KHT deposits and cold stability

POTASSIUM BITARTRATE (KHT) is the crystalline substance that drops out of solution when a wine is cold stabilised. However, if cold stabilisation is unsuccessful, wines can end up with KHT deposits after packaging and these represent around 25-35% of the AWRI helpdesk's haze/deposit investigations each year. So why does this type of deposit continue to be an issue for the wine industry? One reason is that there is no universal definition of 'cold stability', so a wine might pass one type of 'cold stability' test yet fail another. A second reason is that wines contain a range of compounds that can inhibit KHT crystallisation, and these can change over time, such that they no longer inhibit crystallisation. This can lead to precipitation of tartrates in wine previously thought to be cold stable.

SO WHAT EXACTLY IS 'COLD STABILITY'?

Cold stability can be described as a wine's tendency to precipitate KHT crystals when exposed to low temperature. Wine tends to contain close to saturation levels of KHT after fermentation and KHT is less soluble at lower temperature (Ribéreau-Gayon et al. 2006). Thus when a consumer places a bottle of wine in a refrigerator, this might decrease the solubility of KHT to the point where it crystallises. Winemakers attempt to prevent this occurring by subjecting wine to some form of cold stabilisation treatment prior to bottling.

WHICH WINE PARAMETERS AFFECT 'COLD STABILITY'?

A wine's tendency to precipitate KHT crystals depends on the concentration of potassium ions (K^+) and bitartrate ions (HT-), but also on other wine compositional parameters, particularly pH, alcohol and the presence of polymeric and colloidal substances. Alcohol decreases the solubility of KHT, while polymeric and colloidal substances, e.g. proteins, polysaccharides and tannins in red wines, can interact to protect against tartrate precipitation. Wine pH is important because it determines the distribution of the different tartrate species that are in equilibrium in wine.

In wine, tartaric acid (H_2T) dissociates in solution to HT- and tartrate T^2- ions according to the following equilibria:

$H_2T \rightleftharpoons HT- + H+$

$HT- \rightleftharpoons T^2- + H+$

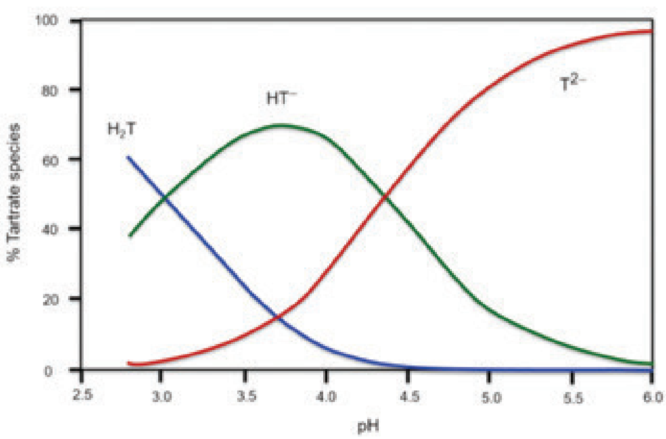

Figure 1. Relative concentration of tartaric acid species in aqueous solution at different pH values: H_2T = tartaric acid; HT- = bitartrate anion; T^2- = tartrate anion.

Figure 1 shows the distribution of the tartrate species as a function of pH. The maximum concentration of HT- (which can precipitate as KHT) occurs between pH 3.6 and 3.7, depending on the alcohol concentration, and this is the point at which precipitation will be greatest. Consequently, any wine treatments that might change a wine's pH, such as blending, acid additions or malolactic fermentation, could affect KHT precipitation. If a wine has been 'cold stabilised' prior to such treatments, cold stability checks must be conducted again before bottling.

WHY DOES WINE PH SOMETIMES CHANGE DURING COLD STABILISATION?

This is a common question, but one that is hard to answer in just a few words. A detailed explanation of this phenomenon is available on the AWRI's website under the heading 'Potassium instability' in the Winemaking/Instabilities section (or enter potassium instability in the search box on the AWRI homepage).

WHAT DOES THE SATURATION TEMPERATURE VALUE FOR A WINE MEAN?

The saturation temperature (T_{sat}) value for a wine is the lowest temperature at which it can dissolve KHT. Observations have shown that crystallisation inhibitors do not affect the solubilisation of salts, so the T_{sat} gives a more reliable prediction of the long term stability of a wine because the T_{sat} value doesn't depend on changes that occur during aging (Ribéreau-Gayon et al. 2006). The lower the T_{sat} value the more stable a wine is, while a higher T_{sat} value suggests that KHT precipitation can happen more easily.

WHICH 'COLD STABILITY' TEST DOES THE AWRI RECOMMEND?

Leske et al. (1996) examined some traditional methods for determining KHT stability, such as refrigeration tests, conductivity tests and concentration product tests. It was found that the 3-day 'brine' test, in which a filtered sample of the wine is stored at -4°C for 3 days and then examined for the visual presence of crystals, provided the most reliable results. That is, the 'brine' test gave results that corresponded most closely with the stability of wines stored under cellar conditions for one year (Leske et al. 1996). However, in general, the 'brine' test, and other similar cold stability tests, only give a picture of a wine's current stability and not its likely future stability (Wilkes 2014). Consequently, the AWRI currently suggests that the most reliable information about a wine's tartrate stability is obtained from a combination of the -4°C/3-day 'brine' test and the T_{sat} test, as the two tests combined give an indication of a wine's current stability and also its potential long term stability. For a more complete discussion on the interpretation of these two cold stability tests, see Wilkes (2014).

References

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