Industry allocated project number	PHI allocated project number

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Indicate (X) client(s) to whom this concept project proposal is submitted. Replace any of these with other relevant clients if required.

NB: The instructions in red, throughout the template, should be omitted from the final document.

FINAL REPORT
(2015)

1. PROGRAMME AND PROJECT LEADER INFORMATION

	Research Organisation Programme leader	Research Team Manager	Project leader
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2. PROJECT INFORMATION

Research Organisation Project number	WW-WdT-12/01
Project title	Anti-oxidant and oxygen program for South African white wines
Short title	Oxidation

Fruit kind(s)			
Start date (mm/yyyy)	1-1-2013	**End date** (mm/yyyy)	12-12-2014

Key words	Oxidation, Sauvignon blanc

Approved by Research Organisation Programme leader (tick box) ☐

THIS REPORT MUST INCLUDE INFORMATION FROM THE **ENTIRE** PROJECT

3. EXECUTIVE SUMMARY

*This must report on the **ENTIRE** project. Address the objectives and milestones of the project as well as the impact of the study on the industry.*

This project investigated the sensory and chemical changes in a Sauvignon blanc wine that underwent controlled, repetitive oxidation. Another aim was to asses the sensory interaction between two impact aroma compounds in Sauvignon blanc 2-methoxy-3-isobutylpyrazine and 3-mercaptohexanol (3MH) with certain oxidation derived compounds such as acetaldehyde, methional and phenylacetaldehyde. All these milestones were achieved. A Sauvignon blanc wines' sensory and chemical changes showed that certain sulphur compounds are most sensitive in terms of oxidation, with associated sensory descriptors being generated. A concurrent increase in oxidation derived compounds were also observed. The relevant statistical analyses showed a good correlation between the chemical and sensory composition of these wines.
Sensory interaction were also observed between oxidation derived compounds as well as 3MH and IBMP. In certain cases these compounds enhanced each other, while a masking or suppressive effect were often observed in others. This research can give industry some valuable information on which compounds are affected by oxidation of Sauvignon blanc as well as build a good foundation for follow on research in this field. A PhD student in wine chemistry also graduated from this research and is currently continuing her research in this field at the Department of Viticulture and Oenology at Stellenbosch University.

4. PROBLEM IDENTIFICATION AND OBJECTIVES

State the problem being addressed and the ultimate aim of the project.

The role of oxygen and anti-oxidants in white wine can play a critical role in the quality and longevity of the wine. However, how these compounds, which include phenolics, glutathione, SO_2 and oxygen, interact and influence the wine is still not well understood. The main aim of this study was thus to investigate the effect of controlled oxidation as could happen in a winemaking environment and assess it's effect on a South African white wine's composition and quality.
The sensory interactions between the varietal characters of Sauvignon blanc and typical white wine oxidation compounds also need attention. Sauvignon blanc is a complex cultivar and can deliver very different wine styles. On the one hand, the volatile thiols can lead to very tropical and fruity wines, while the methoxypyrazines can give the wine a green pepper, grassy and asparagus odour (Lacey *et al.*, 1991; Tominaga *et al.*, 1998; Swiegers *et al.*, 2006; Coetzee & Du Toit, 2012). Both of these odour groups are well sought after for the production of quality wines (Lund *et al.*, 2009b; King *et al.*,

2011). During aging, new aroma compounds can form which can change the aromatic composition of a wine. In white wine, compounds such as acetaldehyde, methional, phenylacetaldehyde and sotolon have been identified to play a key role in the developed aging character of especially white wines. These compounds contribute to the typical aging character by lending aroma attributes such as green apple skin, cooked potato, flowery, honey and curry odours. (Silva Ferreira *et al*., 2002; Frivik & Ebeler, 2003; Silva Ferreira *et al*., 2003a; Jackowetz & De Orduña, 2013). The sensory interaction between these groups of compounds has not been investigated. In this study, various compounds were added singularly and in combination to a model wine medium and evaluated by a trained sensory panel using descriptive analysis. Testing the interactions could shed some light on the oxidation capacity of white wines and possibly serve as a model to evaluate at what concentrations compound interactions become detrimental to the wine aromatic composition.

5. WORKPLAN (MATERIALS AND METHODS)

List trial sites, treatments, experimental layout and statistical detail, sampling detail, cold storage conditions and examination stages and parameters. Add additional rows if required.

A young Sauvignon blanc white wine was obtained and divided into two treatments (reductive with no O_2 exposure and oxidative with O_2 exposure (Refer to table 1). This experiment was performed in 4.5L canisters and the O_2 consumption monitored with the presense O_2 meter over a period of 204 days. At regular intervals O_2 was added to the wines and samples were then taken when the O_2 levels decreased to under 0.5 mg/L at the intervals indicated in Table 1. Sensory QDA was performed on the wines with a trained panel. We also performed a wide range of chemical analyses on the wines at the different stages.

Table 1: O_2 levels added to Sauvignon blanc wine over time.

Time stage	**O_2 consumed (mg/L) in reductive treatment**	**O_2 added to the oxidative treatment in mg/L**	**Total O_2 consumed (mg/L) in oxidative treatment**
T0 (0 days)	0	7	0
T1 (64 days)	0	5	7
T2 (148 days)	0	5	12
T3 (190 days)	0	5	17
T4 (204 days)	0	5	22
T5 (219 days)	0	8	30

We also assessed the sensory interaction between 3MH, IBMP, methional and phenylacetaldehyde. The interaction between 3MH, IBMP and acetaldehyde was also looked at. In tables 2 and 3 the levels investigated are shown, which were chosen to represent those occurring in wine. For this purpose Descriptive analyses were used using a trained sensory panel.

Table 2. Concentrations tested in the sensory interaction study

	Level and concentration				
Compound	1	2	3	4	5
3-Mercaptohexanol (ng/L)	40.0	60.0	500.0	2000.0	6000.0
2-Methoxy-3-isobutylpyrazine (ng/L)	1.0	2.0	10.0	20.0	40.0
Methional (µg/L)	0.3	0.5	3.0	6.0	15.0
Phenylacetaldehyde (µg/L)	0.5	1.0	30.0	80.0	130.0

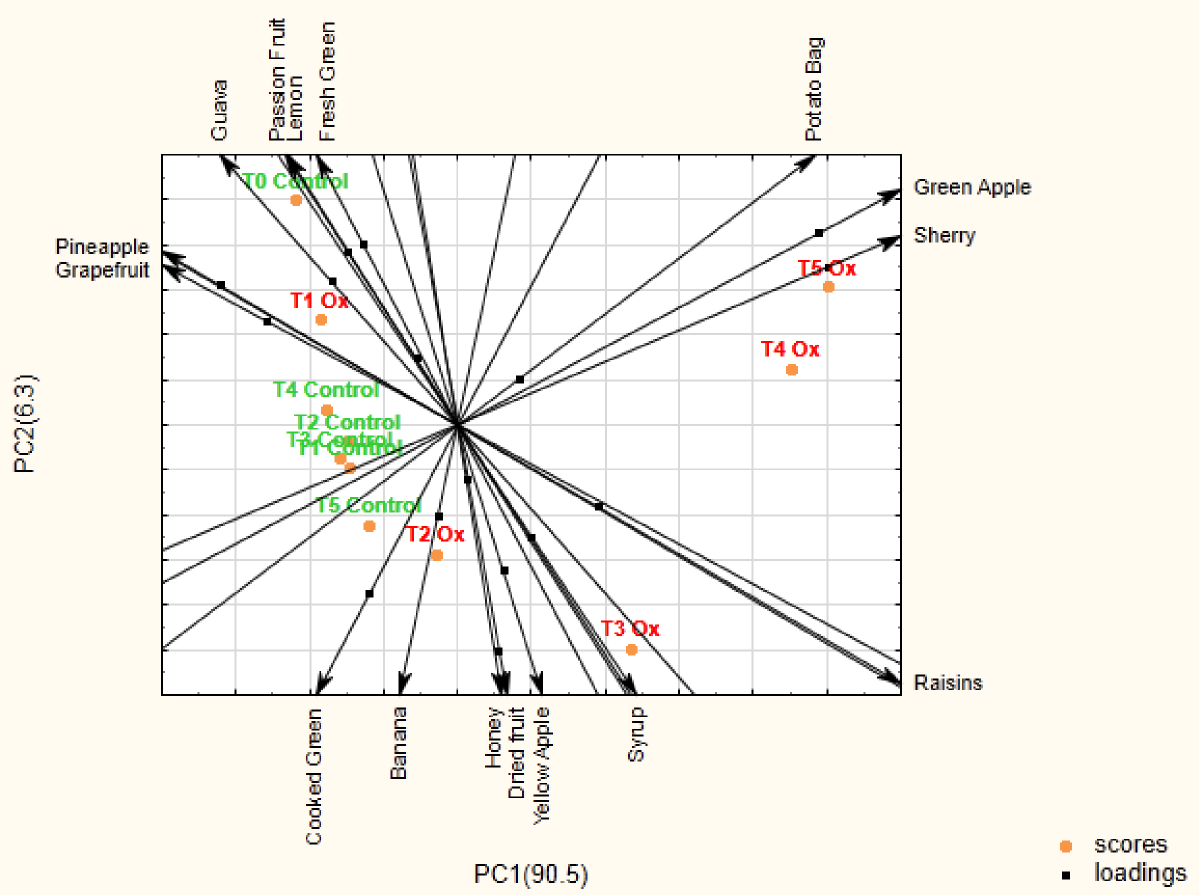
Table 3. Concentrations tested in the sensory interaction study

	Level and concentration				
Compound	1	2	3	4	5
3-Mercaptohexanol (ng/L)	40.0	60.0	500.0	2000.0	6000.0
2-Methoxy-3-isobutylpyrazine (ng/L)	1.0	2.0	10.0	20.0	40.0
Acetaldehyde (mg/L)	0.5	30	60	100	200

6. RESULTS AND DISCUSSION

We assessed the influence of repeated oxidation on a Sauvignon blanc white wine. In Figure 1 the sensory results generated from this work can be seen in a PCA biplot. It is clear that at time 0 the wines were rated as high in passion fruit, lemon, guava and fresh green, which was also the case at the T1 ox treatments. All the reductive treatments during the course of this experiment had these characteristics as well as high pineapple and grapefruit aromas. However, the oxidized treatments first had more cooked green, banana (T2), then honey, dried fruit, yellow apple, syrup characters (T3) as well as green apple and sherry aromas at time T4 and T5.

Fig 1. Sensory results of the Sauvignon blanc wine oxidation experiment.



This is the first controlled oxidative experiment where sensory DA was included which simulated what would happen under real wine making conditions, as all other studies in literature was done under conditions where forced oxidation was applied with levels of O_2 not normally found in winemaking. We have also completed the chemical analyses of these wines (thiols, methoxypyrazines, esters, SO2, glutathione etc) and the results are indicated in Table 4. This clearly indicates a decrease in thiols, certain anti-oxidants, with an increase in certain oxidation derived aroma compounds such as acetaldehyde, methional and furfural. PLS analyses of the data (Figure 2) clearly shows positive aroma descriptors such as tropical, guava, pineapple etc being associated with certain thiols and esters, while negative aroma descriptors such as sherry and green apple with acetaldehyde, furfural, methional etc.

We also investigated the sensory interactions between certain impact aroma compounds of Sauvignon blanc and oxidation derived aroma compounds. It was found that methional had a strong suppressive effect on the grapefruit and guava attributes of 3MH, while methional and IBMP in combination enhanced the cooked potatoes and cooked beans attributes. Depending on the concentration, acetaldehyde enhanced fruity attributes associated with 3MH at a lower concentration while suppression occurred at a higher concentration. Acetaldehyde effectively suppressed the green pepper aroma of IBMP at certain concentrations, while 3MH suppressed oxidised green apple associated with acetaldehyde.

This work highlights the importance of preserving fresh and fruity flavours associated with Sauvignon blanc, while preventing the formation of unwanted aldehydes due to interactions that can influence the overall aroma profile of the wine. Slight oxidation might even enhance the green style associated with certain Sauvignon blanc wines during ageing. However, too high levels of especially acetaldehyde and methional will impart to negative sensory characteristics.

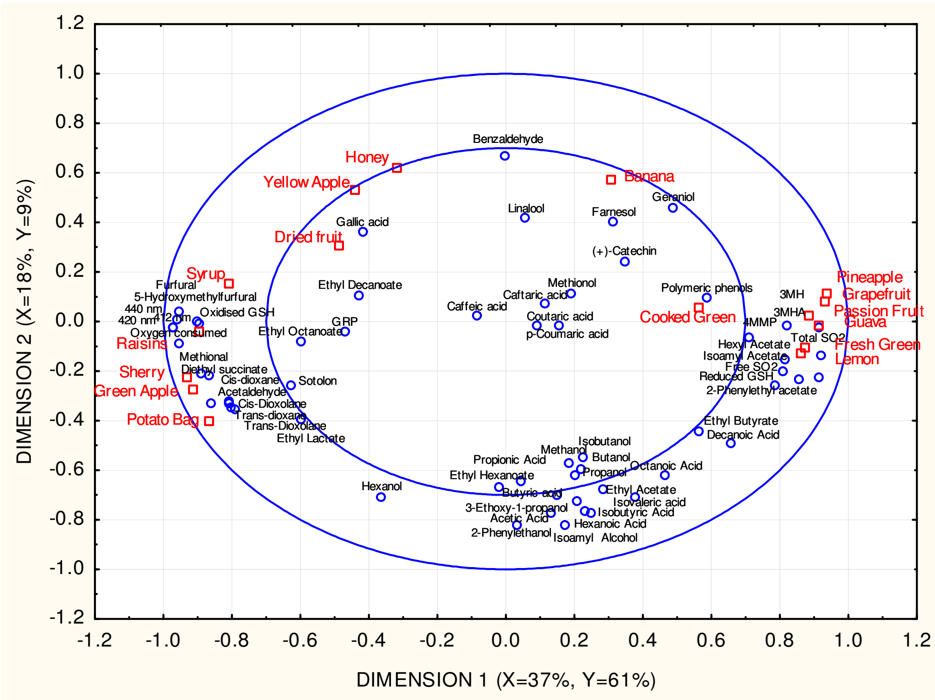
This work serves as a valuable basis for further research into oxidation of SA white wines, as it indicated which compounds are mostly affected during controlled oxidation which simulates real winemaking conditions. It also gives winemakers an idea on what sensory characteristics they can expect when these compounds occur at a certain level in their wines.

Table 4. Concentration and absorbance values of all chemical compounds measured. Values are means of triplicate analysis; different letters in a row indicate significant differences at $p<0.05$.

Compound	unit	T0 Control	T1 Control	T2 Control	T3 Control	T4 Control	T5 Control	T1 Ox	T2 Ox	T3 Ox	T4 Ox	T5 Ox
Oxygen												
Total amount of O_2 consumed	mg/L							6.59^{e}	11.93^{d}	16.99^{c}	22.18^{b}	29.99^{a}
Volatile Thiols												
4-Mercapto-4-methylpentan-2-one (4MMP)	ng/L	37.34^{a}	28.92^{b}	15.40^{cde}	19.47^{c}	9.61^{f}	12.02^{fd}	25.57^{b}	16.15^{cd}	10.22^{fe}	9.71^{f}	9.49^{f}
3-Mercaptohexylacetate (3MHA)	ng/L	97.61^{a}	83.23^{b}	76.41^{bc}	69.15^{c}	62.45^{c}	62.66^{c}	76.14^{bc}	48.15^{d}	41.46^{de}	24.38^{f}	29.58^{fe}
3-Mercaptohexanol (3MH)	ng/L	647.91^{c}	640.33^{c}	807.1^{a}	824.44^{a}	790.71^{a}	709.00^{b}	575.46^{d}	516.31^{e}	397.37^{f}	370.29^{f}	294.90^{g}
Esters												
Isoamyl acetate	mg/L	7.52^{a}	6.36^{b}	5.60^{c}	5.08^{cd}	4.78^{ed}	4.67^{efd}	6.27^{b}	4.93^{ed}	4.44^{ef}	4.40^{ef}	4.13^{f}
Hexyl acetate	mg/L	0.90^{a}	0.87^{b}	0.85^{c}	0.83^{cd}	0.83^{ed}	0.82^{efd}	0.87^{b}	0.83^{ed}	0.81^{ef}	0.81^{ef}	0.80^{f}
2-Phenylethyl acetate	mg/L	2.74^{a}	2.44^{b}	2.26^{bc}	2.17^{dc}	2.09^{dec}	2.02^{de}	2.43^{b}	2.11^{dec}	1.99^{de}	1.99^{de}	1.92^{c}
Ethyl acetate	mg/L	87.09^{a}	81.33^{ab}	82.36^{ab}	82.07^{ab}	73.04^{b}	82.73^{ab}	81.61^{ab}	74.22^{b}	77.47^{ab}	82.23^{ab}	77.73^{ab}
Ethyl butyrate	mg/L	0.57^{a}	0.55^{ac}	0.55^{ab}	0.53^{ac}	0.51^{ac}	0.54^{ac}	0.53^{ac}	0.50^{c}	0.52^{ac}	0.51^{cb}	0.49^{c}
Ethyl lactate	mg/L	5.00^{c}	5.43^{c}	8.05^{ab}	9.05^{a}	7.42^{b}	9.37^{a}	5.68^{c}	7.18^{b}	8.35^{ab}	9.40^{a}	9.41^{a}
Ethyl hexanoate	mg/L	1.50^{a}	1.52^{a}	1.54^{a}	1.54^{a}	1.51^{a}	1.51^{a}	1.52^{a}	1.44^{a}	1.48^{a}	1.56^{a}	1.53^{a}
Ethyl octanoate	mg/L	1.36^{d}	1.87^{b}	1.62^{bc}	1.61^{bd}	1.56^{dc}	1.36^{dc}	1.86^{b}	1.48^{dc}	1.86^{b}	2.27^{a}	1.86^{b}
Ethyl decanoate	mg/L	2.12^{de}	3.91^{a}	2.64^{db}	2.45^{dc}	2.33^{dc}	1.56^{e}	3.40^{ab}	2.27^{de}	3.31^{ab}	3.82^{a}	3.13^{abc}
Diethyl succinate	mg/L	0.45^{g}	0.67^{f}	1.03^{e}	1.28^{d}	1.30^{d}	1.44^{c}	0.72^{f}	1.09^{e}	1.51^{c}	1.77^{b}	1.94^{a}
Acids												
Acetic acid	mg/L	446.88^{a}	415.44^{ac}	438.25^{ab}	433.74^{ab}	371.12^{c}	429.15^{ab}	413.92^{ac}	390.24^{cb}	402.02^{ac}	422.57^{ac}	432.95^{ab}
Propionic acid	mg/L	1.85^{a}	1.74^{a}	1.88^{a}	1.93^{a}	1.68^{a}	1.90^{a}	1.79^{a}	1.70^{a}	1.80^{a}	1.86^{a}	1.86^{a}
Butyric acid	mg/L	0.29^{a}	0.28^{a}	0.29^{a}	0.30^{a}	0.28^{a}	0.29^{a}	0.28^{a}	0.28^{a}	0.28^{a}	0.29^{a}	0.28^{a}
Isobutyric acid	mg/L	0.78^{a}	0.73^{ab}	0.76^{ab}	0.76^{ab}	0.70^{b}	0.74^{ab}	0.74^{ab}	0.71^{ab}	0.71^{ab}	0.76^{ab}	0.74^{ab}
Isovaleric acid	mg/L	0.63^{a}	0.58^{ab}	0.60^{ab}	0.61^{ab}	0.58^{ab}	0.60^{ab}	0.59^{ab}	0.56^{b}	0.57^{b}	0.60^{ab}	0.57$_{ab}$
Hexanoic acid	mg/L	5.51^{a}	5.22^{a}	5.40^{a}	5.44^{a}	5.30^{a}	5.32^{a}	5.23^{a}	5.03^{a}	5.09^{a}	5.32^{a}	5.32^{a}
Octanoic acid	mg/L	8.02^{a}	7.34^{ac}	7.82^{ac}	7.94^{ab}	7.84^{ac}	7.85^{ac}	7.27^{ac}	7.24^{ac}	7.05^{cb}	6.98^{c}	7.46^{ac}
Decanoic acid	mg/L	2.97^{a}	2.25^{ce}	2.54^{cb}	2.54^{cb}	2.53^{cbd}	2.66^{ab}	2.18^{ce}	2.28^{ceb}	2.02^{e}	2.07^{e}	2.14^{ed}
Alcohols												
Methanol	mg/L	107.93^{ab}	97.44^{ab}	107.83^{ab}	90.69^{ab}	83.25^{ab}	116.69^{a}	96.79^{ab}	69.46^{b}	83.93^{ab}	88.58^{ab}	103.24^{ab}
Propanol	mg/L	61.62^{a}	57.05^{ab}	58.88^{ab}	57.88^{ab}	50.21^{b}	56.40^{ab}	57.12^{ab}	52.55^{ab}	54.81^{ab}	57.32^{ab}	56.47^{ab}
Butanol	mg/L	1.70^{a}	1.59^{ab}	1.66^{a}	1.59^{ab}	1.38^{b}	1.56^{ab}	1.55^{ab}	1.47^{ab}	1.49^{ab}	1.57^{ab}	1.56^{ab}
Isobutanol	mg/L	19.25^{a}	18.14^{ab}	18.53^{ab}	18.13^{ab}	15.90^{b}	17.84^{ab}	17.72^{ab}	16.74^{ab}	17.30^{ab}	17.91^{ab}	17.50^{ab}
Isoamyl alcohol	mg/L	161.59^{a}	155.43^{a}	160.90^{a}	159.98^{a}	149.95^{a}	157.98^{a}	153.75^{a}	148.48^{a}	150.57^{a}	157.03^{a}	158.67^{a}
Hexanol	mg/L	0.91^{cb}	0.91^{c}	0.97^{ac}	0.99^{ab}	0.96^{ac}	0.99^{ac}	0.91^{cb}	0.91^{cb}	0.95^{ac}	1.00^{a}	1.03^{a}
Phenylethanol	mg/L	13.49^{a}	13.00^{a}	13.39^{a}	13.59^{a}	12.71^{a}	13.10^{a}	13.02^{a}	12.57^{a}	12.75^{a}	13.43^{a}	13.57^{a}
3-Ethoxy-1-propanol	mg/L	2.06^{a}	1.92^{ab}	2.09^{a}	2.06^{a}	1.59^{b}	2.01^{a}	2.00^{a}	1.67^{ab}	1.78^{ab}	1.95^{ab}	1.95^{ab}
Methionol	peak/IS ratio	247.41^{a}	243.31^{a}	244.31^{a}	256.05^{a}	236.03^{a}	248.98^{a}	246.16^{a}	240.95^{a}	236.73^{a}	235.56^{a}	238.04^{a}
Monoterpenes												
Linalool	mg/L	10.46^{e}	11.50^{cd}	12.86^{ab}	13.07^{ab}	11.44^{cd}	11.13^{ed}	11.59^{cd}	12.08^{cb}	13.10^{a}	10.68^{ed}	10.88^{ed}
Geraniol	mg/L	1484.25^{a}	1480.22^{a}	1431.77^{a}	1551.61^{a}	1131.57^{b}	984.73^{bc}	1606.67^{a}	1442.44^{a}	1640.41^{a}	864.74^{c}	937.26^{bc}
Farnesol	mg/L	32.84^{a}	39.00^{a}	34.25^{a}	34.03^{a}	18.77^{b}	16.93^{b}	41.99^{a}	34.02^{a}	39.84^{a}	21.26^{b}	20.08^{b}
Antioxidants												
Free SO_2	mg/L	43.33^{a}	31.67^{b}	32.00^{b}	31.33^{bc}	29.67^{dc}	28.33^{d}	19.67^{e}	10.00^{f}	7.00^{g}	6.67^{gh}	5.00^{h}
Total SO_2	mg/L	100.33^{a}	93.33^{b}	90.67^{b}	93.67^{b}	93.67^{b}	92.33^{b}	82.00^{c}	60.67^{d}	59.67^{d}	55.67^{de}	51.33^{e}
Reduced glutathione	mg/L	16.79^{a}	10.27^{b}	7.78^{c}	6.12^{d}	5.55^{d}	5.42^{d}	5.39^{d}	1.52^{e}	0.56^{e}	0.62^{e}	0.57^{e}
Oxidised glutathione	mg/L	0.09^{f}	0.27^{dce}	0.16^{fe}	0.15^{fe}	0.23^{de}	0.15^{fe}	0.21^{df}	0.33^{dc}	0.38^{bc}	0.48^{b}	0.70^{a}
Grape Reaction Procuct	Caftaric acid units	2.04^{c}	3.45^{b}	3.94^{b}	3.86^{b}	5.51^{a}	5.20^{a}	3.62^{b}	3.82^{b}	4.13^{b}	5.74^{a}	4.23^{b}
Phenols												
Gallic acid	mg/L	0.29^{b}	0.52^{a}	0.51^{a}	0.49^{a}	0.51^{ac}	0.50^{a}	0.50^{a}	0.49^{a}	0.52^{a}	0.49^{a}	0.49^{a}
***(+)*- Catechin**	mg/L	2.62^{c}	3.51^{a}	3.47^{a}	3.08^{ac}	3.30^{ab}	3.25^{ab}	3.12^{ac}	2.83^{cb}	2.86^{cb}	2.83^{cb}	2.64^{c}
Caffeic acid	mg/L	6.00^{b}	6.83^{a}	6.43^{ab}	6.39^{ab}	6.64^{ab}	6.64^{ab}	6.35^{ab}	5.93^{b}	6.38^{ab}	6.34^{ab}	6.46^{ab}
***trans*- Caftaric acid**	Caffeic acid equivalents	11.26^{dc}	12.63^{a}	11.90^{ad}	11.97^{ad}	12.40^{ab}	12.46^{ab}	12.01^{abc}	11.13^{d}	11.69^{db}	12.08^{abc}	11.45^{dc}
***p*- Coumaric acid**	mg/L	3.96^{ab}	4.44^{a}	4.17^{ab}	4.17^{ab}	4.29^{a}	4.30^{a}	4.08^{ab}	3.78^{b}	4.07^{ab}	4.03^{ab}	4.11^{b}
***p*- Coutaric acid**	Coumaric acid equivalents	0.75^{e}	0.85^{bc}	0.84^{bc}	0.88^{b}	0.95^{a}	0.95^{a}	0.77^{ed}	0.77^{e}	0.80^{ec}	0.83^{bcd}	0.76^{e}
Polymeric phenols	Catechin equivalents	20.06^{ab}	20.81^{a}	17.89^{cd}	17.62^{cf}	16.52^{fc}	15.92^{fe}	18.62^{cb}	17.19^{cf}	17.67^{cde}	16.65^{fd}	15.72^{f}
Carbonyl compounds												
Acetaldehyde	mg/L	42.61^{d}	41.67^{d}	41.42^{d}	40.43^{d}	40.95^{d}	40.60^{d}	42.84^{d}	42.76^{d}	51.81^{c}	78.44^{b}	94.62^{a}
Methional	ug/L	0.00	0.00	0.00	0.00	0.00	0.00	0.58^{d}	1.31^{c}	2.64^{b}	3.8^{a}	4.1^{a}
Phenylacetaldehyde	ug/L	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzaldehyde	peak/IS ratio	12.53^{d}	12.95^{dc}	14.64^{dc}	17.91^{bc}	17.02^{bd}	16.36^{bd}	20.46^{b}	31.00^{a}	29.43^{a}	15.37^{dc}	6.78^{e}
Furfural	peak/IS ratio	10.91^{e}	18.60^{d}	25.57^{d}	34.61^{c}	34.98^{c}	35.88^{c}	23.32^{d}	51.81^{b}	79.29^{a}	75.77^{a}	81.89^{a}
5-Hydroxymethylfurfural	peak/IS ratio	4.32^{d}	6.91^{bd}	6.07^{dc}	6.82^{bd}	9.29^{bc}	8.80^{bc}	7.41b^{d}	10.55^{b}	16.68^{a}	15.81^{a}	17.42^{a}
Sotolon	ug/L	0.00	0.00	0.00	0.00	0.00	0.00	0.13^{a}	0.15^{a}	0.13^{a}	0.27^{a}	0.41^{a}
Acetals												
***Cis*- dioxane**	peak/IS ratio	14.31^{c}	13.54^{c}	13.78^{c}	15.11^{c}	13.27^{c}	13.31^{c}	16.79^{c}	16.51^{c}	26.04^{c}	41.98^{b}	94.10^{a}
Cis-dioxolane	peak/IS ratio	6.82^{c}	2.82^{c}	2.02^{c}	2.00^{c}	1.86^{c}	1.78^{c}	7.30^{c}	5.34^{c}	28.08^{c}	71.49^{b}	182.00^{a}
***Trans*- dioxane**	peak/IS ratio	3.36^{cd}	3.07^{d}	3.08^{cd}	3.18^{cd}	3.04^{d}	2.97^{d}	3.84^{cd}	3.28^{cd}	5.97^{c}	9.75^{b}	21.61^{a}
***Trans*- dioxolane**	peak/IS ratio	4.91^{c}	2.12^{c}	1.40^{c}	1.34^{c}	1.14^{c}	1.07^{c}	4.25^{c}	3.01^{c}	11.96^{c}	31.23^{b}	82.79^{a}
Spectrophotometric measurements												
420 nm	absorbance units	0.053^{g}	0.055^{gf}	0.059^{ef}	0.058^{ef}	0.059^{ef}	0.061^{e}	0.062^{e}	0.077^{d}	0.085^{c}	0.093^{b}	0.098^{a}
440 nm	absorbance units	0.039^{g}	0.040^{gf}	0.043^{fe}	0.042^{efg}	0.042^{fe}	0.044^{de}	0.047^{d}	0.059^{c}	0.064^{b}	0.070^{a}	0.073^{a}

IS = Internal standard

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



7. COMPLETE THE FOLLOWING TABLE

Milestone	Target Date	Extension Date	Date completed	Achievement
Sensory interactions between IBMP, 3MH, methional and phenylacetaldehyde in model wine	2013		2013	Article published and part of PhD thesis
Sensory results of reductive vs oxidative treated wines	2014		2014	Part of PhD thesis
Chemical analyses of above-mentioned wines	2014		2014	Part of PhD thesis
Sensory interactions between IBMP, 3MH and acetaldehyde	Partially completed 2014		2014	Article published and part of PhD thesis

5. Journal publication(s) – final milestone	2014			Two of the three envisaged peer reviewed articles have been published, while we are busy preparing the third one.

8. CONCLUSIONS

Some O_2 additions to white wines containing sufficient SO_2 should not always damage the wine excessively, but total O_2 levels exceeding 10-20 mg/L can lead to white wine drastically changing and later becoming completely oxidized. This leads to an increase in negative aroma descriptors, with an increase in oxidation related compounds being formed. This work can also give winemakers an idea at what levels oxidation derived compounds such as acetaldehyde might start to become problematic in their Sauvignon blanc wines.

9. ACCUMULATED OUTPUTS

List ALL the outputs from the start of the project. The year of each output must also be indicated.

a) TECHNOLOGY DEVELOPED, PRODUCTS AND PATENTS

Indicate the commercial potential of this project, e.g. Intellectual property rights or commercial product(s).

No new products have been developed, but valuable information regarding the oxidation of white wines has been generated.

b) SUGGESTIONS FOR TECHNOLOGY TRANSFER

Provide steps taken to ensure the transfer of the gained/new information/knowledge to ultimately benefit the South African fresh fruit industry.

These results were presented to the SA and international wine community at various conferences. A number of peer reviewed and popular articles have been written or will be written.

c) HUMAN RESOURCES DEVELOPMENT/TRAINING

Complete the following table, adding more lines if necessary.

Student Name and Surname	Student Nationality	Degree (e.g. MSc Agric, MComm)	Level of studies in final year of project	Graduation date	Total cost to industry throughout the project
Honours students					
Masters Students					

PhD students					
Carien Coetzee	South African	PhD Agric	Obtained degree	April 2014	195000
Postdocs					
Support Personnel					

d) PUBLICATIONS (POPULAR, PRESS RELEASES, SEMI-SCIENTIFIC, SCIENTIFIC)
Please list using the format illustrated in the example below. ***ATTACH PDF COPIES OF ANY PAPERS ALREADY PUBLISHED***

W du Toit, D. Fracassetti, C. Coetzee, A. Vanzo, D. Ballabio. Hoe vinnig verdwyn suurstof uit witwyn? Winelands technical, September 2015.

C. Coetzee, J. Brand, G. Emerton, D. Jacobson, A.C. Silva Ferreira and WJ du Toit (2015). Sensory interaction between 3-mercaptohexan-1-ol, 3-isobutyl-2-methoxypyrazine and oxidation-related compounds. Australian Journal of Grape and Wine Research. 21, 179-188.

C. Coetzee, J. Brand, D. Jacobson, and WJ du Toit (2015). The sensory effect of acetaldehyde on the perception of 3-mercaptohexan-1-ol and 3-isobutyl-2-methoxypyrazine. Accepted for publication in Australian Journal of Grape and Wine Research.

PhD thesis: Coetzee, C. (2014). Oxidation treatments affecting Sauvignon blanc wine sensory and chemical composition. Supervisor, Female, white.

e) PRESENTATIONS/PAPERS DELIVERED
Please list using the format illustrated in the example below.

Coetzee, C. and WJ du Toit (2015) Recent research in Sauvignon blanc at the Department of Viticulture and Oenology. Sauvignon blanc interests group, April 2015.

Effect of oxidation on Sauvignon blanc wine sensory and chemical composition. 34th Conference of the South African Society for Enology and Viticulture, Paarl, South Africa.

Carien Coetzee, Jeanne Brand, Guy Emerton, Dan Jacobson, António C. Silva Ferreira, Wessel du Toit (2015). Sensory interaction between oxidation-related compounds and Sauvignon blanc character impact compounds. 9th Edition of the In Vino Analytica Scientia Symposium, Trento, Italy

Carien Coetzee, António César da Silva Ferreira, Wessel J du Toit (2015).
Repetitive oxidation of Sauvignon blanc wine: comparison of chemical and sensory data. 10th International Symposium of Enology of Bordeaux, Bordeaux, France.

Coetzee , C. Silva Ferreira ,A. WJ du Toit (2013) Effect of oxidation on Sauvignon blanc wine sensory and chemical composition. 34th Conference of the South African Society for Enology and Viticulture, Paarl, South Africa.

Wessel du Toit , Carien Coetzee , Katie Parish , Antonio Cesar Ferreira Paul Kilmartin (2013). Oxidative versus reductive handling of Sauvignon blanc grapes and wine. 15th Australian Wine Technical Conference, Sydney, Australia.

C. Coetzee, A. Silva Ferreira, W.J. du Toit 2013. Repetitive oxidation of Sauvignon blanc wine: the evolution of aroma compounds. 10th Pangborn Sensory Science Symposium, Windsor Barra Hotel, Rio de Janeiro, Brazil.) (11-15 August 2013).

10. BUDGET

a) TOTAL COST SUMMARY OF THE PROJECT

YEAR	CFPA	DFTS	Deciduous	SATI	Winetech	THRIP	OTHER	TOTAL
2013					150 000	75 000		225000
2014					180 000	90 000		270000

b) FINAL BUDGET/FINANCIALS OF PROJECT

Please ensure that the budget is sufficiently detailed and add notes to explain all significant variations from the budget – you may submit this in an EXCEL document. Please report on the budget for the entire duration of the project. Add additional rows if required.

Project duration	Proposed budget	Actual cost incurred	Variance	Notes
TOTAL INCOME				
Industry Funding	330 000			
PHI Funding				
Other Funding	165 000			
TOTAL EXPENDITURE				
Running Expenses				
General operating costs (printing, communication, etc.)				
Local Travel				
Publication costs				
Lab Analysis		R50 000		
Lab Consumables		R55 000		
Sensory panel cost		R100 000		
Running expenses SUB-TOTAL				
HR Administration and Project Management				
HR Technical				
HR Research				
Student Bursaries		195 000		
HR SUB-TOTAL				
OTHER EXPENSES				
17% Levy from US		84 000		
SURPLUS			10 000	