Effect of ion exchange resins on white and red wine pH: Impact on wine sensory characteristics

Rita Borges [a, c], *Conceição Fernandes*[a*], *Celeste Marques*[b], *Carlos Matos*[c], *Alice Vilela*[c], *Filipe-Ribeiro, L.* [c], *Fernando M. Nunes*[c], *Fernanda Cosme*[c**]

a Mountain Research Centre (CIMO), ESA-Polytechnic Institute of Bragança, Portugal
b AEB Bioquímica Portuguesa SA, Zona Industrial de Coimbrões, Viseu, Portugal
c Chemical Research Centre (CQ-VR), Food and Wine Chemistry Lab, UTAD – Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal

*conceicao.fernandes@ipb.pt; ** fcosme@utad.pt

Introduction

The pH control during winemaking is a fundamental parameter by their influence on color, freshness and to achieve wine microbiological stability. The most common acidify correction performed in wineries is addition of tartaric acid; however, this operation could increase the risks of potassium bitartrate precipitations [1, 2]. On contrary, application of ion exchange resins for wine acidification is based on ability of exchanging ions fixed on functional groups, namely by exchanging cations, such as potassium, with hydrogen ions. Nevertheless, there is an important lack of knowledge on the impact of this operation on wine sensory characteristics.

Aim

The aim of this study was to evaluate, at industrial scale, the effect of cation exchange resins on wine pH control and consequently their impact on wine sensory quality, in white and red wine from Douro Valley Demarcated Region.

Material and Methods

Wines characteristics

	White wine (Douro 2015)	Red wine (Douro 2013)
Alcohol content (% v/v)	13.0	12.0
Specific gravity (g/cm^3)	0.9880	0.9930
pH	3.32	3.61
Titratable acidity (g/L tartaric acid)	5.1	4.9
Volatile acidity (g/L acetic acid)	0.27	0.38

Experiments were carried out at industrial scale in Gran Cruz Winery, using ion exchange resins: pH-Stab/AEB laboratory, being the treated wine almost 20% from total volume for white wine and 30 % of total volume for red wine.

Parameters analyzed	Method
Conventional oenological parameters	FTIR Baccus
pH and titratable acidity	OIV (2012)
Chromatic characteristics and color	OIV (2015)
Total phenols, flavonoids and non-flavonoids	Kramling and Singleton (1969)
Mineral composition	OIV (2012)

Sensory analysis: Trained panel of 7 members, fifteen attributes and a five-point intensity scale (ISO 4121, 2003).

Results

Tab. 1. Titratable acidity and pH of the control wines and wines after cation exchange resin treatment (mean ± SD).

	White wine		Red wine	
	pH	Titratable acidity (g of tartaric acid/L)	pH	Titratable acidity (g of tartaric acid/L)
Control	3.32±0.00^a	5.1±0.3^a	3.61±0.00^a	4.9±0.3^a
Resins	3.10±0.00^b	6.2±0.5^b	3.31±0.00^b	6.6±0.1^b

Means within a column followed by different letter are significantly different ($p < 0.05$).

As expected ion exchange resin treatment lowered pH of both wines due to the increased hydrogen content that's provoke the increase of titratable acidity.

Tab. 2. Mineral composition (K^+,Ca^{2+}, Mg^{2+}) of the control wine and wine after cation exchange resin treatment (mean ± SD).

	White wine			Red wine		
	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Calcium (mg/L)	Magnesium (mg/L)
Control	770.6±69.6^a	22.2±1.3^a	84.2±0.2^a	1092.7±8.7^a	52.2± 2.4^a	87,0± 0.4^a
Resins	473.4±24.9^b	19.5±0.9^a	71.7±0.8^b	696.9±2,0^b	31.6± 2.4^b	51.7±0.3^b

Means within a column followed by different letter are significantly different ($p < 0.05$).

Ion exchange resin lowered potassium and magnesium concentration in white and red wine. However, in red wine, only calcium decreased.

In white wine, it was observed a decrease in total phenols. In turns, in red wine, only non-flavonoids content decrease.

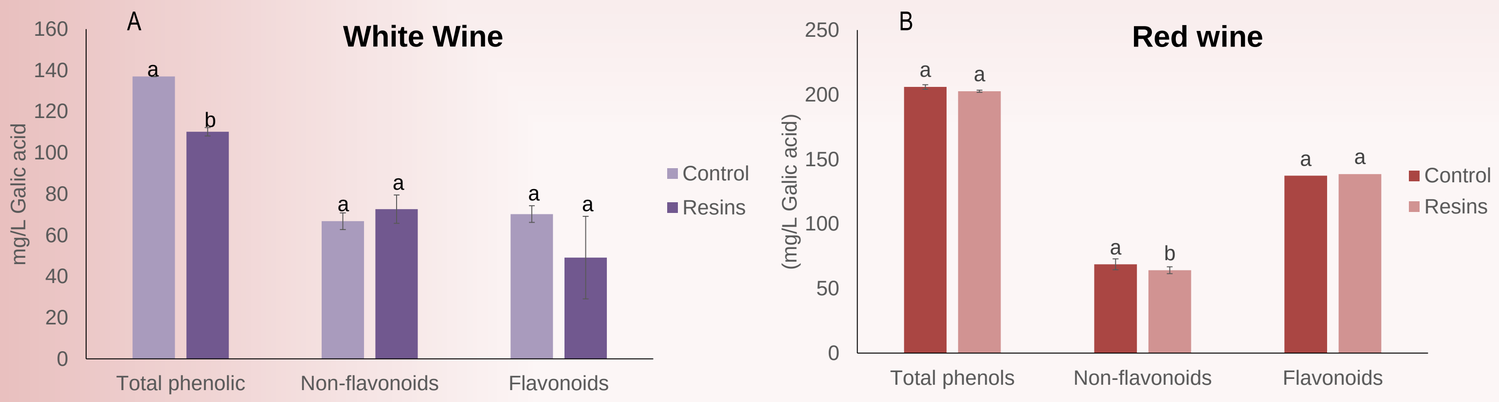

Fig. 1. Flavonoids, no-flavonoids and total phenolic compounds of white wine (A) and red wine (B).

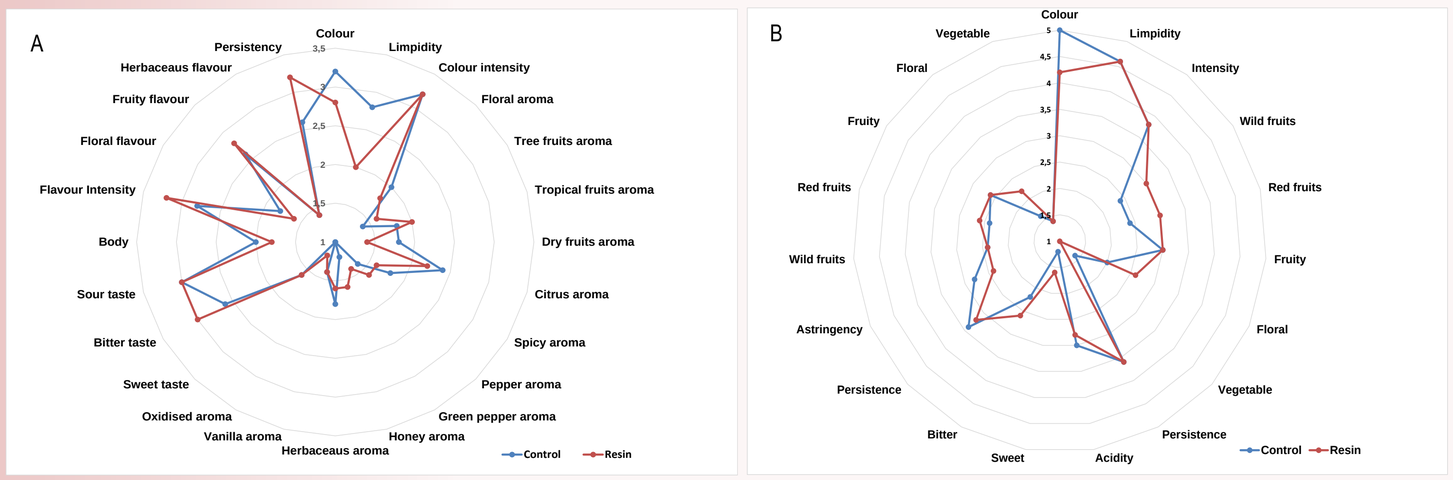

Fig. 2. Sensory profile of white wine (**A**) and red wine (**B**) treated with ion exchange resin (red-line) and control wine (blue-line).

Still no significant differences between treated and control wines, treated white wine was more scored for attributes *flavour intensity*, *fruity flavour* and *persistence*, whereas treated red wine was more scored for attributes *red fruits aroma*, *red fruits flavour*, *floral aroma* and *floral flavour* .

Conclusions

Results obtained in this work showed that the use of ion exchange resin to adjust white and red wines pH could be a good solution for the wine industry.

References

[1] H W Berg, R M Keefer, Am J Enol Viticult, 1958, 9,180–183. [2] B Ratsimba, C Laguerie, B Biscans, M Gaillard, Bull. Soc. Chim. Fr, 1989, 3, 325–330. [3] W R Bonorden, C W Nagel, J R Powers, Am J Enol Vitic, 1986, 37, 143-148. [4] O.I.V. Resolution OENO 43/2000. [5] O.I.V. Resolution OENO 443/2012. [6] H Mira, P Leite, J M Ricardo-da-Silva, A S Curvelo-Garcia, J Int Sci Vigne Vin, 2006, 40, 223–246. [7] C Lasanta, I Caro, L Pérez, Food Chem, 2013, 138, 1072–1078. [8] OIV. Paris: Edition Officielle, 2012.

Acknowledgements

This work was funded by the Chemical Research Centre (CQ-UTAD). AEB Bioquímica Portuguesa is also gratefully acknowledged.