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Proper Use of Sorbic Acid/Avoiding Geranium Taint

If winemakers wish to produce a wine with residual sugar, and are unable to bottle under sterile conditions, then winemakers often elect to add sorbic acid or a sorbate salt (of calcium, sodium, or potassium), to provide antimicrobial protection and to eliminate the chance of in-bottle secondary fermentation. The addition is widely used in sweet wines which have not been fortified or pasteurized and is ONLY complementary to the use of sulfur dioxide.
Most winemakers prefer to use the potassium salt form (potassium sorbate) simply because it is much easier to dissolve in wine than is sorbic acid. Potassium sorbate is a white or yellowish-white crystal, or crystalline powder.

Sorbic acid, by definition, is a polyunsaturated fatty acid naturally occurring in fruits. When combined with alcohol, the sensory result is often described as being similar to bees wax. Personal detection thresholds vary considerably, although generally the detection threshold in white wine is lower than that of red wine. Sorbic acid is non-toxic to humans, ultimately metabolizing into water and carbon dioxide.

Sorbic acid may be added to wines at any time before bottling because the sorbic acid effect persists (does not deteriorate) over time. The usual pH of wine and the typical ethanol range of wine further enhance the effectiveness of sorbic acid.

Generally, sorbic acid is ineffective toward bacteria; and some wine spoilage yeasts, such as *Zygosaccharomyces,* are resistant to it. Additionally, lactic acid bacteria (including the common malolactic fermentation bacteria) are responsible for the degradation of sorbic acid, which can cause substantial changes in the acid composition of wine; such degradation also leads to the appearance of compounds with an aroma of geranium leaves, which have low human detection thresholds. While to some people the aroma of geranium leaves (chemically: aldehyde compounds such as 2-ethoxy-3,5-hexadiene) may be pleasant, most find such aroma in wine unpleasant, and consider the wine to be flawed .

Good practice: sorbic acid should not be used with wines that undergo malolactic fermentation; adequate SO_2 presence with sorbic acid provides good assurance that lactic acid bacteria will not be active to carry on the reaction resulting in geranium taint.

How much sorbic acid should one use in wine?

Sorbic acid must be used exclusively for the conservation of wines containing sugars. It serves no purpose in dry wines. A winemaker should not consider sorbic acid to be an *essential* winemaking tool, but rather a resource to employ to counteract some other problem, e.g. ineffective winery sanitation, poor winemaking practices.

Note that according to the Code of Federal Regulation, the finished wine “shall contain no more than 300 ppm (mg/L)” of sorbic acid.

Wines having residual sugar, or added sugar, should be preserved with a KMS (potassium meta bi-sulfite) addition of at least 2 ounces per 100 gallons and even higher doses for pH levels greater than 3.30. The KMS supply should be fresh and active. In complementary action with the sorbic acid, maintaining 30-40 ppm of free sulfur dioxide is the recommended level to protect against oxidation.

An effective yeast inhibition dose at normal wine conditions is about 100-200 mg/L of sorbic acid regardless of the population of yeast it is expected to control (Ough and Ingraham 1960).

The sorbate form has almost no offensive taste or odor at these levels, especially in sweet wines; its taste threshold is around 150 ppm.

Calculation:

Given that potassium sorbate = 74.7% sorbic acid,

100 mg/L of sorbic acid = (100/.747) = 133.9 *mg/L* potassium sorbate

200 mg/L of sorbic acid = (200/.747) = 267.7 *mg/L* potassium sorbate;

the following formula may be used in calculating the proper addition of potassium sorbate to achieve a certain concentration of sorbic acid (Vine):

Desired sorbic acid x (molecular weight of potassium sorbate/molecular weight of sorbic acid)
x Liters/gallon x gallons of wine:

or

mg/L of sorbic acid desired x (150/112) x (3.8) x gallons of wine

= mg of sorbic acid required

Example:

Consider the following 100-gallon example, in which the Federal Code's maximum of 300 mg/L of sorbic acid is desired:

300 x (150/112) x (3.8) x (100) = 152,679 mg

Dividing the 152,679-mg result by 1,000 results in 153 g of potassium sorbate addition required,
or about 5 1/3 oz for the 100-gallon container.

Alcohol content is known to affect the activity of sorbic acid and is, therefore, another consideration in addition levels. Sweet wines of higher alcohol content require less sorbic acid for stabilization than those of lower alcohol levels. The table below compares wine alcohol content with the concentration of sorbic acid needed for inhibition of wine yeast.

Inhibitory interaction of alcohol content and levels of sorbic acid in wine.
Ough and Ingraham (1960).

Alcohol Content (% vol/vol)	Sorbic acid (mg/L)
10-11	150
12	100
14	50

Occasionally, if one makes a sorbate addition and an acid adjustment prior to bottling, an amorphous white precipitate may form and float atop the mixture. The problem is that sorbic acid, a fatty acid and a solid at room temperature, has a very low solubility in water (1.6 g/L at 68 °F) or wine.

If one, for example, plans to treat a 1000 L (~250 gallon) tank of wine with the required dose, one would have to add 200 grams of sorbic acid. This is the reason why sorbic acid is used in the form of its highly soluble salt, potassium sorbate.

The potassium salt is indeed very soluble in water. However, if mixed directly into a small volume of wine, the wine's acidic pH will cause the sorbate to combine with hydrogen ions from the grape's tartaric and malic acids to form sorbic acid molecules. This effect can be observed as white flocks of insoluble sorbic acid floating inside and atop of the mixture. In order to avoid the flocculation of sorbic acid, it is recommended to mix up the potassium sorbate separately in a bucket of clean water, then to slowly add the solution to a gently stirred tank. Any acid adjustment should be performed separately from the sorbate addition.

Reiteration: the effectiveness of the sorbic acid is closely related to proper pH-dependent sulfur dioxide management of the wine and a minimal microbial load. Recommended is a clarifying filtration *prior* to sorbate additions for all wines with residual sugar, followed by a sterile filtration immediately prior to bottling.

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