Winemaking Chronicle

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Botrytis-altered grapes : Winemaking good practices for red wines

Example of a Popular Premium Cabernet Sauvignon for international markets

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Our vision

The demands of the markets vary a lot both in space and time and our job as consultants is to help the wineries answer and adapt to these demands through the application of our winemaking good practices with prices adapted to the price segments.

The good practices are the core of our vision as consultants. Our definition of good practices is: a set of techniques applied to the winemaking process to reach planned objectives of price x sensory profile x market objectives.

Our good practices are based on experience of experimentation and experience of consulting in many different vineyards and wineries throughout the world.

A practical example

This article is based on a practical protocol for a Cabernet Sauvignon wine (3-5€ FoB/bottle). This protocol is a recommendation for one of our consulting clients. They have applied it fir many years and obtained results conforming to their markets. Through slight adjustments, this example also works with other varieties and other market objectives.

On grapes that are usually planned for making Popular Premium wine but with a presence of a certain amount of Botrytis (max. 10-15% of contaminated berries), applying the following good practices allows to blend the resulting wine with the rest of the final commercial lot with no technical risks.

Contaminated zone and diffusion of the laccase: difference and similitudes

A long maceration and mechanical extractions applied to the Botrytis-contaminated zone of the berry extract a lot of the compounds produced by the fungus such as glucanes, gluconic acid, compounds which are already very oxidised, aromas and flavours of earth and fungus. The damages are generally proportional to the amount of contaminated berries, to the mechanical trituration and the duration of the maceration.

The laccase diffuses very well in all the mass of the harvest and in the must including when the damaged zones are not very triturated, not triturated for a long period of time. Its initial concentration is porportional to the amount of contaminated grapes but, like all other enzymes, it can have a strong action even at low concentration if it encounters substrates and favorable conditions of catalysis, in particular dissolved oxygen. Additionally the laccase will also oxidise compounds from sane berries.

To sum it up, with clusters with only 5-10% of contaminated berries you can end up with a wine completely oxidised IF you don't apply good practices for blocking the laccase.

Winemaking key-points for grapes altered by Botrytis cinerea

To be fast but efficient you should, firstly work with good practices, then make a list of key-points to be applied and lastly build a protocol upon these key-points.

Following are the key-points we used to build the protocol. For simple winery logic they are listed in chronological order.

The protocol built on these key-points is presented in the annex.

Key-point #1: Protect the grapes and the must against oxidations.
<u>Action plan:</u> Adjust the pH and add SO2 very early / Maintain Total SO2 at 30-40mg/L in the must until the clear start of alcoholic fermentation.

With these dosis, which are normal in making a varietal red wine, the SO2 effectively blocks the laccase. Between 30 and 35 mg/L of Total SO2 are enough, especially when the pH has been adjusted to 3,50 or less. Of course this Total SO2 must be present as soon as the first juices releases and it must be as homogenous as possible in all the mass of grapes and then in all the volume of pressed must.

With mechanical harvest the first additional SO2 and tartaric acid (for pH adjustment) should take place in the hopper of the harvest machine. With manual harvest the tartaric acid, the SO2, the ascorbic acid and the Glutastar are added on the grapes before destemming.

Of course with such a treatment we do not destroy the laccase. However if the laccase is kept blocked until its natural inactivation (by tannins, by the pH and with time) it will not cause major damage. The good practices of SO2-addition to block the laccase are also sufficient to block the oxidation chain-reactions by the oxidases of the grapes (tyrosinase) especially at pH lower than 3,50. This preserves certain varietal aromas and red pigments, interesting or their participation to the sensory profile of a Popular premium wine.

Key-point #2: Limit mechanical trituration and strong chemico-physical extractions
<u>Action plan:</u> add maceration enzymes/ Destem and crush /short maceration of 5 to 6 maximum / moderate temperature (24°C max.) / Work on pomace with delestages and avoid short and frequent remontages.

From many experiments started in the 1990's, it is obvious that the early addition of maceration enzymes is very interesting when facing Botrytis-contaminated grapes. With a short maceration at moderate temperature we can consider that the enzymes work nearly exclusively on the pulp of the berry and not directly on the damaged part of the grape -pulp cells being more easily attacked by maceration enzymes (such as Lallzyme EX-V) and the pulp being the zone least contaminated by the mycelium of Botrytis. For these reasons we consider that enzymes don't amplify the damages of the fungus. Enzymes weaken pulp cells and extract directly neutral polysaccharides (e.g. polygalacturonanes) that are fundamental in stabilising the colour. The weakening of the pulp cells allows for more efficient delestages to extract pigments, tannins and aromas from the sane part of the berry.

Destemming and crushing with a well-regulated equipment opens the berry and doesn't triturate particularly the exterior part where the mycelium and the damaged part are. This opening of the berry combined with the enzymes favours an early diffusion of the polysaccharides, pigments and hydrophilic tannins which are the most interesting compounds in the first steps of the maceration. All the while avoiding extraction from the contaminated part of the berry.

The moderate temperature helps better manage the alcoholic fermentation (A.F.) and extractions. Example : 2 days at 20°C followed by 2 to 4 days at 24°C with one delestage a day allow for a quick start of the fermentation which in turn allows to better manage the risks from the laccase. Further more moderate temperatures don't stress the yeast and give time to work the right number of days with relatively low alcohol. Early high levels of alcohol favour violent extractions from the contaminated zone of the grape resulting in wines with harsh tannins, more brown in their colour and aromas and flavours of earth and fungus. Not really what is expected in Popular Premium.

Delestages are very important on such grapes. They allow to work intensely on the right level of extraction of the most soluble elements in the sane part of the berry when the pomace is draining at the bottom of the tank. They also present less mechanical aggression on the damaged part of the berry compared to the more classical remontage. A well-realised delestage has this unique advantage that it eliminates the heavy lees present at the bottom of the buffer tank. With contaminated grapes, these lees contain vegetal particles with fungus mycelium and its negative compounds, potentially agglomerates of glucanes, particles of agglomerated colour that absorbs a lot of the interesting colour. You are better off eliminating all of this with each delestage.

Of course with such grapes we don't make cold soaking: firstly because the cost is not compatible with the price range of Popular Premium and secondly because this grapes are not recommended to let without active fermentation for several days.

Key-point #3 Absorb potential negative elements coming from the altered grapes.

Action plan: Add a specific inactivated yeast known for its specific absorbing properties (e.g. BoosterRouge or Optired) and oak fragments very early on (chips or 'rice grain')

In the context of a well-managed mechanical harvest one part (10g/hL) of the inactivated yeast can be added in the hoppers and transport bins. You normally want to add SO2 and the tartaric acid in the hopper of the harvester and the inactivated yeast in the transport bin.

When harvesting manually, in the hopper of the winery, add 30g/hL of Booster Rouge or OptiRed at the same time as the SO2 and the tartaric acid. When harvesting mechanically with the treatment during transport, add an additional 20g/hL of Booster Rouge in the hopper of the winery. It is important to have these inactivated yeast already mixed in during the pumping of the grapes in order for the grapes to reach the tank already protected and partially cured of some negative elements such as fungus aromas or oxidised tannins.

While filling the maceration tank with grapes protected, destemmed and crushed add fragments of oak (200g/hL of chips of "rice grain"). French oak with 'medium +' toasting (e.g. Odysé 210°C by TN Coopers) is the most efficient for this hard mission. The wood absorbs immediately negative elements of altered grapes and then proceeds to participate in stabilising the colloidal matrix of the wine and its longevity, by the release of its aromas and tannins.

Key-point #4: Apply specific fermentation good practices

Action plan: During the filling of the tank add directly an adapted yeast (e.g. strains Sensy or ICV-OKAY) after rehydration with a protector (e.g. GoFerm Protect Evolution) / Add immediately a last generation organic nutrient (such as O'Tropic) / When the cap is just formed inoculate with a selected lactic acid bacteria (e.g. ML Prime) / Keep the temperature under 22°C / At density 1060 add an organic nutrient (e.g. Fermaid O) / Add oxygen daily during active A.F. while still under the pomace cap.

With altered grapes it is quite obvious that a good management of the SO2 is fundamental for the longevity and the protection of the varietal aromas. As a consequence a hybrid strain of yeast that doesn't produce SO2 nor acetaldehyde is a key-point to obtain effective and stable SO2 during ageing. Furthermore, actions that ensure a very low metabolism of SO2 by *Saccharomyces* are very important: the right dosage of yeast (25 g/hL), rehydration with protection, a good nutrition from at the start with organic nutrient. All of this helps in a rapid start of A.F. and helps avoid an excessive production of sulphur compounds. With the added risks of fungus and earth aromas coming from Botrytis, it is fundamental to manage correctly the sulphur 'pool ' of the wine. Direct inoculation of a selected yeast with a good rehydration is essential in this protocol since selected yeasts have a high content in stress-resistance factors which, in turn, will help ensure a regular and complete A.F., obtain a better expression of varietal aromas and obtain a good balance of the sulphur 'pool'. Any process of multiplication in the winery before inoculation dilutes these resistance factors and will result in wine less clean, less sound, with less varietal aromas and less longevity.

A nutrient such as O'Tropic added at the beginning of A.F. helps enhance and stabilise fruity-fresh and mineral varietal aromas which is the best we can hope to achieve with altered grapes.

Since 2000 it is clear that malolactic fermentation (M.L.F.) with coinoculation is an advantage with such grapes and the objective of fruity aromas of the Popular Premium segment since we obtain an earlier M.L.F. and more fresh fruit aromas.

Recently the ML Prime bacteria has added another dimension to this step: great effectiveness, a more directly fruity style and an easier management of the SO2, as we will see later. ML Prime is a *Lactobacillus*. It only works in coinoculation. You want to add just has the cap has formed. ML Prime ferments the malic acid at the same time the yeast is doing the A.F. and more than 99% of its population dies as soon as the malic is consumed. When the sugars are consumed malic acid is consumed and there is close to no live ML Prime cells alive.

As a consequence, SO2 can be added immediately after the end of sugars with a lower dosage compared to when there is a great population of *Oenococcus* to kill. This way the blocking of the laccase is continuous and with less SO2. Of course this is even better with the objective of a fruity style in Popular Premium and the stabilisation of the lower amount of colour extracted.

Once the A.F. is active (easy sensible indicator: the cap is completely formed) we can add oxygen to the must. The amount depends on the concentration in polyphenols and the colour of the fermenting must. For security and safety, a addition of 3-4 mg/L of pure oxygen with a macro-oxygenator will stabilise the colour from sane grapes, will help the yeast and will help manage the sulphur 'pool' of the wine, the same way it does with sane grapes. During the active A.F. all the positive points of oxygenation are in effect and there is no risk of damages at the recommended concentrations.

Key-point #5: Apply specific ageing and storing good practices

Action plan:

1. After a test for oxidasic breakdown, drain after 4-6 days total of maceration / Add a specific yeast with chelated copper (Reduless at 2 g/hL) / Protect from oxygen

2. Adjust the temperature of the must to 20°C until the sugars are consumed / Test for oxidasic breakdown and rack the next day [Racking #1]

3. Keep the temperature at 20°C / Add staves (200 g/hL French oak toasting medium +)

4. When sugars are finished check that ML Prime has consumed all of the malic acid / Add 1g/hL Reduless / Adjust the pH at 3,50 if necessary and add 4 g/hL SO2 / Rack the next day [Racking #2] protecting from oxygen / Cool down to 10-12°C and add an ageing inactivated yeast (e.g. Noblesse at 10 g/hL)

5. Keep the temperature at 10-12°C and the molecular SO2 at 0,7 mg/L for 10-15 days under protection of oxygen.

6. Test for oxidasic breakdown and rack again [Racking #3]

7. Keep the temperature at 10-12°C and the molecular SO2 at 0,7 mg/L / Add an ageing inactivated yeast (e.g. Noblesse at 10 g/hL) / Add 1g/hL Reduless and the staves remains with the wine. / Let the wine in this tank for 15-20 days.

8. Test for oxidasic breakdown and prepare for tangential filtration / Normally at this point the laccase is deactivated and did no discernible damage to the wine.

9. After the filtration add 1 g/hL Reduless, an ageing inactivated yeast (e.g. Noblesse at 20 g /hL) , new staves (100 g/hL French oak, toasting medium +). Keep temperature at 10-12°C, Molecular SO2 at 0,7 mg/L, one agitation a month. From this point on the wine can be blended without problem with wine made from sane grapes.

The goal of this whole action plan is to manage what laccase could potentially still be active, to manage the stability of the green colour, to manage the development of the fruity varietal aromas needed for this segment of price and avoid the development of sulfur-like off-smells and off-tastes and the development of aromas and flavours of earth and fungus.

The rackings and the filtration are here to eliminate the heavy lees that absorb a lot of colour and bring potential aromas and flavours of earth and fungus. Similarly, small particles of already unstable colour can potentially absorb a lot already stable colour. These are the reason we want to reach rapidly a low turbidity in the wine. Later we compensate by adding Noblesse. Wineries equipped with a centrifuge can centrifuge the wine between the points 6 and 7 of the action plan. Potentially another centrifugation can be done before the tangential filtration. Well-managed centrifugations help secure a good final result. If the wine remains hard to filter make trials with beta-glucanase enzymes (such as lallzyme Process Glucan).

Thanks to all the specific work of ML Prime, we can manage very early the adjustment of pH, the earlier first addition of SO2 after the draining, the adjustment of temperature, the additions of inactivated yeasts, all of which are key points for the control and stability of microbial florae, of colour, of the sensory cleanliness of the wine, of the SO2 and for the management of the laccase risks. All of this combined with a relatively low dosage of SO2.

Fractioned additions of Reduless, the first one at the same time as the draining of the liquid part of the wine, allow to work on the pool of sulphur compounds slowly and in real-time for a clean, sound one with good longevity and the right expression of its varietal aroma.

Fractioned additions of ageing inactivated yeasts such as Noblesse allow to absorb negative elements of the wine before they settle into the wine (unstable colour, earthy aromas, herbaceous aromas, drying and bitter tannins). These additions also build the colloidal matrix step by step with additional liberation of macromolecules. Considering that the maceration has been shortened, we want to compensate a lower concentration in grape polysaccharides with more macromolecules of specific yeast. All of this is very important to clean the wine of potential problems and stabilise the red colour and the varietal fruity aromas.

The oak staves that follow the wine from the start of A.F. allow to remove step by step the negative elements of the wine (see above) through the sponge effect of the wood. Using specifically staves rather than smaller fractions of oak allow for a progressive adjustment of the fruity aromas and the mouthfeel and tannic structure of the wine. In the situation of a wine weaken by the contamination by *Botrytis,* it is even more important.