Improving Red Wine Color and Mouthfeel Over Time

Maximizing polymeric pigments can help winemakers improve red-wine quality

By Caroline Merrell and Melissa Hansen

Formation of polymeric pigments is important for successful cellaring of red wine as they help soften wine's astringency and provide long-lasting color. Research supported by the Washington State Wine Commission has identified factors that can maximize polymeric-pigment formation to help improve red-wine quality.

During fermentation and while red wine ages, polymeric pigments form from the reaction of anthocyanins and tannins, phenolic compounds that come mainly from the skin and seeds of the fruit. Anthocyanins contribute to the red color of grapes and wine; tannins are astringent but add flavor complexity and structure to a wine.

A study by Washington State University scientists examined the effects of fruit maturity, alcohol and wine aging on the concentration of anthocyanins, tannins and polymeric pigments in Cabernet Sauvignon and Syrah. The goal was to determine the most important factors involved in forming polymeric pigments and provide winemakers with practical guidelines to keep polymeric pigments stable in a wine environment over time.

This article summarizes the research that answers the following questions: 1) What drives polymeric pigment formation—the concentration of anthocyanins or tannins? 2) Is there a critical anthocyanin-to-tannin ratio in the fruit or wine that winemakers should target to maximize the formation of polymeric pigments?

Constant vineyard conditions

Syrah and Cabernet Sauvignon grapes were used to obtain different anthocyanin and tannin concentrations and ratios between the two compounds. Cabernet Sauvignon generally produces grapes with darker color and high levels of tannins. Syrah grapes are typically dark but lower in tannins than Cabernet Sauvignon. The two cultivars are prevalent in Washington State.

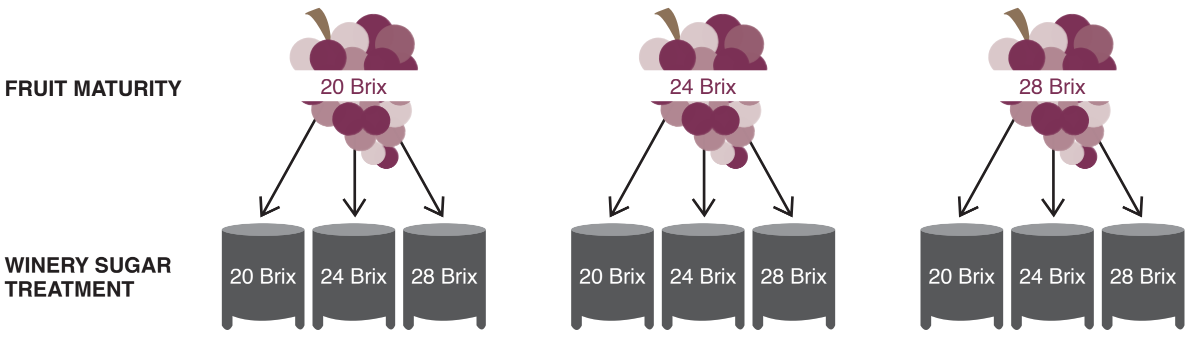
BOTTOM LINE

If you want more polymeric pigments in your wine, make sure your fruit is fully ripe for development of anthocyanins. If you are in a region where long hang time is problematic, for high-tannin varieties, maximize color through vineyard-management techniques that encourage open canopies and good sun exposure to the fruit zone. These include open canopy, deficit irrigation, leaf removal and low-vigor vines. For low-tannin varieties such as Syrah and Pinot Noir, maximize color development in vineyard and winery techniques to increase tannin levels (minimum of 20 days of skins -on extended maceration); ferment at higher temperatures or make higher-alcohol wines (2%-3% higher than your normal concentration).

The trial was conducted in a commercial vineyard in the Columbia Valley AVA during the 2015 growing season. Fruit (1.5 tons) was harvested at three different maturity levels: 20°, 24° and 28° Brix. Harvest dates were separated by approximately three weeks between each pick.

Initial fruit-soluble solids concentration (Brix) was manipulated in the winery by removing juice (*saignée*) and then either sugar adjustment or water-back prior to fermentation to have three alcohol concentrations (low 11-12%, medium 14-15% and high 17%) represented at each grape maturity. (See Figure 1, Three Harvest Dates, Nine Wines.) *Saignée* occurred immediately after the crush to minimize anthocyanin loss while maintaining the juice-to-solids ratio across all treatments.

THREE HARVEST DATES, NINE WINES



Experiment was designed to achieve varied tannin and anthocyanin concentrations within the same vineyard.

KEY POINTS

Polymeric pigment content increases primarily from increased anthocyanin concentration; the higher the anthocyanin level in fruit and wine, the more polymeric pigments in the wine.

Tannins also increase polymeric pigment concentration, though the effect is not as strong as anthocyanins. However, in varieties with low tannin levels, such as Pinot Noir or Syrah, it is especially important to maximize tannin levels.

For both Syrah and Cabernet Sauvignon, polymeric pigment concentration increased with fruit maturity and alcohol, as increasing fruit maturity (to above 24° Brix) increased anthocyanin and increasing alcohol, due to higher sugar at crushing, increased tannin concentrations.

Wines made from very mature Syrah and Cabernet Sauvignon fruit (28° Brix) resulted in highest polymeric pigment concentration and therefore had the best color and potential mouthfeel modification in the trial.

The ratio between anthocyanin and tannin level was not important in polymeric pigment formation.

Techniques during post-fermentation storage that decrease monomeric anthocyanins will help increase polymeric pigment formation. These include such practices as warmer storage temperatures and additional cellar storage time.

Picking the fruit at different maturities and making wines with different alcohol levels created variations in the wine anthocyanin and tannin concentrations and resulted in a range of anthocyanin-to-tannin (A:T) ratios from a constant set of growing conditions and vineyard location.

Effect of fruit maturity and alcohol

In the trial, ripe fruit in both Cabernet Sauvignon and Syrah had the highest anthocyanin levels among the three harvest treatments (unripe 20° Brix, ripe 24° and overripe 28°). However, wine made from overripe fruit had equal or greater anthocyanin content than wine made from ripe fruit. Wine alcohol treatments did not affect anthocyanin extraction but did increase tannin extraction. Tannin concentration was not always influenced by pick date, although the unripe Cabernet Sauvignon had significantly more tannin than wines made from the ripe and overripe fruit. Generally, riper fruit led to wine with more anthocyanins, while higher alcohol led to wine with higher tannin concentration.

Polymeric pigment content increased with both increasing fruit maturity and wine alcohol. (See Figure 2, Effect of Fruit Maturity and Alcohol on Polymeric Pigments.)

Polymeric pigment formation: no A:T ratio

Based on previous research that examined the interaction of anthocyanins and tannins, it has been suggested that the A:T ratio plays an important role in polymeric pigment formation because both tannin and anthocyanin are needed for development of polymeric pigments.[6] However, past studies were conducted in isolated systems, and few have followed the polymeric pigment formation over time due to the difficulty of manipulating treatments while keeping grape growing and winemaking factors constant.

The variation of anthocyanin concentration in the trial was

ACCELERATED DEVELOPMENT OF BOTTLED WINE

Since polymeric pigment formation occurs over time, the trial needed to include bottled wine development, which can add years and expense to the research. To accelerate the aging process, bottled research wines were held in an incubator at higher-than-normal temperatures of 30° C (86° F). Incubated wines were chemically compared to cellar-aged wines at 15° C (60° F) to determine how the accelerated aging compared to traditionally aged wines. Previous studies found that a 10° C increase in temperature increased the rate of aging reactions by a factor of 2. This study chose 30° C because it would increase the speed of aging reactions by 2.5-fold, but without risk of evaporation or chemical degradation in the bottled wine.

One month of incubator aging was determined to be the equivalent of one year in a commercial cellar for phenolic development. The incubator-aging technique of four months resulted in the equivalent of wine stored for four years at cellar temperature for polymeric pigment analysis.

This accelerated bottled-wine development was for research purposes only and is not recommended as a wine storage technique. Wine aroma evaluation was not part of the overall study nor part of the accelerated aging experiment. Temperatures this high are likely to have a negative effect on aromas.

considerable. Anthocyanin content varied up to about two-fold in the same cultivar, and tannin concentration varied up to 1.5-fold in response to ripeness or alcohol. These variations gave a two- to three-fold difference in the A:T ratio for the same variety.

This study found the A:T ratio was a very poor predictor of polymeric pigment concentration. The best single predictor for polymeric pigment formation over time was initial wine anthocyanin content, which increased with more fruit maturity. This result contradicted the importance of A:T from previous literature.

Although initial wine anthocyanin content in this study was a strong polymeric pigment predictor, fruit anthocyanin levels did not directly correlate to wine anthocyanin content. Based on findings from this study, winemakers should focus on the initial anthocyanin concentration of wines — not fruit anthocyanin concentration — because it was the strongest predictor of polymeric pigments in Cabernet Sauvignon and Syrah wines.

Maximize polymeric pigmentation

This study found that higher fruit maturity increased anthocyanin concentrations and that higher wine alcohol increased tannin levels. Both the increased ripeness and alcohol led to the highest polymeric pigment concentrations. Therefore, the easiest way to maximize polymeric pigment formation is to use ripe, mature fruit (24°-28° Brix) and make medium- to high-alcohol (14%-17%) wine.

In regions or growing seasons where it is difficult to harvest mature, ripe fruit—but tannin levels are not a problem—the focus should be to maximize fruit and wine color. Growers can use vineyard-management practices such as keeping the canopy open, growing low-vigor vines, removing leaves in the fruit zone and implementing deficit-irrigation strategies to encourage maximum color (anthocyanin) development in the fruit.

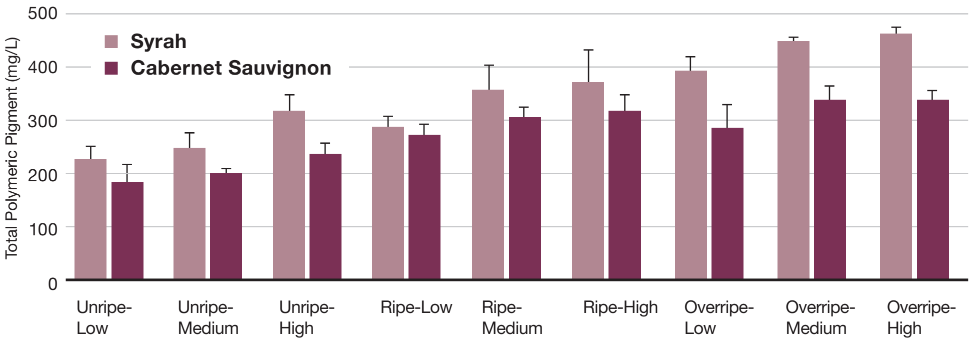
But once grapes are picked, it is difficult for winemakers to increase color; extraction of anthocyanins in the winery is relatively quick, and concentration reaches maximum levels early in fermentation and then declines.

The trend of cold soak—holding the must at a low temperature for hours to days before fermentation—has become popular in some regions as a technique to increase color, although there is conflicting research on its effectiveness. Cold soak might extract more anthocyanin temporarily, but it does not extract additional tannins and research shows no increase in polymeric pigment formation from cold soak.[1]

To maximize polymeric pigment formation in low-tannin varieties such as Pinot Noir or Syrah, use vineyard and winery techniques to increase both color (see above) and tannins in the wine. Efforts to increase tannin levels are most successful at the winery level, although some research found that low-vigor vines within an individual vineyard had higher grape-tannin levels.

No relationship has been found between tannin levels of fruit and tannin concentration in the resulting wine. It is difficult to predict tannin extraction from fruit ripeness or maturity, but earlier research[2,3,4,5] found that winemakers can manipulate tannin extraction through extended maceration (minimum of 20 days needed to see differences), increased fermentation temperature (keep as warm as conditions allow without killing yeast) and higher alcohol (an increase of 2%-3% above normal winemaking practices).

EFFECT OF FRUIT MATURITY AND ALCOHOL ON POLYMERIC PIGMENTS



Polymeric pigment formation increased with both increased alcohol and maturity. Note: Wines are represented by harvest maturity (unripe 20° Brix, ripe 24°, overripe 28°) and alcohol level (low 11-12%, medium 14-15%, high 17%).

This article was condensed from the report "Effects of Berry Maturity and Wine Alcohol on Phenolic Content during Winemaking and Aging," published in the *American Journal of Enology & Viticulture*, January 2018.

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To see the bibliography for this article, go to winesandvines.com and search under Magazine › Features › October 2018