical device Multiplex® 3.6 (Force-A, Orsay, France) (Fig. 2). The spectroscopic indices of flavonols (FLAV_UV) and chlorophyll (SFR_R) contents were considered.

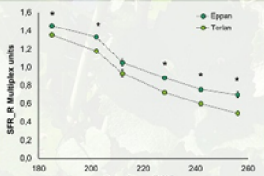
Figure 2: Fluorescence-based sensor, Multiplex® 3.6, Force-A, Orsay, France.

Sampling plan (Fig.1):
- 2 consecutive vintages (2017-2018)
- 6 samplings from clusters-closure to grape maturity
- 3 rows per each vineyards
- 50 grape clusters per each row flashed

Standard grape maturity tests were performed to assess total soluble solids (TSS) and total acidity content of the grape juice by (FT-IR WineScan, FOSS, Denmark). At maturity, the grapes were processed with a standard vinification protocol for white wines. Total polyphenolic content of wines was determined by Hyperlab wine analyzer (Steroglass, Italy).

Results

CHLOROPHYLL index
SFR_R = FRF_R/RF_R



The results showed a decrease of chlorophyll index SFR_R during the berry ripening process in both the vineyards studied.
The two SFR_R curves showed the same chlorophyll degradation trend (Fig. 3).

Figure 3: Chlorophyll index curves. Each point shows the mean ±standard error of six samplings done in two consecutive vintages at the same day of the year (DOY). Asterisks indicate values that significantly differed according to Student's t-test, α=0.05.

The berry skin values of SFR_R index did not differ between the row-side and grape-clusters sun-light exposure (Fig. 4).

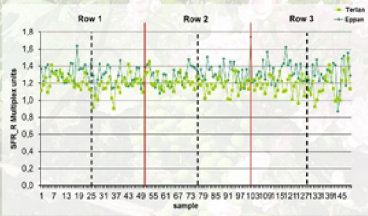
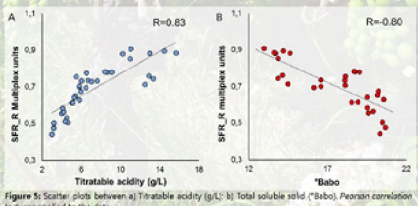


Figure 4: Example of a complete Multiplex® measurement of SFR_R index. The graph shows the data of each single grape cluster measure done in Terlan and Eppan. Red lines divide the three rows and black lines divide the two site of each row (north-south in Terlan and east-west in Eppan).



The SFR_R index positively correlated with titratable acidity and total soluble solid ("Babo) of cv. Pinot blanc berry juice (Fig.5).

Figure 5: Scatter plots between a) Titratable acidity (g/L); b) Total soluble solid (°Babo). *Pearson correlation* test was applied to the data.

FLAVONOLS index
FLAV_UV = log(1/FRF_UV)

The results showed an increase in flavonols index FLAV_UV during the berry ripening process. A significant difference in FLAV_UV index at harvest is showed (Fig. 6). The FLAV_UV index significantly differed according to the grape clusters sun-light exposure (Fig. 7).

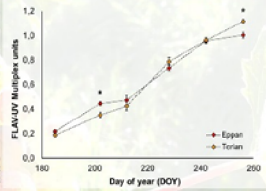
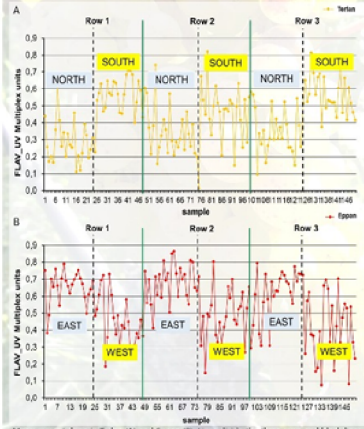


Figure 6: Flavonols index curves. Each point shows the mean ±standard error of six samplings done in two consecutive vintages at the same day of the year (DOY). Asterisks indicate values that significantly differed according to Student's t-test, α=0.05.



The berry skin FLAV_UV values of Pinot blanc positively correlated with total polyphenolic content of wines (*Pearson correlation* R=0.78)

Figure 7: Example of a complete Multiplex® measurement of FLAV UV index. The graph shows the data of each single grape cluster Measurement done in Terlan (A) and Eppan (B). Lines divide the three rows and black lines divide the two site of each row (north-south in Terlan and east-west in Eppan).

Conclusion – In conclusion, the Multiplex® indices can improve precision viticulture strategies (implementation of precision harvest practices or canopy management). The SFR_R index permits an indirect evaluation of ripening process of white grapes in term of grape sugar content and acidity, while FLAV_UV index can provide useful indications to winemakers about the taste of final product, especially in the case of vinification with maceration process. Future studies will be necessary to better correlate the FLAV_UV values and the flavours of white wine.

Acknowledgments
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