Great dry white wines can only be produced if they are kept for a prolonged period on their lees. The main risk associated with this type of ageing, particularly in vats, is the development of olfactory reduction defects, due to the formation of sulfur compounds in the wine. When wines are aged in barrel, controlled aeration through the barrel staves, as well as frequent, gentle stirring of the lees, significantly inhibit the development of these foul-smelling molecules. Thus, the sulfur compound content of white wine aged on its lees gradually decreases over the first months of ageing (Figure 1), especially in new barrels (Figure 2).

However, if reduction odours appear during alcoholic fermentation or sulphuring, the use of barrels for ageing will not be sufficient to eradicate the defect (Figure 3).

This problem may arise because certain simple rules have not been observed during wine production. It is generally a case of carefully adjusting the turbidity of the must to between 100 and 200 NTU, reducing the amounts of sulfur dioxide used during racking (<8 g/L), carefully rinsing the barrels before they are filled with must to prevent the wood from releasing SO₂, and finally delaying sulfuring of the wine until ten days after alcoholic fermentation is completed.

In any case, if a white wine intended for ageing on its lees in barrel shows a reduction fault after alcoholic fermentation, the winemaker needs a simple method for eliminating unpleasant odours without compromising the ageing quality. Simply racking and aerating wine with this type of defect will not be sufficient to eliminate unpleasant odours (Figure 4).

In order to assure an advantageous and lasting effect on wine reduction, this process must be accompanied by the removal of the lees. Ageing then continues on fine lees. Although this practice reduces the sulfur compound content of the wine, it is not always sufficient to eradicate the defect completely.

The aptitude of wine lees for eliminating foul-smelling thiols

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Figure 5), it does have a detrimental effect on the aromatic quality of the wine, especially in new barrels. In fact, protection of the aromas from oxidation cannot be guaranteed in the absence of the lees.

A single batch of barrel-fermented wine, showing a marked reduction defect at the end of alcoholic fermentation, was used to make a comparison between different treatments: double racking with aeration (sample B), racking with aeration and total removal of the lees (sample C) and finally, racking with aeration and temporary removal of the lees (sample D). In this last variation, the lees were replaced after 48 hours. Sample A was the control. The results showed (Figure 6) that, after double racking, the H$_2$S, methanethiol and ethanethiol contents, principally responsible for olfactive reduction defects, were lower than in the control. In sample C, separated from its lees, the defect was also reduced. Nevertheless, neither of these two racking methods were effective enough to remove the defect entirely. Unpleasant odours were still noticeable on tasting.

However, when the lees were kept separately in barrel for 48 hours and stirred then put back into the wine, the methanethiol and ethanethiol disappeared completely from the wine. The wine was clear.

This result may seem paradoxical. It is in fact generally accepted that the lees are responsible for the development of reduction odours in wine. This is why white wines aged in vat are usually racked straight after alcoholic fermentation and separated from their lees to avoid this kind of harmful effect. However, if we follow the development of sulfur compounds in lees kept in barrel, we see a rapid decrease in the sulfur compound content. Only 24 hours after being separated from the wine, they no longer contain any methanethiol (Figure 7).

The H$_2$S content decreases more gradually (Figure 8).

In addition, when these lees are put back into a reduced wine, not only do they cease to generate any new sulfur compounds, but as demonstrated in the previous example, there is a significant decrease in the methanethiol content (Figure 9). This all seems to suggest that yeast walls are able to absorb certain volatile thiols (methanethiol and ethanethiol).

In order to verify these observations, we added lees taken from a sulfured white wine to a standard medium with known methanethiol and ethanethiol concentrations. The lees were thoroughly rinsed, then added at the rate of 3% to the thiol solution. The sulfur compound content shows that the methanethiol and ethanethiol present in sample A, the control, disappeared from the sample to which the lees had been added (Figure 10).

Therefore, adding lees to a wine with a reduction defect significantly reduces unpleasant odours identified during tasting.

Finally, we investigated the yeast’s thiol fixation mechanism. In view of the molecular structure of the yeast walls and the lees’ selective absorption of molecules with a free SH function, we assumed that disulfide bridges could be formed between some of the wine’s volatile thiols and the cysteine in the yeast wall mannoproteins. To prove this hypothesis, we attempted to release the methanethiol and ethanethiol...
absorbed by the lees used in the experiment described above. For this purpose, we used dithiothreitol (DTT), a reagent capable of breaking down the disulfide bridges. The results presented in Figure 11 showed that adding DTT to a standard medium, containing lees saturated with methanethiol and ethanethiol, promotes the release of these compounds into the medium.

It does seem, as a result, that fixation of certain volatile thiols, by the lees, activates the formation of disulfide bridges.

In conclusion, it has been proven that a dry white wine with a reduction defect following alcoholic fermentation must be treated appropriately. We recommend racking and aerating the wine, with temporary removal of the lees. This practice has the double advantage of eliminating unpleasant odours and making it possible to continue ageing on the lees. The lees are kept separately in barrel and stirred frequently, then put back into the wine. At this stage, not only do they cease to generate sulfur compounds, but their walls also absorb the methanethiol and ethanethiol.

We thus conclude that using fresh lees can act as a remedial treatment for reduction defects. This practice is authorised by the oenological code of practice.