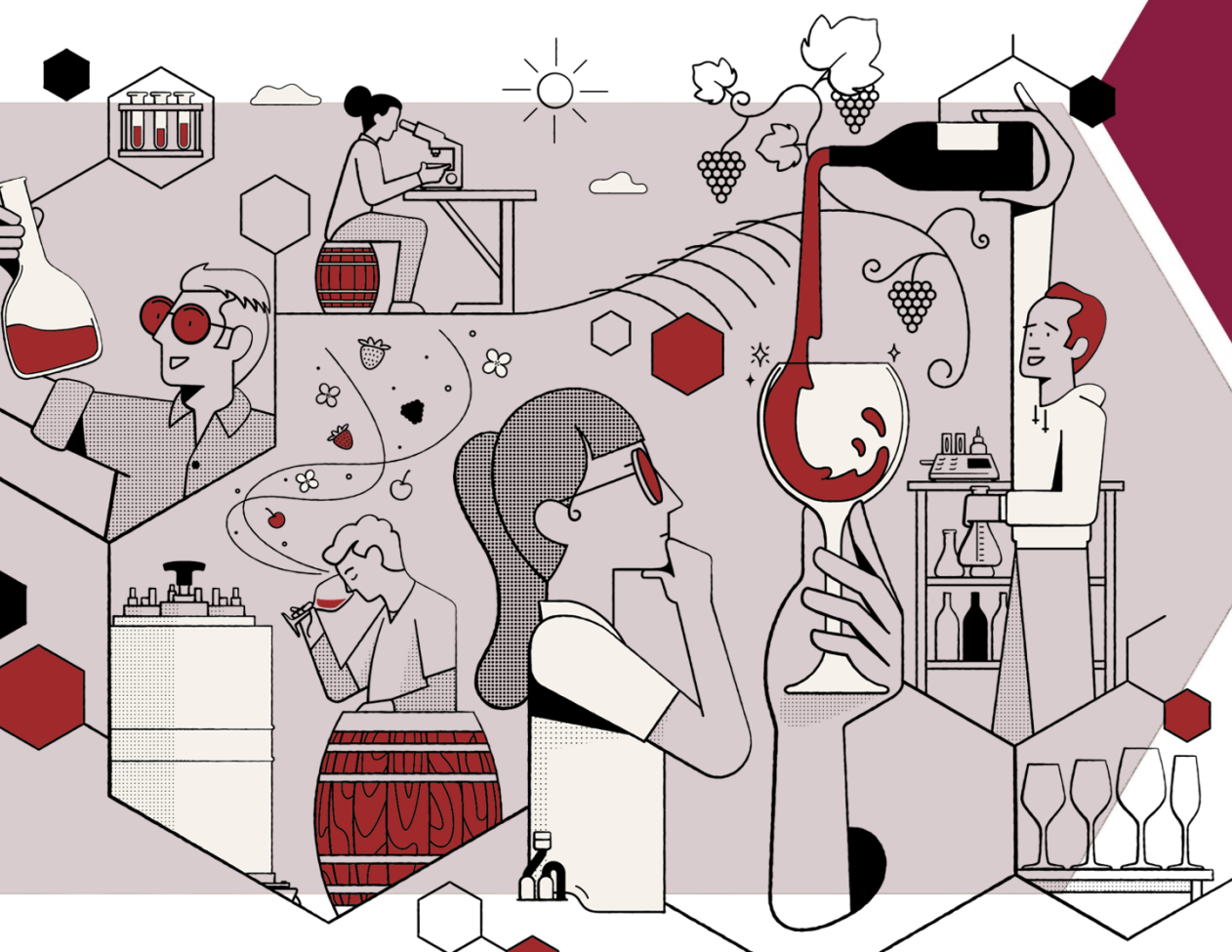


Effectiveness of different antioxidant treatments on Sauvignon blanc

Test Case Winery Trial #1



APPROVED FOR RELEASE BY:
Research Winemaker Ngarita Warden

ISSUE DATE: 22 September 2023

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Introduction

For various reasons there is growing interest in finding other preservatives, such as glutathione, tannins and mannoproteins to replace, or at least complement, the action of sulphur dioxide (SO₂) during the winemaking process.

Once aromatic varietal juice (such as Sauvignon blanc) is oxidised the quality is permanently impaired as many of the chemical reactions involved in oxidation are irreversible. A challenge throughout the winemaking process is to maintain aroma and employ preventative strategies in relation to oxidation, rather than reactive.

The use of SO₂ as an additive during the vinification process is well known due to its antioxidant, antimicrobial and antioxidasic actions (Stockley et al., 2021). Many wineries complement SO₂ with ascorbic acid as it is most effective at consuming oxygen, however, the use of ascorbic acid on its own will generate hydrogen peroxide, which can lead to rapid oxidation. SO₂ can react quickly with hydrogen peroxide therefore removing it and minimising any hydrogen peroxide induced oxidative damage. The use of SO₂ and ascorbic acid in tandem becomes important for this reason and drives the winemaking practice of using sulphur dioxide to complement ascorbic acid, rather than just SO₂ on its own. (Barril et al., 2016; Pons-Mercade et al., 2021).

The alternate antioxidants selected for this trial were glutathione (GSH), mannoproteins and tannins. All three of the alternatives used in this trial contained a proportion of inactivated dry yeasts (IDY). The use of yeast derivatives to minimise/control both must, and wine oxidation is a relatively new winemaking strategy (Bahut et al., 2020). However, recent studies have shown how some inactivated dry yeasts can consume oxygen at a greater rate than SO₂ alone (Pons-Mercade et al., 2021).

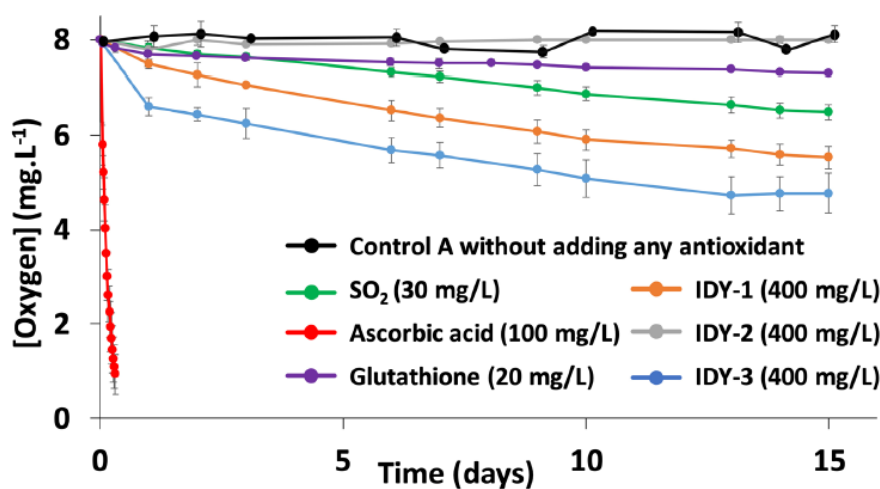


Figure 1. Effect of different antioxidant products (including three types of Inactivated Dry Yeast (IDY) on oxygen concentration in a model wine solution (Pons-Mercadé et al., 2021).

Objectives

The purpose of this trial was to assess the impact each alternative antioxidant product has on the palate, aroma, thiol content and longevity of 2022 Marlborough Sauvignon blanc, compared to the control.

The objectives of the trial are:

- to trial three different products used as antioxidants in winemaking compared to a control
- to compare the thiol concentrations immediately post-bottling
- to analyse the sensory properties of the resultant wines post-bottling
- to compare the effectiveness of the products/techniques as antioxidants and report on the outcomes

Methods

Scope

Glutathione (reduced form = GSH)

Glutathione is a tripeptide present in both grapes and must, mostly in its reduced form of GSH. GSH plays a fundamental role in preventing oxidative processes in both musts and wines. It does this by its ability to scavenge ortho-quinones, which are the main protagonists of colour browning and aroma loss through oxidative mechanisms.

In recent times, the role and application of glutathione in both viticulture and winemaking has received significant scientific and commercial attention. The primary reason for this attention relates to its use as an additional, and natural mechanism in the prevention and control of oxidative spoilage of primarily white wine.

Although the addition of pure glutathione (GSH) is not allowed under current regulations, the concentration of this compound can be increased in wine through the addition of glutathione-enriched dry yeast preparations (Gabielli, et al., 2017).

Tannins

Enological tannins are complex polyphenolic compounds that can be obtained from various botanical sources, often grape skin, or seed. Historically tannin additions as part of the winemaking process have been widely utilised due to their ability to aid and improve the aroma and palate characteristics of wines, and for stabilising colour in red wines (Li et al., 2020).

Tannins are also being investigated as a promising alternative to control oxidative processes during winemaking. Tannins prevent the oxidation of musts and wines possibly because of a dual mechanism involving the inhibition of oxidative enzymes and free radical scavenging activity (Strati et al., 2021).

Mannoproteins

Mannoproteins are naturally occurring proteins that are found in yeast cell walls. Wine naturally contains mannoproteins as they are released during yeast fermentation and then later during yeast autolysis if the wine sits on its lees.

Inactivated dry yeast containing high levels of mannoproteins are readily available on the market and have been proven to enhance mouthfeel and promote tartrate stability. More recent research shows that mannoproteins may also have antioxidant ability.

It is thought that if added prior to inoculation, mannoproteins quickly bond with anthocyanins and aromatic compounds protecting them from oxidation and precipitation (Beshliu, 2022).

Trial Protocol

Fruit receival

Sauvignon blanc fruit from Marlborough was machine harvested (with a standard field addition of PMS) and received at Bragato Research Institute on 30 March 2022. The fruit was 100% destemmed and crushed using a Pellenc Selectiv Process Winery S de-stemmer and Pellenc Extractiv crusher on the 50% extractive setting. Post crush/destem the fruit was divided into four equal weight batches for further processing.

Each batch was pressed separately using a Diemme Enologia Membrane Press set to the Sauvignon Blanc 130 program where there is 15 min at no pressure followed by 115 min up to 1.8 bar. Post pressing, 180L was transferred to four 200L fermenters, with 2g/hL Rapidase enzyme plus 0.5g/L BentUP bentonite to aid settling. Table 1 outlines the antioxidant treatments pre-fermentation. Juice analysis was conducted and can be found in Table 2. The tanks were set at 7°C under inert gas cover for cold settling.

Table 1. Batch and additives pre-ferment

Treatment	Additives	Wine Code
Control	80ppm PMS + 40ppm Ascorbic Acid added at press tray	Wine A
Tannins	300ppm IOC Full Protect added at cold settling	Wine B
Glutathione (GSH)	300ppm Fermentis SpringArom added at cold settling	Wine C
Mannoproteins	300ppm Enartis Pro Blanco added after cold settling, pre-inoculation	Wine D

Table 2: Juice analysis

		Wine A	Wine B	Wine C	Wine D
Total acidity	g/L	11.28	11.34	11.12	10.82
L-Malic acid	g/L	4.8	4.8	4.4	4.5
pH		3.02	3.01	3.02	3.04
°Brix		18.4	18.4	18.0	18.1
YAN	mg/L as N	159	168	162	179

Fermentation

The tanks were racked 48 hours after pressing and gradually warmed to 16° C before being inoculated with Fermentis CK-S102 yeast at 200 ppm and Oenobrand's Natuform Bright at 300 ppm as a yeast rehydration nutrient. Once the fermentation was active, the temperature was adjusted to 14° C. The °Brix was monitored daily (Figure 2) with an aim of 1.5 °Brix decrease per day which required additional temperature adjustments between 13 - 14° C. Once 5 °Brix was reached, ferments were set to 18° C to ensure a strong finish. Ferments were considered complete when an enzymatic glucose/fructose was <1.5 g/L.

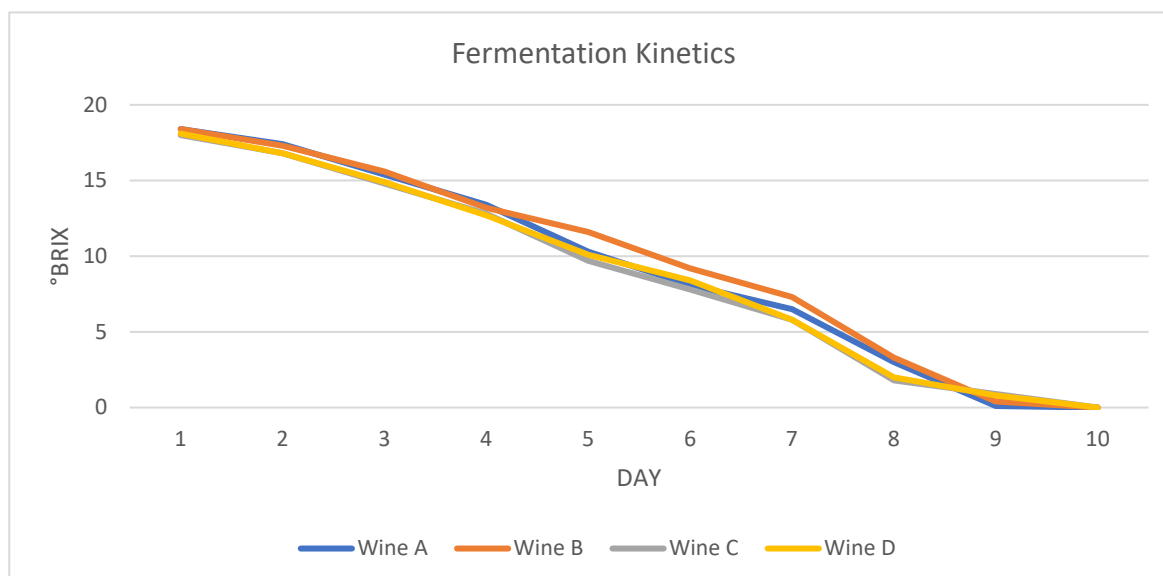


Figure 2. Daily °Brix tracking

Post Ferment Treatment

Following the completion of fermentation, tanks were set to 10° C for settling before being racked off gross lees and 120 mg/L of PMS added to each treatment. The wine was stored at 10° C under inert gas for 10 days before progressing to fining and stabilisation.

A heat test was conducted to determine the rate of bentonite required for protein stabilisation. A BentUP bentonite addition of 2.25 g/L was made to each tank. Tanks were set to -1° C and when wine reached desired temperature, an addition of cream of tartar (COT) at 1 g/L was completed with regular agitation for five days before racking. Samples were taken for final wine analysis (Table 3). Wines were prepared for bottling by adjusting the temperature to 18° C, free sulphur dioxide to approximately 30 mg/L and the dissolved CO₂ to 1200 mg/L.

Wine was filtered through a series of three filters including 5.0 pad, 1.2 and 0.45 micron membrane respectively, followed by bottling (750 mL) and capping utilising an Officine Pesce Bottling System under inert gas. Bottled wine was stored at 10 °C.

Table 3. Wine Analysis pre-bottling

		Wine A	Wine B	Wine C	Wine D
Total acidity	g/L	9.3	9.6	8.8	8.8
L-Malic acid	g/L	4.2	4.6	4.3	4.6
VA	g/L	0.65	0.65	0.47	0.52
pH		3.2	3.26	3.28	3.21
Alc %		10.0	10.3	9.9	9.9
Free SO ₂		29	32	31	30
Total SO ₂		110	75	77	75

Results

Thiol Analysis

Wine samples were sent to Hills Laboratory post-bottling in September 2022 and were analysed by SPME-GC-MS/MS. Three organosulfur volatile thiols were measured: 3-mercaptohexan-1-ol (3MH) which gives aromas of grapefruit and passionfruit, 3-mercaptohexyl acetate (3MHA) which gives passionfruit, box tree and sweat and 4-mercapto-4-methylpentan-2-one (4MMP) which gives black currant leaf, box tree and passionfruit. Results can be found in Table 4.

Table 4. Thiol concentration

	Wine A	Wine B	Wine C	Wine D
3MH (ng/L)	1558	1686	1948	1758
3MHA (ng/L)	285	365	405	286
4MMP (ng/L)	103	53	82	85

Sensory Analysis

Sensory Analysis was conducted by a panel of 15 winemakers experienced in making Sauvignon blanc, 9 male and 6 female, aged between 26 and 59 on 8 September 2023. A standardised pour of 40ml of each wine was presented to the panel. Each wine was coded with A, B, C or D with the panellists not aware of which treatment related to each code.

The panellists analysed the wine by olfaction and gustation and used the same tasting mat as per the Test Case package to record their analysis. The panel results are available in a sealed envelope in the Test Case Package.

Discussion

All fruit processing was undertaken with no issues and fermentation tracked at a standard rate to completion for all treatments. The chemical composition of all treatments was within usual parameters typically found in finished Sauvignon blanc wines.

One year post-bottling the wines were all still youthful in both colour and aroma which showed the control and alternative treatments had all provided the juice pre-ferment with oxidation protection. The winemaker panel saw no significant difference between the four wines, with three wines having a very similar overall rating.

The treatment using tannin as the alternate antioxidant ranked slightly lower, with the panellists noting a phenolic, bitter finish to the wine. A similar increase in phenolic content was shown in research on Malgoussia wine, with gallic-based tannin as an alternate antioxidant (Strati et al., 2021).

When comparing the thiol levels, all three alternate antioxidant treatments had higher levels of 3MH and 3MHA, but lower levels of 4MMP than the control. This result concurs with research by Lyu et al. (2021) that revealed glutathione added to Sauvignon blanc juice shortly after crushing can provide antioxidant protection to the juice, reduce/remove the use of SO₂, and produce more volatile thiols in resultant wines than SO₂ plus ascorbic. Larcher et al (2015) showed the addition of tannin containing a significant concentration of S-glutathionylated (GSH-3MH) and S-cysteinylated (Cys-3MH) precursors to Sauvignon blanc juice produced wines with higher levels of 3MH and 3MHA.

An improvement for this trial design would be to have a control with no antioxidant, then a standard of PMS plus ascorbic. This would give us an indication of how the wine would look with no antioxidant use prior to fermentation and see if there was any significant difference.

An area for further research would be to continue using the same antioxidant treatment post-ferment, rather than using PMS for all. This would give a more comprehensive understanding of how alternate antioxidant products perform throughout the whole winemaking process.

In summary, the antioxidant products trialled produced wines of similar quality and similar development one year post bottling as the commonly used combination of PMS and ascorbic acid. Thiol levels were higher in the alternate treatments at bottling, showing these products do not negatively impact thiol development. For producers looking to reduce the amount of PMS used in their wine processing, this study shows that glutathione, tannin and mannoprotein containing IDY all provide juice with protection from oxidation pre-fermentation.

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