Rosé Wines: impact of storage conditions in tank on the polyphenol composition and color.

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Introduction

Color of Rosé wines is an important criterion for consumer choice. This color depends on the concentration of anthocyanins and also of other pigments derived from them. Production conditions (grape variety, winemaking) and storage conditions have an impact on the polyphenol composition, in particular on anthocyanins and other pigments which can be formed by complex chemical reactions (1, 2).
In this work, the effect of conditions of wine storage in tank (temperature, level of sulfite, oxygen exposure) on the color and phenolic composition of Rosé wines was investigated.

Materials & Methods

Rosé wines were made in four different vine-growing areas: Val de Loire, Provence, Tarn, and Bordeaux. In each region, common practices of storage conditions in tank during six months were compared: temperature regimes, two levels of sulfite addition, two levels of oxygen exposure. Sample description is provided in Table 1.
Polyphenols were quantified by ultra-high-performance liquid chromatography coupled to triple quadrupole tandem mass spectrometry (UHPLC- QqQ-MS) used in multiple reaction monitoring (MRM) mode. This method (3) enabled quantification of over one hundred phenolic compounds in Rosé wines. Color characteristics were determined by several color indices and chromatic coordinates (L*, a*, b*) deduced from absorbance measurements (2). Three bottles were analyzed for each sample after bottling in the same conditions and after storage during one year at 20°C.

Table 1 – Code and storage conditions in tank of studied Rosé Wines

			storage conditions in tank		
TRIALS	**Code**	**Grape variety**	**SO_2 (mg/L)**	**Temperature**	**Oxygen exposure**
Val de Loire	6012NO	Cabernet	60	12°C	normal
	30VANO		30	variable	normal
	6012HI		60	12°C	high
	3012NO		30	12°C	normal
Bordeaux	18VANO	Cabernet franc	18	variable	normal
	3012NO		30	12°C	normal
	3012HI		30	12°C	high
	30VANO		30	variable	normal
Tarn	28VANO	Négrette	28	variable	normal
	3812NO		38	12°C	normal
	38VANO		38	variable	normal
	3812HI		38	12°C	high
Provence	2520NO	Grenache-Shiraz	25	20°C	normal
	3512NO		35	12°C	normal
	3520NO		35	20°C	normal
	3512HI		35	12°C	high

Results & Discussion

The polyphenol composition (quantities and proportions) was different between the four series. The concentrations of the main groups of grape compounds (hydroxycinnamic acids, anthocyanins and tannins) are presented in Figure 1. Derived pigments resulting from complex chemical mechanisms (4, 5, 6, 7, 8) were also found in different proportions in the four series:

- caftaric-anthocyanins adducts formed by the addition of anthocyanins onto the quinone of caftaric acid, result from enzymatic oxidation at must stage.
- carboxypyranoanthocyanins (e.g. vitisin A) and pyranoanthocyanins (e.g; vitisin B) are issued from the reaction of anthocyanins with pyruvic acid and acetaldehyde, respectively, depending on yeast metabolism and oxidation.
- phenyl-, catechyl- and guaiacyl-pyranoanthocyanins, formed by reaction of anthocyanins with hydroxycinnamic acids or vinylphenols

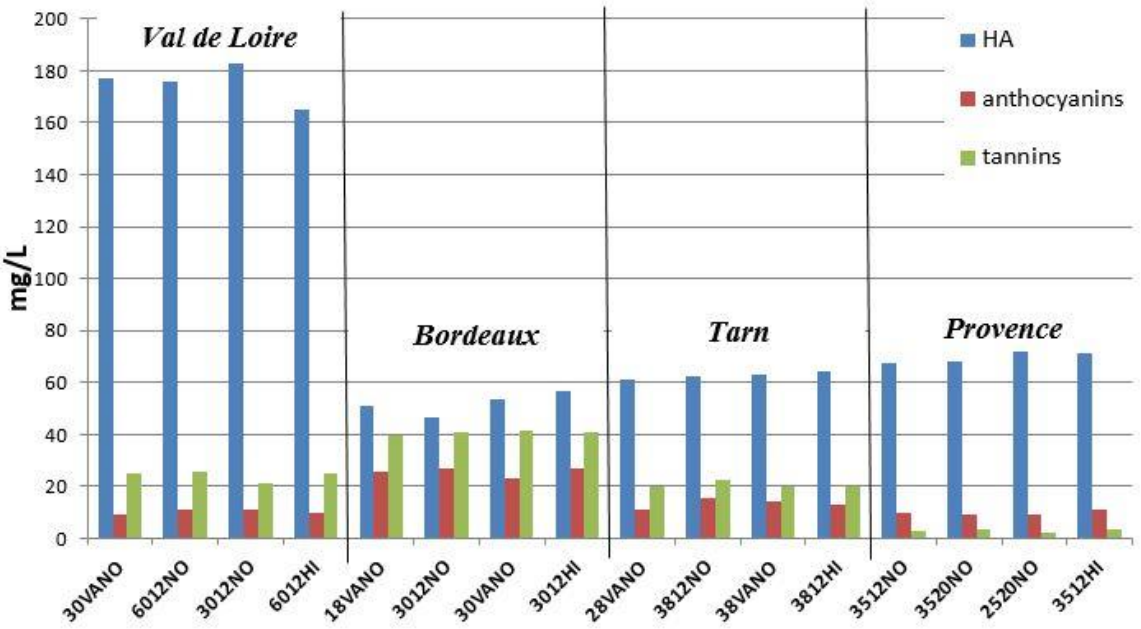

Figure 1 Composition in hydroxycinnamic acids (HA), anthocyanins and tannins of each series of Rosé wines.

A principal component analysis was performed on all the data (color data in green, native anthocyanins in red, derived pigments in blue and the others polyphenols in black) for each trial: Val de Loire (Figure 2), Bordeaux (Figure 3), Tarn (Figure 4), and Provence (Figure 5).

Val de Loire trials

They contained a very high concentration of hydroxycinnamic acids, probably due to a varietal characteristic and a limited oxidation of must (Figure 1). A low level of sulfite and a variable temperature regime led to a loss of anthocyanins and the formation of catechyl-pyranoanthocyanins (Figure 2). Absorbance at 520 nm due to sulfite bleaching resistant pigments (SBRPigments) and the coordinate b* (yellow) were correlated with catechylpyranomalvidin-3Glc (pinotin A) (R=0.67 and R=0.72, respectively).

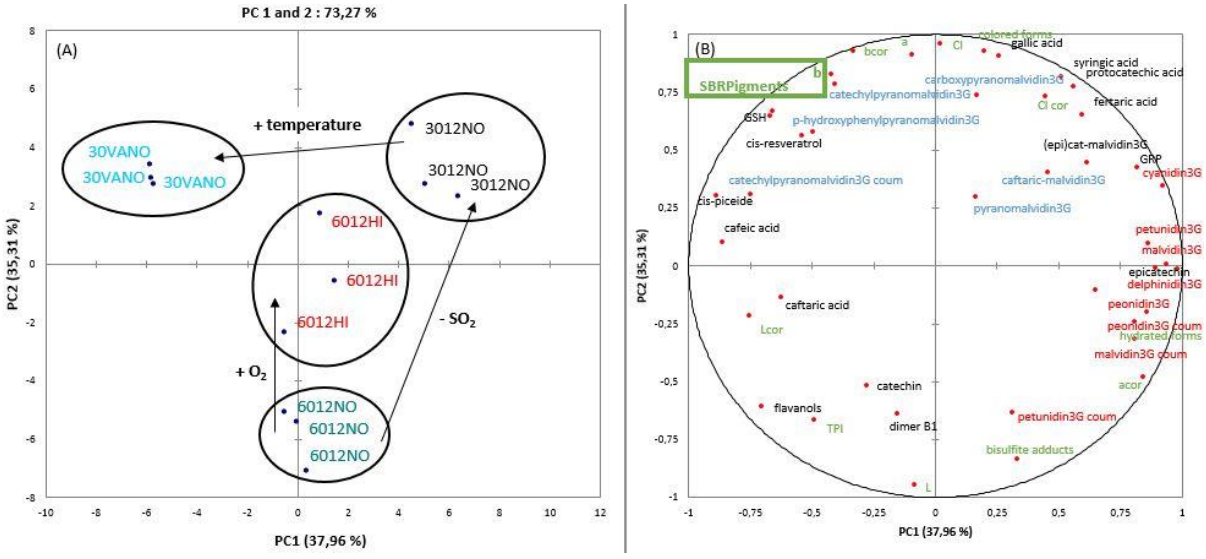

Figure 2 Principal component analysis of the polyphenol and color data of Val de Loire trials: (A) projection of the wines on principal component 1 (PC1) and principal component 2 (PC2) (B) correlation scatterplot of the polyphenol and color variables with PC1 and PC2.

Bordeaux trials

They contained a low concentration of hydroxycinnamic acids (Figure 1) but relatively high concentrations of GRP, flavanols (monomers, dimers, and tannins analysed by HPLC after phloroglucinolysis), anthocyanins and tannin-anthocyanin adducts. This reflects a higher extraction rate than in the other sets and oxidation of a must with a high gluthatione to caftaric acid ratio. A low level of sulfite and a variable temperature regime led mainly to an increase of color intensity, of a* and b*, of absorbance at 520 nm due to sulfite bleaching resistant pigments (SBRPigments), phenyl- and catechyl-pyranoanthocyanins, and a loss of anthocyanins (Figure 3). In this series, sulfite bleaching resistant pigments (SBRPigments) and the coordinates a* and b* were correlated together and negatively correlated with the anthocyanin contents. However, a low correlation between phenyl- and catechyl-pyranoanthocyanins and data color (SBRPigments, a* and b*) suggests an involvement of additional pigments presumably resulting from anthocyanin reactions with tannins (not analysed).

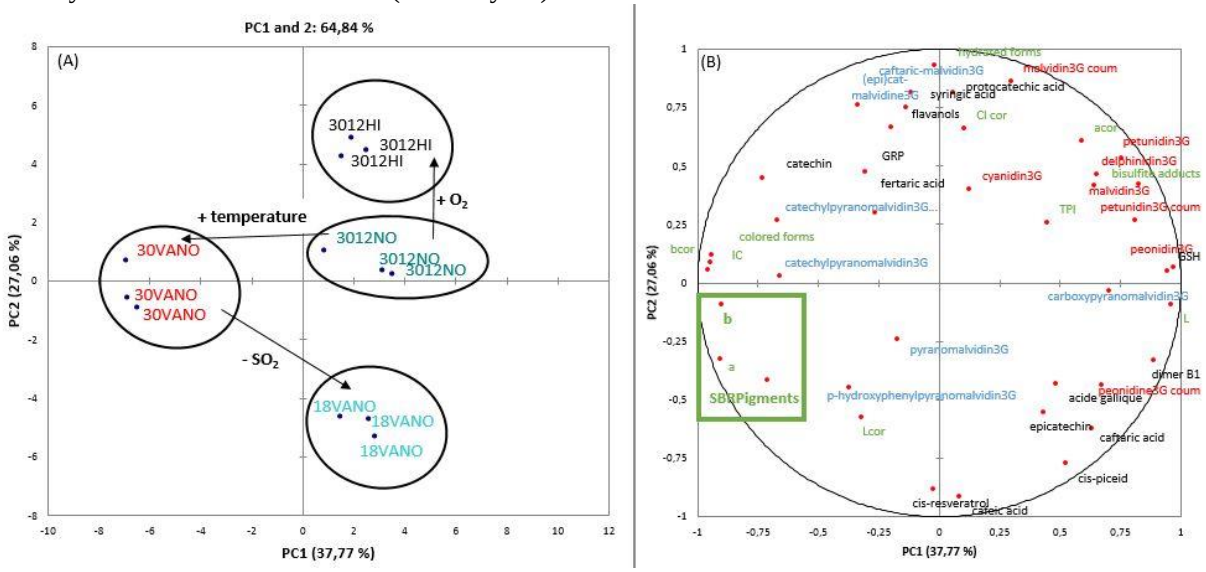

Figure 3 Principal component analysis of the polyphenol and color data of Bordeaux trials: (A) projection of the wines on principal component 1 (PC1) and principal component 2 (PC2) (B) correlation scatterplot of the polyphenol and color variables with PC1 and PC2.

Tarn trials

They contained a relatively high concentration of hydoxycinnamic acids (Figure 1) but a low concentration of GRP and no caftaric-anthocyanin adducts indicating a good protection of musts against oxidation. A low level of sulfite and a variable temperature regime led mainly to a loss of anthocyanins and an increase of color (Figure 4). This was linked to an increase of colored pigments such as vitisins and a decrease of bisulfite adducts. SBRPigments and the coordinate b* were negatively correlated with the anthocyanin concentration (malvidin-3-Gcl, R=-0.83) and b* positively with carboxypyranomalvidin-3Glc (vitisin A) (R=0.76) and pyranomalvidine3Glc (vitisin B) (R=0.72).

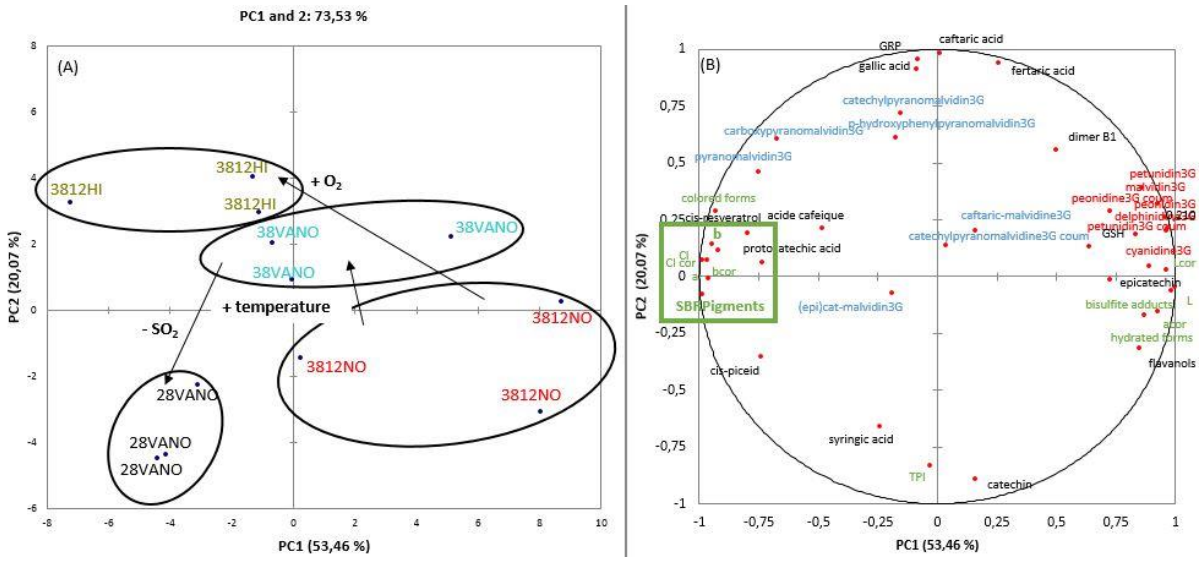

Figure 4 Principal component analysis of the polyphenol and color data of Tarn trials: (A)projection of the wines on principal component 1 (PC1) and principal component 2 (PC2) (B)correlation scatterplot of the polyphenol and color variables with PC1 and PC2.

Provence trials

These very light rosé wines contained a low concentration in polyphenols due to a low extraction (Figure 1). However, they had a concentration of catechylpyranoanthocyanins similar to the other trials. A low level of sulfite and a variable temperature regime led to increased formation of catechyl-pyranoanthocyanins (Figure 5). Color due to the derived pigments and the coordinate b* were correlated together and especially b* with p-hydroxyphenylpyranomalvidin 3Glc (R=0.72) and catechylpyranomalvidin 3Glc (Pinotin A) (R=0.69).

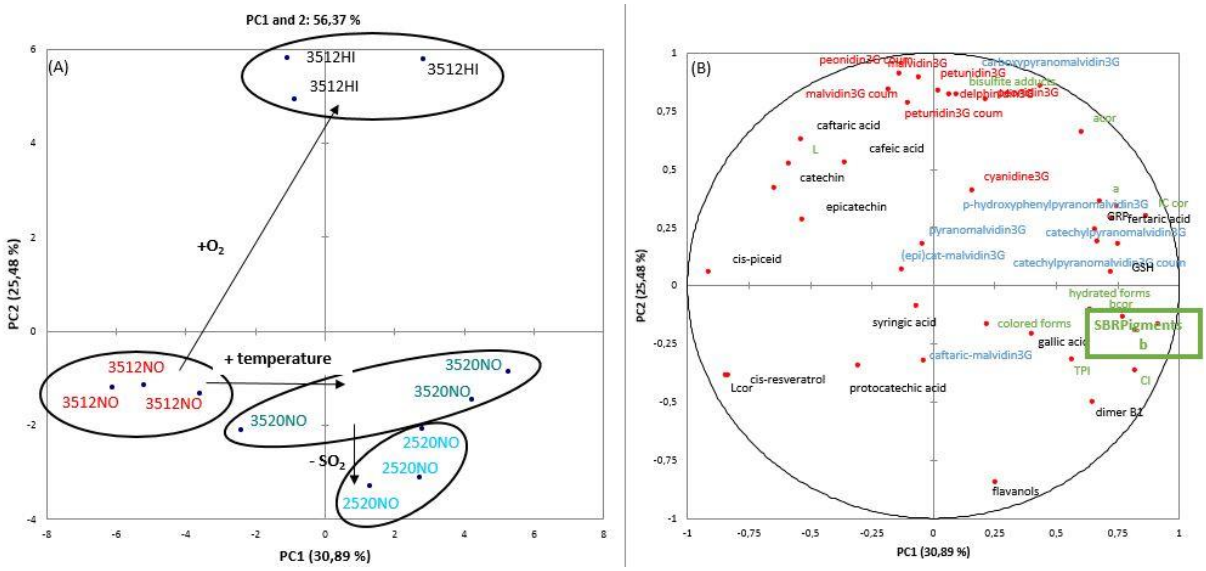

Figure 5 Principal component analysis of the polyphenol and color data of Provence trials: (A) projection of the wines on principal component 1 (PC1) and principal component 2 (PC2) (B) correlation scatterplot of the polyphenol and color variables with PC1 and PC2.

Conclusion

The polyphenol composition of Rosé wines depended of the origin, grape variety and winemaking process. This study showed that the storage conditions in tank impacted the derived pigment composition of Rosé

wines, also depending on the proportions of native compounds (hydroxycinnamic acids, anthocyanins, and tannins) in the wines. In particular, variable temperature regimes and low levels of sulfite led to an increase of colour attributable to a lower extent of sulfite bleaching and an increased formation of sulfite bleaching resistant pigments. Sulfite bleaching resistant pigments and chromatic coordinate b* were correlated, underlining the contribution of these derived pigments to the color of Rosé wines. The proportion and quantity of the different families of derived pigments (pyranoanthocyanins, carboxypyranoanthocyanins, phenyl- and catechylpyranoanthocyanins …) were influenced by the concentration of native compounds combined with the winemaking process (yeasts, storage conditions).

Acknowledgements

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References

1- Cheynier V., Wirth J., Morel-Salmi C *et al.* 2013, "Les composés responsables de la couleur des vins Rosés. Interaction avec l'oxygène", *Rev. F. Oenol.,* 260, 30-33.

2-Wirth J, Caillé S, Souquet JM, *et al*. 2012, "Impact of post-bottling oxygen exposure on the sensory characteristics and phenolic composition of Grenache rosé wines", *Food Chem.* 132, 1861–1871.

3- Lambert ML, Meudec E, Verbaere A. *et al.* 2015, "A high-throughput UHPLC-QqQ-MS method for quantitative screening of polyphenols in rosé wines", *Molecules,* 20(5), 7890-7914.

4-Cheynier V., Rigaud J., Souquet J.-M., *et al.* 1989, "Effect of pomace contact and hyperoxidation on the phenolic composition and quality of Grenache and Chardonnay wines", *Am. J. Enol. Vitic.*, 40 (1), 36-42.

5-Sarni-Manchado P., Cheynier V., Moutounet M. 1997, "Reaction of enzymatically generated quinones with malvidin-3-glucoside", *Phytochemistry,* 45, 1365-1369.

6-Atanasova V., Fulcrand H., Cheynier V. *et al.*, 2002, "Effect of oxygenation on polyphenol changes occurring in the course of wine-making", *Anal.Chim.Acta*, 458, 15-27.

7-Cheynier V., Dueñas-Paton M, Salas E *et al.*, 2006, "Structure and properties of wine pigments and tannins", *Am. J. Enol. Vitic*. 57, 298-305.

8-Fulcrand H, Duenas-Paton M, Salas E *et al.*, 2006, "Phenolic reactions during winemaking and aging", *Am. J. Enol. Vitic*, 57, 289-297.