VIRGINIA WRE WINEMAKERS RESEARCH EXCHANGE

The Impact of Lees Stirring on Red Wine Quality (2017)

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Summary

This study examines impact of stirring the lees of barrel aging red wines. Cabernet Franc wine was settled overnight in tank after pressing and then racked into two identical neutral barrels. Barrel stirring occurred once malolactic fermentation completed and continued once every two weeks until wine was sampled in late April. No major differences were found in wine chemistry. Some lactic acid bacteria counts were higher, and *Brettanomyces* and *Saccharomyces* was higher in the stirred wines as well. No differences were apparent in phenolics, except for an increase in tannin in the stirred wine. For the triangle test, of 21 people who answered, 7 people chose the correct wine (33%), suggesting that the wines were not significantly different. In general, of those who correctly distinguished the wines, 3 had no preference, 2 preferred the stirred wine, and 1 preferred the no stirring wine. For the descriptive analysis, there were no strong trends for the descriptors used in this study. There was a very slight trend for the stirred wine to have lower Astringency. In the future, more studies should be performed with red wine lees stirring, perhaps with differing levels of lees in the wines as well.

Introduction

Marchal et al. (2011) provide an excellent brief review of yeast autolysis in their introduction. Lees are mainly composed of yeast, bacteria, tartaric acid, polysaccharides, and protein-tannin complexes (Zoecklein 2013). Heavy lees generally refers to lees which precipitate 24 hours after fermentation (generally grape particles and large complexes of other lees particulates), and can often lead to offaromas in wine. Light lees precipitate later and are generally beneficial to wine quality, and have less grape particulates and less heavily complexed yeasts and other lees particulates (Zoecklein 2005; Zoecklein 2013). Lees aging can decrease vanilla flavors from oak, and increase toasted flavors (Chatonnet et al. 1992; Tominaga et al. 2000). Others have observed that lees stirring increases yeast character in the wine, decreases fruit and oak character. In some cases, this reduction in oak character can increase the perception of fruit (relative to very oaky control wines) (Zoecklein 2005).

Lees aging also increases the polysaccharide content of wines, particularly mannoproteins, which may enhance wine protein and tartrate stability (Llaubères et al. 1987; Ledoux et al. 1992; Moine-Ledoux et al. 1997; Feuillat 2003; Zoecklein 2005; Zoecklein 2013). Sur lies aging releases mannoproteins and other cell wall polysaccharides which can enhance the colloidal structure, stability, and aromatic quality of red wines while reducing their astringency, making sur lie aging of red wines important (Zoecklein 2005). Although yeast-derived proteins can increase during lees aging, these proteins are not involved in protein instability (Zoecklein 1991).

Lees may also act to preserve fruity and varietal characteristics by preventing oxidation and producing a reducing environment (Marchal et al. 2011; Zoecklein 2013). The release of thiols into the wine from yeast has been attributed to lowering reductive characteristics by being able to oxidize methanethiol and ethanethiol into their non-volatile disulfide forms (Lavigne and Dubourdieu 1996); however, this greatly depends on other factors in the aging process, and could impart a more reductive character to the wine. Yeast glycoproteins from autolysis may also decrease astringency in wines through interaction with phenolic compounds (Escot et al. 2001). Lees autolysis can also impart sweetness to wine (Zoecklein 2005; Marchal et al. 2001), which may be in part due to sweet peptide fractions released during cell autolysis. One such fraction appears to be derived from heat shock proteins (Hsp12p) (Marchal et al. 2011), which is expressed from high temperature, ethanol, oxidative stress, and glycerol concentrations (Varela et al. 1995). All of these factors are present under winemaking conditions (Marchal et al. 2011). The breakdown of peptides can result in aromatic precursors in wines (Zoecklein 2005), but may also provide more nitrogen for spoilage organisms to consume. Many of these impacts of lees aging can be affected by winemaking practices, such as frequency of stirring, amount of lees present, amount of oxygen ingress,

pectinase/glucosidase enzyme additions (such as Extralyse by Laffort), and perhaps even quality of lees. This study examines the impact of one such lees stirring regime on the chemical and sensory qualities of red wine.

Results and Discussion

No major differences were found in wine chemistry. Some lactic acid bacteria counts were higher, and *Brettanomyces* and *Saccharomyces* was higher in the stirred wines as well. No differences were apparent in phenolics, except for an increase in tannin in the stirred wine. For the triangle test, of 21 people who answered, 7 people chose the correct wine (33%), suggesting that the wines were not significantly different. In general, of those who correctly distinguished the wines, 3 had no preference, 2 preferred the stirred wine, and 1 preferred the no stirring wine. For the descriptive analysis, there were no strong trends for the descriptors used in this study. There was a very slight trend for the stirred wine to have lower Astringency. In the future, more studies should be performed with red wine lees stirring, perhaps with differing levels of lees in the wines as well.

Juice Chemistry			
	Brix	pH	TA (g/L)
Juice Chemistry	25.4	3.88	4.65

In House Data

Wine Chemistry													
	Ethanol (%vol/vol)	Residual Sugar (g/L)	pH	TA (g/L)	Volatile Acidity (g/L)	Malic Acid (g/L)	Lactic Acid (g/L)	Ammonia (mg/L)	NOPA (mg N/L)	YAN (mg N/L)	Total SO2 (ppm)	Free SO2 (ppm)	Molecular SO2 (ppm)
No Stir	14.72	3.1	3.82	5.23	1.08	<0.15	1.83	<10	62	66	46	31	0.48
Stir	14.69	3.3	3.83	5.31	1.02	<0.15	1.80	<10	62	66	50	28	0.43
% Change	0%	6%	0%	2%	-6%		-2%		0%	0%	9%	-10%	-10%

Results from ICV in Mid April, Except Nitrogen from ETS

Wine Microbiology									
	Acetic Acid Bacteria (cells/mL)	L. brevis, hilgardii, and fermentum (cells/mL)	L. plantarum, casei, and mali (cells/mL)	L. kunkeei (cells/mL)	O. oeni (cells/mL)	Pediococcus sp. (cells/mL)	B. bruxellensis (cells/mL)	S. cerevisiae (cells/mL)	Z. bailii (cells/mL)
No Stir	108000	<10	1890	380	4500000	8610	30	10300	<10
Stir	157000	<10	9610	340	>10000000	55600	100	440000	100
% Change	45%		408%	-11%		546%	233%	4172%	

Results from ETS in Mid April

Color Profile					
	A420	A520	A620	Hue (420/520)	Intensity (420 + 520 + 620)
No Stir	0.570	0.793	0.214	0.719	1.577
Stir	0.576	0.798	0.220	0.722	1.594
% Change	1%	1%	3%	0%	1%

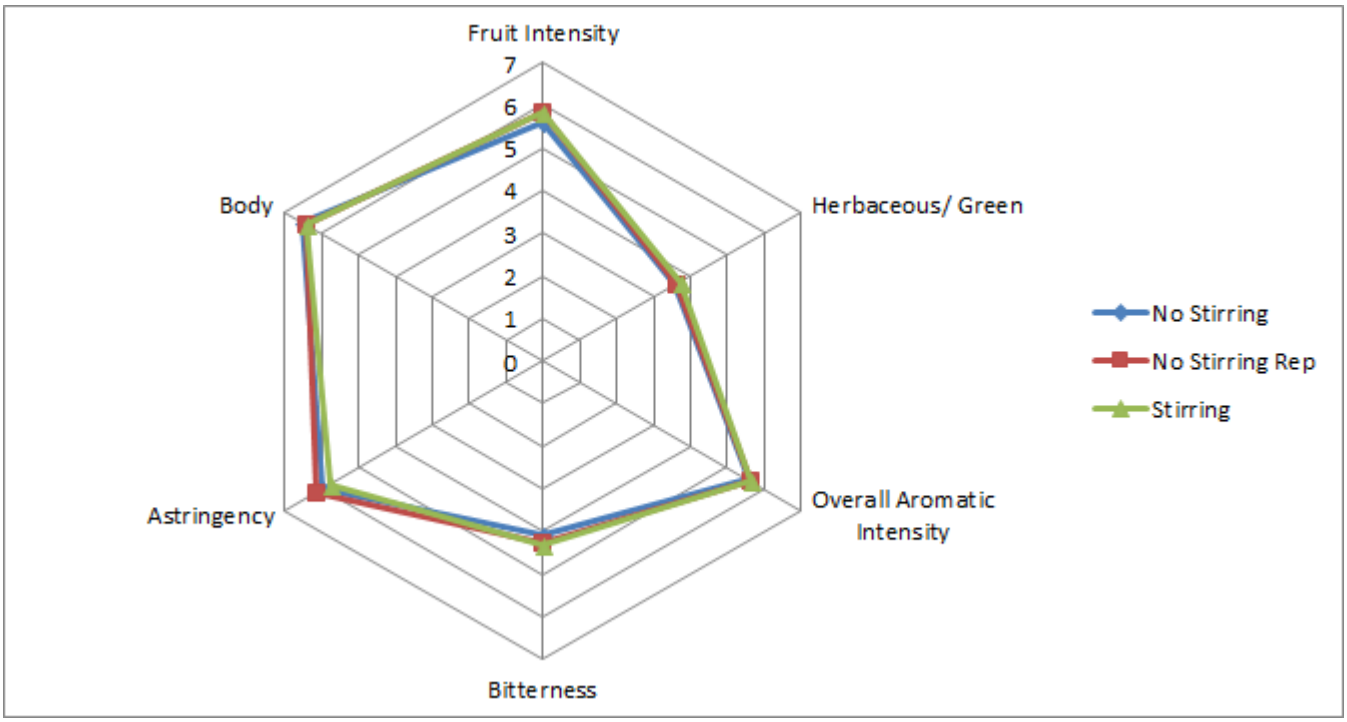
Results from ICV in Mid April

Phenolic Profile					
	Caffeic Acid (mg/L)	Caftaric Acid (mg/L)	Catechin (mg/L)	Epicatechin (mg/L)	Gallic Acid (mg/L)
No Stir	10	60	45	41	66
Stir	10	60	45	38	65
% Change	0%	0%	0%	-7%	-2%

Results from ETS in Mid April

Phenolic Profile								
	Malvidin glucoside (mg/L)	Monomeric Anthocyanins (mg/L)	Polymeric Anthocyanins (mg/L)	Quercetin (mg/L)	Quercetin Glycosides (mg/L)	Tannin (mg/L)	Total Anthocyanins (mg/L)	Resveratrol (cis and trans) (mg/L)
No Stir	239	448	47	16	56	679	495	1.1
Stir	242	450	48	15	57	741	498	1.0
% Change	1%	0%	2%	-6%	2%	9%	1%	-9%

Results from ETS in Mid April



Methods

Cabernet Franc was processed into a tank. 30ppm of potassium metabisulfite was added and mixed with a light pumpover. 15g/hL of D254 was also added. The tank received two pumpovers/day during fermentation, adjusted accordingly throughout the fermentation. 2g/L of tartaric acid was added during fermentation. The Cabernet Franc was pressed, separating the press cut after 0.6 bar. The wine settled overnight in tank. It was racked to neutral barrels after 24 hours. The barrels were monitored for MLF, and once complete had 50ppm of sulfur dioxide added and topped. The stirring began after MLF had completed. It took place once every two weeks until the wines were sampled in Mid-April.

These wines were tasted on May 16. For the triangle test, descriptive analysis, and preference analysis, anybody who did not answer the form were removed from consideration for both triangle, degree of difference, and preference. Additionally, anybody who answered the triangle test incorrectly were removed from consideration for degree of difference and preference. Additionally, any data points for preference which did not make sense (such as a person ranking a wine and its replicate at most and least preferred, when they correctly guessed the odd wine) were removed.

In order to balance the data set to perform statistical analysis for descriptive analysis, any judge who had not fully completed the descriptive analysis ratings were removed. In order to then make the number of judges between groups equivalent, one judge from group 3 was eliminated. This resulted in a final data set of 3 groups, each with 6 judges (considered as replications within groups, and groups were considered as assessors). Data was analyzed using Panel Check V1.4.2. Because this is not a truly statistical set-up, any results which are found to be statistically significant ($p<0.05$) will be denoted as a “strong trend” or a “strong tendency,” as opposed to general trends or tendencies. The statistical significance here will ignore any other significant effects or interactions which may confound the results (such as a statistically significant interaction of Judge x Wine confounding a significant result from Wine alone). The descriptors used in this study were Fruit Intensity, Herbaceous/Green, Overall Aromatic Intensity, Bitterness, Astringency, and Body.

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