IOWA STATE UNIVERSITY
Extension and Outreach

Using Potassium Sorbate to Inhibit Yeast Growth in Bottled Wines

Wines bottled with residual sugar concentration at or above 1 gram per liter have the potential to be at risk for yeast refermentation. Stringent cleaning and sanitation practices, appropriate sulfur dioxide (SO_2) use, and sterile filtration prior to bottling help to prevent refermentation issues. For more information on refermentation, see Iowa State University Extension and Outreach publication FS40–Wine Fault Series: Refermentation, store.extension.iastate.edu/product/15980. Additionally, the use of sorbic acid or its potassium salt (potassium sorbate) is permitted as a preservative by the Alcohol and Tobacco Tax and Trade Bureau (TTB). The additive inhibits yeast (primarily *Saccharomyces cerevisiae*) and molds. Its effectiveness depends on factors such as pH and alcohol content; and should be used in conjunction with appropriate SO_2 additions and wine clarification methods.

Chemical Properties

Sorbic acid (2,4-hexadienoic acid) is a polyunsaturated fatty acid commonly used in the food and beverage industry as a preservative (21 CFR 182.3089, 182.3640). Salts of sorbic acid, such as potassium sorbate, are formed by the reaction of the carboxyl group (COOH) of sorbic acid with potassium hydroxide. Potassium sorbate is commercially available as powder or granules and has better solubility in water than sorbic acid. For this reason, potassium sorbate (commonly referred to as 'sorbate') is recommended as the additive in winemaking. In wine, the solubility of potassium sorbate decreases as concentrations of ethanol and/or sugar increases. Solubility also decreases with decreasing temperature.

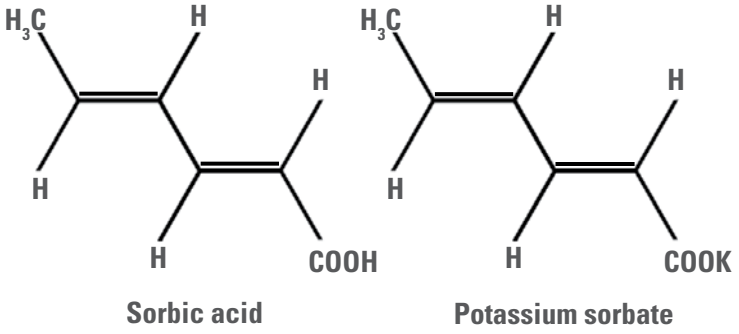

Figure 1. Chemical structures of sorbic acid and potassium sorbate.

Antimicrobial Activity

Sorbic acid inhibits the growth of *S. cerevisiae* yeast and mold. This antimicrobial activity is due to its inhibitory influence on spore development and dehydrogenase enzymes in the microbial cells. Sorbic acid does not prevent bacterial growth from acetic acid bacteria or lactic acid bacteria. It is not effective in preventing growth of non-saccharomyces spoilage yeast such as *Zygosaccharomyces, Brettanomyces/Dekkera*, or the film-forming oxidative yeasts such as *Pichia*.

Considerations for Use

The effectiveness of sorbic acid depends on wine pH and alcohol content, although no suggested dosage has been determined for wine based on the combined factors. At lower pH and with higher alcohol content, sorbic acid is more effective in preventing yeast growth. At pH 3.7 and lower, the percent of the undissociated form of sorbic acid is above 90%, providing greater antimicrobial action than at pH values above 3.7. The ethanol content of a wine also influences the antimicrobial action of sorbic acid. Table 1 provides a recommendation for sorbic acid concentration in clarified wine (<100 cell/mL) based on alcohol content.

Table 1. Recommended concentration of sorbic acid addition based on alcohol content of wine.

Percentage of alcohol in wine	Sorbic acid (mg/L)
10%	150
11%	125
12%	100
13%	75
14%	50

A consideration related to microbial activity is that some lactic acid bacteria and acetic acid bacteria can metabolize sorbic acid, particularly when it is present in low concentrations. Lactic acid bacteria are of primary concern as these metabolize sorbic acid to produce a compound (2-ethoxyhexa-3,5-diene) that causes a wine fault known as geranium taint. For more information see Iowa State University Extension and Outreach publication FS40–Wine Faults Series: Geranium Taint, store.extension.iastate.edu/product/15980. To prevent development of this fault, avoid potassium sorbate use in wines or wine blends that have undergone malolactic fermentation. Make potassium sorbate additions just before bottling (1-2 days) and use appropriate levels of SO_2 based on wine pH to avoid contamination by lactic acid bacteria. Wine should also be clarified or filtered to a low cell count (<100 cell/mL) for bottling.

The TTB legal limit for sorbic acid addition is 300 milligrams per liter (27 CFR §24.246); however, the reported sensory threshold for sorbic acid in wine is approximately 135 milligrams per liter. Additionally, the use of sorbic acid often results in the formation of ethyl sorbate during wine storage, which imparts a candy/pineapple/celery-like aroma. The desired shelf life of a wine should be considered when using potassium sorbate as a preservative, as long-term aging is not recommended.

Calculating Potassium Sorbate Additions

To calculate the amount of potassium sorbate to add to a batch of wine, first determine the concentration of sorbic acid desired. A general recommendation is 150-200 milligrams per liter of sorbic acid; however, the wine's pH and alcohol content should be taken into consideration. Next, use the equation to calculate the addition of potassium sorbate. The molecular weight of potassium sorbate (150 g/mol) is divided by the molecular weight of sorbic acid (112 g/mol) to account for potassium sorbate containing 74.7% sorbic acid (or directly use the factor of 1.34). Then, multiply by volume of wine in liters (L) (to convert from gallons, multiply gallons by 3.785). Lastly, divide by 1,000 to find grams (g) of potassium sorbate to add.

Desired sorbic acid add:
(mg/L) × 1.34 × L of wine ÷ 1000= g potassium sorbate to add

Example calculation: How many grams of potassium sorbate are needed to make a 175 mg/L sorbic acid addition to a 500-gallon batch of wine?

500 gallons × 3.785 L/gallon = 1892.5 L

175(mg/L) × 1.34 × 1892.5 L ÷ 1000 = 444 g potassium sorbate

Alternately, use Table 2 as a quick reference guide:

Table 2. Amount of potassium sorbate needed to obtain various levels of sorbic acid in wine.

Desired Sorbic Acid Addition	Grams of Potassium Sorbate to Add			
mg/L(ppm)	g/gal	g/10 gal	g/100 gal	g/1000 gal
50	0.3	2.5	25.3	253
75	0.4	3.8	38.0	380
100	0.5	5.1	50.7	507
125	0.6	6.3	63.3	633
150	0.8	7.6	76.0	760
175	0.9	8.9	88.7	887
200	1.0	10.1	101.3	1013
225	1.1	11.4	114.0	1140
250	1.3	12.7	126.7	1267
275	1.4	13.9	139.3	1393
300	1.5	15.2	152.0	1520

Key Points for Potassium Sorbate Use in Wine

- The primary antimicrobial activity of potassium sorbate in wine is against yeast and molds; it does not protect against spoilage by acetic acid bacteria or lactic acid bacteria.
- Potassium sorbate is more effective in wines that are clarified, have lower pH, and higher alcohol content.
- Use appropriate additions of sulfur dioxide (SO_2), based on wine pH, in conjunction with potassium sorbate.
- Lactic acid bacteria can utilize potassium sorbate to produce the geranium taint wine fault; its use is not advised in wines that have undergone malolactic fermentation.
- Wine should be mixed well after potassium sorbate addition; note that temperature, alcohol content, and sugar concentration will affect solubility.
- Wine should be bottled soon after (1-2 days) addition of potassium sorbate.

References

Crowell, E.A. and J.F. Guymon. 1975. Wine constituents arising from sorbic acid addition, and identification of 2 ethoxyhexa-3,5 - diene as a source of geranium like off odor. Am. J. Enol. Vitic. *26*(2). 97-102.

De Rosa T., Margheri, G., Moret, I., Scarponi, G., Versini, G. 1983. Sorbic Acid as a Preservative in Sparkling Wine. Its Efficacy and Adverse Flavor Effect Associate with Ethyl Sorbate Formation. Am. J. Enol. Vitic. *34*(2). 98-102.

Dharmadhikari, M. 1992. Sorbic Acid in Vineyard and Vintage View. 7(6).1-5. Missouri Cooperative Extension. Mountain Grove, MO.

Peynaud, E. 1984. The Use of Sulfur Dioxide in the Storage of Wines. In Knowing and making wine. John Wiley & Sons, New York.

Zoecklein, B. 2002. Controlling Microbial Growth in Wine. Section 2. www.apps.fst.vt.edu/extension/enology/downloads/wm_issues/Wine%20Microbiology/Micro2.pdf

Zoecklein, B.W., Fugelsang, K.C., Gump, B.H., and Nury, F.S. 1999. Sorbic Acid, Benzoic Acid, and Dimethyldicarbonate. In Wine Analysis and Production. 209-212. Kluwer Academic/Plenum Publishers, New York.

Authors

Prepared by Maureen Moroney, research scientist, and Jennie Savits, enology program specialist, Midwest Grape and Wine Industry Institute at Iowa State University. Reviewed by Aude Watrelot, assistant professor of enology, Iowa State University Department of Food Science and Human Nutrition.