Management of various vineyard-derived moulds during winemaking

During the past two vintages, Institute staff have had many discussions with winemakers concerning the management of, or minimization of the loss of wine quality caused by, various moulds. The author has also discussed these issues with leading winemaking consultants and overseas winemakers, and as a result of these discussions the following is a synopsis of the theory behind the management of this problem. While much of the advice contained here is anecdotal, the Institute has received positive feedback from a number of winemakers who have put the advice into practice. The author would also welcome any extra information regarding other techniques that have been found to be of use in minimizing the damage caused by mould.

Powdery mildew

Many winemakers consider that the taint caused by powdery mildew in white wine results from the mycelium of the fungus itself, and thus the advice for minimizing taint is based on minimizing the quantity of the mycelium in the juice. The application of a high pressure, high volume water spray in the vineyard the day before harvest, assuming that the weather conditions are such that this will not cause other mould problems, is reported by some winemakers as having a positive effect in minimizing the concentration of mycelium.

Whole bunch pressing of mould-affected white fruit seems to be an established practice in parts of Europe and this is a strategy that some winemakers have reported as useful in minimizing powdery mildew taint. The first approximately 150 L of juice per tonne is often kept separate and is assessed for level of taint. Some feedback suggests that this portion of juice is often far more taint-affected than further pressing fractions, possibly because it contains the greatest concentration of mycelium, and by adopting this strategy winemakers have the option to blend this juice into a lower value product.

Juice from powdery mildew-affected fruit should then be cold settled at the lowest temperature possible to achieve rapid settling, and pectolytic enzymes should be used. Some winemakers have reported that adding a higher concentration of enzyme than usual aids taint minimization, but the Institute would caution against using enzymes in concentration other than that recommended by the manufacturer. By general consensus there is no advantage in adding bentonite at this stage. Rather, post-settling the juice should be racked, and the heavy lees discarded or otherwise treated if heavily tainted, and between 0.5 and 1 g/L bentonite should then be added to the racked juice. After 24 h the juice should then be racked off the bentonite lees before fermentation is initiated.

Penicillium

During the 2000 vintage a winery contacted the Institute and reported an unusual situation, in that it had a serious infection of white *Penicillium* mould without any *Botrytis cinerea* being present. Clearly this situation is more common in parts of Europe, where the advice for minimizing or removing *Penicillium* taint from juice is to fine with between 0.2 and 1 g/L deodorising carbon, followed by 0.01 g/L gelatine to settle the carbon. The juice should then be racked off these lees before fermentation is initiated. While some winemakers also advocate the use of bentonite, an Austrian winemaker who has experience with this problem, who was also working in Australia during the 2000 vintage, was adamant that bentonite has no effect on removing *Penicillium* taint from either juice or wine.

Botrytis cinerea

By far the largest numbers of inquiries received by the Institute concerning moulds relate to red fruit infected with *Botrytis cinerea* (botrytis). Relatively few calls relate to botrytis in white fruit and this is one area where the author would welcome feedback. While the fining of white juice in a manner similar to that described for powdery mildew appears to be common, the advice given below regarding the exclusion of oxygen to minimize oxidative damage caused by laccase also applies. Thus when attempting to minimize taint by fining, winemakers should also aim for rapid commencement of fermentation in order to minimize oxidative damage.

There are two winemaking issues related to botrytis-affected red fruit, namely the taint that may be caused and the control of the laccase enzyme, and the following discussion will focus on the second of these issues. While feedback relating to the minimization or removal of botrytis taint from red must or wine would be welcome, the author feels that application of the principles outlined here forms the basis of minimizing laccase damage and taint.

The level of oxidative damage or taint caused by botrytis appears to differ according to the physiological stage of the botrytis when the fruit is harvested. While individual winemakers have differing opinions as to the physiological stage at which the greatest loss of wine quality occurs, there appears to be some consensus that the greatest laccase activity is at the point when fresh 'furry' mould growth with a high number of visible spores is present.

Minimizing the quantity of mould-affected fruit is obviously beneficial, but can be difficult to achieve in practice. Prior to machine harvesting, sending hand-pickers through the vineyard to remove the worst affected fruit is one option, and some callers have also reported that in some situations machine harvesters will shake-out many botrytis-affected berries from vines in front of the harvester, before the healthy fruit is picked. Feedback received indicates that this strategy has been used successfully in vineyards that are normally hand picked. Whilst the hand sorting of fruit prior to crushing is relatively common in parts of Europe, it is clearly not a viable option in most Australian situations. Encouraging hand-pickers, however, to discard the most badly affected fruit is desirable.

At all stages when handling botrytis-affected fruit, is important to consider that the laccase enzyme can only cause oxidative damage when oxygen is present and it is, therefore, imperative to minimize oxygen pick-up wherever possible. It is also important to remember that a relatively high concentration of sulfur dioxide (SO_2) will have little effect on the activity of laccase. The author does advocate, however, the addition of between 40 and 80 mg/L of SO_2 (in the form of potassium metabisulfite) to botrytis affected fruit, on the basis that a higher than normal population of other unwanted microorganisms is likely to be present when botrytis is present.

The exclusion of oxygen pre- and post-crushing will be aided by the use of dry ice, and by ensuring that the onset of fermentation is rapid. Larger than normal yeast additions should be used and the yeast should be added as early as possible. If SO_2 has been added at the higher end of the rates recommended above, it might be advisable to add a small yeast addition as a 'sacrificial' culture, a few minutes before the bulk of the yeast is added. The sacrificial culture will have the effect of binding much of the free SO_2.

There is strong anecdotal evidence that the addition of oenological tannin during fermentation reduces the damage caused by laccase. If this is the case, the author considers that the beneficial effect is more likely to be due a simple fining reaction, than to deactivation of the enzyme. Whilst it does appear that the addition of some tannin will be beneficial in

most cases, winemakers should also be aware that the addition of tannin may cause a marked change in their wine style, especially at addition rates of up to 500 mg/L, which have reportably been advocated by some tannin suppliers.

Most winemakers choose to ferment botrytis-affected fruit in static rather than rotary fermenters for two reasons. Firstly to minimize the 'macerated mouldy skins' character that is often associated with wines made from botrytis-affected fruit and also because it is easier to remove the fermentation lees when pressing, which is reported to be beneficial. On the negative side, it is easier to exclude oxygen in a rotary rather than static fermenter.

There is also anecdotal evidence that there is more laccase activity in the lees than in the fermenting wine towards the end of fermentation, and this could be considered logical if the 'tannin fining' argument is accepted. Even if no tannin is added, then it is still possible that phenolic compounds from the grapes could cause the precipitation of some laccase during fermentation and it is, therefore, recommended that fermentation lees be separated from the wine as quickly as possible at pressing. If it is possible to drain lees from the fermenter or leave the lees behind in the fermenter when the wine and skins are removed, then this should be done.

Pressing should take place while carbon dioxide (CO_2) is still being actively produced, which in many cases will result in a shorter fermentation than usual. It is, therefore, important to manage the fermentation in order to obtain the required level of extraction during this shorter fermentation time. While fermentation management techniques that cause excessive aeration should be avoided, the oxygen dissolved during a standard pump-over of actively fermenting must will quickly be consumed by yeast, rather than causing oxidation via laccase. Thus pressing when fermentation is still active has the dual advantages of the discouragement of the ingress of oxygen by the CO_2 coming out of solution, and the still-active yeast being able scavenge any oxygen that may be dissolved.

At pressing, wine should be pumped to tanks, not barrels, and inert gas cover will again aid the exclusion of oxygen. The wine should then be racked off gross lees after 24 h, again into tank with inert gas cover, and laccase activity should be tested at this stage. Further racking can be beneficial in order to remove all fermentation lees, and winemakers applying these techniques have reported a gradual reduction in laccase activity as wines are allowed to settle and the lees removed, even in wines made from fruit which had a high level of laccase activity.

If laccase activity is still detected in the wine after several rackings, heating of the wine is advisable, and feedback suggests that this can be performed without an immediately apparent loss of wine quality. While a loss of wine quality due to heating may be a reasonable concern, however, a much greater quality loss will almost certainly result if the laccase present is not deactivated.

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