# THE DIVERSE FUNCTIONS OF OXYGEN – 2ND PART

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## Protecting white and rosé wines from the last quarter of the alcoholic fermentation onwards

White musts and wines from the Mediterranean are very susceptible to pinking, particularly the 1998, 1999 and 2000 vintages. The pinking is attributable to oxidation of small polyphenols of white grapes.

These small polyphenols are naturally colourless. They are soluble in the must and later the wine. When properly protected, they remain colourless during the entire process.

The best prevention is to avoid their participation in oxidative reactions and thus, their colourisation.

- The continuous external protection of the fermenting must by $CO_2$ is the first preventive action.

Yeast continuously produce large amounts of $CO_2$ during active fermentations.

Caution is required from the last quarter of the alcoholic fermentation (from 7.6° - 5.1°Brix) onwards. The headspace above the must has to be saturated with $CO_2$.

In the case of clarified musts, which are rich in sugars and fermented at low temperatures, the risks of a sluggish end of fermentation are high, and so are the risks of pinking.

In order to assess the risk after reaching 5.1°Brix, a 0.25 litre sample is introduced into a flint bottle. When the risk is high, the sample will change colour within hours compared with the must in the tank. In such a situation, the external protection of the must has to be more carefully supervised as long as the fermentation continues.

Sulphiting must with fermenting yeast would be a serious mistake. At this stage, it is completely inefficient to prevent pinking. Also, the yeast will react by producing acetaldehyde and other $SO_2$-binding compounds.

When colourless, the small polyphenols responsible for pinking are virtually unaffected by bentonite or casein finings. A must, which was treated with these compounds during clarification or fermentation, remains susceptible to pinking.

By way of contrast, preventive treatment of fermenting must with PVPP is the only efficient way to complete the protection against oxidation.

Note: In view of the hygienic regulations, please remember to ask the distributor to provide a certificate of conformity with the current regulations, notably the RCEE 1622/2000.

The internal protection of the wine has to be initiated as soon as the alcoholic fermentation is complete. This is valid when the malolactic fermentation is undesired.

- The first protective sulphite addition is carried out in the fermentation tank, as soon as the sugars are depleted.

The addition has to be sufficient in order for some free $SO_2$ to remain during several weeks. For this initial sulphiting, between 5 and 7 g/hl of $SO_2$ are added considering the usual pH values of Mediterranean wines, but the exact addition has to be adjusted depending on the other analytical parameters.

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The addition of ascorbic acid can complete the efficiency of $SO_2$ for certain wines. When all the other parameters have been adequately considered, a 5 g/hl addition will perfectly serve its purpose.

- The homogenous sulphite addition is a key parameter of winemaking.
- It is crucial to achieve the desired $SO_2$ concentration in the entire tank, particularly in the yeast sediment at the tank bottom.
- Afterwards, white wines have to be racked off within 24 h following sulphite addition, while completely avoiding contact with air.

Before the wine is pumped, the pipes and the bottom (up to 1 meter height) of the receiving tank should be saturated with $CO_2$, the pump valves should be in good condition and the pipefittings undamaged. The wine should remain under the $CO_2$ blanket during the pumping.

Numerous studies have shown that sulphite addition to wines in the fermentation tank led to the production of unpleasant sulphur odours (rotten egg, onion, garlic, etc.).

This is the case when the wine is left unstirred on the yeast lees for several days.

For Mediterranean white and rosé wines, sulphite addition to the fermentation tank upon sugar depletion, and 24 hours before racking allows to:

- implement an efficient internal protection during a stage which is very prone to involuntary Venturi effects: the racking
- avoid the production of unpleasant sulphur odours by stirring the yeast twice: once during sulphite addition, and the second time during racking (for those, which have not sedimented).

For rosé wines, the reasons for oxidations during slow final stages of fermentations or during rackings are the same. However, the consequences are different: a loss of the vivid rose hues results, with appearance of more yellowish tones. The preventive measures are the same as for white wines.

**Regular addition of oxygen to red wines during ageing:**

- **Before and after malolactic fermentation**

As soon as the wine has been devatted, 5 factors have to be considered together for the further procedure since they strongly interfere with each other. It is not possible to consider only one of these factors without taking into account the others.

1. The wine polyphenol and polysaccharide composition, and the nature of the cap management
2. The wine yeast lees: their quantity but also their composition
3. Wine and yeast lees stirrings
4. The oak, when barrel ageing is carried out, and obviously
5. The oxygen

How can all these factors be managed and a practical line of action be defined for any wine type?

Certain procedures have organizational priority, notably the rackings.

Racking leads to oxygen additions and stirring of yeast.

When the racking program is planned, its impacts on other factors are assessed: oxygen and yeast stirring. Afterwards, a further addition can be envisaged, if the oxygen contribution through racking was not sufficient, or if the yeast were not sufficiently stirred.

Two examples:

**Example 1. A wine whose alcoholic fermentation finished during maceration.**

Devatting, pressing, and blending of the free-run and first pressings.

Completion of two rackings (24 hours and 72 after devatting) with aeration. Afterwards, inoculation with lactic acid bacteria in order to complete malolactic fermentation within 10 to 15 days after devatting.

Comments:

Since the wine takes up oxygen during the pumpings, dissolved oxygen is supplied twice in the 3 days following devatting. At this stage of the vinification, this practice is consistent with the elimination of large grape particles from the wine, the yeast residue, and the objective of avoiding vegetal aromas and sulphur odours. Normally, there is no need for further oxygen additions.

In wineries where such rackings are easier to perform in closed systems, 2 mg/l of oxygen have to be dissolved in the receiving tank instead, for example with a diffuser.

Afterwards, the fast implementation of the malolactic fermentation will maintain the yeast in solution thanks to the $CO_2$ produced by the bacteria.

Because of the oxygen additions made during maceration (compare first part), and then during the pre-MLF rackings, the wine polyphenolic system (polyphenols and polysaccharides) will be in such a state that it will continue its positive evolution during the 8 to 10 days of MLF at 20°C. The bacterial polysaccharides will also positively participate in the evolution of the system.

After malic acid depletion, a racking followed by a homogenous sulphite addition will establish appropriate microbiological stability and allow promoting the aromatic and gustative development of the wine.

Microoxygenation of the wine can be initiated at the time of inoculation with lactic acid bacteria for certain wines with very high polyphenol concentrations. For these wines, the regular stirring of the residual yeast cells (particularly with an immersed food grade pump) will allow to develop the polyphenol and polysaccharide system even better during MLF.

**Example 2. A short maceration (5 days at 26°C).**

Devatting, pressing, and blending of the free-run juice and first pressings at 5.1°Brix.

One aerated racking 24 hours after devatting. Completion of alcoholic fermentation at 24°C. Inoculation with lactic acid bacteria to complete MLF within two weeks following devatting.

Comments:

The two aerations caused by the devatting and the first racking have stirred up the yeasts and contributed dissolved oxygen twice; the grape sediments have equally been removed. However, during the 5 to 6 days required to complete alcoholic fermentation after devatting, the must does not receive additional oxygen. Thus, it is necessary to add 2 mg/l of oxygen daily, for example with a diffuser. If the diffuser is placed at the bottom of the tank, the addition will also positively contribute to yeast stirring.

As soon as the fermentation is complete, the wine is racked with aeration. 48 hours after this racking step, the wine is racked again and inoculated with lactic acid bacteria.

If these rackings are easier to perform with closed systems, approximately 2 mg/l of oxygen have to be added to the receiving tank every time, for example with a diffuser.

Such as the wine in example 1, this wine will progress in its positive aromatic and gustative evolution during the fast MLF, without oxygen additions or stirrings generally being necessary.

After the depletion of malic acid, the wine is racked and sulphite is added for the same reasons as given in example 1.

- **After the malolactic fermentation**

From this moment onwards, the wines have a fairly low particle load.
In fact, the very first racking after devatting has removed all grape sediments.
The following 2 rackings both remove part of the yeasts.
The post-MLF racking removes very few lactic acid bacteria because lactic acid bacteria sediment very poorly, but they constitute only a very small mass.

The wine always requires oxygen to proceed in the development of the polyphenolic and polysaccharide system. But the oxygen should not be added at similar amounts as during the previous stages.

Microoxygenation is an interesting tool for the purpose of adding small oxygen quantities regularly: Please refer to the experimental results, below.

The constraints and limitations of its utilization in Mediterranean red winemaking are now widely known: Dosage, height of the liquid column in the tank, temperature. Wines, which still contain significant amounts of yeast, have to be stirred regularly by other means (specifically an immersed pump).

During microoxygenation, the wine is developed homogeneously. But yeast are too heavy to be kept in solution through the weak flow caused by the microoxygenation.

During tank ageing, the regular stirring of the wine (especially with an agitator or an immersed pump) also allows to develop wines favourably, specifically those, which were well supplied with oxygen during maceration and before MLF.

In barrels, the method of reference is the batonnage (yeast less stirring).

The schedule is to be adapted according to the moment of barrel filling, and thus the quantity of yeasts still in suspension, the polyphenolic and polysaccharide structure of the wine, the age and quality of the barrels, and the desired integration of wine and oak.

An interesting result may serve as example:

New barrels, a perfectly matured Syrah produced by long maceration, barrelled 24 hours after draining and pressing (with all the yeast from the alcoholic fermentation but without grape particles), barrel MLF, post-MLF sulphite addition, batonnage (yeast lees stirring) once per week during 6 months, then batonnage twice monthly for another 6 months, with no rackings during the 12 months.

While certainly requiring a high workload and a special arrangement in the cellar (barrels limited to one level), in the end, an individual Mediterranean wine is obtained.

In this example, the 5 factors cited above (wine, yeast, oak, stirring, oxygen) have been combined in a particular way, while remaining consistent with certain market objectives.

An experimental demonstration

Corbières 1993 Study.

This initial study on microoxygenation performed by the ICV under winery conditions was carried out with a red Corbières wine (Carignan, Grenache, Syrah). The wine was equally distributed into two identical tanks and held at the same temperature (16°C). A 5 ml/l/month addition of oxygen was chosen for the microoxygenation treatment. After 3 months the wines were sampled and analysed.

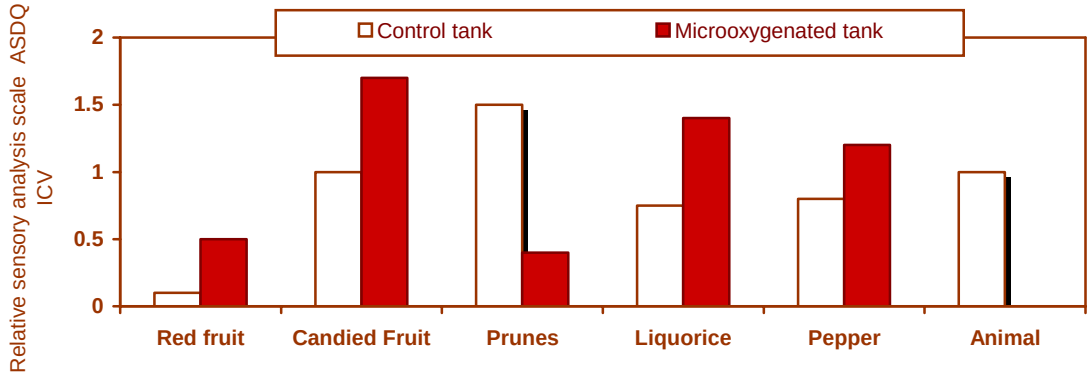


*Figure 1: Effect of microoxygenation on the aroma profile. Corbières 1993*

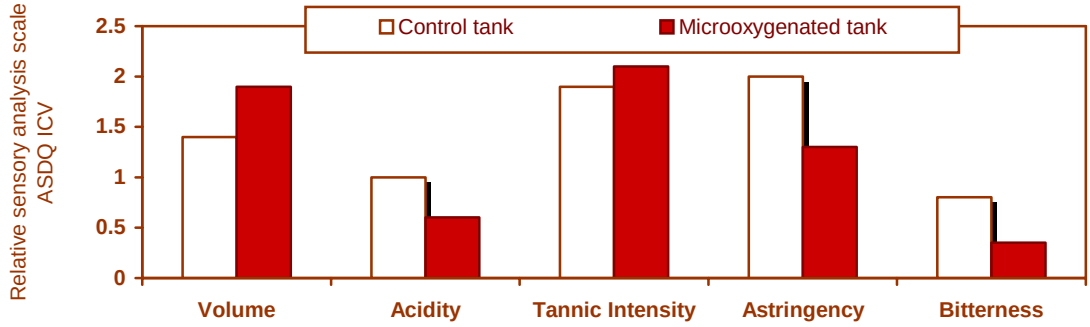


*Figure 2: Effect of microoxygenation on gustative profile. Corbières 1993*

*Experiments carried out by the ICV R&D department. Results published in "La Vigne", n°53, 1995*

**Comments**

The base wine had neither aromatic nor gustative faults. Microoxygenation allowed developing a more mature and concentrated aroma profile: candied fruit, liquorice and pepper. During these 3 months, without stirring or aeration, the control wine developed aromas reminiscent of a fast evolution, even over-ageing ("prune" descriptor dominant), and at the same time "reduced" aromas ("animal" descriptor). Please note that in the case of this wine, the predominant "animal" character is attributable to a lack of aroma expression and not to the development of *Brettanomyces* yeast. In the mouth, the microoxygenated wine has more volume and tannic strength, with tannins of better quality: "astringency" and "bitterness" were lower.

During this initial study in 1993, it was demonstrated that microoxygenation is an efficient and practical method to manage Mediterranean red wines.