Cu-organic acids in red wine after bottling: A time-line for inhibition of reductive aroma compounds

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COPPER IN RED WINE

Cu Fraction & Determination	Attributed Forms	Wine Implication
Cu fraction III (F3) Cu fraction III = Total Cu – (Cu fraction I) total Cu measured by ICPOES or colorimetry	sulfide-bound Cu inert Cu-thiol (sulfhydryl-bound Cu)	Suspended particles in wine (size < 0.2 μm) Not aroma active.
Cu fraction I (F1) Directly measured by filtration-colorimetric or electrochemistry	Cu(II)-organic acid (non sulfhydryl-bound Cu)	Binds H_2S and inhibits its accumulation.

*No Cu fraction II (F2) attributed to loosely bound Cu-thiol complexes was detected in red wines.

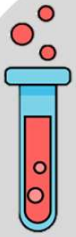
METHOD

Bottling 1
- Shiraz
- Pinot Noir

Bottling 2
- Shz/CabS
- Pinot Noir
- Cabs/Merl

addition of Cu(II)
Bottling 1 add 0, 0.3 and 0.6 mg/L
Bottling 2 add to 0.6 mg/L

bottle ageing for 12 months (14 °C, in dark)



analysis:
- SO_2
- H_2S
- Cu fractions
- Sensory (Pivot® Profile)

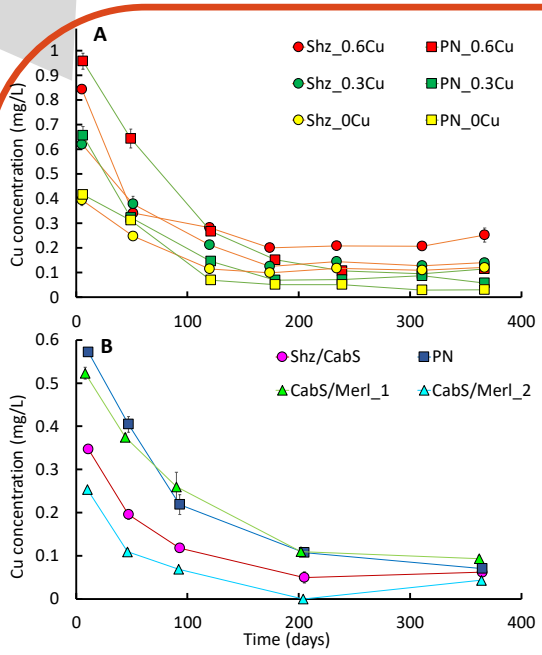


Figure 1. The Cu fraction I concentrations in six Bottling 1 wines (A) and four Bottling 2 wines (B). Error bars represent the standard deviation from triplicate samples.

RESULTS

- Wines with similar total Cu concentrations showed different initial Cu fraction I concentrations.
- Cu fraction I remained in most wines even after 200 days of bottle aging.
- No free H_2S accumulated in any of the red wines.
- Free MeSH concentration became lower with higher Cu fraction I concentration.
- Similar decay rate of Cu fraction I (0.010 ± 0.003) in most red wines.
- The time for Cu fraction I to reach half of its initial concentration (half-life) was around 70 days.

Table 1. The decay rate and half-life of Cu fraction I in red wines.

wine	1st-order decay rate (day^{-1})	half-life (day)
Shz_0.6Cu	0.0076	91
Shz_0.3Cu	0.0093	75
Shz_0Cu	0.0085	82
PN_0.6Cu	0.0109	64
PN_0.3Cu	0.0127	55
PN_0Cu	0.0134	52
Shz/CabS	0.0096	72
PN	0.0086	81
CabS/Merl_1	0.0080	87
CabS/Merl_2	0.0157	44
average	0.010 ± 0.003	70 ± 16

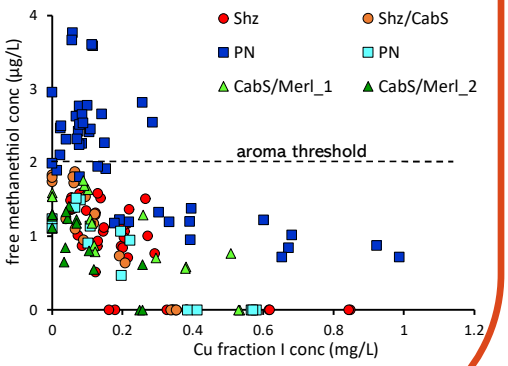


Figure 2. Concentrations of free MeSH in red wines versus Cu fraction I concentrations.

CONCLUSIONS

Cu fraction I:
- suppresses H_2S & MeSH accumulation;
- similar decay rate among red wines.