

Analysis of Organic Acids in Wine by Capillary Electrophoresis with Indirect UV Detection

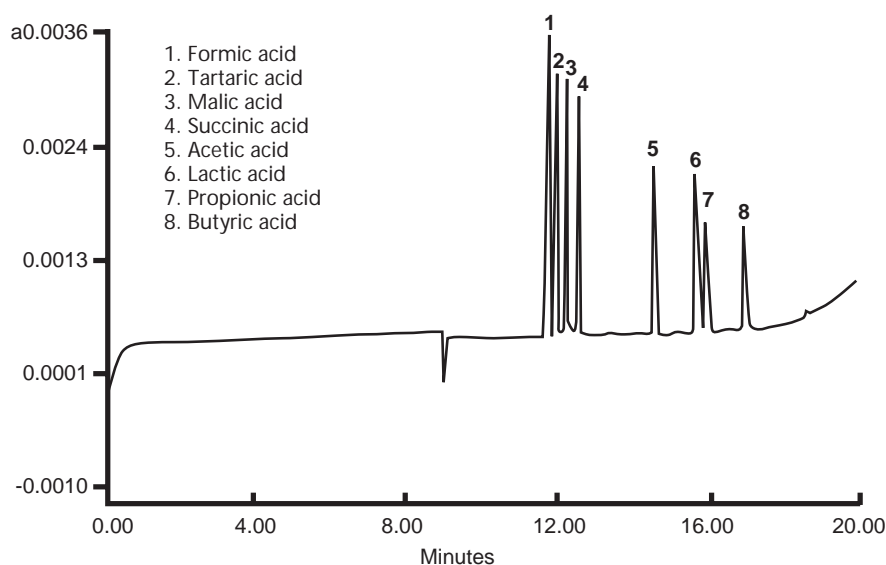


Fig. 1. Separation of eight organic acids by CE.

Analysis Conditions

Instrument	BioFocus® 3000 system
Polarity	negative -> positive
Capillary	75 µm x 100 cm (95.4 cm effective length), uncoated
Run buffer	5 mM sodium phthalate + 0.5 mM flow modifier, pH 5.6
Injection	electrokinetic, 10 kV for 5 sec
Run voltage	20 kV
Detection	Indirect, 254 nm
Cartridge T°	20 °C
Autosampler T°	4 °C

Introduction

Organic acids, present in small quantities, are important constituents in wine. The level of particular organic acids may give desirable or unwanted flavor characteristics to the wine. For example, malic, lactic, citric, and tartaric acids affect the sensory properties of wine, particularly tartness. Excessive amounts of acetic acid make wine undrinkable. Therefore it is important for the winemaker to monitor the level of certain organic acids during the production of wine. The acidity and flavor of a wine is also affected by malolactic fermentation, a process caused by growth of certain bacteria during storage of new wine.

During malolactic fermentation, decarboxylation of malic acid (a dicarboxylic acid) to lactic acid (a monocarboxylic acid) takes place, lowering the total acidity of the wine. Capillary electrophoresis (CE) is an effective method to monitor the presence of organic acids in wine.

Selected wine samples, representing various stages of malolactic fermentation, were centrifuged at 5,000 x g for 10 minutes to remove cells and other particulate matter. The red wine was passed through a reversed phase cartridge to remove the anthocyanins. The colorless liquid was subsequently injected into the CE instrument.

Results

Indirect detection is an effective technique for the analysis of non-UV absorbing analytes such as inorganic ions and organic acids. In the CE run buffer, UV-absorbing ions (in this case phthalate) are incorporated; the resulting negative (“vacancy”) peaks of the analytes are automatically converted to conventional positive peaks by the BioFocus 3000 integrator software. Figure 1 shows the separation of eight organic acids commonly found in wine. Phthalate was selected as background electrolyte because its mobility matches that of the sample ions, resulting in minimal peak broadening.

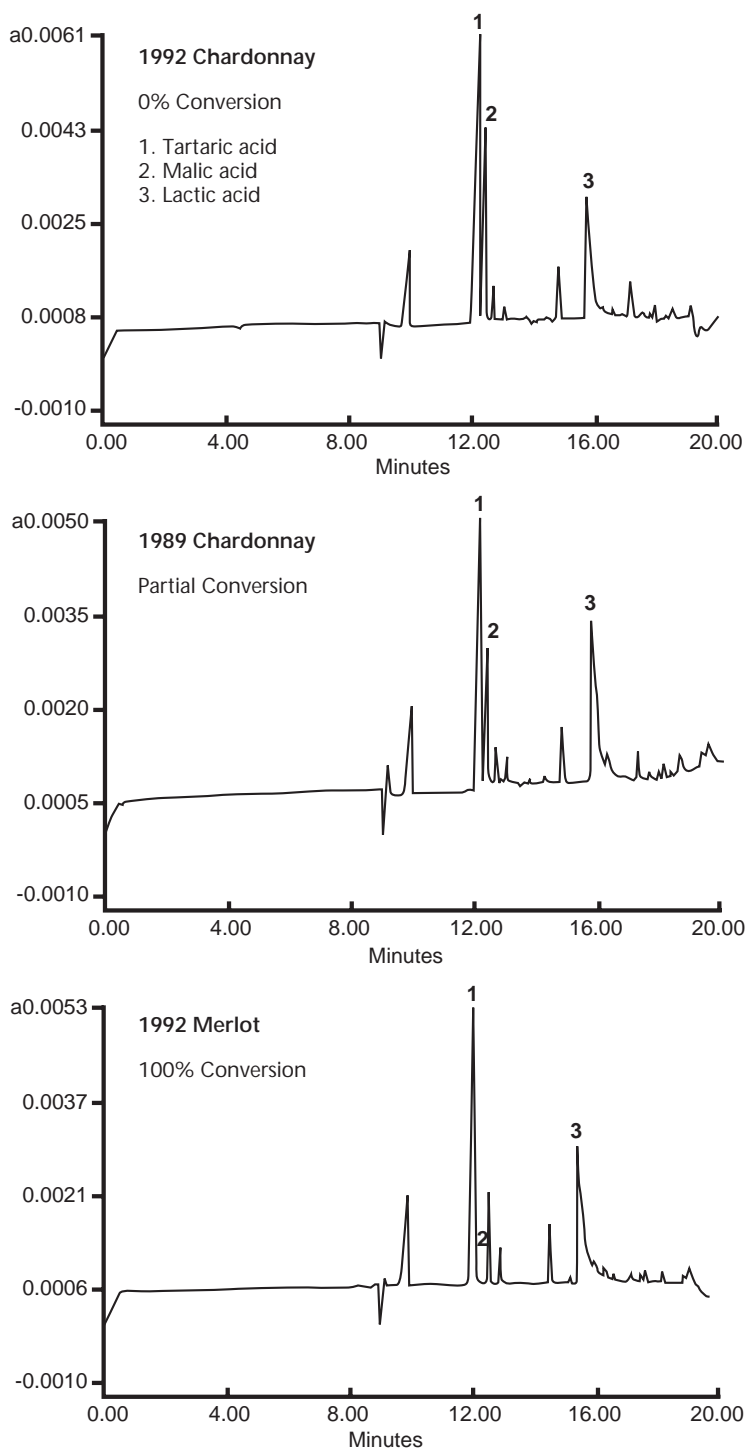


Fig. 2. Electropherograms of three wine samples with varying extent of malolactic fermentation.

The electropherograms of three wine samples are shown in Figure 2. It can be seen that the magnitude of the malic and lactic acid peaks varies with the extent of the malolactic fermentation. This allows an estimate of the degree of malolactic fermentation (this was previously estimated with paper chromatography). Note the presence of a large malic acid peak in the nonconverted chardonnay sample and the absence of this peak in the merlot sample which had undergone 100% malolactic conversion.

In summary, compared to conventional methods such as TLC and HPLC, CE is particularly suitable for the analysis of organic acids because:

- CE provides automated and quantitative analysis.
- The high resolution of the method allows identification of all the important organic acids in short run times.
- Low amounts of solvents are consumed (milliliters per day vs. liters per day with HPLC).
- The capillary separation medium is inherently simple and not readily contaminated, as opposed to an HPLC column.

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