CHEMICAL AND SENSORY EVALUATION OF BORDEAUX WINES (CABERNET SAUVIGNON AND MERLOT) AND CORRELATION WITH WINE AGE•

Kleopatra CHIRA, Nicola PACELLA, Michael JOURDES and Pierre-Louis TEISSEDRE
UMR 1219- Œnologie, Institut des Sciences de la Vigne et du Vin, Faculté d'Œnologie, 210 Chemin de Leysotte, CS 50008 33882 Villenave d'Ornon Cedex F.

E-mail: p.teissedre@u-bordeaux2.fr

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1. INTRODUCTION

Phenolic compounds are one of the most important wine quality parameters. Anthocyanins are a family of phenolic compounds directly related to red wine color (Glories, 1984). Proanthocyanidins are another large family of phenolic compounds and are thought also to make an important contribution to color stabilization by combining with the anthocyanins. Quality evaluation of a red wine is primarily based on wine tasting. Chemical analyses are however performed in addition in order to explain some sensory changes observed. Astringency has been described as one of the most important organoleptic characteristics of wine (Guinard *et al*., 1986). Astringency is not a taste but a mouthfeel and is the feeling of dryness or roughness. As opposed to astringency, bitterness is a taste induced by a large range of molecules, including organic molecules, peptides, inorganic ions and salts. Considering Bordeaux wine reputation, the role of both phenolic compounds and ageing on wine quality, our goal was to study Bordeaux red wines using on the one hand chemical analyses and on the other hand sensory analyses.

2. MATERIALS AND METHODS

2.1. Selection of experimental area and samples.

The study was carried out with samples from two Bordeaux denominations. A total of 24 wine samples ('Cabernet sauvignon' cultivar) from Château Mouton Rothschild (*premier grand cru classé Pauillac*) and a total of 7 wine samples ('Merlot' cv) from Château la Providence (*Pomerol*) were used. The dates of production of these wines range from 1978 to 2005 and from 1979 to 2003 for Cabernet Sauvignon(CS) and Merlot (M) respectively.

2.2 Chemical and sensory analysis.

Proanthocyanidin monomers and oligomers were identified and quantified by HPLC-UV-Fluo (Chira *et al.*, 2009). Percentage of galloylation (%G), of prodelphinidins (%P) as

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well as mean degree of polymerization (mDP) were also determined (Chira *et al.*, 2009). Total phenolic compounds, total anthocyanins, total tannins, hue, color intensity (CI), total acidity, ethanol level and pH were evaluated. Sensory analysis concerning astringency and bitterness intensity was also performed.

3. RESULTS

3.1. Vintage influence on chemical data.

The chemical data of each cultivar have been submitted to the analysis of variance in order to explore the « vintage » effect ($p \leq 0.05$). Principal Component analysis was performed on the variables that differed significantly. For CS wines, the first two Principal Components (PCs) explained 78.94 % of the total variance (fig. 1). Phenolic compounds, anthocyanins, tannins, C, EC levels as well as % G, % P, mDP, hue, CI seem to be parameters adapted to wine discrimination according to vintage. Wines from 1978 to 1988 are rather grouped on the right side of the PC1, disclosing a good correlation with hue, whereas the most recent vintages (2000 to 2005) are placed on the left side of PC1. These wines have a good relationship with anthocyanins, mDP and CI.

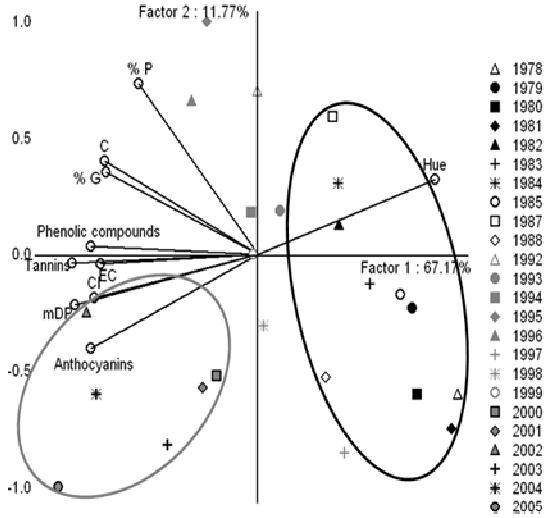

Fig. 1 - PCA representation of individuals (vintages) and variables (Phenolic compounds, Anthocyanins, Tannins, % G, % P, mDP, C, EC, Hue and CI) for CS wines defined by the two first principal components.

Regarding Merlot, a PCA (fig. 2) displays that phenolic compounds, anthocyanins, tannins, C, EC, % G, % P, mDP as well as hue and CI, as in case of CS wines, are the parameters that permit an accurate discrimination in the light of vintage.

3.2. Vintage influence on sensory data.

Sensory analysis results reveal the vintage effect on astringency intensity for both cultivars. Astringency and bitterness vary respectively from 2.6 to 4.8 and from 2.6 to 3.4 for CS. Concerning M wines, astringency and bitterness perceptions vary respectively from 2.2 to 3.4 and from 2.8 to 3.3.

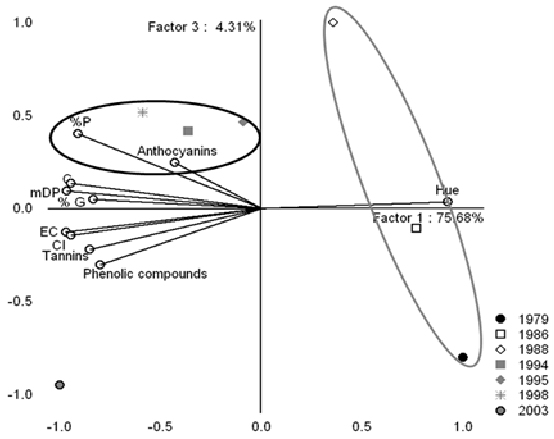

Fig. 2 - PCA representation of individuals (vintages) and variables (Phenolic compounds, Anthocyanins, Tannins, % G, % P, mDP, C, EC, Hue and CI) for M wines defined by the two first principal components.

3.3. Correlations between sensory and chemical data and ageing.

To investigate the extent to which our sensory measures could be explained by chemical composition, Pearson's correlation was performed. In CS wines (tab. 1) monomers, dimmers, total tannins, total anthocyanins, phenolic compounds, mDP, % G and CI were positively correlated whereas the hue is negatively correlated with astringency intensity. In M wines, astringency intensity is positively correlated with C, phenolic compounds and mDP.

Tab. 1 - Correlations between chemical composition and astringency intensity. $P \leq 0.05$ (/ = no correlation).

	CS	M
	Astringency intensity (r, p ≤0.05)	
C	0.58	0.79
EC	0.56	/
B2	0.66	/
B3	0.68	/
B4	0.68	/
mDP	0.71	0.88
% G	0.52	/
Phenolic compounds	0.68	0.80
Total tannins	0.57	/
Total Anthocyanins	0.52	/
CI	0.61	/
Hue	-0.69	/

We illustrate that astringency intensifies significantly with mDP. The highest astringency was perceived for an mDP of 7.6 for CS and for an mDP of 3.4 for M. The established correlation between astringency and mDP permits to characterize tannins

quality when mDP is known. Scale patterns between wine mDP and tannin perception are proposed (fig. 3). For example, CS wines with an mDP between 2 and 4 are characterized mellow and slight astringent, whereas wines with an mDP bigger than 4 are perceived rather tannic.

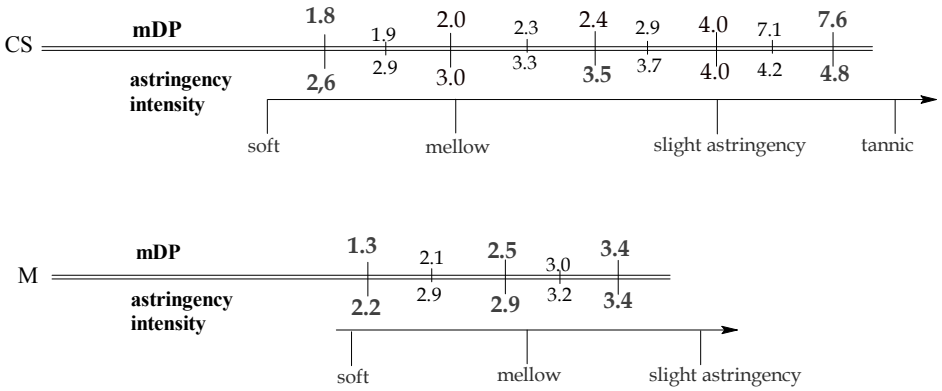

Fig. 3 - Scale pattern between astringency and mean degree of polymerization (mDP) for CS and M wines.

4. CONCLUSION

A comparative study of chemical and sensory properties was conducted for Bordeaux Cabernet sauvignon and Merlot wines. We evidenced for the first time that phenolic compounds, total anthocyanins, total tannins, tannin monomers (C, EC), % G, % P, mDP, as well as hue, CI, and astringency appear as the relevant criteria for vintage differentiation, for both cultivars. Correlations between chemical and sensory analyses are also highlighted.

Abstract

This study was carried out on 24 vintages of Cabernet sauvignon and on 7 vintages of Merlot produced by two different Bordeaux growing areas. Proanthocyanidin monomers and oligomers, and several parameters of the proanthocyanidin fraction were analytically assessed. Sensory analysis concerning astringency and bitterness was also performed. The different wines show a variation in several parameters of proanthocyanidin composition, which are correlated with wine age. Perceived astringency is correlated with the proanthocyanidin degree of polymerization (mDP), which is in turn linked to vintage. Merlot wines show sensory and analytical differences from Cabernet sauvignon wines.

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