Oregon Wine Advisory Board
Research Progress Report

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Phenolic Compounds in Grapes and Wine

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In experiments in grape skin light transmission in 1991, we found that quercetin (a phenolic compound found in many plants) accumulates in sun exposed grape skin. The accumulation of quercetin in grape skins appeared to be a protective response to solar radiation and we were able to show that quercetin effectively screens grape tissue from potentially damaging UV radiation.

In this study there were very large differences in quercetin skin concentration between sun exposed and shaded grapes. In Pinot noir, we found eight times more quercetin in sun exposed tissue than in shaded and in Chardonnay the difference was even greater. With this large difference in concentration, it seemed likely that cluster sun exposure could be having specific effects on quercetin levels in wine, and it also seemed likely, given the high concentrations of quercetin in sun-exposed skin, that these differences could be significantly effecting wine quality.

During 1992 we continued this research in a commercial Pinot noir vineyard. The vineyard was trained to a single wire hanging trellis system. One of the characteristics of hanging trellis systems is a wide range in cluster exposures. Clusters on the top of the canopy receive direct sunlight all season while more protected clusters may receive little direct sunlight. We used this variation and selected clusters from three levels of sun exposure: very exposed, moderately exposed, and fully shaded. Wines were made from each cluster exposure level and fruit and wine were analyzed for phenolic composition. Fruit from sun-exposed positions had very high quercetin levels. Quercetin levels were about six times higher than in fruit from shaded clusters. Anthocyanins, the red pigments in grapes and wine, were not affected to nearly the same degree and the moderately sun-exposed clusters had the highest anthocyanin concentration. Quercetin and anthocyanin levels in wines were closely related to fruit levels.

Several other phenolic compounds were also affected by cluster sun exposure. Anthocyanins in wine react with other phenolic compounds to form larger "polymeric" molecules. This process is one of the key aspects of wine aging and contributes to a wines stability and longevity. In this study, wines from the sun-exposed clusters had greater amounts of polymeric pigment, and it appears that quercetin may have been directly involved. Cluster sun exposure also resulted in lower levels of catechin and cafeoyltartaric acid content in wine. These are important wine constituents but it is not yet clear if the changes in these compounds were related to quercetin or some other sun exposure response. Vork on seed phenolics in the Pinot maturity trial showed that catechin in seeds decreases greatly during ripening. It may be that seeds in shaded berries are less "mature" and contribute more catechin to a wine than seeds from sun-exposed berries.

As the wines have aged, differences between the wines from the different sun exposure levels are becoming greater. At harvest there were only small differences in anthocyanin concentrations in the

berries and there were no significant differences in anthocyanin concentrations in the new wines. However, by March 1994, about the time the wines would normally be going to market, there was significantly more visible red color in the wine from sun-exposed clusters. Some of this difference could be due to the greater color stability of the polymeric anthocyanin pigments that formed in these wines and some of the increase in color may be due to co-pigmentation. Co-pignientation is an interaction of anthocyanins and other non-colored phenolic compounds that results in an increase in the pigmentation strength of the anthocyanins. Quercetin has been shown in other beverages to increase the "redness" of anthocyanins, and that may be what we are observing in these wines.

The effects of quercetin on wine taste are still unknown, although quercetin could have astringent and bitter characteristics. We are currently working on sensory evaluation of quercetin and sun exposure in the Department of Food Science.

In 1993, we initiated a survey of commercial Pinot noir vineyards to determine the range of quercetin, and other phenolics, present in commercial wines. Fruit and wine from 36 vineyard blocks was sampled and subjected to a range of analyses (see Enology progress report). These samples came from a wide range of sites with different grape growing and wine making practices. As expected, we found considerable differences in fruit and wine phenolic composition. Quercetin in fruit samples ranged from 0.31 to 1.57 mg1g fresh weight. Wine quercetin levels varied by greater amount with the highest concentrations being more than fifteen times higher than the lowest. Other phenolic compounds also varied by similar ranges. This composition and that much of this variability is directly due to vineyard factors. In samples with high quercetin levels, vineyard clusters exposure was generally responsible. The highest fruit and wine quercetin concentrations were from young vineyards with hanging trellis systems. The lowest levels were from older vineyards with upright vertical trained canopies. Wine processing variables also had a significant impact on the level and types of phenolics present in wine (see enology progress report).

Our goal for 1994 is to continue evaluating phenolic composition of commercial fruit and wine samples. We will be evaluating the effects of vineyard practices in more detail this year by sampling in existing and new experiments established by growers rather than the random sampling techniques we used in 1993. We hope that this research will more clearly define which vineyard practices most affect grape phenolic composition and how wine making practices interact with the raw materials present in gapes to produce a quality wine.

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