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Influence of cationic exchange for reducing pH on the composition and quality of sparkling wine

Arnau Just-Borràs[1], Pere Pons-Mercadé[1], Jordi Gombau[1], Pol Giménez[1], Glòria Vilomara[2], Marta Conde[2], Antoni Cantos[2], Joan Miquel Canals[1], Fernando Zamora[1]

1Departament de Bioquímica i Biotecnologia, Facultat d'Enologia de Tarragona, Universitat Rovira i Virgili, C/ Marcel.li Domingo s/n, 43007 Tarragona, Spain
2 Juvé & Camps SA, c/Sant Venat, 1, 08770 Sant Sadurní d'Anoia, Barcelona, Spain

Climate change has without any doubt an important impact on viticulture and oenology. The composition of wine is being altered due to lack of rainfall and the increase in temperatures during the grape ripening period; it is therefore becoming more common to find wines with low titratable acidity, high ethanol content and high pH. The increase in pH is especially problematic in sparkling wines, because they need higher acidity to maintain adequate freshness. In this research, the effects of using cation exchange on sparkling wine composition and quality was studied.

Materials and methods

Around 2,000 L of Macabeo must was divided equally into two parts: one underwent cation exchange using a cation exchange column (FreeK+ column, Agrovin, Ciudad Real, Spain) and the other did not undergo any treatment. Subsequently, the two musts were blended together in different proportions (0, 5, 10, 15, 20, 25, 35 and 45 % of treated must) in order to obtain a set of grape musts with different pHs. All the different blends were used for making base wines by microvinification. After stabilisation, these base wines were used for producing sparkling wine using a traditional method. Eleven and twenty months later, the bottles were disgorged and their contents used for analysis.

Analytical methods recommended by the OIV[1] were used to determine ethanol, residual sugar, pH, titratable acidity and the different acids. The potassium concentration was determined by FAES[2]. Proteins were measured by HRSEC-DAD[3] and polysaccharides by HRSEC-RID[4]. A Mosalux device was used to measure foaming properties[5].

A sensory analysis was performed by a trained panel. The tasters were required to evaluate the intensity of 6 attributes (Colour, Balance Reduction/Oxidation, CO2 integration, Structure, Acidity and Global quality) on a scale of 1 to 10.

Results and discussion

Figure 1 shows the effects of cation exchange treatment on A) pH and B) titratable acidity of the must, base wine and corresponding sparkling wines after 11 and 20 months of ageing. The results show that the pH of the grape must decreased significantly with the increase in proportion of treated must in the blend, whereas the opposite was true for titratable acidity. These two trends were also observed in the base wine and in both sparkling wines. These results agree with previously published results[6,7].

Figure 2 shows the influence of cation exchange treatment on the potassium concentration of the base wine. As expected, the potassium concentration decreased progressively with the increase in proportion of treated must in the blend. These data confirm the effectiveness of cation exchange treatment for removing this cation from wines, and that it is precisely this potassium depletion that causes the pH to decrease.

No significant differences were found in the effects of the cation exchange treatment on the content of ethanol and residual sugars, or on any of the following acids: L-malic, L-lactic, acetic, succinic and citric. Only tartaric acid concentration was observed to increase progressively with the increase in proportion of treated grape must in the blend. This behaviour can be explained by the fact that the lower the potassium concentration, the lower the crystallisation of potassium hydrogen tartrate in the wine. This is the main reason why tartaric acid concentration and titratable acidity increase when the proportion of treated must is increased in the final blend.

The concentrations of proteins and polysaccharides were not significantly affected by the cation exchange treatment, which indicates that this treatment does not alter the colloidal wine composition. This is a very interesting result, because polysaccharides (mannoproteins) and especially proteins have been described as being foam enhancers and stabilisers in sparkling wines[3]. Almost all wine proteins have a positive charge at wine pH, since their isoelectric point is higher than the wine pH. Therefore, it would be reasonable to assume that cation exchange resins can retain part of these proteins. However, according to our results, cationic exchange does not remove them.

With regard to the properties of the foam, no notable differences

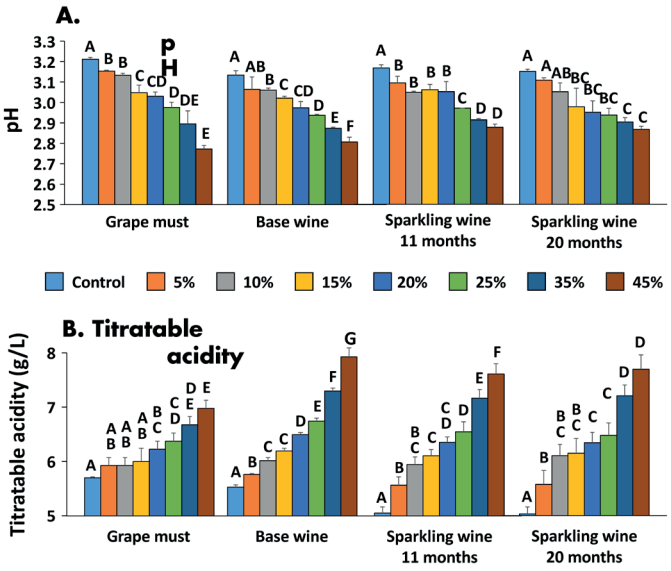


FIGURE 1. Influence of cation exchange treatment on pH and titratable acidity.

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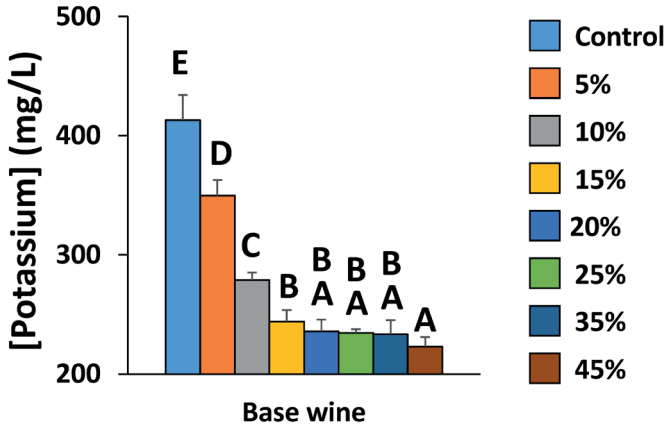


FIGURE 2. Influence of cation exchange treatment on potassium content of the base wine.

were observed in the effects of the cation exchange treatment on the base wine or on the sparkling wine of 11 months. However, a significant decrease in the foam parameters (maximal height - HM and stable height – HS) was observed in the sparkling wines aged for 20 months, but only when the proportion of treated must in the blend was very high. These data therefore indicate that while the cationic exchange treatment of the grape juice does not affect the foaming properties of the base wine and young sparkling wines, it can negatively affect the foaming characteristics of older sparkling wines, especially when the proportion of treated must is very high.

Figure 3 is a radar chart of the results obtained from the sensory analysis of the sparkling wines aged for 20 months. The only sensory attribute for which the trained panel found clear differences was acidity, with no differences detected for any of the other descriptors. The panel also considered that the sparkling wine increased in freshness when the proportion of the treated grape must in the blend was not too high. However, the acidity of the sparkling wines made from a very high proportion of treated grape must was preceived as excessive. The fact that the panel did not find any differences in the other sensory attributes indicates that the cation exchange treatment of the must does not exert a negative sensory effect on the final sparkling wine quality.

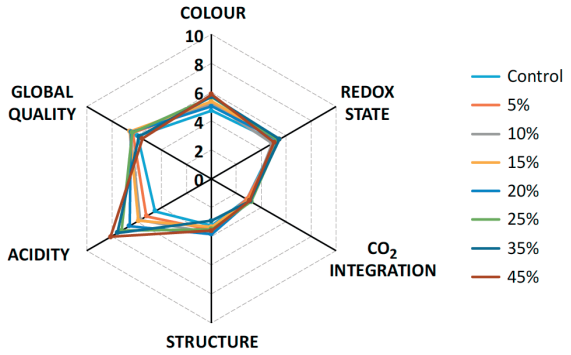


FIGURE 3. Influence of cationic exchange treatment on the sensory perception of sparkling wines after 20 months of ageing.

Conclusion

From these results, it can be concluded that applying cation exchange treatment to the must is a very useful tool for reducing the pH of sparkling wines and increasing their freshness. In addition, this is a very low-cost treatment, since, according to the manufacturer's data, its estimated cost is only 0.25 euros/hL. However, the fact that excessive treatment can upset the acidity balance and negatively affect the quality of the sparkling wine should be taken into account. ■

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