

## Introduction

Despite all that is known about the chemistry of SO<sub>2</sub> in wine, many questions about its practical use remain. Information is readily available in about the dynamic equilibrium of SO<sub>2</sub> in all its forms in solution<sup>1</sup> and the role of each of these forms in the antimicrobial, anti-enzymatic and antioxidant activities of SO<sub>2</sub> in wine<sup>2</sup>. Some sources provide guidelines for target free and molecular SO<sub>2</sub> to achieve different goals<sup>3</sup> and recent work has highlighted the limitations of our current measurement techniques<sup>4</sup>.

Given this knowledge, winemakers must make practical decisions such as the magnitude and timing of SO<sub>2</sub> additions based on their own winemaking goals. For example, is it better to do large additions and allow the free SO<sub>2</sub> to drift down over time, or several small additions to a target? This study explored the effects of the concentration and timing of SO<sub>2</sub> additions at the end of malolactic fermentation in Cabernet Franc and Cabernet Sauvignon produced in the Monticello AVA of Virginia.

## References

- (1) Boulton, R.; Singleton, V. L.; Bisson, L. F.; Kunkee, R. E. *Principles and Practices in Winemaking*; Chapman and Hall, Inc: New York, 1996.
- (2) Zoecklein, B. W. Sulfur Dioxide: Science behind This Antimicrobial, Antioxidant, Wine Additive. *Practical Winery and Vineyard Journal* 2009.
- (3) Cojocaru, G.; Antoce, O. Chemical and Biochemical Mechanisms of Preservatives Used in Wine: A Review. *Sci. Pap. Ser. B: Hort.* 2015, 56, 457–466.
- (4) Howe, P. A.; Worobo, R.; Sacks, G. L. Conventional Measurements of Sulfur Dioxide (SO<sub>2</sub>) in Red Wine Overestimate SO<sub>2</sub> Antimicrobial Activity. *Am J Enol Vitic.* 2018, 69 (3), 210–220.

## Materials and Methods

Wine from a single lot was racked after the completion of malolactic fermentation then transferred to comparable barrels for treatment. In 2018, Cabernet Franc wine was used while Cabernet Sauvignon wine was used in 2019. In each year, three pairs of comparable barrels were treated. In 2018, one member of each pair received 30 mg/L SO<sub>2</sub> (“low dose”) while the other received 75 mg/L (“high dose”). In 2019, the comparison was between 75 mg/L (“high”) and 100 mg/L (“very high”). Each year, Free SO<sub>2</sub> was measured periodically using aeration oxidation for 6 months with subsequent SO<sub>2</sub> additions made to achieve a target of 0.5 mg/L molecular SO<sub>2</sub>. General wine chemistry, phenolic chemistry, and microbiology were assessed at the end of 6 months.

Modified sensory analysis was completed by an untrained panel of wine producers. Wines were presented blind in randomly numbered glasses for a triangle test. Tasters were then asked to score each wine on a scale of 0 to 10 for color intensity, aromatic intensity, fruit intensity, astringency, and overall wine quality. They were also given open ended questions to describe the wines. Results for the triangle test were analyzed using a one-tailed Z test. Descriptive scores were analyzed using repeated measures ANOVA.

## Results and Conclusions

In 2018, wine receiving the high dose maintained free SO<sub>2</sub> levels at or near the target of 0.5 mg/L molecular SO<sub>2</sub>, (27 mg/L free) but still required SO<sub>2</sub> additions during aging. Wines given a low initial dose required many subsequent small additions of SO<sub>2</sub> over 6 months and spent much of the aging period below the target. The high dose wines had higher concentration of anthocyanins at the end of 6 months with no differences in polymeric anthocyanins or tannins. Two of the three low dose barrels finished aging with higher acetic acid than their high dose counterparts.

In 2019, wine receiving the “very high” dose maintained free SO<sub>2</sub> levels above the 0.5 mg/L target for molecular sulfur throughout the aging period without a need for additional doses. There was no difference in acetic acid accumulation between doses. At the end of the aging period, very high dose wines had higher total anthocyanins but lower tannins than high dose wines. Modified sensory analysis by an untrained panel of 23 winemakers found the wines were significantly different in a triangle test with significantly higher descriptive scores for aromatic intensity in the “very high” dose wine (p=0.05). Scores for color intensity and overall wine quality were nearly significantly different (p=0.07 and 0.1 respectively).

In the production winery, adding a larger initial dose of SO<sub>2</sub> better maintains SO<sub>2</sub> level associated with protection of wine than smaller doses toward the same target.

