VIRGINIA WRE WINEMAKERS RESEARCH EXCHANGE

The Impact of Different Maceration Techniques in Cabernet Franc (2015)

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Summary

This study examines the impact of different maceration techniques on the sensory and phenolic attributes of Cabernet Franc wine. Three different maceration techniques were employed: A control (no cold soak or extended maceration), *maceration a chaud du marc*, and cold soak with extended maceration. The cold soak with extended maceration showed slightly increased tannin, increased browning and decreased color. It also had lower ethanol, lower TA, and higher pH. *Maceration a chaud du marc* slightly increased polymeric pigment and color, and slightly decreased hue. There was a slight tendency for judges to prefer the wine made from *maceration a chaud du marc*. The wines were all very light and mild, so chemical and sensory differences may have been hard to distinguish as opposed to more intense wines. More studies on these fermentation practices are warranted, especially with different red varieties.

Introduction

Cap management techniques are essential to producing a high quality red wine. One of the most basic means to manipulate the cap is to alter the length of time that the pomace is in contact with the juice or wine.

Skin contact with fermenting juice has complex equilibrium interactions involving extraction into juice and adsorption onto solids of phenolic and aromatic compounds. This relationship is further complicated in that the physical integrity of grape cellular components degrade over time. For example, the release of anthocyanins from hypodermal vacuoles involves rupture of the cell membrane and vacuole. This process can be impacted by ethanol, heat, carbon dioxide, and sulfur dioxide. However, ultimate collapse of cell membranes instead of merely rupturing them may prevent release of these compounds into the juice (Sacchi et al. 2005). The degradation of grapes can also result in higher levels of insoluble solids in the fermentation, which may adsorb anthocyanin and other compounds and reduce color. Thus, equilibrium dynamics between solid and juice phases change throughout the fermentation. For example, anthocyanin concentration tends to peak early and then decline as fermentation continues (Berg and Akiyoshi 1956; Kovac et al. 1992; Sacchi et al. 2005). This is likely not due to limited solubility, but instead due in part to instability and formation of polymeric pigment. (Kovac et al. 1992; Sacchi et al. 2005). Additionally, extended maceration lowers color intensity and anthocyanin concentration (Casassa et al. 2013a, 2013b, 2013c; Yokotsuka et al. 2000; Casassa et al. 2016), which suggests that anthocyanin adsorb onto skins and other insoluble solids which increase during extended maceration.

Cold soaking is often a way to increase the contact time of wine in an aqueous phase, as opposed to extended maceration which results in more contact time in an ethanol-rich phase. Cold soaking extracts anthocyanin and skin tannin, but not much seed tannin (since efficient

seed tannin extraction requires ethanol). Thus, cold soaking may produce a wine with less seed tannin, because it might allow for the winemaker to reduce maceration time in the presence of ethanol. However, the impact on color is variety-dependent and inconsistent. For example, Pinot noir often loses color from cold soak, whereas Cabernet Sauvignon tends to gain color from cold soak. There does not seem to be much benefit from cold soaking beyond 3 days (Zoecklein 2007). Other authors have found that, in general, cold soaking does not enhance color or phenolic content of wines; if anything, it will sometimes decrease color and phenolic intensity (Sacchi et al. 2005).

Seed extraction occurs with increasing ethanol concentration due to the dissolution of the seed coat by ethanol. Thus, stem and skin tannin are extracted for the first 5-7 days of fermentation before seed tannins begin to be extracted (Zoecklein 2007). Increasing maceration time can increase tannin and anthocyanin content in wine, but this depends on the length of time. Extended maceration generally only increases tannin content from skins and seeds (Berg and Akiyoshi 1956; Zoecklein 2007). The formation of polymeric pigment is often enhanced by longer maceration times, especially at low pH (Sims and Morris 1985; Scudamore-Smith et al. 1990). This increase in polymerization may help soften the mouthfeel of wines (Zoecklein 2007), although this must be balanced with increasing seed tannin extraction from longer maceration times.

Total volatile compounds tend to increase with increasing levels of skin contact (Ramey et al. 1986; Baumes et al. 1989; Moyano et al. 1994; Cabaroglu et al. 1997; Fischer et al. 2000; Selli et al. 2003; Mansfield et al. 2011), often showing a correlation between skin contact time and aromatic intensity (Schmidt and Noble 1983). However, skins also seem to adsorb volatile compounds that develop more during fermentation, such as fatty acid precursors and hexanol-derived aroma compounds (Ferreira et al. 1995; Callejón et al 2012). In red wines, volatile phenols tend to increase with increasing levels of skin contact as well (Ristic et al. 2011). The adsorption and extraction equilibria phenomena of yeast and grape-derived aromatic compounds is complex and not well understood.

Thus, manipulating the contact time of juice/wine with pomace can potentially have a great impact on resulting wine chemical and sensory qualities. Cap management techniques attempt to control the contact time, temperature, and extraction kinetics between the pomace and the juice. A unique cap management technique is *maceration a chaud du marc* (MCM) (Vivas 2007). This technique removes fermenting juice from the pomace after a small drop in Brix (often around a specific gravity of 1.060), to allow the juice to undergo much of its fermentation off of the skins in tank. The juice fermentation temperature is maintained between 20-25°C in order to encourage aromatic development and maintain varietal character. Meanwhile, the leftover pomace is brought to a very warm temperature (35-40°C) to facilitate cellular breakdown of grape components. This improves anthocyanin and tannin extraction, as well as promotes earlier extraction so that polymeric pigment formation can occur more effectively. The juice is then added back to the pomace once the density reaches around 1.020 to complete fermentation. After the juice is recombined with the pomace, fermentation is finished at around 27°C with normal pumpover regimens (Vivas 2007).

MCM produces concentrated, fruity red wines with rapid tank turnover and minimal aging requirements (Vivas 2007). The goal of this technique is to increase cellular breakdown at higher temperatures to allow for more extraction, to prevent juice fermentation at excessive temperatures which could otherwise negatively impact aromatic development, and to minimize the amount of time that grape seeds are exposed to an ethanol-rich environment to reduce seed tannin extraction. Wines produced by MCM can have similar extraction profiles to wines produced with extended maceration, in a fraction of the time. The short extraction time of MCM can help to produce softer, rounder tannin structure. Additionally, these wines generally have higher levels of higher alcohols, hexanol, and esters. The impact of this technique on isoamyl acetate and phenethyl acetate can greatly affect wine aroma (Vivas 2007).

The goal of this study is to compare traditional fermentation to *maceration a chaud du marc* as well as fermentation with both cold soak and extended maceration.

Results and Discussion

No chemical differences were observed between wines, except that the wine with cold soak and extended maceration had higher pH, lower TA, and lower ethanol. This wine also had more browning and less color intensity. Extended maceration tended to slightly increase tannin. Interestingly, *maceration a chaud du marc* did not exhibit much differences relative to the control, besides increased color and increased polymeric pigment. At the tasting, 21% of judges preferred the control, 54% preferred the *maceration a chaud du marc*, and 25% preferred the cold soak with extended maceration. There may have been some off-flavors in these wines, however. Additionally, all of these wines were very light bodied reds, with a light red color.

	Ethanol (% v/v)	Residual Sugar (mg/L)	pH	TA (g/L)	VA (g/L)	Malic Acid	Total SO2	Free SO2
Control	12.44	1.0	3.69	4.60	0.43	none	57	24
Maceration a Chaud du Marc	12.56	5.4	3.69	4.84	0.45	none	61	17
Cold Soak with Extended Maceration	12.07	1.2	3.92	4.35	0.47	none	57	24

Color Profile

	420	520	620	Intensity	Hue
Control	0.121	0.161	0.032	0.314	0.752
Maceration a Chaud du Marc	0.133	0.190	0.037	0.360	0.700
Cold Soak with Extended Maceration	0.112	0.128	0.027	0.267	0.875
% Change Chaud du Marc	10%	18%	16%	15%	-7%
% Change Cold Soak and Extended	-7%	-20%	-16%	-15%	16%

Phenolic Profile

	Tannin (g/L)	Pigment (AU)	Phenolics (AU)	Pigmented Tannin (AU)	Free Anthocyanins (AU)
Control	0.45	12.43	29.57	0.72	11.22
Maceration a Chaud du Marc	0.44	12.42	29.54	0.78	11.11
Cold Soak with Extended Maceration	0.49	12.09	29.78	0.72	10.89
% Change Chaud du Marc	-2%	0%	0%	8%	-1%
% Change Cold Soak and Extended	9%	-3%	1%	0%	-3%

More studies in Virginia are needed to more fully understand whether MCM is appropriate for Virginia winemaking. This technique has not yet been scrutinized rigorously in Virginia. Furthermore, this technique can be risky, because if the pomace does not sufficiently self-heat to 35-40°C then proper cellular breakdown will not occur in the short time required, and microbial contamination can occur (Vivas 2007). However, MCM has potential to produce red wines with good phenolic balance and extraction, and should be explored at a smaller scale in Virginia.

Methods

Cabernet Franc was harvested from the same block in bins and was de-stemmed and lightly crushed in 3 separate t-bins (approx. 0.75 tons each).

1) **Control:** received no cold soak nor extended maceration.
2) **Maceration a Chaud du Marc/*hot maceration of pomace:*** received no cold soak nor extended maceration. At a specific gravity of 1.060, fermenting juice was racked into another tank where the temperature was kept around 20°C (70°F), while the skin was left in the original T bin and temperature was brought up to 42°C (107°F). When juice in the tank reached a specific gravity of 1.020 it was blended back with the skins. The rest of the fermentation was controlled to not allow the temperature over 26°C (80°F). At a specific gravity of 1.000, wine was racked and pressed.
3) **Cold Soak and Extended Maceration**. Grapes were cold soaked for 4 days with 7g/hl of yeast. After 4 days, another 7g/hl of yeast were added, alcoholic fermentation proceeded normally, and a 5 day extended maceration occurred after the end of alcoholic fermentation

Fermentations were inoculated at 15g/hL (except for the cold soak and extended maceration treatment) and nutrient added at a specific gravity of 1.070. Bins were punched down twice per day. The control and the Maceration a Chaud du Marc treatment were pressed off on the same day. Following fermentation, each lot was transferred to identical barrels.

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