Oregon Wine Advisory Board
Research Progress Report

1994 - 1995

Pinot Noir Processing Effects on Wine Color and Phenolics

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We have studied commercial fermentation practices for three vintages in order to learn how they affect extraction and stability of anthocyanin pigments and other phenolic compounds in Pinot noir. Wines were monitored during fermentation, processing, and aging for anthocyanin and phenolic content, color intensity, and for phenolic profiles using high performance liquid chromatography (HPLQ).

Anthocyanin pigments are extracted rapidly upon crushing and reach a maximum concentration within about three days. Subsequently, the anthocyanin concentration decreases rapidly. Up to 50% of the maximum extracted anthocyanin content is lost within three months of age. Polymeric pigments are not detectable in grapes at crushing but are present in new wines by one month of age and increases slowly with aging due to polymerization.

The total phenols are extracted throughout fermentation reaching a maximum at the time of pressing. Polymeric phenols are detectable early in processing and may be extracted from seeds during fermentation as well as formed by condensation reactions of precursor phenols such as catechin. Catechin is extracted primarily from the seeds (and stems) and increases with maceration time. During processing and aging the total phenols decrease slowly with time due to polymerization and precipitation. Monomeric flavonoid phenols such as catechin and polymeric flavonoid phenols (condensed tannins) may have a pronounced effect on perceived bitterness and astringency in wines. Monomeric flavonoids are bitter and as they polymerize and increase in molecular weight they become more astringent. The relative quantity and ratio of different phenolic fractions are affected by processing and may have a pronounced impact on the sensory character of a wine.

During the 1994 vintage, processing variables included addition of 0, 50, and 100 mg/I of sulfur dioxide at crushing, pre-fermentation maceration at 40C, post-fermentation maceration for 5 and 15 days at ambient cellar temperature, early pressing (4 days), whole cluster fermentation, and use of three different yeast strains. Control wines were fermented with Lalvin RC 212 Bourgorouge with 50 mg/l of sulfur dioxide added at crushing and were fermented on the skins for 7 days prior to pressing. All treatments were done in triplicate.

Analysis at three months of age showed that the 1994 wines with the greatest color intensity were the control and the whole cluster fermentation treatments followed by the 5 day postfermentation maceration treatments. Polymeric anthocyanin content was greatest for the whole cluster fermentation and the control wines.The 5 day pre-fermentation maceration had significantly lower color as did the 15 day post-fermentation maceration and the early press treatments both of which had the lowest total color of all the treatments (Figure 1).

Total phenolic content was highest in the whole cluster fermentations followed by the 5 day and 15 day post-fermentation maceration, and the control wines. The 15 day post-fermentation maceration wines had lower total phenols and lower anthocyanin content than the 5 day postfermentation maceration wines suggesting precipitation of color and other phenolics with extended skin contact (Figure 2). Polymeric phenolic content was highest in the whole cluster fermentations followed by the 15 and 5 day post-fermentation maceration treatments. These three treatments were also significantly higher in catechin content than the other treatments with the whole cluster fermentation wines being the highest. The total phenols were lowest in the early press and the pre-fermentation maceration treatments. The lowest catechin content was found in the early press, the pre-fermentation maceration, and the control wines (Figure 3).

Quercetin content was highest in the control and whole cluster treatments followed by the 5 day post-fermentation maceration treatments. Quercetin aglycon, the hydrolysis product of quercetin, was also significantly higher in these treatments (Figure 4). In general, the higher the anthocyanin content the higher the quercetin and the quercetin aglycon content. We now know that anthocyanin pigments can associate with other phenols such as quercetin aglycon to increase their solubiltiy in wines. This association may also help to protect the anthocyanins from reacting with other compounds through steric hindrance. The association of anthocyanin pigments with other phenolic compounds can increase apparent color, a phenomenon known as co-pigmentation. Compounds such as quercetin and quercetin aglycon may be important in increasing color stability in red wines.

Differences were also observed in anthocyanin content and color intensity in new wines fermented with different yeast strains. Three yeasts were compared including Lalvin RC 212 Bourgorouge (Control), Lalvin RA 17 Bourgoroucre, and Lalvin WAD 27. Young wines fermented with RC 212 had the highest anthocyanin content and the greatest color intensity, followed by RA 17 and WADS 27 (Figure 5). Wines fermented with both the RA 17 and WADS 27 also had lower total phenols than RC 212.

No differences were observed in anthocyanin content, color intensity, or total phenolic content in our 1994 wines fermented with 0, 50, and 100 mg/l of sulfur dioxide added at crushing. Similarly, no differences were observed in our 1993 trials with 0 and 50 mg/l of sulfur dioxide added at crushing. In our 1992 trials, however, young wines with no sulfur dioxide added at crushing had lower anthocyanin content and lower color intensity than wines fermented with 50 mg/l. The extractive effect of sulfur dioxide on anthocyanin pigments may be more significant in years of low color compared to years of high color. Both the 1993 and 1994 vintages had greater color and lower total phenolics in our trials than the 1992 vintage.The relative ratio of anthocyanin to total phenolic concentration in the control wines at three months of age was about 8% in 1992 compared to 23% in 1993 and 28% in 1994.

We have observed that other fermentation practices do not always have the same effect in different vintages as well, presumably due to significant variation in color and phenolic composition in the fruit at harvest. For example, pre-fermentation maceration in our trials produced wines with lower anthocyanin content in 1992, higher anthocyanin content in 1993, and lower anthocyanin content in 1994 compared to control wines. Fruit phenolic composition has been shown to vary with vintage, maturity, cluster light exposure, and with yield. The dynamics of color and phenolic extraction depend upon the initial composition of the fruit as well as the affects of specific processing practices. Knowledge of the initial fruit phenolic composition as well as the effects of different fermentation practices is essential to more controllable and predictable winemaking.

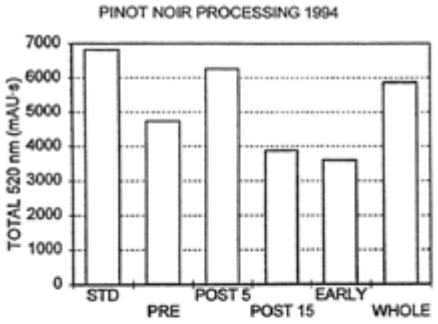

Fig. 1

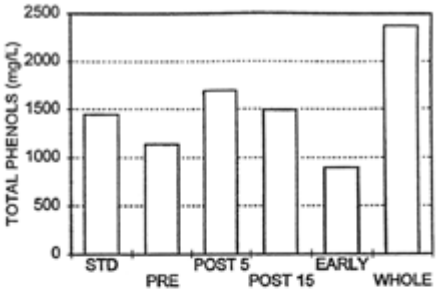

Fig. 2

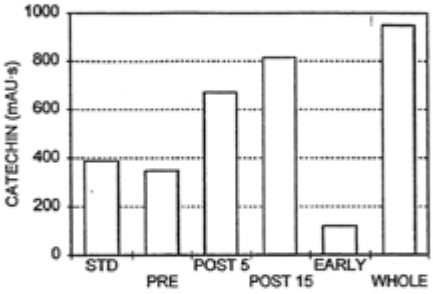

Fig. 3

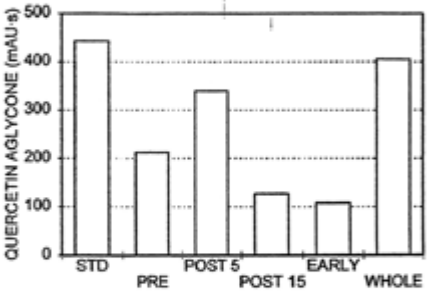

Fig. 4

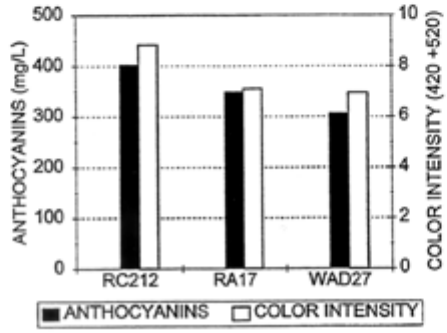

Fig. 5