ask the AWRI

Understanding copper hazes in wine

When hazes or deposits form in white wine, there are a range of possible culprits, including protein, polysaccharides or even microorganisms. Of these, copper casse is an instability that occasionally displays unusual properties, with the associated haze sometimes observable and at other times not. In this column, AWRI Senior Oenologist, Adrian Coulter, responds to some of the questions commonly asked about copper casse and explains its sometimes curious behaviour.

What is a copper casse?

Copper casse is a haze that can occur in white wine. The haze may initially have an off-white, fluffy, 'cloud-like' appearance before developing into a light-brownish deposit that settles at the bottom of the bottle or tank. Most research on copper hazes was conducted in the 1950s, with Kean and Marsh (1957) concluding that the haze commonly referred to as copper casse is typically a combination of several hazes, namely, protein-tannin, copper-protein and a copper-sulfur complex. However, the haze might also contain a copper-polysaccharide portion (Karadjova *et al.* 2002). Regarding the copper-sulfur complex component of the haze, Lukton and Joslyn (1956) indicated that both cuprous (Cu+) and cupric (Cu^{2}+) sulfide were present. However, there have been conflicting reports in the literature as to the oxidation state of copper in copper hazes.

Why or how do copper hazes form?

Copper hazes form in the absence of oxygen or under 'reducing' winemaking conditions. Their formation is favourable in white wines that contain free sulfur dioxide (SO_2), copper and protein. The risk of haze development increases with increasing concentrations of copper, higher temperatures and with exposure to light (Lukton and Joslyn 1956).

While the mechanism of formation and chemical composition of copper hazes have not been fully elucidated, the following explanation is generally accepted. Under aerobic conditions, copper is present in the Cu^{2}+, oxidised state. However, in the presence of SO_2, when the reduction–oxidation (redox) potential decreases to a sufficiently low level, copper is reduced to Cu+. Under these conditions (i.e. low redox potential), an unstable copper colloid is initially formed, followed by the flocculation and precipitation of this colloid on contact with proteins in the wine (Ribéreau-Gayon *et al.* 2006).

Given protein is involved, will bentonite fining prevent a copper haze developing?

Fining a wine with enough bentonite to achieve heat stability will certainly decrease the likelihood of a copper haze forming. However, bentonite fining does not necessarily remove all protein from wine and a copper haze can still develop in a heat-stable wine if the concentration of copper is elevated.

If my wine is heat stable, how do I avoid a copper haze?

In a bentonite-fined, heat-stable wine, development of a copper haze is typically more dependent on the concentration of copper than the level of residual protein. Consequently, minimising the concentration of copper is the best strategy. The AWRI suggests a copper concentration of 0.5 mg/L or more is likely to lead to potential copper instability in white wine. However, due to their variability in complexing power and the type and amount of proteins present, wines vary greatly in their susceptibility to copper haze. Consequently, while the value of 0.5 mg/L is a good 'rule of thumb', some wines might develop a haze at a slightly lower concentration

and others might not develop a haze at a slightly higher concentration.

Why do copper hazes disappear sometimes?

As mentioned above, a copper haze develops in a susceptible wine when its redox potential decreases to a sufficiently low level. However, haze formation is reversible in the early stages of development, such that the haze can disappear if the wine's redox potential increases (i.e. under oxidising conditions). Consequently, a haze might develop in a tank of susceptible wine if the wine is sparged with nitrogen to a point where no dissolved oxygen is detected. Later, as the level of dissolved oxygen increases over time, the haze can disappear. In a wine that has just been fined with copper to remove a 'reductive' character, a haze can occur in a matter of days after nitrogen sparging. However, due to the variability in composition of wines mentioned above, the haze might take weeks to develop in another wine.

Why should I postpone a bottling if I decide to add copper just beforehand?

Due to the variability in the time required for a copper haze to develop, sufficient time should be allowed for a wine to 'self-stabilise' in bulk storage if the concentration of copper is at, or close to, 0.5 mg/L after a copper addition (as determined by post-addition copper analysis). Therefore, if copper fining trials indicate that a wine requires a copper addition just prior to a scheduled bottling date, it is advisable to postpone the bottling to allow self-stabilisation to occur. If the bottling is not postponed, it is possible that a copper haze might develop after bottling, which is more of an inconvenience than postponing bottling.

AWRI helpdesk

The AWRI helpdesk provides a free-of-charge technical advisory service to Australia's grapegrowers and winemakers. For further information about copper hazes or any other technical matter, contact the helpdesk on (08) 8313 6600 or helpdesk@awri.com.au

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References

Karadjova, I., Izgi, B., Gucer, S. 2002. Fractionation and speciation of Cu, Zn and Fe in wine samples by atomic absorption spectrometry. *Spectrochim. Acta Part B At. Spectrosc.* 57(3): 581-590.

Kean, C. E., Marsh, G. L. 1957. Investigation of copper complexes causing cloudiness in wines. I. Chemical composition. *Am. J. Enol. Vitic.* 8(2): 80-86.

Lukton, A., Joslyn, M. A. 1956. Mechanism of copper casse formation in white table wine. II. Turbidimetric and other physico-chemical considerations. *J. Food Sci.* 21(4): 456-476

Ribéreau-Gayon, P., Glories, Y., Maujean, A., Dubourdieu, D. (eds.) 2006. *Handbook of Enology, Volume 2: The Chemistry of Wine-Stabilization and Treatments*. John Wiley & Sons.: 102-103.

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