Repetitive oxidation of Sauvignon blanc wine: the evolution of aroma compounds

C. Coetzee [1], A.C. Silva Ferreira [1,2], W.J. du Toit [1]

email: wdutoit@sun.ac.za

[1]Department of Viticulture and Oenology, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa.

[2]Universidade Católica Portuguesa, Escola Superior de Biotecnologia, Rua Dr António Bernardino de Almeida, 4200-072, Porto, Portugal.

Viticulture and Oenology
STELLENBOSCH UNIVERSITY

INTRODUCTION

South African Sauvignon blanc wines can be given aroma descriptors such as green pepper, grassy, asparagus; while other more tropical aromas include passion fruit and guava. Compounds responsible for these descriptors have been identified to be mostly the methoxypyrazines and the volatile thiols. The major issue concerning Sauvignon blanc oxidation seems to be the degradation of these positive related aroma compounds, especially the sulphur-containing volatiles, and the formation of compounds responsible for oxidative aromas such as aldehydes and sotolon. The change in chemical composition relates to sensory changes which leads to a wine with an aged character. In this study, a young Sauvignon blanc wine was saturated with oxygen at five different stages over a 7 month period. Chemical and sensory analyses were done for all five stages 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:

- Aroma compounds such as the volatile thiols and oxidation related aromatic compounds such as acetaldehyde, methional and sotolon
- Overall sensory perception of the wine
- Non volatile compounds such as glutathione

$$OAV = \frac{\text{Concentration}}{\text{Threshold}}$$

The ratio of an odour active compound to its threshold of human detection. An OAV of 1.0 would mean a compound was present at a level equal to its threshold of detection; compounds with a high OAV are likely to impact the aroma of the wine.

EXPERIMENTAL PROCEDURE

- Commercial wine obtained just after 2011 harvest
- Wine divided into 4.5 L bottles (Figure 1) - triplicate
- No oxygen added to Control samples (Table 1)
- Oxygen added according to specified treatments (Ox) ,process repeated once all oxygen was consumed
- Wine stored in the dark at 15˚C at all times
- Sensory and chemical analyses were done once all the samples was collected
- Descriptive analyses - 12 Judges, 8 training sessions, 6 testing sessions

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 and total amount of oxygen dissolved

Treatment and days aged		Dissolved oxygen concentration (mg/L) 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

Figure 1. Oxygen sparging

RESULTS

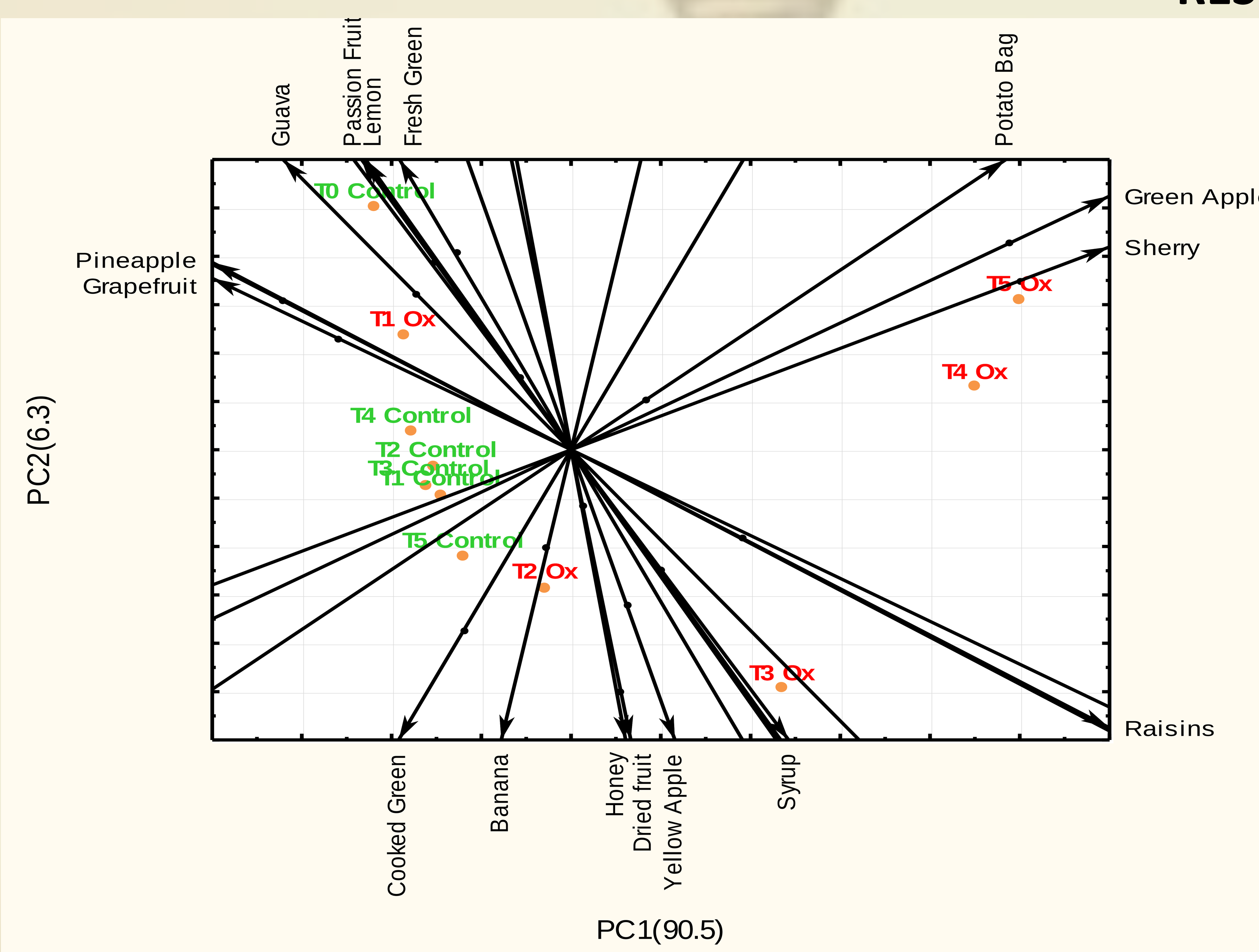

Figure 2. PCA plot of data obtained from descriptive analyses of wines oxidized to various degrees over time

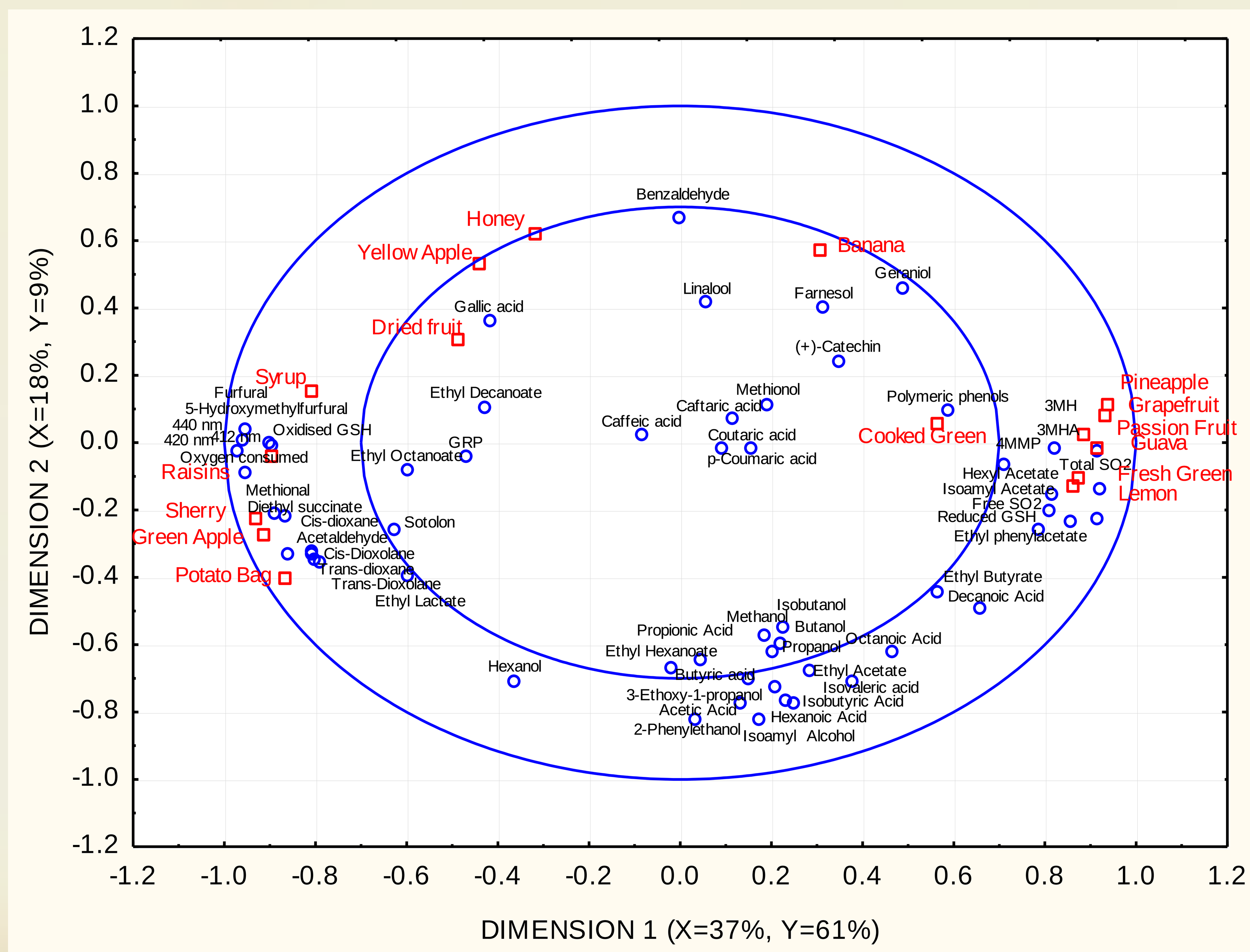

Figure 3. PLS plot of component 1 and component 2 containing chemical information in the X-space and the sensory descriptive data in the Y-space

Table 2. Concentrations and OAV (in brackets) of various compounds

	4MMP (ng/L)		**3MHA (ng/L)**		**3MH (ng/L)**	
Perception threshold in Model wine	0.8 ng/L		4.2 ng/L		60 ng/L	
Treatment	Control	Ox	Control	Ox	Control	Ox
Time						
T0	37.34^{a}(46.7)		97.61^{a}(23.2)		647.91^{c}(10.8)	
T1	28.92^{b}(36.2)	25.57^{b}(32.0)	83.23^{b}(19.8)	76.14^{bc}(18.1)	640.33^{c}(10.7)	575.46^{d}(9.6)
T2	15.40^{cde}(19.3)	16.15^{cd}(20.2)	76.41^{bc}(18.2)	48.15^{d}(11.5)	807.1^{a}(13.5)	516.31^{e}(8.6)
T3	19.47^{c}(24.3)	10.22^{fe}(12.8)	69.15^{c}(16.5)	41.46^{de}(9.9)	824.44^{a}(13.7)	397.37^{f}(6.6)
T4	9.61^{f}(12.0)	9.71^{f}(12.1)	62.45^{c}(14.9)	24.38^{f}(5.8)	790.71^{a}(13.2)	370.29^{f}(6.2)
T5	12.02^{fd}(15.0)	9.49^{f}(11.9)	62.66^{c}(14.9)	29.58^{fe}(7.0)	709.00^{b}(11.8)	294.90^{g}(4.9)

	Methional (µg/L)		**Sotolon (µg/L)**		**Acetaldehyde (mg/L)**	
Perception threshold in Model wine	0.5 µg/L		2 µg/L		0.5 mg/L	
Treatment	Control	Ox	Control	Ox	Control	Ox
Time						
T0	0.58(1.2)		0.00(0)		42.61^{d}(85.2)	
T1	0.58(1.2)	0.58^{d}(1.2)	0.00(0)	0.13^{a}(0.1)	41.67^{d}(83.3)	42.84^{d}(85.7)
T2	0.58(1.2)	1.31^{c}(2.6)	0.00(0)	0.15^{a}(0.1)	41.42^{d}(82.8)	42.76^{d}(85.5)
T3	0.58(1.2)	2.64^{b}(5.3)	0.00(0)	0.13^{a}(0.1)	40.43^{d}(80.9)	51.81^{c}(103.6)
T4	0.58(1.2)	3.8^{a}(7.6)	0.00(0)	0.27^{a}(0.1)	40.95^{d}(81.9)	78.44^{b}(156.9)
T5	0.58(1.2)	4.1^{a}(8.2)	0.00(0)	0.41^{a}(0.2)	40.60^{d}(81.2)	94.62^{a}(189.2)

Values are means of triplicate analysis, OAV indicated in brackets; different letters within a compound denote significant differences at p<0.05.

CONCLUSIONS

The volatile thiols and a few acetate esters seems to be the main aroma compounds contributing to the fresh and fruity attributes described by a trained sensory panel. The low detection threshold of some of these compounds could make them very important in young Sauvignon blanc aroma profile and the preservation of these compounds during aging is very important. On the other hand, aroma compounds such as methional (*potato*) and acetaldehyde (*green apple*) could be detrimental to an aging wine as it reached an OAV level of 8.2 and 189 respectively and correlated well with oxidation related aroma attributes. The formation of methional in white wines have been reported in forced aged experiments (Silva Ferreira *et al.*, 2002). These results confirms the formation of methional even during mild oxidative conditions. Interestingly, T1 Ox correlated well with the fresh and fruity descriptors even though it was treated with oxygen. This suggests that a small dose of oxygen does not have the detrimental effect on the wine as is generally believed in practice. High OAV values does not necessarily lead to intense aroma perception by the panel. Aroma compounds could add to the complexity of the wine flavour at certain concentrations. Interactions between volatile compounds (as well as non-volatile compounds) could also influence the intensity of the attribute as well as the specific attribute used to describe the odor. Future work should include an interactive study to investigate masking and enhancing effects of certain compounds (such as acetaldehyde) at various concentrations.

Silva Ferreira, A.C., Guedes de Pinho, P., Rodrigues, P. & Hogg, T., 2002.
Kinetics of oxidative degradation of white wines and how they are affected by selected technological parameters. Journal of Agricultural and Food Chemistry 50, 5919-5924.