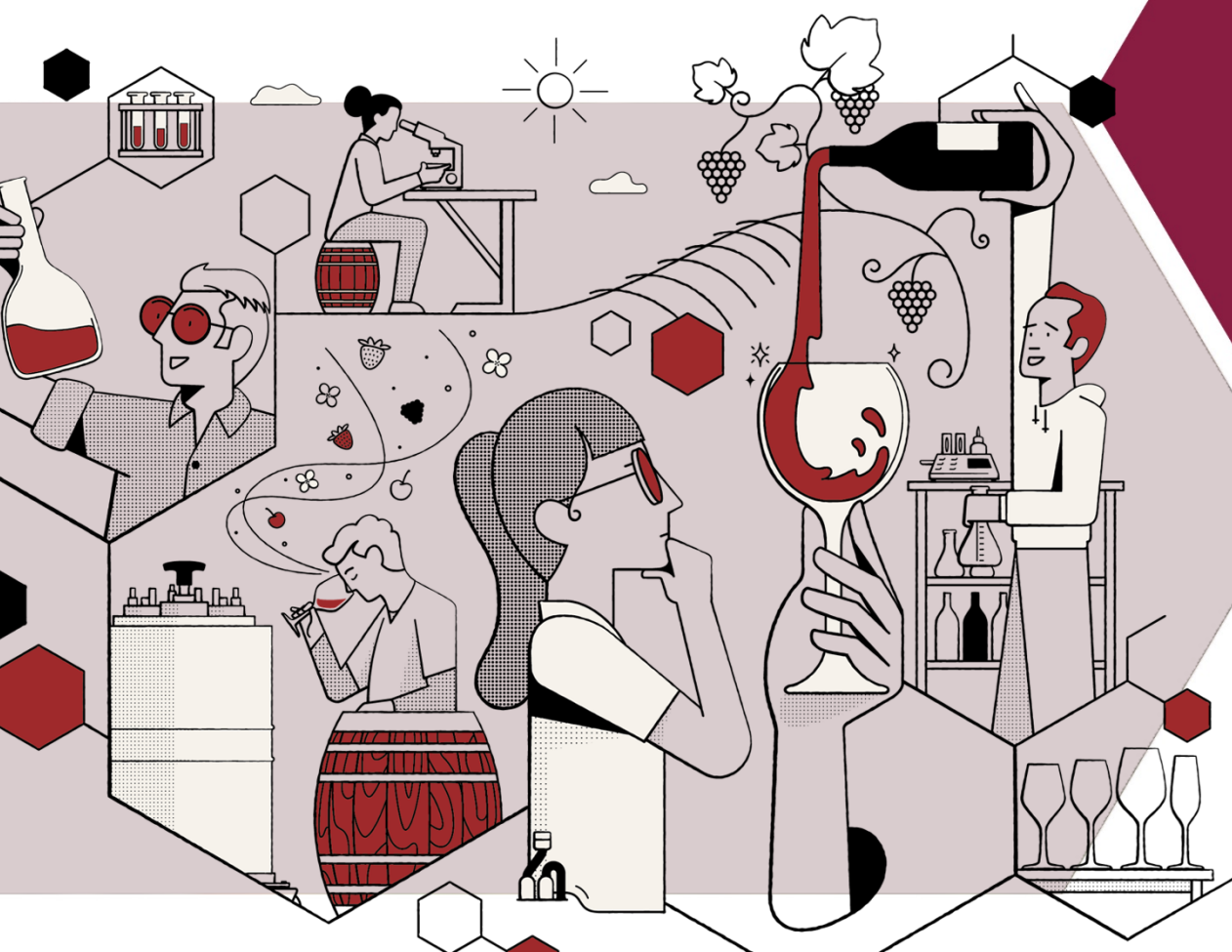


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Different techniques for controlling pH and acidity in Pinot noir and the resultant impact on wine longevity

Test Case Winery Trial #2



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Introduction

Acidity in grapes mainly consists of tartaric and malic acid, which together comprise more than 90 percent of the total acidity (Chidi et al., 2018). During the fermentation process, other acids are formed (for example succinic, acetic and gluconic), while others (malic) may disappear and lactic form due to bacterial action (malolactic conversion) (Bartowsky, 2014).

pH and TA are important measurements of acidity throughout the winemaking process. They give us an indication of what is going on with the overall acid balance of the juice or wine. Too little acidity and the palate of the finished wine can seem flat or flabby, too much and the wine can seem sharp and sour (Hale, 2023).

These measurements are also important with regard to wine stability and longevity. pH has a large impact on the availability of free SO₂ in the molecular form, which is the form most active in protecting the juice/wine from oxidation and microbial spoilage. A lower pH shifts free SO₂ towards a greater percentage in molecular form (Stockley et al., 2021). With red wines, pH can also impact hue, intensity and stability of colour, with higher pH wines negatively impacted.

Objectives

The objective of this trial is to investigate different techniques or timing to manage the pH and acidity of Marlborough Pinot noir throughout the winemaking process and to compare these approaches one year post-bottling on the aroma, palate balance and development of the wine.

The objectives of the trial are:

- to trial four different times/products for adjusting pH and acidity during winemaking
- to measure colour intensity and hue of the resultant wines one year post-bottling
- to analyse the sensory properties of the resultant wines one year post-bottling
- to compare the effectiveness of the times/products and report on the outcomes

Methods

Fruit receipt

100% Pinot noir fruit from Marlborough was hand harvested and delivered to Bragato Research Institute on 2nd April 2022. The fruit was weighed, 80ppm of Potassium Metabisulphite (PMS) and 40ppm ascorbic acid added, then crushed and 100% destemmed. 182 kg of crushed/destemmed fruit was placed into four 200L open-top fermenters, respectively.

Four treatments

Four different methods for controlling pH and TA were trialed and these are outlined in Table 1. For all treatments, any acid adjustment was completed using tartaric acid. Juice samples were taken, and initial juice parameters can be found in Table 2. Acid adjustments to take the pH to 3.3 happened on Wine B, C & D at this stage. The fermenters were set to 10° C and the fruit was plunged once daily for three days for pre-fermentation maceration.

Table 1: Pinot noir pH stability trial – treatments and treatment codes

Treatment	Code
Adjust pH prior to bottling only.	Wine A
No adjustment pre or during ferment.	
Adjust to pH 3.3 at juice then three small additions of tartaric acid throughout alcoholic fermentation, plus pH adjustment prior to bottling.	Wine B
Adjust pH at juice to 3.3 then ferment using Laktia yeast as it produces lactic acid. Adjust pH prior to bottling.	Wine C
Adjust pH at juice to 3.3 and then adjust pH prior to bottling.	Wine D

Table 2: Juice analysis

		Wine A	Wine B	Wine C	Wine D
Total acidity	g/L	5.98	5.83	5.87	5.8
L-Malic acid	g/L	3.94	3.79	3.55	3.79
pH		3.75	3.77	3.66	3.7
°Brix		22.3	22.7	22.2	22.4
YAN	mg/L as N	200	208	184	188

Fermentation

The tank temperatures were adjusted to 22°C. Wines A, B & D were inoculated with Lalvin RC212 at 200 ppm along with Laffort Dynastart at 200 ppm as a protectant for yeast rehydration.

Wine C was inoculated with Laffort Laktia, a non-saccharomyces yeast (*Lachancea thermotolerans*), known to produce lactic acid during metabolism and can decrease pH by as much as 0.5 (Lallemand, 2020). The juice was sequentially inoculated 36 hours later with Lalvin RC212 at 200 ppm along with Laffort Dynastart at 200 ppm as a protectant for yeast rehydration.

Forty-eight hours post ferment initiation an addition of CH35 MLF bacteria was added to all tanks at 0.01 g/L for malo-lactic conversion. As the YAN was approx. 200 mg/L (N) no DAP additions were required with any of the ferments.

During fermentation, Wine B had 1.5g/L tartaric added. This was added in 0.5g/L batches, three times during ferment.

Ferments were plunged once daily (two plunges on the third day) until they reached <2 °Brix when plunging ceased and both primary and malolactic conversion were allowed to complete. The °Brix was monitored daily and ferment was considered complete when an enzymatic glucose/fructose was < 0.8 g/L.

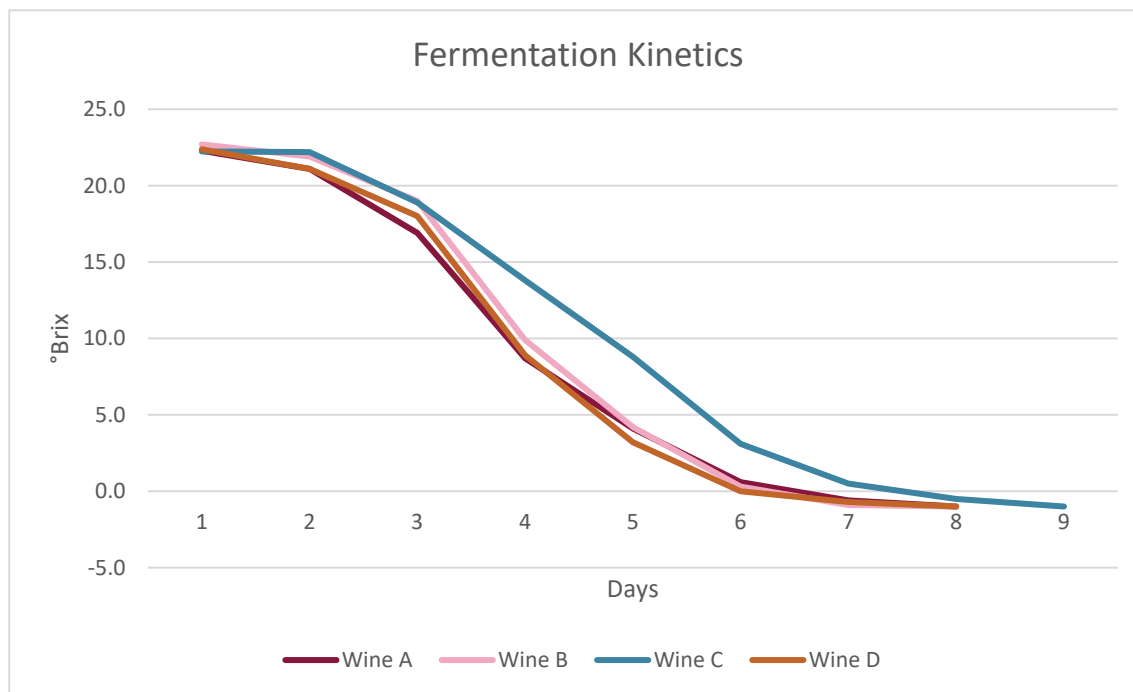


Figure 1. Daily Ferment Tracking

Post Ferment Treatment

All treatments were kept on skins for a total of 20 days from processing before being drained and pressed using a Diemme Hydraulic Press. Samples were taken post pressing; analysis can be found in Table 3.

Table 3: Post-press analysis

		Wine A	Wine B	Wine C	Wine D
Alcohol strength	%v/v	13.24	13.25	13.04	12.95
Total acidity	g/L	4.91	5.88	5.43	5.15
Volatile acidity	g/L	0.61	0.6	0.48	0.51
L-Malic acid	g/L	0.0	0.0	0.0	0.0
pH		3.84	3.59	3.62	3.67
Residual Sugar	g/L	0.5	0.6	0.4	0.6

MLF was considered complete when an enzymatic malic acid test was <0.2 g/L. Once MLF was complete, wines were sulphured at 120ppm PMS.

Two weeks prior to filtration and bottling, wines were fined with an addition of egg whites at 10g/hL to reduce coarse phenolics.

Wines were racked off egg whites, and brought up to 18 °C in preparation for bottling and full analysis undertaken. Post-fining analysis is shown in Table 4.

Table 4: Post-fining analysis

		Wine A	Wine B	Wine C	Wine D
Alcohol strength	%v/v	13.24	13.32	13.02	13.02
Total acidity	g/L	4.85	5.73	5.32	5.05
Volatile acidity	g/L	0.74	0.63	0.6	0.58
L-Malic acid	g/L	0.0	0.0	0.0	0.0
pH		4.0	3.75	3.78	3.78
Residual Sugar	g/L	0.5	0.6	0.4	0.6
Free SO ₂	mg/L	26	18	19	18

Wines were adjusted with tartaric acid addition to have a final pre-bottling pH of between 3.6-3.7. Free SO₂ was adjusted to approx. 35mg/L. Final pre-bottling analysis is found in Table 5.

Table 5. Final Wine Analysis

		Wine A	Wine B	Wine C	Wine D
Alcohol strength	%v/v	13.24	13.32	13.02	13.02
Total acidity	g/L	6.82	6.59	6.23	6.29
Volatile acidity	g/L	0.74	0.63	0.6	0.58
L-Malic acid	g/L	0.0	0.0	0.0	0.0
pH		3.63	3.67	3.66	3.68
Residual Sugar	g/L	0.5	0.6	0.4	0.6
Free SO ₂	mg/L	34	35	33	34

Wine was filtered through a series of two filters including 5.0 pad and 1.2 membrane micron followed by bottling (750 mL) on 23 August 2022 and screwcapped utilising an Officine Pesce Bottling System under inert gas. Bottled wine was stored at 10 °C.

Results

Colour Analysis

Colour analysis was conducted at Pacific Rim Oenology one year post-bottling using CloudSpec, a new UV-Vis technology that can measure turbid samples. The CloudSpec generates full UV-Vis spectra from 250-850 nm.

Absorbance (A) readings were taken at 420 nm (yellow pigments), 520 nm (red pigments), 620 nm (blue pigments) and 280 nm (total phenolics). The hue (a simplistic measure of the appearance of the colour) can be found in Figure 2. Young red wines have a hue value on the order of 0.5–0.8 which increases throughout aging, reaching an upper limit of around 1.2–1.4. The colour density values (a simple measure of the darkness of the wine) were also calculated and the results can be found in Figure 2. Total phenolics can be found in Figure 3.

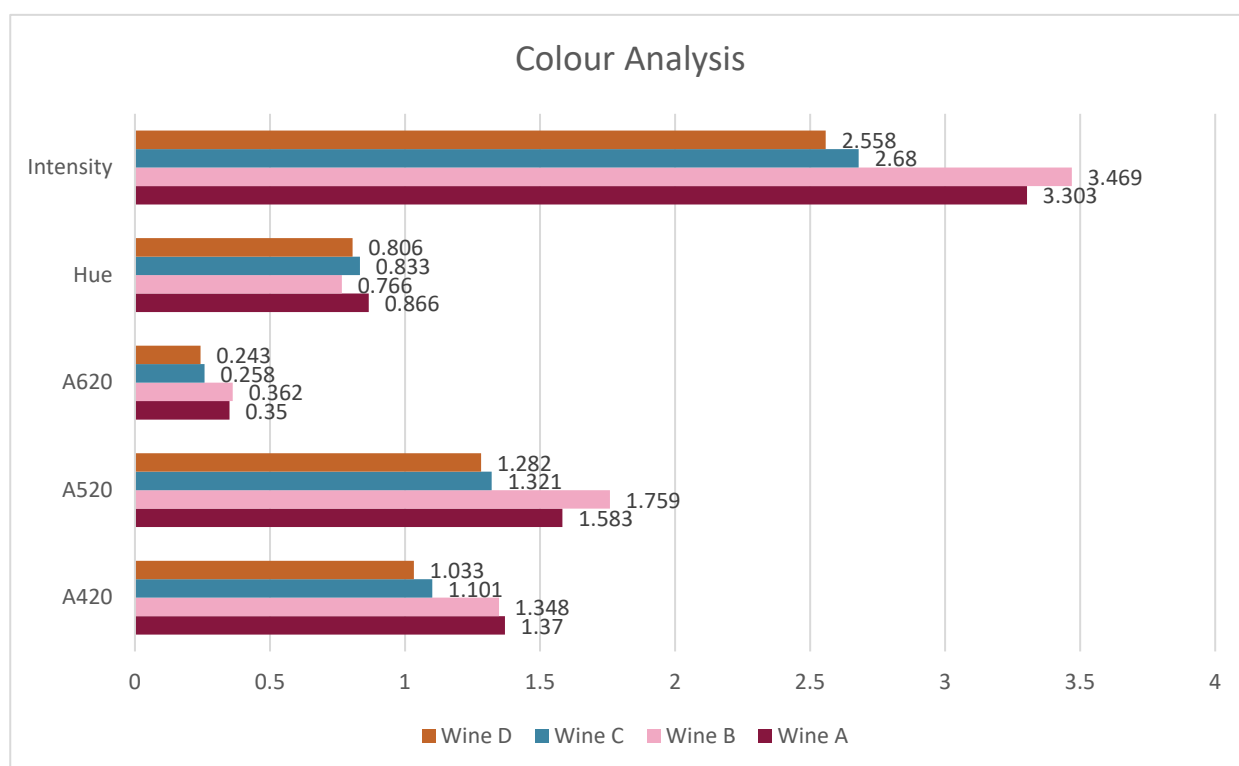


Figure 2. Colour Analysis of Pinot noir pH trial

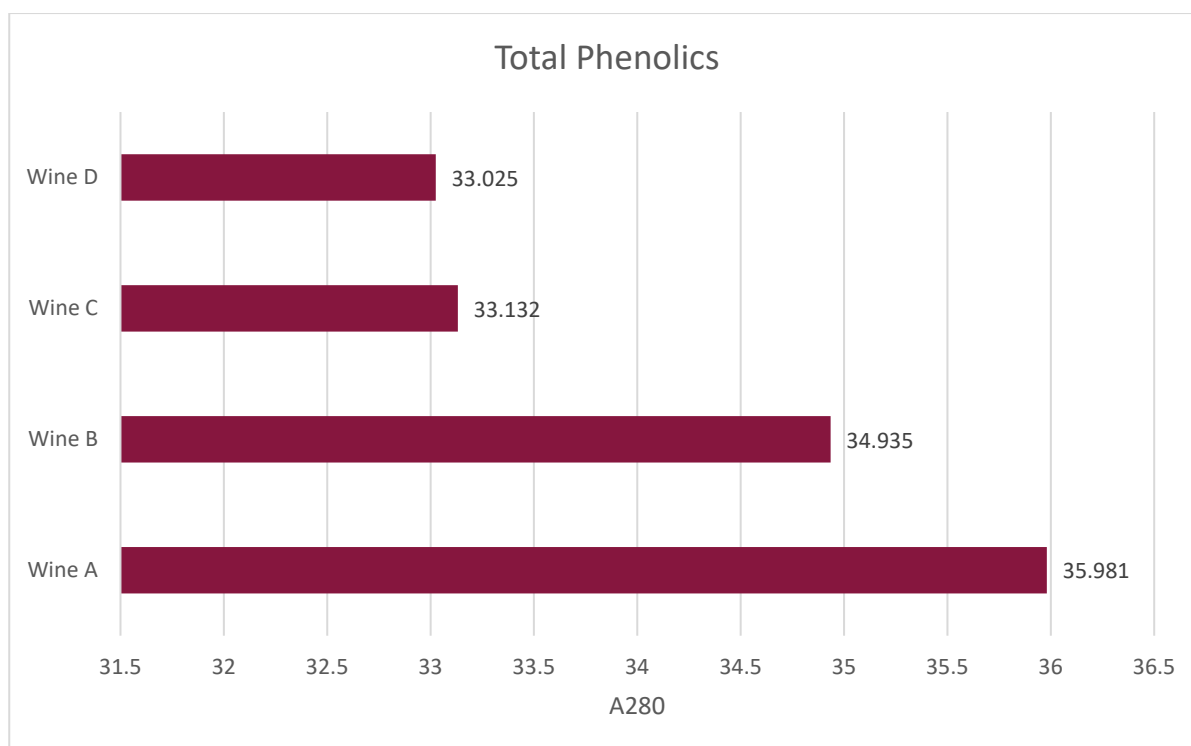


Figure 3. Total Phenolics Pinot noir pH trial

Sensory Analysis

Sensory Analysis was conducted by a panel of 15 winemakers, 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. The panellists were presented with wines coded A, B, C & D with the panellists not aware of which treatment related to which 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 the usual parameters typically found in finished Pinot noir wines.

Although the pH prior to adjustment at pre-bottling differed between Wine A (pH 4) and the other three treatments (pH 3.75), there were no significant differences seen in either the colour or the sensory assessment of the wines one year post-bottling. Volatile acidity (VA) and total phenolics were slightly higher in the treatment where pH was only adjusted directly prior to bottling (Wine A) compared with the other treatments. The higher VA may be due to an increased level of spoilage organisms able to exist at the higher pH; this was not quantified as part of this trial. The higher level of phenolics shown in Wine A concurs with research by Gambuti et al. (2022) that shows reactions leading to the formation of new pigments and increased polymeric structures are favoured in red wines acidified later in processing.

The sensory panel slightly preferred Wine B (pH adjusted to 3.3 prior to ferment with acid additions during fermentation), with this wine being perceived to have higher levels of dark fruits and softer tannins than the other wines.

Further colour and sensory analysis at two years post-bottling will occur to see if the treatments have an impact on longer term maturation of Pinot noir.

In summary, this trial shows that timing or technique of acid adjustment has no significant impact on the sensory characteristics and longevity of Pinot noir one year post-bottling. A recommendation for a future trial would be to include a control that had no acid adjustments prior to bottling to illustrate how adjusting pH prior to bottling is beneficial to red wine longevity.

References

Bartowsky, E. (2014) *Encyclopaedia of Food Microbiology*. 2nd edition, pages 800-804.

<https://doi.org/10.1016/B978-0-12-384730-0.00357-8>

Chidi, B., Bauer, F., Rossouw, D. (2018) Organic Acid Metabolism and the Impact of Fermentation Practices on Wine Acidity: A Review. *South African Journal of Oenology*. <http://dx.doi.org/10.21548/39-2-3164>

Gambuti, A., Picariello, L., Forino, M., Errichiello, F., Guerriero, A., Moio, L. (2022) How the Management of pH during Winemaking Affects Acetaldehyde, Polymeric Pigments and Color Evolution of Red Wine. *Journal of Applied Sciences*. <https://doi.org/10.3390/app12052555>

Hale, N. (2023) What is acidity in wine? *Wine Enthusiast Magazine*.

<https://www.wineenthusiast.com/basics/advanced-studies/what-is-acidity-in-wine/>

Lallemend Oenology (2020) *Level 2 Laktia Specification sheet*.

<https://www.lallemendwine.com/en/australia/products/catalogue/wine-yeasts/109/level-2-solutions-laktia/>

Stockley, C, Paschke-Kratzin, A, Teissedre, P, Restani, P, Garcia Tejedor, N, Quini, C (2021) SO₂ and Wine: A Review. *OIV guide*.