Winemaking Chronicle

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Botrytis-altered grapes : Winemaking good practices for red wines with thermovinification

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. 15-20 % 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.

In wineries with the right equipment, working on these grapes with the thermo or thermo-flash is an obvious benefit.

Contaminated zone and diffusion of the laccase: difference and similitudes

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. Since each winery works in their own specific ways, each one with a different equipment for thermo, we will limit ourselves here to main common aspects.

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

Key-point #1: Inactivate the laccase

Action plan: Reach 60°C in all the mass of the grapes the fastest possible

The laccase is completely deactivated after 60 seconds at 60°C. At the working scale of a winery we can consider 'immediately' when the grapes reach 60°C. There is no need to go higher. This also saves on the heating energy.

Another characteristic of the laccase, its optimal temperature of action is 55°C. Hence the advise of reaching the most rapidly possible 60°C and in doing so limit as much as possible the time spent at this temperature of maximum activity. From the moment the grapes reach 60°C there is no more laccase in the must or the grapes. The different thermo or thermo-flash industrial equipment available have varying efficiency in the speed at which they heat the grapes and must: this is a key-point in choosing your equipment.

However keep in mind that damages done before the treatment will remain in a form or another.

Key-point #2: Benefit from the work of enological enzymatic complexes

Action plan: Add an enzymatic complex (e.g. Lallzyme Thermo) on the grapes before destemming and crushing and make sure its reaches its best efficiency.

Since the 1990's, studies have shown that working with a maximum temperature of 68°C or below allows to benefit from the pectinase, cellulase, hemicellulase, activities of certain specific enological enzymes (e.g. Lallzyme Thermo).

These enzymatic actions release rapidly the polysaccharides from the grapes (polygalacturonanes for instance) that are very stable and are key-points in stabilising the colour. The stability of the colour is of course one of the challenges of the thermo.

The weakening of the structure of the pulp also helps towards the effectiveness of the temperature-induced extractions. This is why it is not necessary to raise the temperature higher than 68°C. Additionally there is less creation of grapes *purée* and less filtration issues with the finished wine.

Summary: to inactivate the laccase and benefit from enzymatic actions we want to work between 60°C and 68°C.

An efficient dosage of enzymes also hydrolyses the pectins of the extracted must. When there is a buffer tank before the thermic treatment, a test for pectins allows to see if the enzymes are already hydrolysed which is an indicator that we already have liberation of polysaccharides and that the weakening of the pulp is finished or well-advanced. The enzymes having completed their first action, we can start with the thermic treatment.

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.

Key-point #3: Before the thermic treatment protect the grapes and the must against oxidations.

Action plan: Adjust the pH and add SO2 very early / Maintain Total SO2 at 30-40mg/L in the must until the passage in the thermo.

As said above, a well-managed thermo guarantees the deactivation of the laccase. However, before the grapes reach the thermo installation, we must limit the damages from the laccase. To do this, the normal dosage in making a varietal red wine, between 30 and 35 mg/L of Total SO2, is 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, it is only blocked. 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. Until the grapes reach the thermo, this preserves certain varietal aromas and red pigments, interesting or their participation to the sensory profile of a Popular premium wine.

Key-point #4 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 a situation of pressed thermo-treated must or in that of fermentation of thermo-treated pomace, inactivated yeasts and oak fragments must be added immediately to the fermentation tank.

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.

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 cooked aromas from the thermo. It 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 #5: 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 fermentation is started and active or when the cap is formed (thermo-treated pomace) 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 in active fermentation.

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 it just has the cap has formed or just as you see active fermentation. Note: the strains of yeast Persy and ICV-Okay are favorable to the coinoculation.

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. 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; and of course with the demand of wines with less SO2 this and additional advantage.

Once the A.F. is active 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 5-6 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 #6: Apply specific ageing and storing good practices

Action plan: To simplify this article we consider the more classical fermentation of pressed must).

1. 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 #1] protecting from oxygen and centrifugate / Cool down to 10-12°C and add an ageing inactivated yeast (e.g. Noblesse at 10 g/hL)

2. Keep the temperature at 10-12°C, the pH under 3,50 and the molecular SO2 at 0,7 mg/L for 10-15 days / Possible micro-oxygenation at 2-3 mg/L/month / After 10-15 days , centrifugate again and do a tangential filtration.

3. 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, either by thermo or classical maceration.

The goal of this whole action plan is to manage the laccase, to manage the stability of the red 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, fungus and cooked/burned jam.

The rackings, the centrifugations 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 that wish to make a fruity Popular Premium must be equipped with the necessary centrifuges and filters. Otherwise it is very difficult to build a clean, fruity and stable wine. 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. Here 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 added to the wine after its filtration allow to remove step by step the negative elements of the wine (see above) through the 'sponge effect' of the wood. Using specifically staves for their bigger size 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.