INTRODUCTION AND METHODS

Commercial fermentation practices have been evaluated for several vintages to determine their effects on anthocyanin and phenolic extraction, wine color intensity, color stability, and sensory characteristics of Oregon Pinot noir wines. Trials have included fermentation processing practices (1994), the use of different commercial yeast strains (1995 and 1996), the addition of enological tannins (1996), and the use of macerating pectinase enzymes for color and phenolic extraction (1996 and 1997). Differences in wine composition have been observed in anthocyanin content, wine color intensity, total phenols, and specific phenolic fractions as measured by high performance liquid chromatography (HPLC). The HPLC analysis has been provided by ETS Laboratories, St. Helena, CA. The wines from these trials have undergone sensory evaluation by a winemaker industry panel in the Sensory Laboratory of the Department of Food Science using the technique of free-choice profiling. Significant differences have been observed in color intensity, aroma, flavor, body, and mouthfeel characteristics.

Processing Practices: Pinot noir fermentation trials during the 1994 vintage were done with winegrapes harvested from Woodhall Vineyards in Alpine. Analysis of wines at 14 months of age showed that whole cluster fermentation (100%) produced wines with the greatest color intensity and the highest total and polymeric phenolic content. Both whole cluster fermentations and control wines pressed at dryness after 8 of skin contact time (SCT) produced wines with enhanced bitter and astringent character and enhanced floral, cherry, berry, and prune/raisin characters compared to the other treatments. Whole berry fermentations and pre-fermentation maceration treatment (6 days, 4°C) produced wines with color intensities similar to control wines but with lower total phenolic content. Post-fermentation maceration (14 days SCT) produced wines with color intensity comparable to control wines, however, prolonged post-fermentation maceration (20 days SCT) decreased color significantly. Both post-fermentation treatments produced wines with increased seed phenolic content. Whole berry fermentations and both post-fermentation maceration treatments produced wines with enhanced body, mouthfeel, vegetal, and musty/mushroom characters. The whole berry fermentations also enhanced floral, spicy, and herbal aroma character.

Yeast Strains: Commercial yeast strains were evaluated during the 1995 and 1996 vintages (14 and 5 strains, respectively) for their effects on anthocyanin content and wine color stability. Winegrapes used in these trials were harvested from Croft Vineyards in Monmouth in 1995 and from Woodhall Vineyards in 1996. Anthocyanin content and color intensity differences were observed in new wines in 1995 (but not 1996) possibly due to differential adsorption of anthocyanin pigments by yeast strains. Yeasts may act as 'proteinaceous' fining agents by binding with and then precipitating anthocyanin pigments.
20 months of age the color intensity of the 1995 wines decreased significantly and were similar for all the yeast strains evaluated. In 1996, color intensity of the experimental wine was much greater than in 1995 and no differences were observed in color intensity of new wines fermented with five different yeast strains.

**Enzymes and Enological Tannins:** Macerating pectinase enzymes and enological tannin additions were evaluated during the 1996 vintage with fruit harvested from Woodhall Vineyards. Trials included the addition of two color extracting enzymes Scottzyme Color Pro and Color X added at a rate of 100ml/ton, the addition of three enological tannin preparations Laffort Tanin VR Supra and Laffort Quertanin added at 11 5g/ton, and Oenotan Selection freeze dried oak tannin added at 40g/ton. Enzymes and tannins were added after crushing, destemming, addition of 50 mg/l sulfur dioxide, and addition of 250 mg/L of rehydrated Lalvin RC 212 yeast. Wines were also produced using 0, 25, 50, and 100% whole clusters for comparison to the tannin and enzyme trials. Trials from the 1997 vintage included the addition of five macerating pectinase enzymes using both low and high levels recommended by the manufacturer. Winegrapes used in these trials were also from Woodhall Vineyards. Scottzyme Color Pro and Scottzyme Color X were added at the rate of 60 and 100 ml/ton, Lallzyme Ex at 15 and 3 0 g/ton, Rapidase EX at 15 and 30 g/ton, and Vinozyme G at 25 and 50 g/ton.

**CURRENT PROGRESS AND DISCUSSION**

Previous research on the use of commercial pectinase enzyme preparations in Oregon Pinot noir and Cabernet Sauvignon wines showed that some enzyme preparations are capable of reducing red wine color through pigment modification and subsequent degradation (Wightman, J.D., Price, S.F., Watson, B.T., and R.E. Wrolstad, 1997). Several new macerating pectinase enzyme preparations are currently being marketed for their ability to increase red wine color and color stability. In 1996 and 1997 commercial enzyme preparations were evaluated in Oregon Pinot noir wine for their effects on wine color and phenolics. Three commercial tannin preparations also marketed for enhancing color stability were evaluated in 1996.

In 1996, Scottzyme Color Pro and Scottzyme Color X added prior to fermentation at 100ml/ton produced wines with greater color intensity than untreated control wines. The enzyme treated wines were also higher in polymeric anthocyanins, total phenols, and polymeric phenols than untreated controls (Fig 1). Enological tannin additions produced wines with concentrations of total phenols and polymeric phenols similar to untreated controls and did not increase the color intensity of new wines (Fig 2). Wines produced with 100% whole clusters also had greater color intensity than control wines as well as higher concentrations of polymeric anthocyanin, total phenols and polymeric phenols than the wines produced by enzyme treatment (Fig 3). The use of 25 and 50% whole clusters did not have as pronounced effect on wine color as did 100% whole clusters.
Fig. 1

Scottzyme Color X
HPLC Phenolic Profile

- Control
- Color X

gallic acid
polymeric anthocyanins
monomeric anthocyanins
malvidin
quercetin aglycone
quercetin glycosides

catechin
epicatechin
dehydrate phenols
caffeic acid

Fig. 2

Tanin VR Supra

- Control
- VRS

gallic acid
polymeric anthocyanins
monomeric anthocyanins
malvidin
quercetin aglycone
quercetin glycosides

catechin
epicatechin
dehydrate phenols
caffeic acid
Wines from the 1996 enzyme and tannin addition trials were evaluated in July of 1997 (at 9 months of age) by an industry winemaker panel in the Food Science Sensory Laboratory. Wines produced with the addition of both Scottzyme Color Pro and Scottzyme Color X were perceived by winemakers as having greater color intensity and visual clarity than untreated control wines. The enzyme treated wines also had increased aroma and flavor intensity including enhanced spicy, floral, cherry, raspberry aromas and flavors, and enhanced bitterness and astringency characteristics. The addition of the three enological tannin preparations produced wines with aromas, flavors, and colors similar to control wines (see Sensory Evaluation of Pinot noir Processing Trials: 1996 Enzyme and Tannin Additions, Goldberg, McDaniel, and Watson). The 1996 enzyme and tannin addition wines will undergo sensory evaluation by an industry winemaker panel again at about 16 months of age.

Five commercial macerating pectinase enzymes were evaluated during the 1997 vintage at both low and high dosage rates recommended by the manufacturers. The anthocyanin content of new wines at the time of pressing (dryness) and at the end of malolactic fermentation (MLF) is shown in Fig. 4. The anthocyanin content at the time of pressing was the same or slightly higher in wines produced with enzyme addition compared to untreated controls. By the end of MLF a loss in anthocyanin content was observed in all the treatments and the anthocyanin content was similar to or lower in most of the enzyme treatments compared to the controls. Only the Scottzyme Color Pro wine at the low dosage rates was higher in anthocyanin concentration than the control wine.
Although anthocyanin concentration in new wines was not generally higher with enzyme addition, several of the enzyme treatments produced new wines with greater color intensity than untreated controls. Color intensity of new wines at the end of ULF as measured by the sum of the absorbence at 420 and 520 nm at wine pH is shown in Fig. 5. Addition of Scottzyme Color Pro, Scottzyme Color X, and Vinozyme G produced new wines with greater color intensity than controls at both the low and the high recommended dosage rates. The low dosage rate of Lallzyme EX appeared to be more effective in increasing color intensity than the high dose rate. The low dose of Rapidase EX did not increase color while the high dose showed a slight increase. The increase in new wine color by the enzyme treatments may be due to increases in polymeric anthocyanin content and/or due to co-pigmentation effects of other extracted phenols interacting with anthocyanins to enhance their color intensity.
Fig. 5

1997 Pinot noir Enzyme Trials
Color Intensity at Wine pH
End of MLF

Color Intensity 420+520 nm

Enzyme Treatments

- Control
- C-Pro low
- C-Pro high
- C-X low
- C-X high
- L-EX low
- L-EX high
- R-EX low
- R-EX high
- V.G low
- V.G high
All five of the enzyme treatments produced new wines with greater total phenolic content than untreated controls. Scottzyme Color Pro at the high dose rate produced wine with the highest total phenolic content at pressing, however, by the end of MLF a significant decrease in total phenols was observed, presumably due to polymerization reactions and precipitation. Similar decreases in total phenols were observed in the control wines and in wines produced with the addition of Scottzyme Color X. The new wines at the end of NIELF are currently being analyzed by HPLC for specific phenolic profiles. The wines will undergo sensory evaluation by a winemaker industry panel at 8 months of age and later at about 16 months of age.

LITERATURE CITED