Effect of oxidation on Sauvignon blanc wine sensory and chemical composition

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INTRODUCTION

From the fermentative stages up to bottling and aging, wine usually comes into contact with oxygen which can cause oxidation of various aroma compounds such as the volatile thiols (4MMP, 3MH and 3MHA) as well as non volatile compounds such as glutathione (GSH). This has been known to cause a decrease in wine quality and an increase in unwanted flavours. In this study, a young Sauvignon blanc wine was saturated with oxygen at five different stages over a 7 month period. Chemical analyses and sensory analyses were done for all five stages at the end of the trail to investigate the effect of repetitive oxidation on the various wine constituents and the sensory characteristics of the wine.

AIMS

Assess the effect of repetitive oxygen addition and subsequent aging on:

- Overall sensory perception of the wine
- Character impact compounds such as the volatile thiols and oxidation related aromatic compounds such as acetaldehyde
- Non volatile compounds such as glutathione

Figure 1. Control and Ox samples (left) Oxygen sparging (right)

EXPERIMENTAL PROCEDURE

- Commercial wine obtained just after 2011 harvest
- Wine divided into 4.5 L bottles (figure 1)
- No oxygen added to Control samples (table1)
- Oxygen added to specified treatments (Ox)
- Process repeated once all oxygen was consumed
- Wine stored at 15˚C at all times

Treatment example:

- T1 Ox was oxygenated only once and the sample was frozen (-20˚C) after oxygen was consumed. All other treatments was oxygenated again thereafter.
- T5 Ox was oxygenated at 5 stages to reach a consumed oxygen level of 30 mg/L

Table 1. Treatment code and total amount of oxygen consumed (mg/L)

		Dissolved oxygen concentration (mg/L)	
Treatment and days aged		Control	Ox
T0	**(0 days)**	0	
T1	**(64 days)**	0	7
T2	**(148 days)**	0	12
T3	**(190 days)**	0	17
T4	**(204 days)**	0	22
T5	**(218 days)**	0	30

RESULTS

The PCA biplot of the results obtained during sensory profiling of the wine samples is shown in figure 2. 96.8% of the variation was described by the first two factors. PC1 is driven by different descriptors with fresh and fruity descriptors located at the left of the PC and oxidation characters developing to the right. T0 Control had the highest intensity in fresh and fruity descriptors. Control samples T1-T5 displayed a lower intensity of these descriptors and started to develop characteristics shown at the bottom of the biplot.

The oxidized samples developed considerably from left to right. Surprisingly, T1 Ox was more closely associated with T0 Control when compared to any of the other wines. T2 and T3 Ox was mildly oxidized showing higher intensities in honey, dried fruit, yellow apple and syrup aromas. T4 and T5 Ox was completely oxidized with strong characters of green apple, sherry and potato bag.

The aromatic thiols are known to be very sensitive to oxidation. In the control and the oxidized samples there was a significant decrease in concentration of 4MMP and 3MHA (table 2). However, the Control samples of 3MH initially increased, probably due to ester hydrolysis of 3MHA to produce 3MH. Antioxidants such as glutathione (GSH) and free SO_2 concentration decreased during aging, however this decrease was more significant in the Ox samples. Acetaldehyde concentrations increased from 42.6 mg/L (T0) to 94.6 mg/L (T5 Ox). This could have a significant influence on the oxidative character of the wine contributing especially to the green apple and sherry descriptors. Spectrophotometric analyses at 420 nm showed a clear increase in the brown color in the wines. This was confirmed by a panel arranging wines from least oxidized to most oxidized (figure 3).

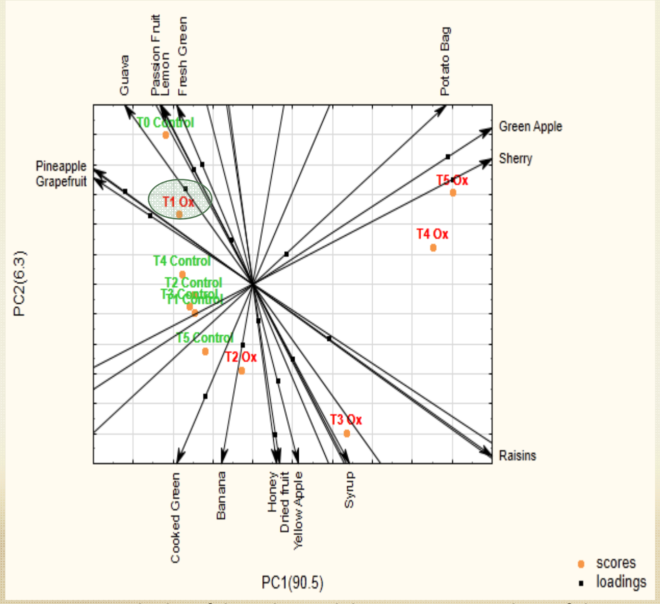

Figure 2. PCA biplot of data obtained during sensory analysis of the wines

Table 2. Concentrations of various compounds and spectrophotometric measurements at 412 nm

	4MMP (ng/L)		3MH (ng/L)		3MHA (ng/L)		GSH (mg/L)		Free SO_2 (mg/L)		Acetaldehyde (mg/L)		420 nm	
	Control	Ox	Control	Ox	Control	Ox	Control	Ox	Control	Ox	Control	Ox	Control	Ox
T0	37.3^{a}		647.9^{c}		97.6^{a}		26.8^{a}		43.3^{a}		42.6^{d}		0.053^{g}	
T1	28.9^{b}	25.6^{b}	640.3^{c}	575.5^{d}	83.2^{b}	76.1^{bc}	10.3^{b}	5.4^{d}	31.7^{b}	19.7^{e}	41.7^{d}	42.8^{d}	0.055^{gf}	0.062^{e}
T2	15.4^{cde}	16.1^{cd}	807.1^{a}	516.3^{e}	76.4^{bc}	48.2^{d}	7.8^{c}	1.5^{e}	32.0^{b}	10.0^{f}	41.4^{d}	42.8^{d}	0.059^{ef}	0.077^{d}
T3	19.5^{c}	10.2^{fe}	824.4^{a}	397.4^{f}	69.1^{c}	41.5^{de}	6.1^{d}	0.6^{e}	31.3^{bc}	7.0^{g}	40.4^{d}	51.8^{c}	0.058^{ef}	0.085^{c}
T4	9.6^{f}	9.7^{f}	790.7^{a}	370.3^{f}	62.5^{c}	24.4^{f}	5.5^{d}	0.6^{e}	29.7^{dc}	6.7^{gh}	40.9^{d}	78.4^{b}	0.059^{ef}	0.093^{b}
T5	12.0^{fd}	9.5^{f}	709^{b}	294.9^{g}	62.7^{c}	29.6^{fe}	5.4^{d}	0.6^{e}	28.3^{d}	5.0^{h}	40.6^{d}	94.6^{a}	0.061^{e}	0.098^{a}

CONCLUSIONS

The negative effect oxygen has on wine was evident in this trail and it seems that in this case, a dissolved oxygen concentration of 17-20 mg/L was the turning point where any sought after characteristics started to diminish. Interestingly, T1 Ox (which consumed 7 mg of oxygen and aged for 64 days at 15 ˚C) was more closely correlated to T0 Control when compared to other control samples (even T1 Control). This could indicate to slight oxidation not leading to a decrease in quality as is generally believed. Further analyses should be done to determine the factors causing some wines to still score fresh at sensory analyses, even after oxygen was added.

Figure 3. Wines arranged from least oxidized to most oxidized