Winemaker Trial

Oxygen Trials Reveal Effects of Processing Regimes on Chardonnay Style

Looking to cater to his winery's broad audience of Chardonnay drinkers, winemaker Theo Smith of Rappahannock Cellars in Virginia experimented with how varying the levels of oxygen during juicing affected his wines' aromas and flavor profiles.

THEO SMITH BEGAN his love of grape growing in 2006 during an internship in the Ohio River Valley. After receiving a BA in biology and a minor in chemistry from Franciscan University of Steubenville, he went on to Brock University to complete a certificate program in viticulture and enology. Smith has since worked harvests in Canada, the U.S. and France. He has been the winemaker at Rappahannock Cellars since 2011. With his love of crafting sparkling wines, Smith is also winemaker for Renault Winery in N.J., where he is helping rebuild the sparkling wine brand.

TRIAL OBJECTIVE: The objective of this trial was to explore the effects of different juice processing approaches (including stabulation and hyperoxygenation) on wine style in Chardonnay.

TRIAL DESCRIPTION: A 12-ton lot of Chardonnay was whole cluster-pressed with no added SO_2. Immediately after pressing the tank was mixed and then split into three tanks to receive three separate treatments: control, stabulation and hyperoxygenation.

The control tank received 30 ppm SO_2 and was cold-settled for one day prior to racking to a stainless steel tank for fermentation. A second tank was hyperoxygenated by pumping juice through a sump cart before returning to the top of the tank with splashing. Hyperoxygenation was run for one hour until the juice was fully brown and dissolved oxygen was 3.2 mg/L. (The dissolved oxygen in the control tank was 0.06 mg/L.) After hyperoxygenation, the juice was cold-settled for one day prior to racking to a stainless steel tank for fermentation.

The third tank was cooled to 32° F (0° C to 2° C) for four days with daily anaerobic stirring with nitrogen gas followed by blanketing with nitrogen (stabulation). After four days of stabulation, the tank was allowed to warm to 50° F prior to racking off the lees to a stainless steel tank for fermentation.

Each tank was inoculated with 25 g/hL Cross Evolution yeast rehydrated in 30 g/hL Go-Ferm. Fermentation was monitored daily for Brix and temperature. At the completion of fermentation, wine received 50 ppm SO_2.

Lot 1: Control **Lot 2:** Hyperoxygenated juice **Lot 3:** Stabulated juice

ANALYSIS NAME	LOT 1	LOT 2	LOT 3	UNITS
free sulfur dioxide	18	13	18	mg/L
molecular sulfur dioxide	0.42	0.28	0.4	mg/L
total sulfur dioxide	80	67	81	mg/L
titratable acidity	6.8	5.9	6.7	g/L
pH	3.43	3.47	3.45	
volatile acidity (acetic)	0.24	0.23	0.22	g/L
L-malic acid	2.92	0.54	2.91	g/L
glucose + fructose	0.2	0.2	0.5	g/L
ethanol at 20°C	13.24	13.19	13.24	% vol
ethanol at 60°F	13.2	13.15	13.2	% vol
Glutathione HPLC MS/MS (QQQ)	11.5	7.1	16	mg/L
Phenolic Profile (HPLC)				
gallic acid	<0.2	<0.2	<0.2	mg/L
catechin	<0.2	<0.2	<0.2	mg/L
astilbin	1.6	0.9	1.5	mg/L
tannin	17.5	16.9	17.7	mg/L
grape reaction product	4.4	<0.2	4	mg/L
caftaric acid	15.2	2	16.1	mg/L
caffeic acid	1.4	2.8	1.6	mg/L
quercetin glycosides	<0.2	<0.2	<0.2	mg/L
quercetin aglycone	<0.2	<0.2	<0.2	mg/L

ETS LABORATORIES

TRIAL CONCLUSION: When the wine had just finished fermentation, the general wine chemistry was expected to be very similar. Preliminary sensory analysis indicated differences in body and aromas among the lots. The wine with the most stabulated juice had generous fruit on the nose. The lot that received hyperoxygenation had more mineral character on the nose but less fruit. A further sensory analysis was completed by a blind panel of winemakers at a session in February.

The main chemical difference was that the hyperoxygenated lot went through partial malolactic fermentation, but the control and stabulation lots did not. All lots were sulfited at the end of alcoholic fermentation. Hyperoxygenation was done without the addition of sulfur dioxide, which gives microbes more opportunity to work.

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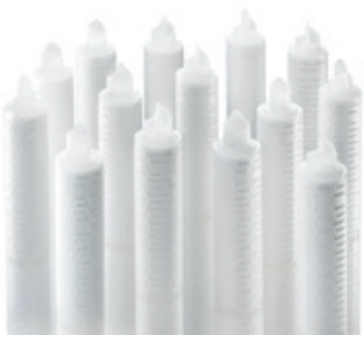

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White wine phenolics show that the hyperoxygenated lot had notably lower levels of caftaric acid (14.8 mg/L in control; 1.7 mg/L in hyperoxygenated), as well as caffeic acid. Both of these compounds would be expected to react with oxygen and precipitate with hyperoxygenation. Though there is no difference in color in the young wine, it is expected that the wine from hyperoxygenated juice will have less browning with age as a result of this change.

Winemaker Post-Mortem

Why were you interested in observing different juice processing approaches? Why Chardonnay over any other variety?

Smith: We grow a lot of great Chardonnay, and our wine club has varying stylistic preferences. We try to explore ways to deliver our customers different expressions of the same variety.

Describe how you set up the trial.

Smith: We used fruit from our Brown Bear Vineyards site in Shenandoah County, Virg. This site tends to produce Chardonnays with a lot of nerve and minerality, which is the core of what we would like our Chardonnays to convey. All fruit came from one block. It was pressed into a single tank, stirred and separated into three tanks for the trial.

Joy Ting from the Winemakers Research Exchange helped set up, execute and compile the data for the trial. Based on previous experience and research, we figured we would end up with three very different wines.

In the hyperoxygenated lot, did you approach the experiment with a desired DO in mind? If so, how did you determine that number?

Smith: We did not have a specific DO target. We read that we should pump over the entire volume of the tank two to three times and conclude hyperoxygenation within one hour. We pulled samples periodically to check the browning of the juice and watched the DO as an indicator of saturation. The DO did not change much in the first 30 minutes as most of the oxygen was getting bound. The juice began to brown noticeably, concurrent with a rise in DO, which makes sense.

In the stabulated lot, did you have any difficulty maintaining an anaerobic environment during the course of the trial?

Smith: The largest ingress of oxygen to the juice was from pressing. We didn't use a closed press and did not add $S0_2$ to the press pan because of the hyperoxygenated trial. Once the juice was in tank, we used a sparging stone and nitrogen to maintain an inert environment.

Did you encounter any complications during the course of the trial? If so, how did you and your team address that issue?

Smith: The hyperoxygenated trial accidentally went through partial ML. We did not add $S0_2$ to the juice, and there was plenty of O_2 for any indigenous microbes to use. Next time, we may try to pick earlier to retain more acid to help inhibit ML.

Was the outcome of this trial as you predicted?

Smith: The wines were very different than expected. The stabulated lot showed much more intense fruit and volume than we expected. Unfortunately, the hyperoxygenated lot went through ML, but this turned out to be our favorite wine now that it is aging in barrel.

Our initial impressions were that the control and stabulated wines had melon, tangerine and grassy notes (thiols). The wine from the stabulated juice had slightly more of these characteristics, as well as higher perceived density. The wine from the hyperoxygenated juice had more truffle and tea-like notes with more minerality and a leaner palate.

What were some of the notes from the sensory analysis you conducted in February?

Smith: These wines were included in a Winemakers Research Exchange sensory session where 30 winemakers tasted the wines blind. Both the stabulated and hyperoxygenated wines were distinguishable from the control in triangle tests. The wine made from the stabulated juice had significantly higher scores for overall aromatic intensity, citrus aromas and fruit intensity relative to control, using repeated ANOVA (Analysis of Variance) measures. The wine made from hyperoxygenated juice had significantly lower scores for fruit intensity and aromatic intensity with no differences in scores for acidity, minerality, bitterness or astringency. Note, these wines are still very young, and the hyperoxygenated lot is expected to improve in its scores for bitterness and astringency as it ages.

Based on the results of the trial, do you expect Rappahannock Cellars to make any changes to its Chardonnay winemaking routines?

Smith: The results were quite encouraging. We definitely have a home here for all three of these juice treatments.

What are some of the winemaking lessons/ takeaways you learned by conducting this experiment?

Smith: The hyperoxygenated lot showed fewer phenolics in the wine chemistry. Perhaps, if this treatment were used on press fractions or sparkling production, it may reduce or eliminate the need for PVPP or other fining agents. The stabulated trial shows a lot of potential, not just from a wine quality standpoint but also from a logistical perspective. The ability to create an inert and cold environment and add to that environment different lots of juice that have been processed over a one- or two-week period can save tank space and reduce the number of fermentations to manage. We have done this with our Rosé and really like what it has done for wine quality and cellar flow.

Do you plan to do a follow-up to this trial?

Smith: Yes, we will perform the same trial on our Chenin Blanc and continue to use it with our Chardonnays. We will also explore the application of these juice treatments in sparkling production, using both the traditional and Charmat methods. **WBM**