The Influence of Initial Phenolic Content on the Outcome of Pinot noir wine Microoxygenation

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Introduction

Over the years, microoxygenation (MOX) has become a popular vinification technique to improve wine sensory qualities. However, among the impacting factors reported, few studies have considered the effects of initial phenolic content (Cano-López et al. 2008). Therefore, the present study investigates the importance of this factor particularly with light-coloured Pinot noir wines.

Method & Treatments

The process of wine oxidation (**Figure 1a**) involves the redox cycling of Fe (II) and Fe (III), forming hydroxyl radicals that react with phenolic compounds (Danilewicz 2016). In the present study, micro-levels of oxygen were delivered into wine using a sealed-end diffuser tube coated with a fluorinated ethylene-propylene copolymer (FEP) membrane (**Figure 1b**). The wine (15 L) was continuously mixed at 300 rpm by a stir bar to allow even oxygen distribution.

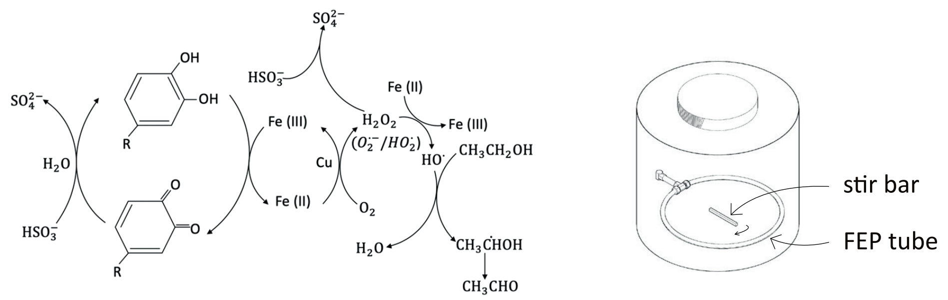

Figure 1. Schematic of wine oxidation process with the iron catalysed oxidation reactions (a), adapted from Danilewicz (2016); the use of oxygen diffuser inside 15L MOX tank (b).

Two Pinot noir wines from the 2020 vintage from Marlborough, New Zealand, with a low (PN1) and a high (PN2) phenolic content (**Table 1**) were sterile filtered after malolactic fermentation and treated with two oxygen doses (i.e., 0.50 ± 0.08 and 2.17 ± 0.3 mg/L/day) for 14 days with temperature control at 15°C (**Table 2**). Afterwards, the wines were aged for 1 month followed by SO_2 addition of 100 mg/L (after the day 44 analyses) with the end point determined 4 days later (day 48).

Table 1. Wine composition and phenolic content of PN1 and PN2 wines at time 0 prior to starting MOX.

Initial Phenolic Content	Conventional Analyses		Harbertson-Adams Assay	Tannins	Colour Absorbances	
	pH	TA (g/L)	Total Anthocyanins (mg/L)	MCP Tannin (g/L)	Colour Density 420 + 520 nm (a.u.)	SO_2 Resistant Pigments at 520 nm (a.u.)
PN1	3.6 ± 0.0	7.8 ± 0.0	191.8 ± 3.1	0.45 ± 0.01	5.7 ± 0.0	1.37 ± 0.00
PN2	3.6 ± 0.0	7.9 ± 0.0	281.6 ± 2.3	0.67 ± 0.01	7.2 ± 0.0	1.54 ± 0.00

Initial values are presented as mean ± standard error for conventional analyses (n=2) and phenolic analyses (n=6);MCP Tannin: tannin concentration measured by tannin precipitation with methylcellulose (Mercurio et al. 2007).

Table 2. MOX treatments on the two Pinot noir wines (n=3).

Pinot noir Wine	Control with no MOX	MOX: 0.5 mg/L/day	MOX: 2.17 mg/L/day
PN1	C1	T1	T2
PN2	C2	T3	T4

Results

On wine colour:

- **MOX** applied to **PN2** (**T3** and **T4**) showed **higher increases** in the **colour intensity** (**Figure 2a**) and **SO_2 resistant pigments** at 520 nm (**Figure 2b**) than PN1 (T1 and T2), which were not significantly varied between MOX doses at day 44.
- At the same time, **MOX** induced the **decline** in **monomeric** and **total anthocyanin** content, which was considerably **higher in PN2** (10~17%) **than** in **PN1** (3~7%).
- With **MOX**, both **PN1** and **PN2** had higher **increases** in **large polymeric pigments** at 520 nm absorbance, but **only in PN2**, where MOX had also maintained a **higher** concentration of **small polymeric pigments** with anthocyanin colour.
- However, final **SO_2 addition** (100 mg/L) showed a more substantial impact on these wines, largely **cancelling** out the **colour improvement,** except for the SO_2 resistant pigments.

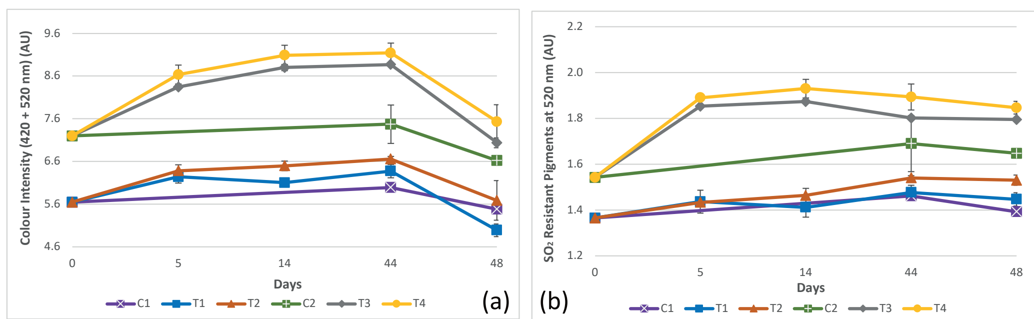

Figure 2. Changes in colour intensity (a) and SO_2 resistant pigments at 520 nm (b) in PN1 and PN2 wines with and without MOX (mean ± standard error, n=6).

On tannin composition:

- **MOX increased tannin concentration** (except T1) and led to a **decrease** of **the measured tannin mass conversion** via depolymerisation with phloroglucinol (**Figure 3**).
- **MOX** did not strongly affect the percentage of seed derived tannins but **lowered** skin derived **(-)-epigallocatechin** extension units by 1.7 to 1.9 %.
- These changes due to **MOX** could **increase** perceived **astringency** (Ma et al. 2014).

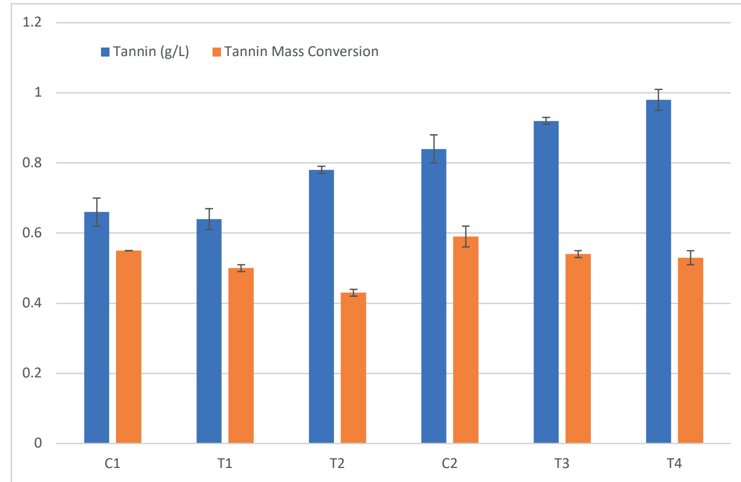

Figure 3. End point results of tannin concentration (g/L) and tannin mass conversion (x 100 as a percentage) in PN1 and PN2 wines with and without MOX (mean ± standard error, n=6).

Conclusions

- The **Pinot noir wine** with the **higher phenolic content benefited** more from MOX, significantly increasing colour intensity and SO_2 resistant pigments in association with a higher increase in polymeric pigments.
- However, these changes **did not guarantee colour stability**, as SO_2 bleaching largely erased the improvement on colour intensity in all wines.
- Concerning **MOX**'s impact on **astringency**, with the **increase** of **tannin concentration** and **decrease** of **tannin mass conversion** and **(-)-epigallocatechin**, **MOX** should be applied to **Pinot noir** and other low phenolic wines with caution.

Acknowledgement

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