Benefits of cork-based technical closures for the aging of Burgundy wines

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Introduction

Precision enology is being used to make increasingly well-defined wines. In this context, the lowering of SO_2 doses, which is being made necessary for health and quality reasons, must not negatively impact the bottle aging of wine. Closure choice affects the maintenance of SO_2 levels over time, with a direct consequence on the wine's oxidative or microbiological evolution. Winemaking trends for age-worthy wines are therefore tending towards the use of impermeable closures. A test involving accelerated aging was therefore set up. It involves the use of half-bottles (37.5 cl) and various storage temperatures. Traditional cork closures were compared with Diam® closures.

Materials and methods

The study was conducted with a Pinot noir wine and a Chardonnay wine (Bourgogne [Burgundy] appellation). These wines were made by IFV using procedures with varying amounts of SO_2 addition, in order to obtain four final levels: 160, 100, 50 and 10 mg/l total SO_2. At bottling, all batches had volatile acidity of less than 0.50 g/l expressed as H_2SO_4, a microbial population of less than 10 cells/ml and no oxidative character. The wines were filtered at 1.2 µm and protected from air during bottling (inert gas blanketing of the tank, transfer lines and bottles prior to filling). The closures were inserted with a single-head corking machine equipped with a vacuum extraction system (Gay). The bottles were "Burgundy" type, 37.5 cl in size (filling to 55 mm). Dissolved oxygen monitoring was performed after bottling, using the PreSens® system (duplicate batches – incubation for 2 weeks at 22 °C, then for 2 weeks at 25 °C).

Four types of closures were compared: two natural cork closures (Super and Extra grades) and two Diam® closures (technical closures made from Diamant®-treated granulated cork including microspheres). Bottle aging was conducted under two temperature conditions: 10 °C and 25 °C. Regular analysis was performed between the time of bottling and 28 months of bottle aging. This monitoring included four to eight points, depending on the analysis being performed. Free and total SO_2 were monitored for the batches with 100 and 160 mg/l of SO_2. Color (colorimetry, L*, C*, h° space) and sensory analyses were performed on the batches with 50 and 10 mg/l of added SO_2. The sensory analyses, conducted in a dedicated room, used Fizz® software. The samples were presented in random order to the judges (7-10, depending on the session). The test revealed a profile: scoring of aroma and overall qualities and oxidation and reduction intensities, with a discontinuous four-box scale.

Figure 1: Evolution of dissolved oxygen after bottling.

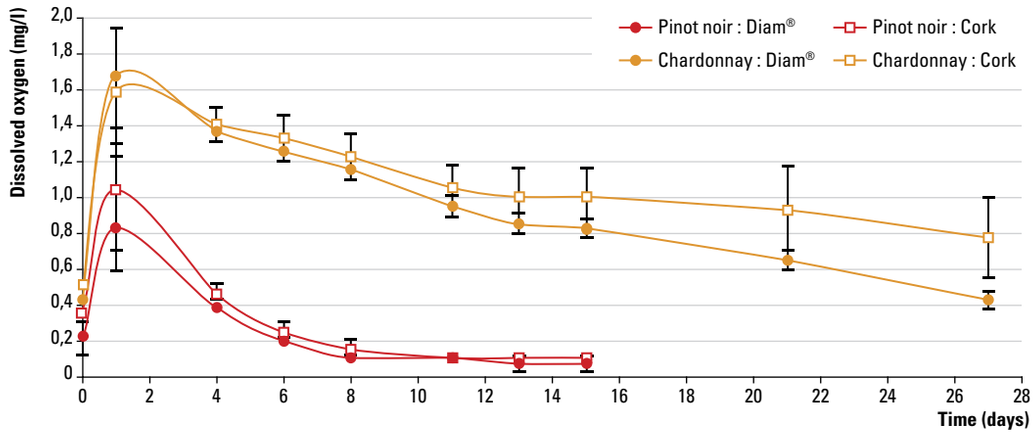
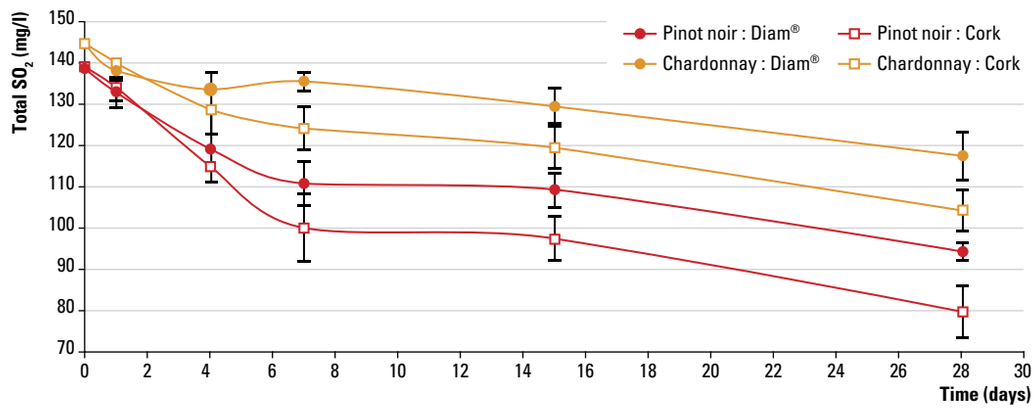


Figure 2: Evolution of total SO_2 after bottling *(mean values for bottle aging at 10 and 25 °C).*



Results

Since the two natural cork references, on the one hand, and the two Diam references, on the other, give similar results, the results are presented as mean values.

Dissolved oxygen monitoring (batches with 10 mg/l of added SO_2). The dissolved oxygen level is low just after bottling (about 0.5 mg/l), confirming the effectiveness of inert gas blanketing. Within 24 hours after bottling, the dissolved oxygen content increases by about 1.1 mg/l for the Chardonnay batches and by 0.6 mg/l for the Pinot noir batches ***(figure 1).*** This increase comes from the closure, owing to a release of oxygen following its compression. For Pinot noir, the dissolved oxygen content is lower because some is consumed by polyphenols, and it decreases quickly within one week. For Chardonnay, the decrease is much slower. One month after bottling, the natural cork batches contain, on average, 0.35 mg/l of dissolved oxygen more than the Diam® batches.

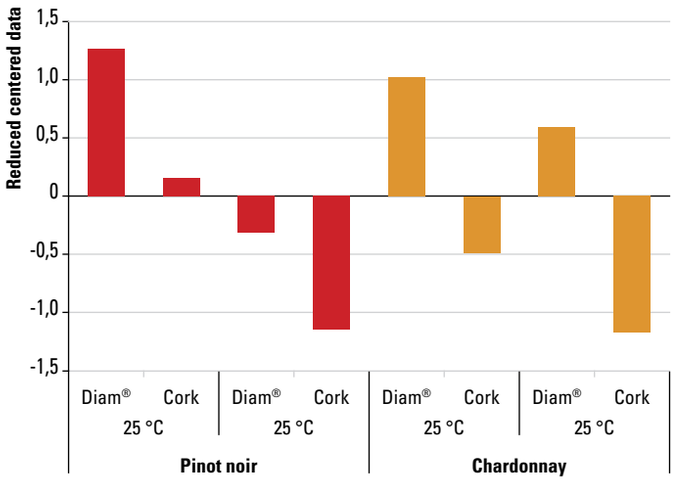
SO_2 monitoring (batches with 100 and 160 mg/l of added SO_2, mean values for both levels). The changes in total SO_2 after bottling reveal a decrease during the first six months. This decrease is greater for Pinot noir than for Chardonnay ***(figure 2).*** The decrease is then relatively linear and parallel, with a clear closure effect. For both Pinot noir and Chardonnay, the Diam® closure retains about 10 to 15 mg/l more SO_2 than the natural cork. The free SO_2 content is always slightly higher for the Diam® closure than for natural cork, with an insignificant temperature impact for Chardonnay, but a much greater one with Pinot noir ***(table 1).*** The presentation of total SO_2 contents, in reduced centered form, clearly shows that the closure effect is proportionally greater than the temperature effect for Chardonnay, whereas the opposite is true for Pinot noir ***(figure 3).***

Color monitoring (batches with 10 and 50 mg/l of added SO_2). The hue angle (h°) component of the colorimetric index provides information about color hue: red for 0°, yellow for 90° and green for 180°. For Pinot noir, the hue angle is lower for the Diam® closure than for natural cork, indicating that the red component is greater ***(table 1).*** Aging at lower temperature also promotes a lower hue angle. For Chardonnay, hue angle is greater for the Diam® closure than for natural cork, indicating greater presence of green in its color. The temperature effect is not significant in this case. These results thus indicate that natural cork closures tend to enhance the yellow color of Pinot noir and Chardonnay, when compared to the Diam® closure. Sensory monitoring (batches with 10 and 50 mg/l of added SO_2). More than 80% of the analyses of variance performed on the sensory profile attributes are significant. The aroma and overall qualities of the Diam® wines are greater than those for the natural cork wines ***(table 1).*** The differences are greater for Chardonnay than for Pinot noir. Cork taint was found in only two of the natural cork wines (one for each wine color), with little effect on the data. The oxidative intensity of the Diam® batches is lower than for the natural cork batches for Pinot noir, with a temperature effect as well ***(table 1).***

Tableau 1: Analytical determination during bottle aging.

Values: mean ± S.D.			Free SO_2 rate (%)	Colorimetry	Sensory analysis (score out of 10)		
				Hue angle, h (°)	Aroma quality	Overall quality	Oxidative intensity
Bottle aging time (37.5 cl)			7 to 28 months	15 to 28 months	7 to 28 months		21 to 28 months
Pinot noir	Diam®	10 °C	37 +/- 3 %	28,1 +/- 0,8	5,6 +/- 0,8	5,7 +/- 0,8	1,1 +/- 0,7
		25 °C	32 +/- 6 %	32,4 +/- 1,8			3,5 +/- 0,7
	Cork	10 °C	35 +/- 3 %	29,4 +/- 1,3	4,9 +/- 0,8	4,9 +/- 0,9	2,7 +/- 2,2
		25 °C	30 +/- 6 %	34,1 +/- 1,8			3,7 +/- 0,7
Chardonnay	Diam®	10 °C	52 +/- 2 %	102,3 +/- 0,5	4,3 +/- 0,6	4,6 +/- 0,5	2,3 +/- 0,4
		25 °C	50 +/- 1 %	102,4 +/- 0,2			3,1 +/- 1,6
	Cork	10 °C	49 +/- 1 %	100,8 +/- 0,5	2,7 +/- 0,8	2,9 +/- 0,7	6,2 +/- 0,6
		25 °C	49 +/- 4 %	100,6 +/- 0,5			6,8 +/- 0,4

Figure 3: Mean contents of total SO_2 between 7 and 28 months of bottle aging.



For Chardonnay, the closure effect on oxidative intensity is quite high, whereas the temperature effect is low. The natural cork wines are oxidized, which explains the lower quality scores with respect to the Diam® batches. Reduction intensity is virtually zero for the Pinot noir and Chardonnay batches with natural cork closures. The score (out of 10) remains very low for Chardonnay with Diam® closures: 1.8 ± 1.1.

Conclusions

These results show the importance of closure choice for age-worthy wines. With a sufficiently impermeable closure, it is reasonable to consider using a winemaking process with minimal addition of SO_2. The results were obtained with 37.5 cl bottles and a bottle aging period of 28 months. The observed loss of SO_2 was greater during the first few months after bottling, making it possible to extrapolate these results for a bottle aging period on the order of 5 years with 75 cl bottles. Under these conditions, use of a Diam® closure means that the winemaker can decrease SO_2 content in the finished wine by 10 to 15 mg/l, when compared with natural cork closures, for similar protection during bottle aging. For wines with very low sulfur levels, we can see that the Diam® closure limits oxidative changes and preserves overall quality. For Pinot noir, closure choice and temperature are both important. For Chardonnay, the importance of closure choice is predominant. ■

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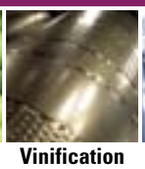
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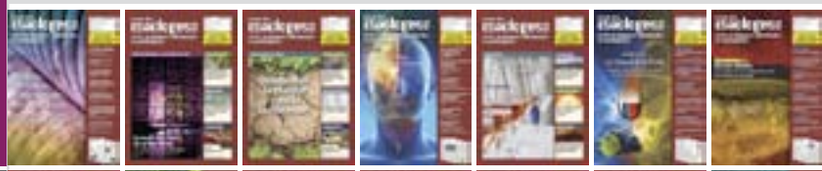

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