Making water additions to high sugar must

In February, the Australia New Zealand Food Standards Code (FSC) was amended to allow limited addition of water to high sugar must and juice to reduce the chance of fermentation problems. Previously, water had not been allowed as a direct additive to grape juice, must or wine, with a maximum (cumulative) addition of 70 mL/L water allowable only for the incorporation of permitted additives or processing aids during the winemaking process.

Under the new amendment, water may be added to juice or must prior to fermentation to reduce the sugar level to no less than 13.5°Baumé (Bé) (equivalent to 24.3°Brix). This means that the amount of water allowed depends on the initial sugar level of the juice or must. Note that 'must' is defined as freshly pressed grape juice that contains the pulp, skins, seeds, and stems and that has not begun any fermentation. An additional 70 mL/L (7%) of water can then also be added during winemaking to incorporate any required additions.

Calculating water additions

While the change to the FSC seems relatively simple, calculating how much water to add to bring a must down to a certain Baumé level takes a bit of thought. This is because the common measures of sugar levels in juice (Baume or Brix) are actually measures of density rather than sugar concentration, and the relationship between density and g/L sugar is not linear. To make this process as simple as possible for Australian winemakers, the AWRI has developed a water addition calculator which is being added to the AWRI Winemaking Calculators app and will also be available from the calculators page on the AWRI website at https://www.awri.com.au/industry_support/winemaking_resources/calculators/. The calculator is expected to be available in early April. The calculator has been based on algorithms commonly used by fruit juice companies to dilute fresh juice for fruit juice products.

For example, using the calculator, an expected typical dilution of a must from say 15 to 13.5°Bé would be achieved through an 11% dilution (by volume) with water. A further dilution of this batch of fruit with an additional 70 mL/L (7%) of water during winemaking additions would result in a final maximum dilution of around 18% by volume.

Dilutions of red must can be slightly more difficult to calculate than those of clarified white juice due to the presence of whole berries, solids and possibly whole bunches including stalks. Red grape must is usually measured by mass, with different extraction volumes possible. The calculator has thus been designed to allow different expected extraction rates to be specified, resulting in more accurate calculations of required water additions; however, each batch of

fruit will still vary in its solid to liquid proportions. Shrivelled fruit in hot vintages, with lower juice to weight ratios, and more sugar within berry skins that is not extracted until fermentation gets underway will affect these calculations. Winemakers are thus urged to use caution, or incorporate an error margin in their calculations, to ensure that must is not over-diluted by mistake below the legal level of 13.5°Bé. Estimation of the potential alcohol in these diluted musts may also be more accurately determined by measuring the glucose + fructose concentration of the diluted must.

Choosing the right water

When considering adding water to a high sugar must, it's important to think about the type of water available for use and what else might be added to the must along with the water. The common types of water used in wineries include rainwater, mains/potable water, water from boilers or treated river water. Bore water is not generally recommended for human consumption.

Mains/potable water is often treated with chlorine, chlorine dioxide, chloramines, ozone and hydrogen peroxide, combinations of these and other minor disinfectants. Chlorination is commonly used in metropolitan areas and chloramines (chlorine derivatives of ammonia, mainly monochloramines) are more commonly used in regional areas and where the water has longer to travel. Information about the disinfectants and levels used in local mains water can be sourced from the local water authority or water treatment plant. For example, South Australian water quality summaries at different locations can be obtained from the SA Water website: http://www.sawater.com.au/community-and-environment/water-quality/in-your-area-whats-in-your-water. Chlorine-containing disinfectants have potential to introduce chlorine-like or chlorophenol taints into treated must and can also affect yeast viability.

Rainwater is not treated with chlorine-containing compounds and as such is ideal for use in additions to musts. However, since most wineries are unlikely to have the volumes of rainwater required for must dilution, mains/potable water is the next best option, but it should be treated if required to remove chlorine/chloramines before use to minimise risks of fermentation problems and/or chlorine-related taints.

Brewers typically treat the water used in beer production to reduce chlorine levels down to <1 mg/L to prevent chlorine-related taints. Normal ranges of total chlorines in mains water are between 0.5 and 1.5 mg/L (maximum <5 mg/L) (Australian Drinking Water Guidelines 2011).

Chlorine present in water may dissipate in a holding tank overnight, while chloramines are more stable and can persist for several weeks. Monochloramines are typically removed by addition of chlorine, with subsequent removal of free chlorine, but this process is likely to be cumbersome for wineries to achieve. Thus, chlorine and chloramines are best removed from water using carbon filtration. Reverse osmosis, sparging or boiling water are also options. Sodium thiosulfate can be used to dechlorinate tap water for use in aquariums and swimming pools but is not recommended for water intended for consumption.

Risks of adding water to must

Aside from the risk of introducing chlorine-related taints to musts and wines, there are some other risks associated with water additions that should be considered. If the water used to make the addition contains some other kind of taint this could be transferred to the must and the resulting wine. Stored water supplies may develop geosmin and 2-methylisoborneol taints, which are responsible for 'earthy' or 'musty' characters. Geosmin taint present in water used to push wine through hoses has been known to cross contaminate wines with this aroma. Water aroma should therefore be assessed before its addition to musts.

The salt content of any water to be used for must additions should also be taken into account, given that water sources across Australia vary in their hardness. Hard water contains high levels of calcium and magnesium salts and can cause scale build-up on tanks or could introduce higher levels of calcium into must. Water can be softened by water treatment plants but this can then lead to higher levels of sodium and chloride that may increase levels of these components in wine. Water that is too soft, such as water treated by reverse osmosis, can also become corrosive, with potential to damage pipes and fittings. Corrosiveness (commonly measured by the Langelier index) is reduced by increasing calcium carbonate concentration. Wineries should therefore be aware of the potential for adding calcium, magnesium, sodium and chloride to musts through water additions and monitor their concentrations to ensure compliance with maximum export levels for these elements. They should also be aware of the potential risk of calcium instabilities from increased calcium levels.

Finally, winemakers should remember that water additions will dilute nutrients and acidity of must. Bench trials have shown that a typical level of dilution such as the example above (dilution of a must from 15 to 13.5°Bé, or an 11% dilution) may not change the pH level, but would reduce the concentration of other wine components such as tartaric acid, malic acid, overall titratable acidity, and nutrient levels such as ammonia and yeast assimilable nitrogen (YAN) by around 8–10%. Winemakers are thus advised to measure the Baume, pH, titratable acidity, YAN and malic acid concentration after the water addition has been

made to obtain an initial set of parameters pre-fermentation. These values can then be used to determine any required additions that need to be made. There will be a temptation to add tartaric acid or nutrient additions based on the initial grape parameters but after dilution these additions may need to be revised.

Lastly, some simple logistics should be remembered. It's important to ensure that the tank containing the juice or must has sufficient capacity to take the extra volume of water addition plus a sufficient ullage to allow for fermentation. Water additions can be made by measuring tank dips pre- and post-water addition or by flow meters if available. The juice and water also will require adequate mixing before any measurements and before fermentation to ensure there is no stratification in the tank. Addition of water to must means that the water added should be treated as a food product and thus added through food grade hoses and not added by way of existing water hoses already connected that may be used in the winery for other purposes, such as cleaning.

Effects of water additions on wine composition

AWRI researchers are undertaking a project in vintage 2017 to investigate chemical and sensory effects of a range of dilution treatments in Shiraz must. The trial will look at the effects on colour, flavour and aroma compounds as well as the compounds that affect wine texture such as tannins and polysaccharides. Straight additions of rainwater to high sugar musts will be trialled along with treatments where some juice is removed and replaced with rainwater and the traditional method of saignée where some juice is removed and not replaced, thus concentrating the must.

The trial wines will undergo formal sensory assessment after approximately one year in bottle.

Need assistance?

Winemakers considering making water additions this vintage can contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8313 6600 for advice.

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