INTRODUCTION AND OBJECTIVES

Phenolic compounds are key quality components of wine affecting sensory characteristics, wine color, and wine stability. Phenolics are responsible for much of the mouth flavor of wines affecting astringency, bitterness, and the "length" of the flavor impression on the palate. The color in both red and white wine is due to phenolic pigments, primarily anthocyanins, and flavonols. Biochemical changes in the phenolic compounds in wines over time, are responsible for many of the flavor changes associated with wine aging.

The primary source of most of the phenolic compounds in wine is grape skins. The total concentration of phenolics in skins is influenced by the environment of the grape clusters during their development. Generally the more light and sun exposure the cluster receives the higher will be the concentration of phenolics and anthocyanins. We have seen similar results in our research on grape canopies and wine quality at OSU. However, we have also seen that increases in total phenolic concentration are often accompanied by changes in the relative concentration of specific phenolic compounds. This was first apparent in changes in the ratio of total anthocyanins to total phenolics. Wines made from very exposed clusters had increases in total phenolics that were often much greater than the increases in anthocyanins.

In 1991 we found that exposed grape skins had much higher concentrations of flavonols than shaded skins. The increase in flavonol concentration was much greater than increases in other phenolic compounds and could account for a change in the anthocyanin phenolic ratio. In 1992 we began more careful analysis of grape skins. The primary objectives were to describe changes in the phenolic profiles of grape skins exposed to the sun and to determine if these changes had an impact on the phenolic profiles of wines.

RESULTS AND DISCUSSION

During the summer of 1992 high pressure liquid chromatography (HPLC) equipment was purchased to investigate phenolic compounds in grapes and wine. This equipment can be used to separate, identify, and quantify phenolic compounds. Skin extracts from sun-exposed grape skin were found to have 50 times the flavonol concentration of shaded skins. This response was found in both red and white varieties. The flavonol quercetin was responsible for most of the increase.

Further research clearly showed that quercetin is only produced in sun-exposed grape skin. In an experiment where clusters were covered with aluminum foil we were able to show that 50 percent of the quercetin in skins was synthesized before veraison, and that the differences
between sun-exposed and shaded clusters is established well before the initiation of anthocyanin synthesis.

To determine if cluster exposure was affecting quercetin levels in wine, replicated wine lots were made from clusters selected on the basis of their exposure. All the clusters were selected from a single block of Pinot noir grapes in a commercial vineyard. Wines from sun exposed clusters had six times more quercetin than wines from shaded clusters. Anthocyanins were much less affected by cluster exposure. It was clear from this experiment that quercetin levels in wine could be affected by a grower's vineyard practices. HPLC chromatograms at 360 nm of phenolic compounds from exposed and unexposed grape skin extracts and wines in this experiment are shown in figure 1. They show that the phenolic profiles of wines and skin extracts are quite different and that both skin and wine can be greatly affected by cluster exposure. We have discovered several "exposure sensitive" peaks, but it appears that quercetin is by far the most responsive compound to changes in cluster exposure.

Quercetin is widely distributed in various plant tissues. It has been the object of increased attention in recent years, primarily due to its role in protecting plant tissue from damage by UV light, and for its unclear role in human health. Quercetin has been shown to be a mutagen in microbial assays (the Ames test) but has consistently passed mammalian tests for mutagenesis. In some animal feeding studies, quercetin was shown to prevent certain forms of cancer. Quercetin is getting increasing attention in the popular press as public awareness of wine and health increases. More information on the origin of health related compounds in wine could significantly contribute to the discussion.

Quercetin may also have significant effects on wine sensory character, both as an independent compound and as a constituent of condensed tannins. Although quercetin and anthocyanins share many structural similarities, anthocyanins are significantly more soluble in wine. It is possible that high levels of quercetin in wine could reduce the size of soluble tannins affecting both color stability in wine and the sensory impact of the tannins. Quercetin and other flavonols have also been identified as the main pigments contributing to amber and yellow color in white wines. This would generally be considered a positive quality characteristic.

Our future research is aimed at two main areas: the role of the cluster environment in quercetin synthesis, and the effects of quercetin concentrations on wine quality.
Figure 1. HPLC chromatograms at 360nm of grape skin extracts and wines from a cluster exposure trial at Freedom Hill Vineyard, 1992. Q=quercetin.