WINE MADE EASY

Sulfur-based Off-flavors in Wine

What Is Sulfur?

Sulfur is a nonmetal element used in grape production and winemaking through various chemical forms. It is also a component of many volatile (i.e., gaseous, aromatic) and nonvolatile compounds found in wine.

The element sulfur is naturally found in grapes. Winemakers typically add a form of sulfur to the wine through potassium metabisulfite additions, which breaks into sulfur dioxide in the wine. However, sulfur-based compounds may also be generated during yeast fermentation and malolactic fermentation, or extracted from the grape during wine production.

What Is Sulfur Dioxide (SO_2)?

Sulfur dioxide, the main preservative used in wine, is produced naturally through fermentation. Asthmatics may have adverse reactions to sulfur dioxide and should approach foods that contain sulfur dioxide with caution. All wines produced in the United States must contain less than 250 ppm total sulfur dioxide. In general, most dried fruits often contain more sulfur dioxide than the maximum allowable limit in wine.

What Are Sulfurlike Off-odors in Wine?

Sulfur contributes to several wine off-flavors, including the presence of hydrogen sulfide (H_2S), reductive aromas (developed by mercaptans/thiols or disulfides), and a high concentration of free sulfur dioxide. The word "sulfur" is often used, incorrectly, to describe all of these aromas and flavors. However, each defect has a particular aroma/flavor association that is somewhat unique:

- H_2S has the aroma of rotten eggs or hard boiled eggs.
- Mercaptans or thiol-based compounds and disulfides have various aromas/flavors. Many common descriptors include canned or cooked vegetables, canned asparagus, garlic, onion, cooked cabbage, garbage, putrefaction, burnt rubber, canned corn, and molasses.
- High free SO_2 smells like recently burned matches and often causes a burning or irritation in the nose.

Chemically, all of these compounds are very different despite the fact they all contain the element sulfur. Additionally, remediating these defects in wine requires winemakers to properly identify the problem and use appropriate techniques to treat the problem.

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DID YOU KNOW?

You can tell if a wine contains H_2S by using the "penny test." Drop a penny from before 1982 into about 30 milliliters of the questioned wine. Cover and swirl the glass. Smell the wine only. If the penny addition cleans up the wine, chances are that the wine has hydrogen sulfide problems. The copper in the penny has reacted with the hydrogen sulfide to clean up the wine aroma. Dispose of the wine and clean the penny.

Remediating H_2S in Wine

H_2S is a common problem associated with homemade and commercial wines. This flavor compound is often associated with primary fermentation and can develop at three key points:

1. The beginning of fermentation (often perceived with the rapid development of carbon dioxide)
2. The end of fermentation (perceived during racking or as wine sits in tank)
3. During yeast death (when wines may be sitting on gross lees)

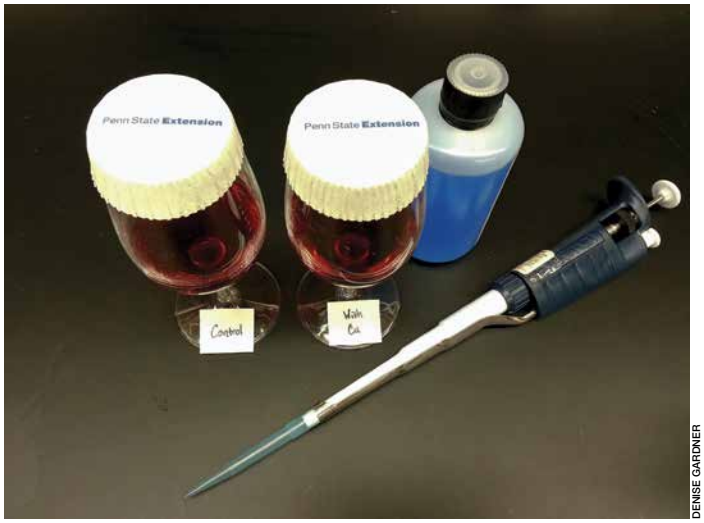
Recent research points to nitrogen management (i.e., yeast-assimilable nitrogen, or YAN) as a way to prevent H_2S development through fermentation. However, H_2S development may occur despite nutrient management strategies.

Copper addition, in the form of copper sulfate, is often used to remediate aromas/flavors associated with H_2S. One percent and 10 percent copper sulfate solutions can be purchased through your local wine supplier. Winemakers can evaluate whether copper sulfate additions will remediate the aroma/flavor by running a copper screen.

Before making copper additions to the entire tank of the wine in question, remember to do a series of bench trials. Bench trials should be conducted before making these and other product additions to your wine.

Copper Screen

1. Add 50 milliliters of wine to two glasses.
2. Label one glass "control" and the other "copper addition" (see image below).
3. Add 1 ppm of copper sulfate to the "copper addition" glass.
4. Cap both glasses for 15 minutes.
5. Sniff (smell only!) both glasses. Most people start with the "control." If the aroma/flavor of the "copper addition" glass has improved, or the H_2S aroma has subsided, then a copper addition trial should follow.



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Copper addition trials should be used to remediate hydrogen sulfide problems. Here, various concentrations are added to the wine to determine the minimum concentration of copper needed to remediate the H_2S aroma. Remember that the legal limit for copper allowed in a finished wine is 0.5 ppm.

Copper Additional Trial

1. Pour 50 milliliters of H_2S-problem wine into five glasses.
2. Label the following glasses: (1) control, (2) 0.5 ppm copper, (3) 1.0 ppm copper, (4) 1.15 ppm copper, and (5) 2.0 ppm copper.
3. Using a 2 percent copper sulfate solution, add the following increments to each glass:
    a. 0.0 mL to glass 1 = no copper addition
    b. 0.1 mL to glass 2 = 0.5 ppm copper addition
    c. 0.2 mL to glass 3 = 1.0 ppm copper addition
    d. 0.3 mL to glass 4 = 1.5 ppm copper addition
    e. 0.4 mL to glass 5 = 2.0 ppm copper addition
4. Cap each glass and wait 15 minutes.
5. Sniff (smell only!) each glass to determine when the H_2S aroma is gone. This is the concentration of copper sulfate that will need to be added to the tank containing the H_2S wine.

Excess copper sulfate can be removed with bentonite, yeast hulls, or fresh lees additions. Thoroughly mix each product into the wine, and then rack after it has fallen to the bottom of the tank. Always remember to confirm the residual copper concentration with a certified wine lab.

Resources

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