DIFFERENT OXYGEN AND SULPHUR DIOXIDE CONCENTRATIONS IN 'SAUVIGNON BLANC' MUST: EFFECT ON THE COMPOSITION OF THE MUST AND WINE•

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1. INRODUCTION

'Sauvignon blanc' is an important white wine cultivar in South Africa. Flavours associated with wine originating from 'Sauvignon blanc' are often described as either green or tropical. The green character can further be described as also being green pepper, grassiness or vegetative. These aromas normally originate from metoxypyrazines, of which 2-methoxy-3-isobutylpyrazine (IBMP) and 2-methoxy-3-isopropylpyrazine (IPMP) are the most important (Allen *et al*., 1991). Tropical aromas of Sauvignon blanc wines are normally due to volatile thiols, of which 4-mercapto-4-methyl-pentan-2-one (4MMP) reminiscent of box tree, passion fruit and black current and 3-mercaptohexan-1-ol (3MH) and 3-mercaptohexyl acetate (3MHA), which have passion fruit and grape fruit aromas, are the most important (Darriet *et al*., 1995; Tominaga *et al*., 1998) . These compounds are released from their precursors during alcoholic fermentation by the yeast.

During crushing of grapes, oxygen comes into contact with the grape must. Oxidation enzymes such as polyphenol oxidase and laccase can oxidize phenolic compounds in the must. Grape Reaction Product (GRP) is formed due to the oxidation of phenolic compounds in juice, such as caftaric acid, leading to the formation of an *o*-quinone. This *o*-quinone can associate with thiols such as glutathione (GSH) forming GRP in the process. It has also been proven in model wine solution that *o*-quinones can also react with volatile thiols such as 3MH (Nikolantonaki *et al*., 2010). These *o*-quinones can originate from the oxidation of caftaric acid, (+)-catechin or (-)-epicatechin.

In South Africa winemakers will often treat 'Sauvignon blanc' juice very reductively, by adding sulphur dioxide (SO_2), ascorbic acid or inert gasses such as N_2 or CO_2 to the must. This is done to protect the above-mentioned tropical aromas. The precursors of volatile thiols has been showed to be either cysteinylated or glutathionylated (Fedrizzi *et al*., 2009). However, these precursors have been shown to be not very sensitive towards oxidation (Roland *et al*., 2010). The question thus arises whether the above-mentioned reductive treatments of 'Sauvignon blanc' juice are really necessary to preserve these tropical aromas. Sulphur dioxide is often added to grape must to inhibit oxidation enzymes such as polyphenol oxidase or laccase. Sulphur dioxide can also react with H_2O_2 formed by

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the oxidation of phenolics, as well as reduce the *o*-quinone back (Danilewicz *et al*., 2008; Ribéreau-Gayon *et al*., 2006).

We have thus decided to investigate the effect of different oxygen and SO_2 additions to 'Sauvignon blanc' must. Previous studies have investigated the effect of different skin contact times, oxidation sensitivity of the precursors and the mechanisms of interaction between the thiol and *o*-quinones in model wine solutions (Nikolantonaki *et al*., 2010; Patel *et al*., 2010; Roland *et al*., 2010) , but little work has been done investigating the interaction between oxygen and SO_2 additions in real 'Sauvignon blanc' juice.

2. MATERIALS AND METHODS

During the 2009 vintage we collected 'Sauvignon blanc' juice from two different cellars (cellar 1 and 2). Both these cellars had Inertys presses (Bucher Inertys) which enable the pressing of the grapes under reductive conditions, as the membrane of the press is filled with N_2. The two juices were collected at roughly 1 bar pressure. This ensured higher concentrations of press juice, which had lower concentrations of SO_2 (less than 1 mg L^{-1} free). The juices were collected in steel canisters of which the air was previously removed by N_2 sparging and transported to the cellar of the Stellenbosch University. After this the two juices were divided into 4.5 L glass bottles and subjected to different treatments.

These treatments/additions were thus the following:

A. <0.5 mg L^{-1} O_2/ no SO_2

B. <0.5 mg L^{-1} O_2/ 60 mg L^{-1} SO_2

C. 4.0 mg L^{-1} O_2/ no SO_2

D. 4.0 mg L^{-1} O_2/ 60 mg L^{-1} SO_2

After settling at 15 °C overnight the juices were racked and inoculated with the yeast strain Vin 7 (Anchor Yeast Biotechnologies). After the completion of alcoholic fermentation the wines were racked again, left at 4 °C to settle and then bottled. After settling of the juice and in the wines samples were drawn and different analyses performed. These included caftaric acid with a modified HPLC version of Peng *et al*., 2002, volatile thiols and methoxypyrazine concentrations with GCMS (Tominaga *et al*., 1998) and glutathione concentrations determination with LCMC (Du Toit *et al.,* 2007). All experiments were performed in triplicate.

3. RESULTS AND DICUSSION

Slight differences in fermentation speed were observed between the different treatments, but all wines fermented to a residual sugar level of less than 4 g L^{-1}.

Glutathione concentrations in treatments A, B and D did not show significant differences. However, in treatment C, where no anti-oxidative protection of sulphur dioxide was available and oxygen was added, GSH levels dropped significantly in the juice during the settling period. Glutathione levels in treatments A, B and D were around 25 and 58 mg L^{-1} in juices 1 and 2 compared to those in treatment C which were around 5 and 42 mg L^{-1}, respectively. However, GSH levels dropped to lower than 10 mg L^{-1} in all treatments in both juices after alcoholic fermentation, with very little differences observed between the treatments. Caftaric acid and (+)-catechin concentrations were also significantly lower in treatment C, probably due to GRP formation between the *o*-quinone and GSH. Again in most cases no significant differences were observed between treatments A, B and D.

These tendencies were also seen in the 3MH and 3MHA concentrations in the final wines. 3MH concentrations found in wines from treatment C ranged from not detected to around 1100 ng L^{-1} in wines 1 and 2 respectively. Little differences were observed in the 3MH concentrations in the other treatments, with values ranging between 120 to160 ng L^{-1} and 1500 to 1600 ng L^{-1} for wines 1 and 2, respectively. Similar tendencies were also seen for 3MHA concentrations in both wines, with treatment C again having significantly lower concentrations of this thiol compared to the other treatments.

Levels of IBMP showed in general little differences between the different treatments, both in the juice and wines. This is in agreement with findings of Marais, 1998, who also found these compounds to be not very sensitive towards oxidation.

Recent findings from Roland *et al*. (2010), showed that the precursors of the volatile thiols do not seem sensitive towards oxidation. Decreases in thiol concentrations in model wine have been shown to be due to association of certain volatile thiols with *o*-quinones. Sulphur dioxide has also been showed to block this reaction (Nikolantonaki *et al*., 2010) which was also the case in our study. These results could have a profound impact on how winemakers treat 'Sauvignon blanc' juice in future, as only the judicious use of SO_2 in the must seems sufficient to protect volatile thiols in the resulting wine.

Abstract

The effects of different oxygen and sulphur dioxide additions to South African 'Sauvignon blanc' musts were investigated. Oxygen addition without SO_2 protection led to lower levels of certain volatile thiols in the wines, with a corresponding decrease in certain phenols and glutathione concentrations. However, sulphur dioxide prevented this from happening. Methoxypyrazines levels were also less affected by oxidation.

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