WINEMAKING UPDATE

Number 1B | 2021

Managing oxidative risk with biological tools

Part II – Post-fermentation

We have seen in Part I of *Managing oxidative risk* how to fight oxidation in must with specific inactivated yeast, such as Glutastar™. Even though the impact of Glutastar™ is evident all the way to the bottle, there are sensitive stages post fermentation, where oxygen contamination needs to be controlled via O_2 scavenging in order to avoid wine oxidations. In the post-fermentation stages, the oxygen ingress can vary depending on the type of operation done with the wine. There are numerous time points when wine is potentially exposed to oxygen along the way to the bottling step, and beyond.

❹ Storage | ❺ Cold Stabilisation | ❻ Transport & bottling

Preventing oxidation in wine/post-fermentation

Once the fermentations are finished, and before bottling, the wine is vulnerable to oxidation (Table 1). The oxygen ingress can vary from 0.1 mg/L to 8 mg/L depending on the operation. SO_2 is used to protect the wine or physical deoxygenation is used to remove any excess oxygen.

	Potential oxygen ingress	Factors affecting oxygen ingress
Pumping	~ 0.1 to + 2mg/L	State of pump, transfer behaviour
Filtration	0.5 to + 2 mg/L	
Centrifugation	<0.5 to + 5 mg/L	
Rack-off	2 to 8 mg/L	w/w-out aeration
Truck transportation	0.5 to + 5 mg/L	Tank size, distance/duration
Cold stabilisation	0.5 to + 5 mg/L	Tank size, continuous/batch, agitation, duration
Bottling and tirage	Variable (1 to 5 mg/L)	
Disgorging	Variable (<0.5 to + 5 mg/L)	

Table 1. Post-fermentation process that are susceptible to oxygen ingress.

How tradition-based science protects finished wine from oxidation

SO_2 is typically used to prevent oxidation in finished wine. The traditional method of keeping the wine on lees can also be used but there are risks associated with this method (contamination, quality of the lees). Based on this age-old method, research from the INRAE (J-M. Salmon) showed the potential of specific inactivated yeast to **consume oxygen** and protect wine from oxidation. A wide range of distinct yeast derivatives obtained from different yeast strains and different processes for inactivation were tested and measured for their O_2 consumption ability. One exhibited the best oxygen consumption capacity of 1 mg/L of dissolved oxygen and rate of 0.74 mg O_2/h when added to the model wine medium at a concentration of 20 g/hL as shown in Figure 1. This high rate of consumption can protect the wine from oxidation during the various steps from post-fermentation processing up to bottling. This unique specific inactivated yeast is now available to winemakers as Pure-Lees™ Longevity which exhibits remarkable ability to scavenge oxygen. In order to study the benefits of Pure-Lees™ Longevity, winery scale trials were conducted during storage, cold stabilisation and transport of white wines.

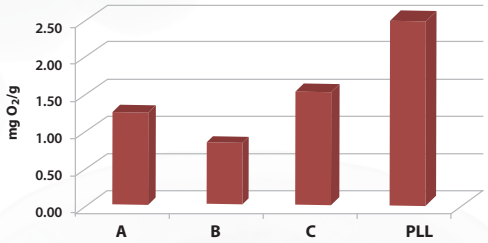

Figure 1. Maximal O_2 consumption capacity by different inactivated yeast.

Cold stabilisation

A winery trial (Australia) was done in Chardonnay where 3-6 mg/L of oxygen was generally picked up during cold stabilisation and would need up to 2 weeks to remove with sparging post-cold stabilisation to reach the quality spec of < 0.5 mg/L of dissolved oxygen.The winery would usually use gallic tannins to protect from oxidation during cold stabilisation as the lowering of the temperature would hold more dissolved oxygen. After cold stabilisation, when the temperature increased again, the dissolved oxygen caused oxidation reactions, hence the need to protect the wine. It is thus interesting to trap the oxygen at this early stage with Pure-Lees™ Longevity as a strategy to be efficient in the protection of the wine while reducing the use of SO_2.

The wine was kept for 5 days at -4°C with agitation and control was compared to the addition of either Pure-Lees™ Longevity or their usually treatment, gallic tannins. The initial level of dissolved oxygen was 3 mg/L and in the treated tanks, the levels were reduced to 3.2 and 0.6 mg/L for gallic tannins and Pure-Lees™ Longevity respectively (Table 2). The Australian Chardonnay, showed a much lower DO in the wine treated with Pure-Lees™ Longevity (Table 2).

	Rate	Dissolved oxygen (mg/L)
Control	-	3.5
Gallic tannin	20 ppm	3.2
Pure-Lees™ Longevity	400 ppm	0.6

Table 2. Dissolved oxygen measured in Chardonnay during cold stabilisation trial with Pure-Lees™ Longevity.

Wine racking and storage

When applied during the racking (addition of the product at the bottom of the reception tank), Pure-Lees™ Longevity leads to the scavenging of O_2, thus limiting oxidation phenomena (Figure 2). After some months of storage, wines present a higher free SO_2 fraction and a brighter color. During storage and racking, many trials have shown the positive impact of Pure-Lees™ Longevity in wine aroma, color preservation (Figure 3) and SO_2 addition limitations (Table 3).

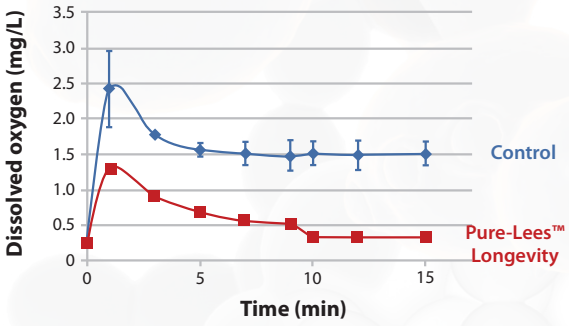

Figure 2. Evolution of the amount of dissolved oxygen in Chardonnay wine (INRAE, France) racked from one tank to another: control compared to an addition of 20 g/hL of Pure-Lees™ Longevity at the bottom of the destination tank before racking

	Control	Pure-Lees™ Longevity 20 g/hL
Free SO_2	18	28
Total SO_2	130	130

Table 3. Sauvignon blanc (Gers, 2014) 4 months in contact with Pure Lees™ Longevity and 4 months in bottle

Wine with normal SO_2 | Wine with ½ dose of SO_2 | Wine with dose ½ of SO_2 + Pure-Lees™ Longevity

Figure 3. Sauvignon blanc (Gers, 2014) 4 months in contact with Pure-Lees™ Longevity and 4 months in bottle

Bulk wine transport

More recently, during a trial involving transport of wine in flexitanks from New Zealand to France, the addition of Pure-Lees™ Longevity during the loading of the flexis with the wine (up to 20 g/hL) made it possible to obtain on arrival a wine whose aromatic qualities are better preserved.

Indeed, the 3MH thiol concentration (passion fruit and grapefruit) is almost twice as high in wine protected by Pure-Lees™ Longevity (Figure 5).

Its acetate, A3MH (passion fruit) and thiol 4MMP (boxwood) are also in greater concentration in the wines. The thiols are very sensitive to oxygen and are better protected with Pure-Lees™ Longevity. The same trend was also seen for the SO_2 (free and total) and dissolved oxygen (Figure 4). Consequently these wines had a longer shelf life and a better market value.

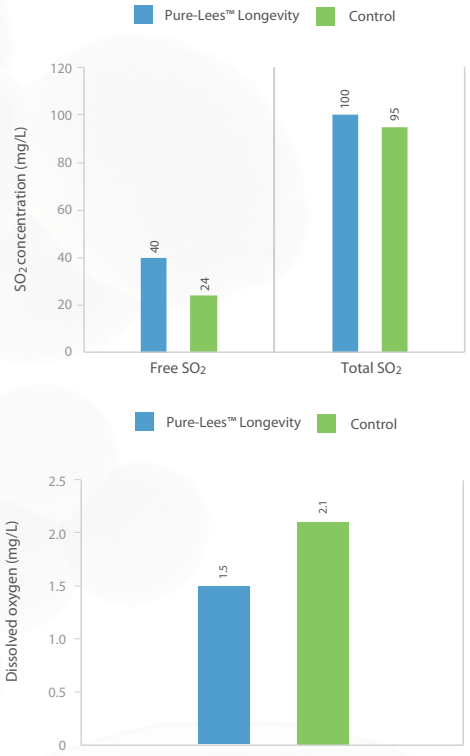

Figure 4. SO_2 (free and total) and dissolved oxygen at bottling of New Zealand Sauvignon blanc

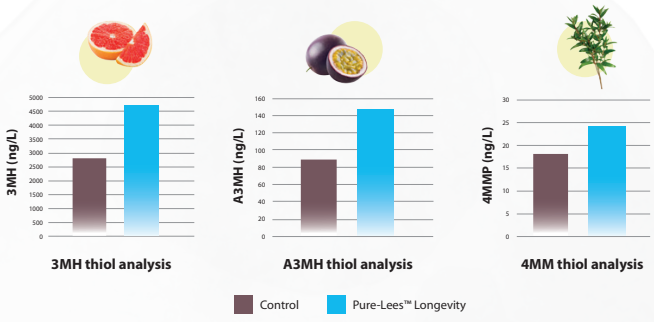

Figure 5. Thiols concentration of New Zealand Sauvignon blanc at bottling

Overall, using Pure-Lees™Longevity has proven to be an effective tool to control oxidation post-fermentation and is now being used all over the world for wine racking, storage, cold stabilisation and bulk wine transport.

Summary

The use of biological tools during the winemaking processes to prevent oxidation is being adopted by producers to maintain the sensory integrity of their wines all the way to the consumers. It is also part of an overall strategy of bioprotection to reduce the use of SO_2 and both Glutastar™ and Pure-Lees™ Longevity are essential tools to reach this goal, in the pre-fermentation and post-fermentation stages respectively.