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VITICULTURE & ENOLOGY
UNIVERSITY OF CALIFORNIA DAVIS

The effect of *Saccharomyces cerevisiae* and *Saccharomyces bayanus* yeast on colour properties and pigment profiles of Cabernet Sauvignon red wine

By: Y. Hayasaka, M. Birse, J. Eglinton, and M. Herderich

In: Australian Journal of Grape and Wine Research. 13(3):176-185, 2007

• Anthocyanins, which are extracted from the skins of grapes during winemaking, are short-lived pigments. But immediately after crushing, new, more complex and stable pigments –called polymeric pigments, or pigmented polymers- start forming, and will continue to evolve throughout winemaking and aging. Recently, a new type of complex pigment has been proposed: the *pyranoanthocyanins*. Pyranoanthocyanins are the result of the binding of an anthocyanin with a vinyl-phenol (a phenol containing the radical –CH-CH2), or with similar molecules. The important matter here is that both **polymeric pigments** and **pyrano-anthocyanins** are responsible for a large portion of wine color, both in young and aged wines.

• Yeast-derived metabolites (like acetaldehyde and pyruvic acid) are also involved in the formation of pyranoanthocyanins and polymeric pigments. Therefore –the authors hypothesized- the color of a red wine can be influenced by the type of yeast used during fermentation. The goal of this study was to evaluate the difference in color and pigment composition of two wines made from the same grape variety (Cabernet Sauvignon), but with two different yeasts: *S. cerevisiae* and *S. bayanus.*

• Randomly-selected grape bins were crushed into six 900 L rotary fermentors. Three of them were inoculated with *S. cerevisiae* (AWRI 838) and the other 3 with *S. bayanus* (AWRI 1375). The wines fermented at 20°C and were pressed at about 1°Brix (5-6 days) into 6 upright 760 L tanks. After completing MLF, the wines were cold-stabilized, 0.45 micron-filtered, bottled, and stored at 15°C. Samples for color analysis were taken at Day 8 (pre-MLF) and at Day 387 (after aging 1 year).

• The authors measured the following color components:
_ CIELab values
_ color intensity (A420+A520) and color hue (A420/A520)
_ proportion of non-bleachable pigments (reading A520 before and after adding $SO_{2)}$
_ total anthocyanins (HPLC)
_ polymeric pigments (HPLC)
_ pyranoanthocyanins (using a new technique called, I'm afraid, *direct infusion electrospray mass spectrometry*). In this technique, non-volatile molecules are rapidly ionized and, therefore, can be measured directly from the liquid phase).

• **Results.** The results below were consistent across the three fermentation replications within each strain. Both wines had an identical pH of 3.67+ 0.05.

Wines fermented with *S. bayanus* had more:	Wines fermented with *S. cerevisiae* had more:
· residual glucose/fructose	· alcohol
· bound and total SO2	· free anthocyanins (early and after aging)
· b* (yellowness) (early on, Day 8) · b*, a* (redness), L* (darker) and color intensity (after aging, Day 387)	
· polymeric pigments (1.5 times more)	
· non-bleachable pigments	
· anthocyanins linked to acetaldehyde	
Both *S. bayanus* and *S. cerevisiae* had the same:	
· main pyranoanthocyanins	

• Some interesting conclusions from the results above:

_ even though the wine fermented with *S. cerevisiae* had the most anthocyanins, the wine fermented with *S. bayanus* had the most color intensity. In other words, **anthocyanin concentration is not correlated with color intensity or redness** (a*);
_ non-bleachable pigments arise from the transformation of anthocyanins -which are SO2-bleachable- into polymeric pigments and other complex pigments such as pyranoanthocyanins. *S. bayanus* was more effective than *S. cerevisiae* in progressively transforming grape anthocyanins into stable non-bleachable pigments;
_ although the composition of the main pyranoanthocyanins was not affected by the strain of yeast used, the level of anthocyanins linked to acetaldehyde (or acetaldehyde-mediated linkages, found in both pyranoanthocyanins and polymeric pigment) was twice as high in *S. bayanus* wines as in *S. cerevisiae* wines from Day 8. That is, the greater color of *S. bayanus* wines seems to be due to the increased production of acetaldehyde by *S. bayanus* during fermentation. [If you enjoy chemical structures, make sure you check out the authors' representations of the main pyranoanthocyanins and the two main mechanisms by which polymeric pigments arise -direct condensation or ethyl-bridge];
_ all in all, it would seem that the *S. bayanus* wine–which had the highest color intensity- compensated for a lower initial concentration of anthocyanins by increasing the production of acetaldehyde, which resulted in a higher level of non-bleachable pigments and acetaldehyde-mediated pigments, which are more stable than anthocyanins. As the authors point out, the contribution of these pigments to wine color should not be underestimated.

In conclusion, the formation of polymeric pigments and pyranoanthocyanins was affected by the use of two different yeasts, and resulted in differences in wine color. *S. bayanus* produced wines that maintained greater values of *color intensity*, *a**, and *b**, and retained greater levels of *polymeric pigments* and *non-bleachable pigments* after aging, compared to *S. cerevisiae*, the most common winemakers' yeast.

Author: Bibiana Guerra, Editor: Kay Bogart. This summary series funded by J. Lohr Vineyards & Wines.