Oregon Wine Advisory Board
Research Progress Report

1995 - 1996

Effect of Fermentation Practices on Pinot noir Wine Quality

Barney Watson, Hsiao Ping Chenl, Mina McDaniel', Cindy Ledererl, Sheri Youngl, Steve Price
Department of Food Science and Technologyl
Price Research Services and ETS Laboratories

Winemakers commonly attribute differences in color, color stability, and phenolic composition to different fermentation practices. The extraction of anthocyanin pigments and other phenolic compounds from the skins, pulp, seeds, and stems to a large degree determines the composition and quality of red wines.

During the 1994 vintage we designed a trial to evaluate a range of commercial processing practices for their effects on color and phenolic composition, and wine quality of Oregon Pinot noir wines. In addition to significant differences observed due to fermentation processing practices preliminary trials with several yeast strains also showed differences in wine color and phenolic profiles. During the 1995 vintage a trial was established to evaluate fourteen commercial yeast strains as well as spontaneous fermentations for their effect on color, phenols, and wine quality.

FERMENTATION PROCESSING TRIALS

Pinot noir harvested from the Woodhall Vineyard in Alpine was used for the 1994 processing trials. Treatments included: crushing and destemming with 3, 8, 14, and 20 days of maceration before pressing, crushing and desternming with a 6 day prefermentation maceration at 40F prior to fen-nentation, and fermentation of whole berries and whole clusters. The wines were monitored during fermentation for extraction of color and phenols and during aging at 3, 6, and 14 months for color, phenols, and phenolic profiles using high performance liquid chromatography (BPLC).

Color and phenolic B?LC analysis of the wines are shown using radar plots to graphically compare the phenolic profiles of the different treatments expressed as percentages relative to the levels found in the control wines. Each phenolic parameter is shown as a single point and is labelled on the outside of the graph. The center of each circle is zero and the lines inside and outside the control (normalized to 100%) represent the percentage differences either lower or higher than the control, respectively.

In January 1996 at 14 months of age the wines underwent sensory evaluation by an industry tasting panel using free choice profiling. The data is currently being analyzed by the Sensory Science Laboratory in the Food Science Department. Samples were taken at the time of the sensory evaluation and analyzed for color, total phenols, and phenolic profiles by BPLC.

Control fermentation: maceration for 8 days prior to pressing: Control wines were crusheddestemmed and 50 ppm S02 was added prior to inoculating with yeast. The caps were mixed into the fermenting wines 2X daily and the wines were pressed after 8 days of skin contact time at cap

fall at about -1.0 Brix. Fermentation temperatures ranged from 25-320C.

Post fermentation maceration for 6 days:

Post fermentation maceration for 6 days produced new wines with distinctly different phenolic profiles than the controls. The most dramatic differences were in the increase in gallic acid, catechin (cat), epicatechin (epicat), and polymeric phenols (poly 280) extracted from the seeds. Total anthocyanins (tot 520), malvidin, and quercetin (q agly, q gly) were slightly lower and total phenols (tot 280) were slightly higher than the Controls (Figure 1).

Post fermentation maceration for 12 days:

Post fermentation maceration for 12 days produced wines with even more striking phenolic profiles. In addition to dramatic increases in the seed phenolics, there were significant losses in cinnamic acids, quercetin compounds, malvidin, and total anthocyanins. Only the polymeric pigment remained at levels comparable to the control wines. The total phenolic content was only slightly greater than the control despite the prolonged maceration largely as a result of the offsetting gains and losses in the various phenolic components (Figure 2).

During maceration total phenols and total anthocyanins reached a maximum after about 10-12 days on the skins followed by losses in both color and total phenols with extended maceration, presumably due to polymerization and precipitation and/or oxidation reactions (Figure 3). Both polymeric phenols and polymeric color were observed to decrease during extended maceration after 10 to 12 days on the skins.

Prefermentation maceration for 6 days at 40F:

Total phenols were lower in the pre-fermentation maceration treatments than in the control wines, even though the total time on the skins was 14 compared to 8 days. Total color (tot 520) and malvidin were also lower suggesting less color extraction from the skins occurred. Polymeric pigment content and the extraction of seed phenolic components was similar to the control wines. Quercetin glycosides and caftaric acid (cinnamates) were present at lower concentrations. These compounds are easily hydrolyzed and several days of maceration prior to the onset of fermentation with little or no alcohol present may favor enhanced enzymatic hydrolysis of these phenolic components (Figure 4).

Whole berry fermentation:

Whole berry fermentations (8 days maceration) were less extractive than the control wines and had slightly lower total phenols, lower seed phenols (particularly catechin), and lower color (total 520 and malvidin). Polymeric color (poly 520) was similar to the control wines. The cinnamates (caftaric and caffeic) were present in slightly greater concentration possibly due to less influence of oxidation with whole berries than with fruit that was crushed and destemmed (Figure 5).

Whole Cluster Fermentation:

The whole cluster fermentations (8 days maceration) produced wines with dramatically different phenolic profiles than the control wines. Total phenols were over 150% higher in concentration with gallic acid, catechin, and polymeric phenols at concentrations of 200% or more of the control levels due to additional phenolic extraction from the stems. Both caftaric acid and quercetin glycosides are also present in the stems and were extracted during, the whole cluster fermentations resulting in levels greater than in the controls. Total anthocyanins and malvidin were present at levels similar to control

wines, however, polymeric color over 150% greater (Figure 6).

Summary of processing trials effects on color and phenolic profiles in Pinot noir wines:

Total anthocyanins (all phenolic compounds absorbing at 520nm) are shown in Figure 7 as total peak area from the HPLC chromatographs compared to the color intensity of the wines (absorbance at 520nm at wine pH). The control wines (8 day maceration prior to pressing) had the highest total anthocyanin content followed by the whole cluster, the14 day maceration, and the whole berry fermentations. The whole cluster fermentation wines (WCI), however, had higher red color intensity (520 nm) measured at wine pH than the control wines even though the total anthocyanin content was slightly lower. The wines produced with 3 and 20 day maceration prior to pressing had the lowest color intensity.

Extended maceration times significantly increased extraction of seed phenolics such as catechin due to solubilization. with alcohol. Polymeric phenols (poly 280) also increased due to extraction from the seeds and/or formation from extracted phenolic precursors. Pre-fermentation maceration (PrM) produced wines with catechin levels comparable to the control wines. Whole berry fermentation (WBr) reduced extraction of phenolics like catechin from the seeds while whole cluster fermentation (WCI) produced wines with the highest catechin levels due to additional extraction from the sterns(Figure 8). Catechin and epicatechin are known to be bitter and may impart harshness to wines if present in sufficient concentrations.

YEAST FERMENTATION TRIALS

Pinot noir harvested from Croft Vineyards in Monmouth was used for the yeast fermentation trials during the 1995 vintage. Commercial dry yeast strains (14) as well as spontaneous fermentations were evaluated for extraction of color and phenols during fermentation. Fruit was crushed, destemmed and 75 ppm S02 added prior to fermentation. Rehydrated yeast were used to inoculate each replicate with the exception of the spontaneous fermentations which received no inoculation. The wines were fermented at 25C for 6 days followed by 32C for 2 days and pressed. The new wines are being analyzed for color, total phenols, and for phenolic profiles by BPLC. The yeast trial wines will be analyzed during aging and evaluated by an industry sensory panel at 8 months of age.

Anthocyanin content, wine color, and total phenols in young wines differed with yeast strains used during fermentation. Total anthocyanins ranged from 179-328 mg/l, color intensity (520+420nm, wine pH) from 3.42-4.53, and total phenols from 862-1208 mg/l (Figures 9, 10&11). Preliminary HPLC analysis of five of the treatments showed that there were also differences in specific phenolic components in wines fermented with different yeast strains. For example, wines produced using Lalvin RC212 had higher levels of most phenolic components than the average (of five treatments analyzed) especially the seed phenolic components gallic acid, catechin, and epicatechin (Figure 12).

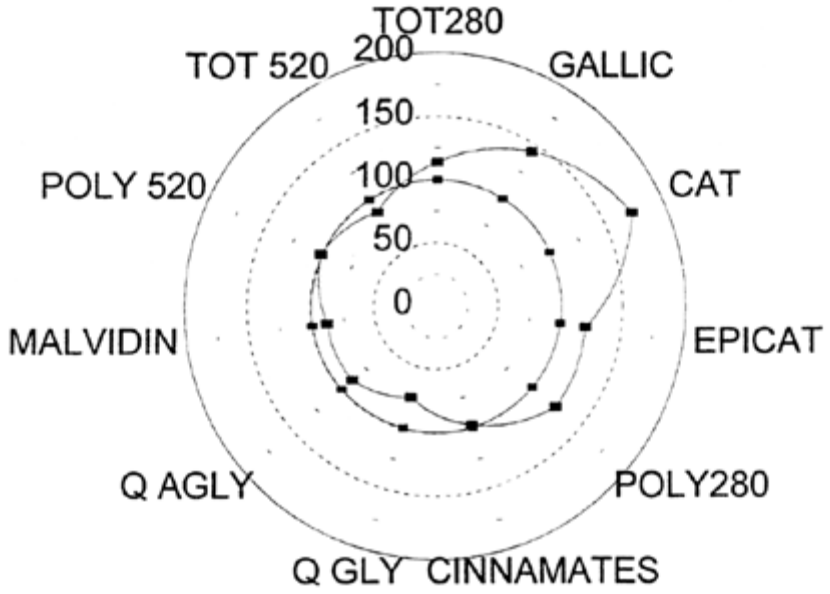

Figure 1: 14 day maceration

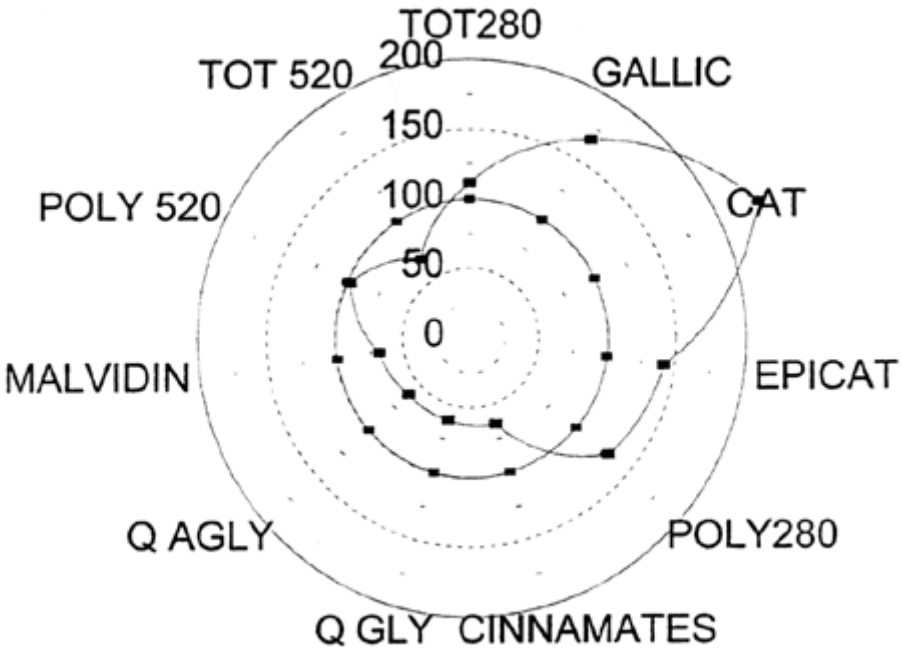

Figure 2: 20 day maceration

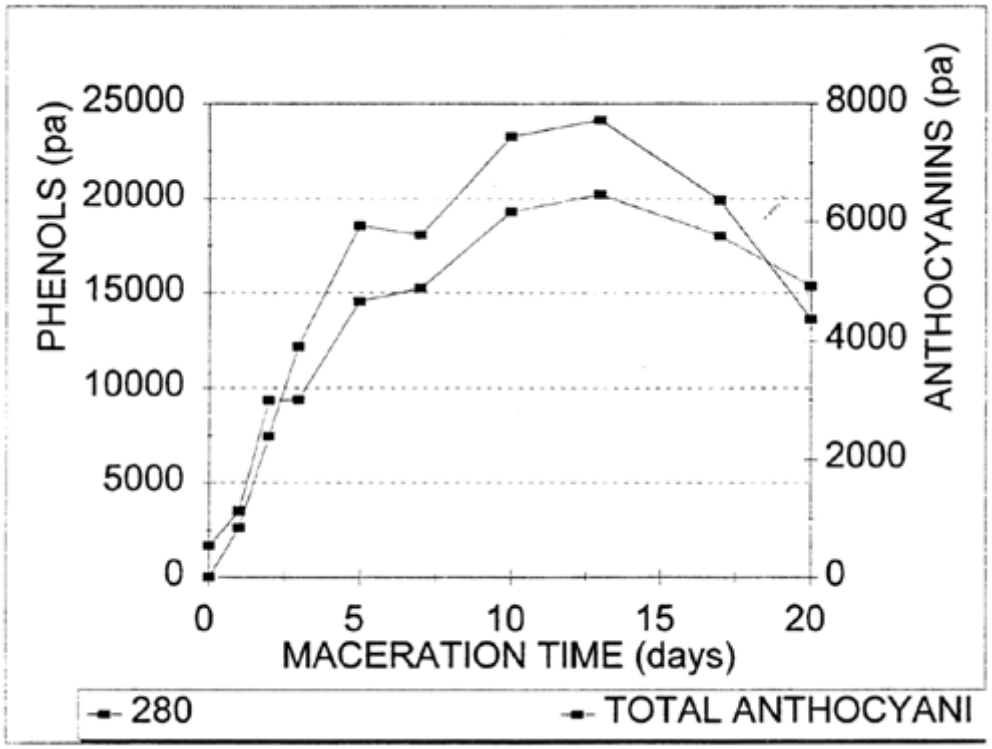

Figure 3

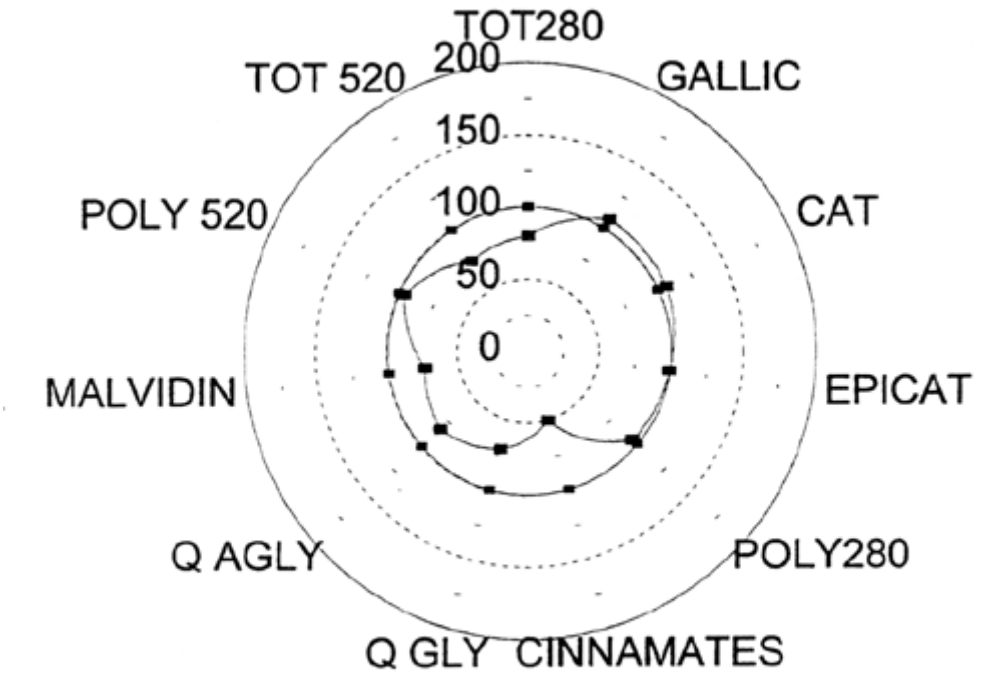

Figure 4: Prefermentation Maceration

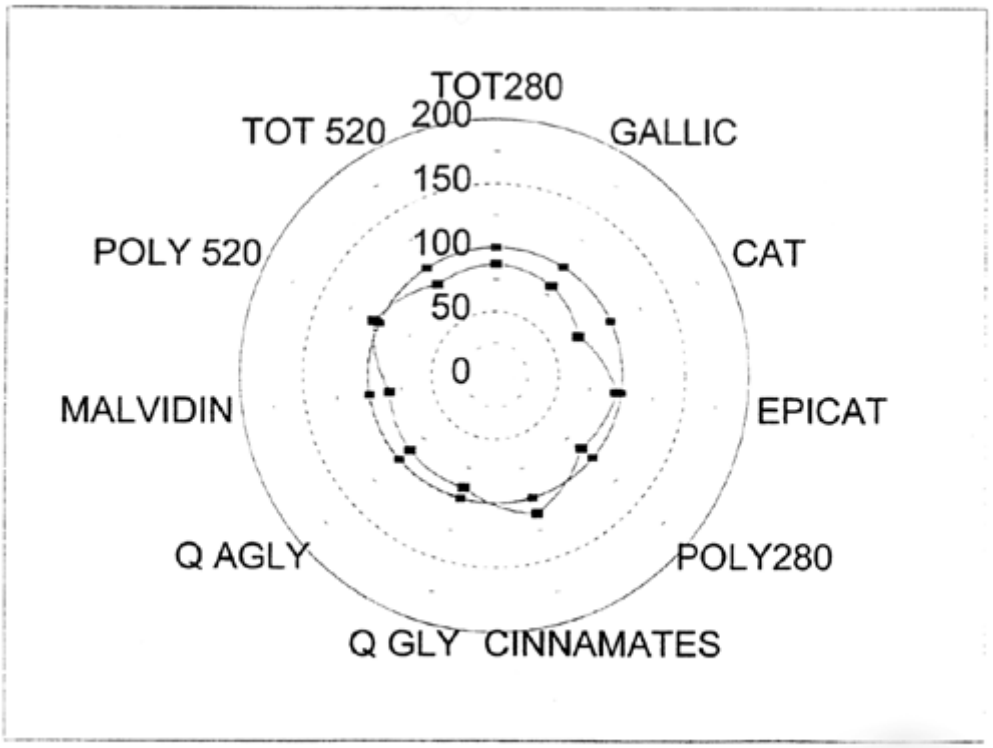

Figure 5: Whole Berry Fermentation

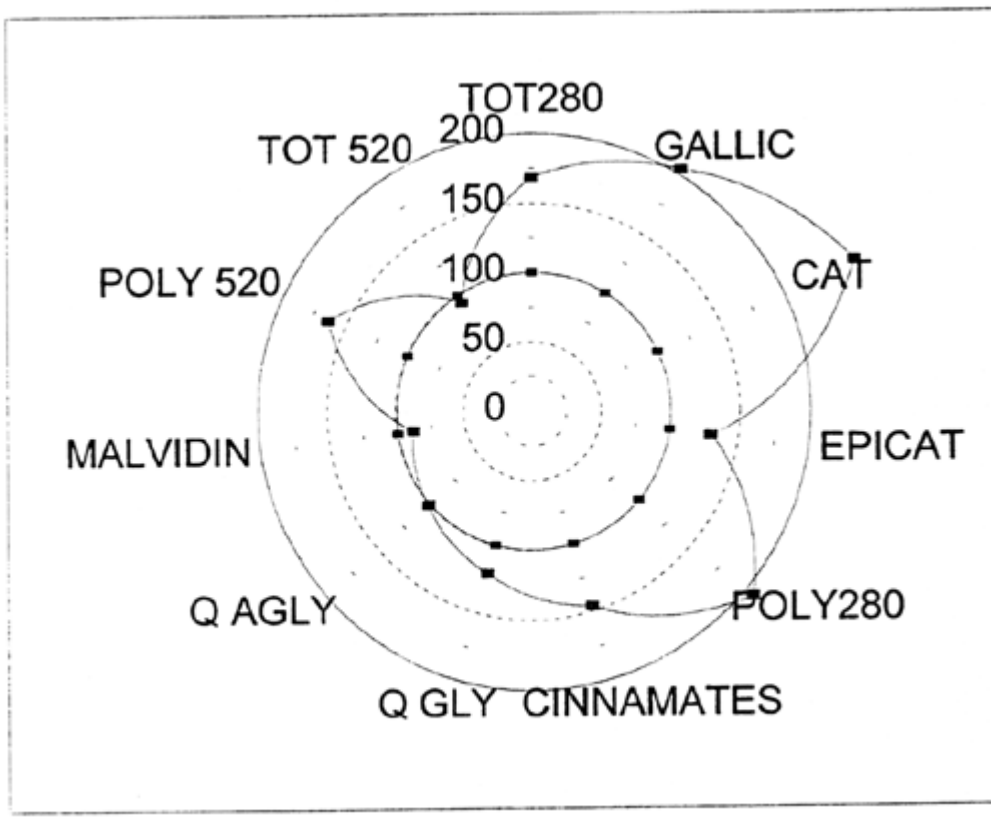

Figure 6: Whole Cluster Fermentation

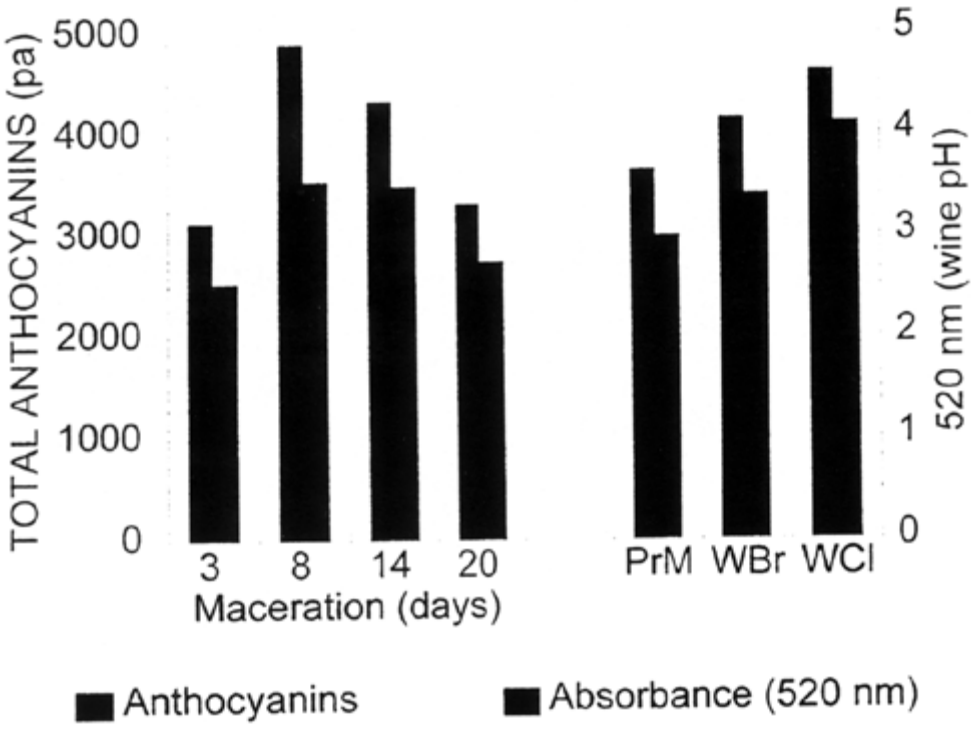

Figure 7: Total Anthocyanins

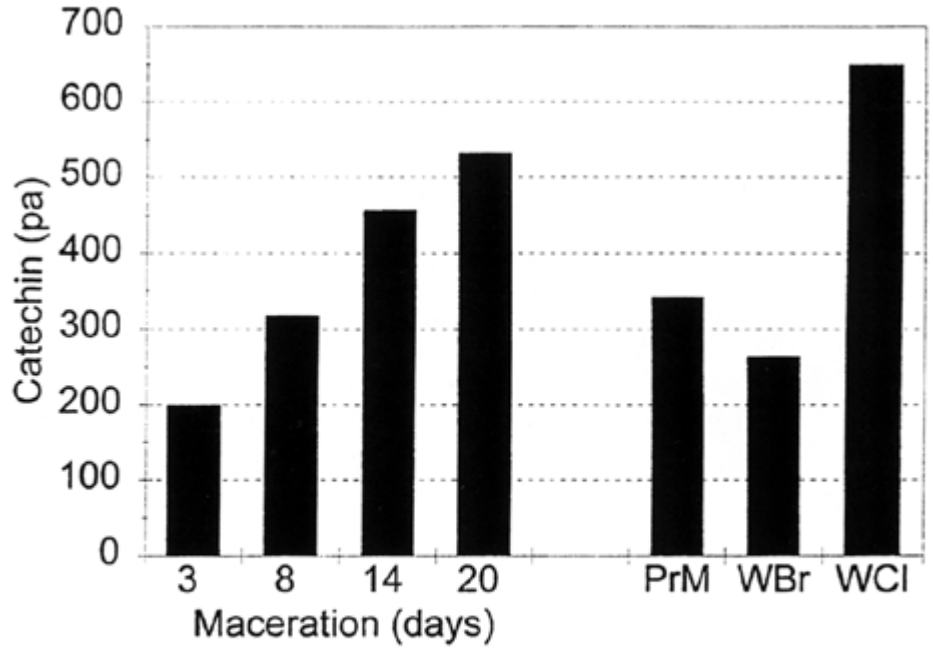

Figure 8: Catechin

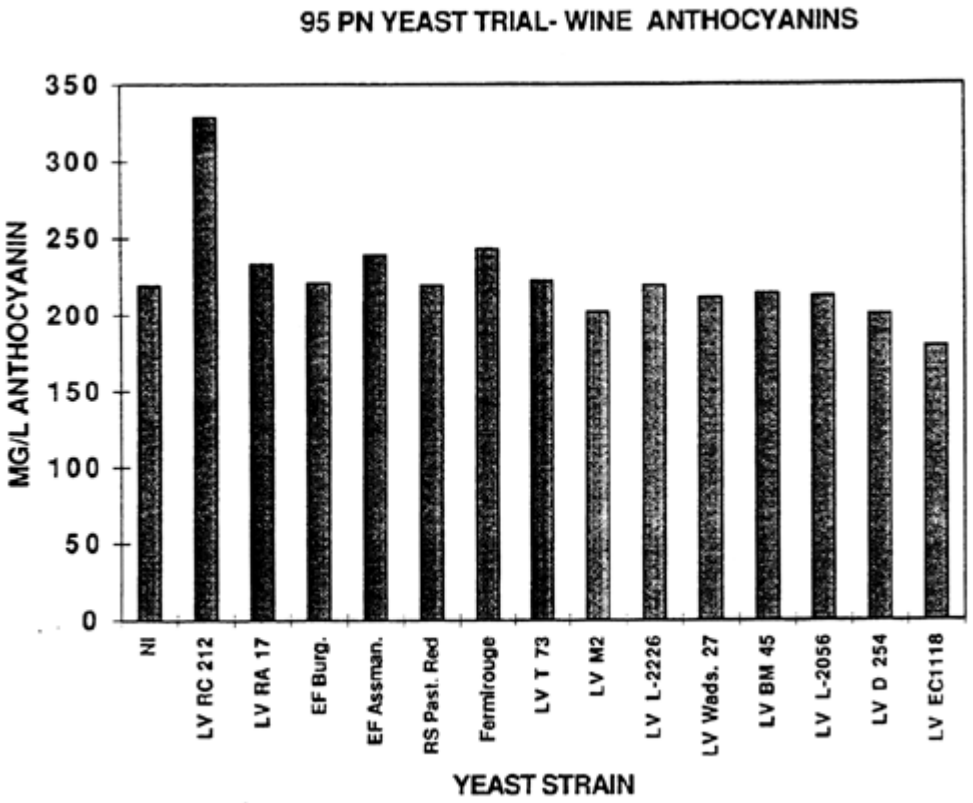

Figure 9

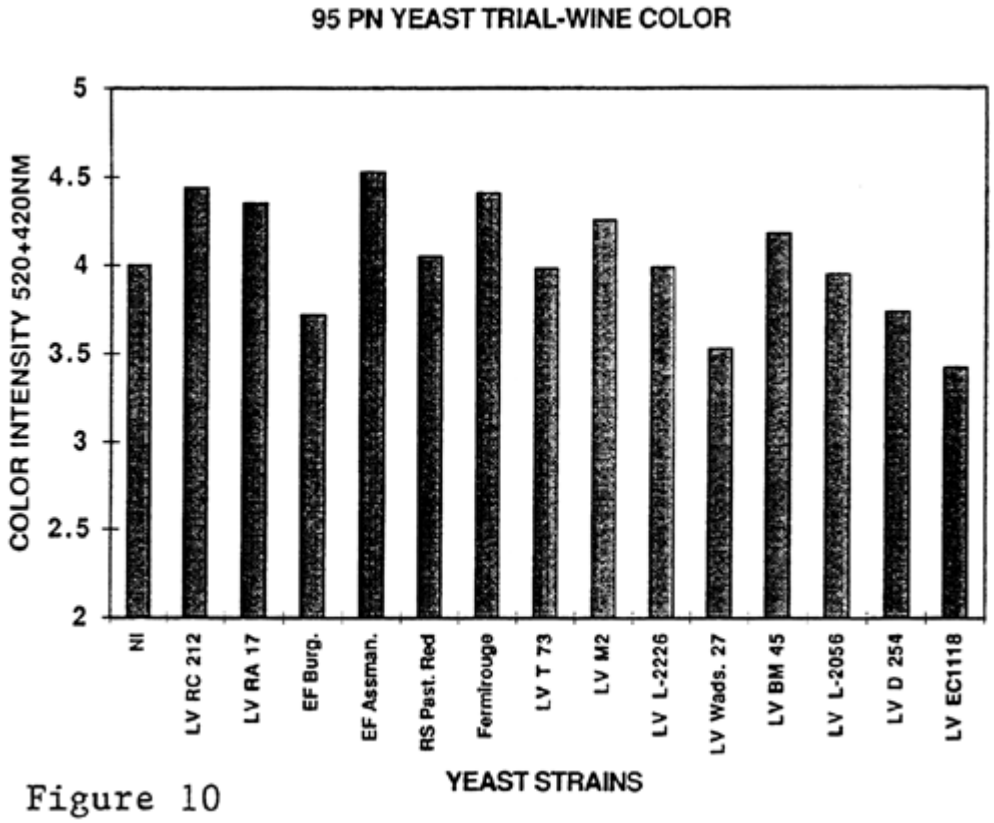

Figure 10

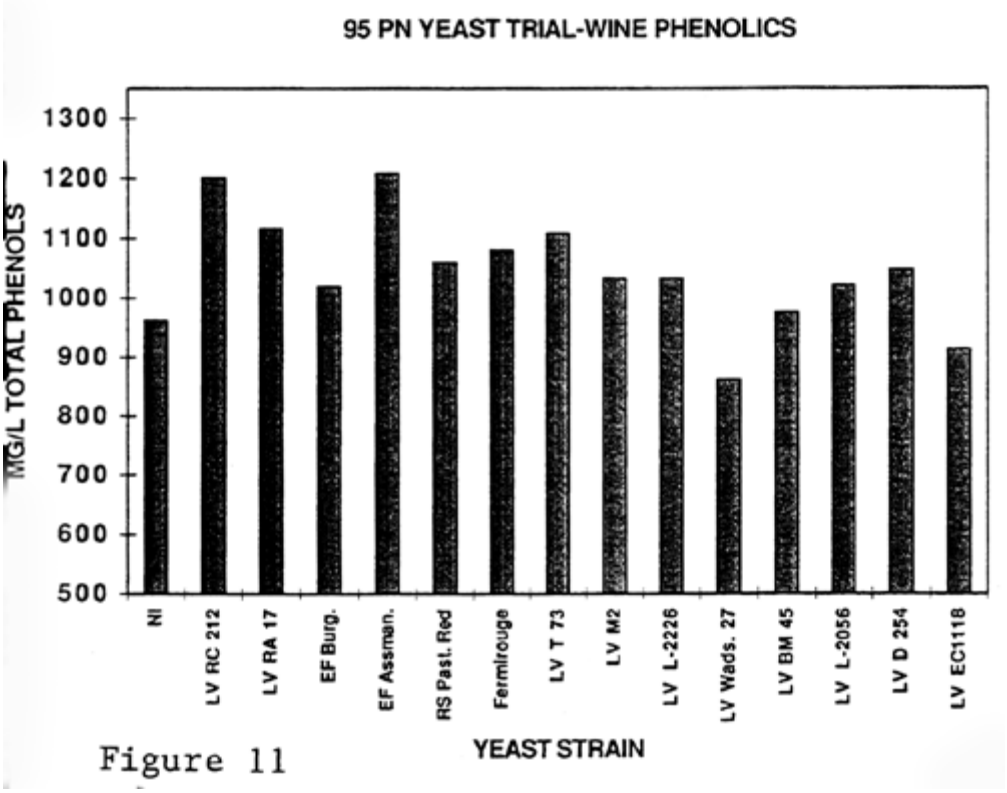

Figure 11

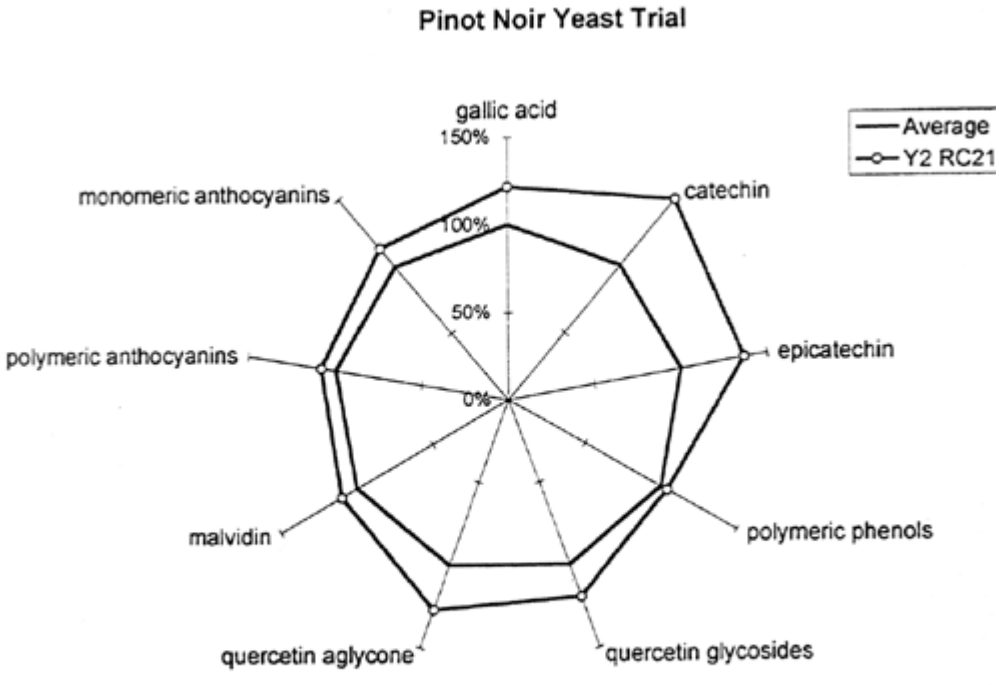

Figure 12

E T S Laboratories / Price Research Services