# Optimizing Deacidification Methods for Cold Climate Cultivars

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**Background and Rationale:** Shorter growing seasons and cooler temperatures of northern climates can cause grapes grown in those regions to be high in total acidity, especially malic acid. New cold-hardy cultivars have the added challenge of being genetically predisposed to having very high levels of both tartaric and malic acid. The resulting wines can be harsh and astringent unless winemakers take action to mitigate the sensory affects of high acidity. Enological treatments for reducing acidity include physical (blending and amelioration), biological, and chemical methods. While each of these treatments may positively impact a wine's acidity, they each may have drawbacks in terms of other sensory impacts to the wine.

**Methods:**

1. **Winemaking:** Difficult winters in both Minnesota and New York resulted in insufficient fruit yield to perform in-vivo deacidification trials in 2014. The final year of trials has thus been postponed until the 2015 season.

2. **Chemical Deacidification Modeling:** Chemical Deacidification trials in 2012 and 2013 suggested that the double-salt deacidification treatment, as traditionally applied to juice, is ineffective for preferential removal of malic acid or equitable removal of malic and tartaric acid. To test the hypothesis that malic acid solubility limits its removal in juice, a series of solutions with varying pH, °Brix and ethanol concentration were devised (and run in duplicate) to assess the solubility of the calcium salts of tartaric and malic acid. Solubility was assessed via HPLC analysis of test solutions.

**Results:** In all cases, calcium tartrate was significantly less soluble than calcium malate (Table 1), as expected from both empirical and prior experimental data. Calcium malate solubility also decreased with increasing pH, and with increasing concentrations of both ethanol and sugar (measured as °Brix). Variation in pH showed the greatest impact in calcium malate solubility, with solubility decreasing from 7 g/L to 3 g/L as the pH moved from 3.0 to 5.0.

**What the results mean:** These simple models provide insight into factors that limit the efficacy of double-salt chemical deacification. The effect of pH is notable, as the traditional double-salt process involves an initiation step that increases the pH of a portion of the juice to 4.5-6.5pH in an effort to remove additional calcium malate. While the solubility of calcium malate does decrease at higher pH, suggesting more precipitation of malic acid from the juice solution, data also indicate that calcium tartrate remains less soluble than calcium malate at high pH, and will thus be preferentially precipitated from solution. Changes in calcium malate solubility due to ethanol and sugar concentration allow rough contrast of the theoretical double-salt efficacy in juice and wine; juice, of course, would contain 20-25°Brix and 0% ethanol, while wine would contain 12-15%

ethanol and generally <2°Brix. The overall higher solubility in solutions containing as much as 25°Brix than in those with 15% ethanol (1.8 g/L and 0.4 g/L, respectively) suggests that removal of calcium malate may be more effective in new wines rather than in juice. Further modeling studies are underway to verify the impact of these data in wine.

**Table 1: Solubility of calcium tartrate and calcium malate in solutions with varying concentrations of ethanol (EtOH), sugar (°Brix), and acid (pH)**