

5.5: Q-NMR for Time Course Evolution of Malic and Lactic Acid

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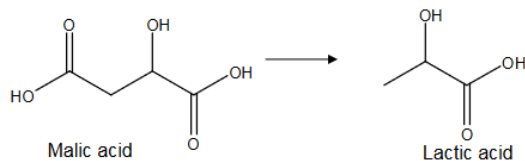


Figure 1. Structures of malic acid and lactic acid. Conversion of malic acid to lactic acid can take place during malolactic or alcoholic fermentation.

Wines consist of various components present at different concentrations. The major components are ethanol, water, glycerol, sugars and organic acids such as malic and lactic acid shown in the figure above. Low levels of malic acid (0.4-0.5 g/L) are a prerequisite for the commercial production of some red wines. In addition, the regulation of this acid is essential in the elaboration of other types of wines such as white and rosé. The levels of malic acid can be controlled by allowing the spontaneous growth of lactic acid bacteria which carry out the malolactic fermentation as shown in Figure 1 above. Q-NMR is useful in evaluating wine quality with respect to age, origin, and effects of adulteration. Control of the fermentation process is essential in determining the desired wine quality. This example illustrates the use of Q-NMR to monitor the fermentation process by measuring levels of malic and lactic acid over the concentration range of 1-3.2 mM. The effectiveness of Q-NMR analysis is compared with the results of enzymatic measurements.

In this experiment, wine samples were collected from various tanks containing grapes of different varieties. Samples were collected directly and preserved at -25 °C. Prior to recording NMR spectra, sample pH was adjusted to 3.0. Succinic acid was used as an external standard. Matrix effects were evaluated by spiking the wine with malic and lactic acid. NMR spectra were obtained by coaddition of 128 transients using a 90° pulse, a spectral width of 10 ppm and a relaxation delay of 60 s. The water resonance was suppressed by irradiation with a selective presaturation pulse.

In order to evaluate the effectiveness of Q-NMR for this analysis, the results were compared with those obtained from an enzymatic assay which consumes malate and produces NADH (Boehringer test). In this test the UV absorption of NADH at 340 nm is used for quantitation. The results of the enzymatic assay were in good agreement with the corresponding measurements by Q-NMR. The major advantages of Q-NMR in this example include minimal sample preparation and rapid analysis.

Reference

Avenoz, A.; Busto, J. H.; Canal, N.; Peregrina, J. M. *J. Agric. Food Chem.* **2006**, 54, 4715-4720

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