

Controlling *Brettanomyces* during winemaking



Introduction

Brettanomyces is a yeast commonly found in wineries, which has the potential to cause significant spoilage in wines through the production of volatile phenol compounds. These compounds, in particular 4-ethylphenol (4EP), 4-ethylguaiacol (4EG) and 4-ethylcatechol (4EC), are associated with undesirable sensory characters such as 'Band-Aid', 'medicinal', 'horsy', and 'barnyard', which are collectively often known as 'Brett' character. Because *Brettanomyces* can be found across all Australian wine regions, and can cause such negative sensory effects, it is sensible for all wineries to have a control strategy in place, even if Brett spoilage problems have not been experienced in the past. Steps taken to control Brett are also likely to have additional positive consequences in avoiding other microbiological spoilage, volatile acidity (VA) and general wine instability problems.

The growth of *Brettanomyces* in wine is affected by a range of factors, some of which are interlinked. This means that controlling Brett requires a multi-faceted approach. If just one factor is addressed in isolation, it is unlikely to be successful. However, if action is taken on all or most of the factors discussed the risk of Brett spoilage should be greatly reduced. Key factors in a Brett control strategy are outlined below.

General sanitation

Cleaning and sanitation in the winery are extremely important in controlling a range of microbial spoilage problems, by helping to prevent the build-up of unwanted yeast, bacteria or moulds. During vintage, care should be taken to ensure that crushers, presses and must lines are cleaned and sanitised regularly (at least daily), so that populations of unwanted microorganisms can be kept to a minimum. Keeping processing

equipment clean will also help prevent the accumulation of organic material, which can harbour microorganisms.

Tanks and barrels should also be cleaned regularly to prevent microbial cross-contamination when wines are transferred within the winery. Additionally, the microbial status of any wines or barrels entering the winery, and the 4EP/4EG concentrations of the wines, including those intended for topping, should be ascertained.

Residual sugar

Brettanomyces growth is strongly favoured by the presence of residual sugar in wine. Optimising the success of primary fermentation is therefore an important part of a Brett prevention strategy. The simplest ways to minimise residual sugar in red wine are to:

- have the strongest yeast starter culture possible by following supplier recommendations – especially with high sugar musts
- aerate the fermentation when it is most active – conduct at least one aerative racking, or rack and return
- avoid temperature shock of yeast when pressing – aim to keep wines within two degrees of fermenter temperature for at least twelve hours during and after pressing.

It is also important to check residual sugar levels in red wines using an enzymatic assay, rather than assuming that primary fermentation is complete.

Sulfur dioxide (SO₂)

SO₂ is a very important wine additive, both in preventing microbial spoilage and in

minimising wine oxidation and promoting wine longevity. Simply adding more SO₂ is not necessarily the best way to control Brett, although in some cases this is appropriate. Rather, it is better to use SO₂ in a way that is most effective. A more detailed discussion of SO₂ use in winemaking can be found in Robinson and Godden (2003); however, there are some simple principles that can be applied to minimise the risk of Brett spoilage.

- To dramatically reduce the probability of microbiological problems, add some SO₂ at the crusher. Note that this may eliminate all yeast and bacteria, which might result in the need to inoculate for malolactic fermentation (MLF).
- When adding SO₂ to wine, remember that only about 35 to 40% is yielded as free SO₂ (the component that has antimicrobial activity) – so add enough to make a difference. One large addition is much more effective than several small additions.
- Don't forget about the relationship between free SO₂ and pH. The higher the pH of wine, the more SO₂ is needed to achieve the same antimicrobial effect.
- Wine is particularly vulnerable to microbiological spoilage during MLF, so it is a good idea to make a big SO₂ addition as soon as MLF is completed – and to do everything possible to help MLF go through quickly.
- SO₂ is less effective when added to wines with high turbidity. This doesn't mean that SO₂ shouldn't be added to hazy wines, but if it is, more will be needed to have the same effect. It also means that working to maintain

low turbidity throughout wine maturation will reap benefits.

- The ratio of free to total SO₂ is a useful winemaking tool and is worth monitoring. A decrease in this ratio indicates that free SO₂ is being lost or bound to other wine components, and if this occurs, the reasons should be investigated.

During even the most careful transfer of a wine, 5 mg /L of free SO₂ can be lost.

pH

Brettanomyces growth is favoured by high pH; however, this is predominantly due to the relationship between pH and SO₂ effectiveness. At the end of MLF, wines are usually at their highest pH and lowest SO₂ concentration, which makes this a critical time for potential *Brettanomyces* growth and wine spoilage. It is recommended that winemakers clarify red wines and make a single large SO₂ addition as soon as possible after MLF, rather than a series of smaller additions.

Barrel sanitation

While barrel sanitation should be an important component of any Brett control strategy, it is crucial to remember that barrel sanitation alone will not solve a Brett problem. Additionally, any effort put into barrel sanitation will be wasted if the barrels are re-contaminated with wine containing a high population of *Brettanomyces* yeast.

A wide range of barrel sanitation methods are used in wineries around the world, including: cold and hot water rinses, filling with SO₂ solutions, steam cleaning, ozone, ultrasonics, microwaves and even blasting with particles of dry ice.

To remediate known contaminated barrels the AWRI recommends hot water as the most effective and practical sanitation method; that is, filling barrels with hot water of at least 70°C and leaving it in the barrels for at least 30 minutes, or 85°C water for at least 15 minutes (Coulter et al. 2003), ideally until the outside of the barrel is hot to touch. The hot water may be reused to sanitise other barrels, although caution should be exercised with pumping hot water, due to the possible negative effects on pump stators and hoses. For these reasons, it may be better to transfer the water using a syphon and gravity.

Barrel topping

The wine used for topping barrels can be a potential source of *Brettanomyces* and other microbiological contamination. It is commonly poorly stored – often on ullage and without adequate SO₂. Simple steps taken to ensure that topping wine is stored carefully, at low temperature and without ullage, and is maintained at a suitable level of SO₂ to prevent microbial growth, could prevent widespread wine contamination. Storing topping wine at elevated SO₂ concentrations can be beneficial, because when used for topping it helps control the growth of film-forming microorganisms in barrels.

New barrels vs old barrels

While it might be commonly assumed that older barrels pose greater risk, due to the possibility of *Brettanomyces* yeast having become established in the old wood, it should be remembered that all other things being equal, wine stored in new barrels will lose SO₂ faster than wine stored in older barrels. This factor should be taken into account for wine going into new barrels, or recently cleaned barrels, to ensure that SO₂

concentrations are maintained at high enough levels to inhibit microbial growth.

Filtration and clarification

Wines with high turbidity are generally at a higher risk of microbial spoilage (including Brett) than those with lower turbidity. This is due, at least in part, to the influence of high turbidity on SO₂ effectiveness. It is important, when confronted with a hazy wine, to determine what components make up the haze, rather than simply to assume that the haze is benign in nature. If a haze is found to contain viable microorganisms, then filtration of the wine before bottling is highly recommended. While some winemakers seem hesitant to filter red wines, it is the AWRI's position that a well performed filtration of the appropriate grade is a much better option than taking the risk of post-bottling microbial spoilage.

Other treatments and monitoring options

While the prevention of *Brettanomyces* infection by combining the strategies discussed here has been shown to be highly effective and is strongly recommended, some other treatments for Brett are also available. Chemical treatments that aim to reduce or eliminate viable Brett cells include sorbic acid, chitosan and dimethyl decarbonate (DMDC), which may be most useful when use immediately prior to pre-bottling filtration.

Traditionally, microbiological plating has been used to positively detect and quantify the presence of viable cells but this has now been largely replaced by commercial systems based on DNA detection. These systems can detect and quantify the presence of *Brettanomyces* cells before the

concentration of volatiles has risen above the sensory threshold, and therefore have an advantage over after-the-fact detection by sensory evaluation.

Silicon dioxide and activated carbon have been shown to have some ability to remove *Brettanomyces*-derived volatiles from wine when used as fining agents, although their effectiveness and the dose required may vary between wines. Fining trials are therefore recommended.

By far the most effective method of removing *Brettanomyces*-derived volatiles is reverse osmosis (RO). Mobile RO services are available in most Australian wine production regions. It has been reported that up to 7% of 4-ethylphenol can be removed with each pass of a wine through a RO machine, but care should be exercised because positive volatiles might also be removed, particularly with repeated passes. It is therefore recommended that wine is repeatedly sensorially assessed during RO treatment, and that samples are taken periodically for comparative purposes as the treatment progresses.

In most cases, fining or RO will not reduce the concentration of *Brettanomyces*-derived volatiles to the point where they are no longer sensorially detectable, but may reduce them to the point where it is possible to blend the wine so that the *Brettanomyces* character is no longer obvious. It has also been shown that the perception of *Brettanomyces* volatiles may be masked by other characters found in wine, such as oak volatiles.

More information these chemical treatments, monitoring systems, fining and RO can be found in the [Brett FAQ page](#) on the AWRI website.

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