Winemaker Trial:
Use of PVI/PVP to Remove Copper and Aluminum to Avoid Sulfide Formation

Winemaker Cheney Vidrine looks to addition to stop potential reduction in canned Pinot Noir

CHENEY VIDRINE IS ONE of the winemakers at Union Wine Company, where he plays a significant role in an organization that crafts wines that diverge from what our industry considers "normal." Union Wine Company has been able to bring innovation to an industry that has historically found it hard to innovate by spearheading the canned-wine movement with its much-loved brand Underwood.

TRIAL OBJECTIVE: To evaluate the efficacy of PVI/PVP to remove metals, particularly copper and aluminum, and to help mitigate the potential formation of reduced sulfides. Empirical evidence within the wine industry suggests that wine packaged in cans has a higher potential than bottles to become reductive. This has predominantly been attributed to the presence of the can's air impermeability and partially attributed to a higher metal content of cans, which increases the reductive potential within the wine.

TRIAL DESCRIPTION: During the week of Dec. 2, we packaged our 2019 Underwood Pinot Noir. Prior to cross-flow filtration, we transferred wine from a large blending tank into four 550-gallon tanks. We added 50 g/hL of Claril HM, an Enartis product, to two of the tanks, following manufacturer instructions. The wines were racked, cross-flow-filtered, and then canned or bottled from the tanks on the same day. Random cans and bottles were removed from the line and kept for analysis. The treated and untreated wine will be packaged in both bottles and cans. Five bottles and five cans from both treated and untreated wine were analyzed two weeks after packaging, and again at six months after packaging. Analysis to be conducted includes free and total SO_2, pH, DO, CO_2, aluminum, iron and hydrogen sulfides.

Lot 1: 2019 Underwood Pinot Noir - Can - Untreated
Lot 2: 2019 Underwood Pinot Noir - Can - PVI/PVP
Lot 3: 2019 Underwood Pinot Noir - Bottle - Untreated
Lot 4: 2019 Underwood Pinot Noir - Bottle - PVI/PVP

TRIAL ANALYSIS:

Analysis Date:	12/9/19	12/23/19		4/28/20	
Free SO_2 (mg/L)	Can Control	9.2	(0.8)	4.6	(4.2)
	Can Claril HM	6.0	(0.0)	3.8	(0.8)
	Bottle Control	15.2	(1.3)	17.0	(1.0)
	Bottle Claril HM	15.6	(0.5)	13.7	(1.2)
Total SO_2 (mg/L)	Can Control	47.6	(1.3)	69.2	(1.1)
	Can Claril HM	39.8	(0.4)	62.2	(1.5)
	Bottle Control	56.6	(1.5)	82.7	(2.1)
	Bottle Claril HM	56.0	(0.0)	78.3	(2.3)
pH	Can Control			3.56	(0.05)
	Can Claril HM			3.58	(0.01)
	Bottle Control			3.56	(0.03)
	Bottle Claril HM			3.60	(0.01)
Dissolved Oxygen (mg/L)	Can Control	1.1	(0.3)	0.0	(0.0)
	Can Claril HM	0.3	(0.1)	0.0	(0.0)
	Bottle Control	0.3	(0.1)	0.0	(0.0)
	Bottle Claril HM	1.5	(0.1)	0.0	(0.0)
Carbon Dioxide (mg/L)	Can Control	1068.0	(69.5)	720.6	(18.8)
	Can Claril HM	1153.0	(63.5)	840.2	(18.3)
	Bottle Control	708.0	(134.1)	608.7	(6.1)
	Bottle Claril HM	698.0	(138.0)	620.3	(1.5)
Aluminum (µg/L)	Can Control	292.2	(8.6)	277.0	(1.4)
	Can Claril HM	230.8	(7.2)	223.5	(6.4)
	Bottle Control	263.4	(5.4)		
	Bottle Claril HM	228.8	(24.3)		
Iron (mg/L)	Can Control	2.56	(0.0)		
	Can Claril HM	2.33	(0.0)		
	Bottle Control	2.54	(0.0)		
	Bottle Claril HM	2.38	(0.0)		
H_2S (mm 4 LT)	Can Control	0.4	(0.1)	ND	
	Can Claril HM	0.5	(0.1)	ND	
	Bottle Control	0.6	(0.1)	ND	
	Bottle Claril HM	0.7	(0.1)	ND	

*Values in parentheses represent one standard deviation above the mean.

Winemaker's Post-Mortem

Why were you interested in studying the effects of PVI/PVP to remove metals? Have you experienced reduction in your canned wines that you can specifically attribute to the presence of metals?

Vidrine: Though we have not had reduction issues in any of our canned wines, we recognize that there are plenty of unknowns associated with the effects of aluminum cans on the wine held within. These chelator products have been available to winemakers for a number of years as a tool to reduce metals that are naturally present in wine, such as iron, aluminum and residual copper. These metals will oxidize volatile aromatic compounds at low concentrations and can lead to browning and hazing at higher concentrations. If the packaged wines contain mercaptans, the metals can oxidize these complex sulfides into di-sulfides.

In conversations with other winemakers about canning wine, it was discussed that one possible source of reduction was the high aluminum content imparted by cans. It has been proposed that SO_2 within the wine reacts with the elevated aluminum, forming hydrogen sulfides (Allison, et al., 2020). Since we have not seen any aluminum concentration data for wine packaged in cans compared to bottles, we decided to generate some. If the cans have an increased level of aluminum, we wanted to evaluate the efficacy of PVI/PVP to reduce its concentration, as well its potential to improve organoleptic properties.

Enartis has been a great partner in this experiment. They ran much of the analysis, discussed ideas and offered more questions for which we collaboratively continue to seek answers.

Why did you choose to test PVI/PVP on your glass bottles as well?

Vidrine: We did so essentially as a control for the two variables being evaluated: packaging type and PVI/PVP treatment. By packaging wine into bottles or cans and treated with or without PVI/PVP, we are able to compare quantitative analysis and subjective organoleptic properties between all four treatment groups.

What were some of your and your colleagues' initial hypotheses prior to beginning the trial?

Vidrine: Our primary hypothesis was that wines packaged in cans would have an elevated aluminum content than those packaged in bottles. Our other primary hypothesis was that PVI/PVP would reduce metal content in the treated wines. If that was true, then we predicted that the treated wines, irrespective of packaging type, would taste subtly "fresher" after approximately six months. If any H_2S was detected, we anticipated that the treated wines would have developed less than the untreated wines. We also wanted to evaluate the effect of residual and bound copper's effect on the shelf life of these wines and explore the efficacy of Claril HM to reduce copper levels.

Were the trial results as you predicted?

Vidrine: The results show that untreated wine packaged in can had a greater amount of aluminum compared to bottes. Regardless of how the wine in this trial interacted with this aluminum, this has very important implications: aluminum was imparted into the wine by the can. Wine matrices are very complex; and while this specific wine did not show an increase in hydrogen sulfides, another wine with a lower pH and higher free SO_2 might have. Allison et al. wrote an insightful literature review focused on this subject.

As expected, the wines treated with PVI/PVP had a lower amount of iron and aluminum. This was particularly evident with the 21 percent reduction of aluminum in the treated cans compared to the untreated cans. Interestingly, the aluminum content remained constant after four months of aging in can. This suggests that in this trial, the aluminum was imparted at or just after the time of packaging and that the liner maintained its integrity thus far.

Copper levels within all wines were below the detectable limit.

What was the impression of the IQ guests who were able to taste your trial wines?

Vidrine: There was a tremendous diversity of opinion on which wine was the "favorite." Most tasters elected to not taste the four samples blind. We are of firm belief that we should all inherently question our own personal biases. That being said, guests had a tendency to prefer the wines treated with PVI/PVP over untreated wines.

What was your and your team's impression of the wines? Did any of you have a favorite between the wines?

Vidrine: We found the PVI/PVP-treated wines, regardless of packaging type, tended to be more aromatic, smelling "cleaner/crisper" than their respective control wines. The bottled wines displayed more primary fruits, like cherry and plum, whereas the canned wines were characterized as having fewer overall aromatics with more secondary fruit notes. While no one had strong feelings toward any one wine, the consensus was that the bottles treated with PVI/PVP were the favorite.

Given the results of the trial—both sensory and analytical—do you foresee Union Wine adjusting any winemaking protocols?

Vidrine: While we found the treated wines to have fresher and fruitier aromas and taste, we did not find this effect to be great enough to justify completely altering our canned Pinot Noir winemaking protocols. However, we will begin trialing this product on a regular basis and consider using it in the future.

We plan to conduct the experiment again this year; however, we will use either Pinot Gris or Rosé. We suspect the treatment will provide protection against oxidation, resulting in more vibrant wines, especially after a year in package.

What are some of the winemaking lessons you learned during the course of this trial?

Vidrine: The biggest takeaway was a stronger awareness of the potential effect of heavy metals on aromatics and flavor. The effect of metals to oxidize wines is well known, but the opportunity to quantitatively and qualitatively observe this effect on our own wine was powerful. **WBM**

References:

Allison Rachel, Sacks Gavin, Maslov-Bandic Luna, Montgomery Austin, Goddard Julie. *The Chemistry of Canned Wines.* 2020. Research focus 2020-1 . Cornell University, Department of Food Science.