

Convenient, inexpensive quantification of elemental sulfur by simultaneous in situ reduction and colorimetric detection

Research in Plain English

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Figure 1. Monitoring fermentation. (Image by Misha Kwasniewski)

Background:

Sulfur is widely used by the wine industry as a fungicide for powdery mildew. While it is an inexpensive and effective method to control this pesky pathogen, sulfur residues on grapes can have undesirable effects in the winery. During fermentation, yeast can convert sulfur into hydrogen sulfide (H_2S), which produces off aromas, often described as “rotten eggs.” How then can growers fight off powdery mildew, without compromising the integrity of their wines? Furthermore, how can grape growers accurately measure sulfur levels to avoid critical levels?

Previous methods for measuring sulfur have typically been expensive and time consuming. Some applications have even required handling and disposing of transition metals and organic solvents, best left for trained professionals with specialized laboratories. As such, these applications are not feasible for most

growers or small to mid-sized wineries. We have developed an alternative test that is both simple and inexpensive to quantify levels of sulfur residue on grapes.

Experimental Design:

To develop a practical method that can be used just as easily in the field as in the winery, we selected hydrogen sulfide detection tubes as a foundation. These tubes, classically used by the mining industry for health and safety monitoring, have also been adapted for measuring H₂S in wine. These tubes are widely available because they are widely used by the mining industry.

With tubes having the correct sensitivity, it is possible to quantify H₂S production in small fermentation lots (0.5-20L) or to quantify elemental sulfur levels in wine. This is accomplished in two ways: 1) Letting an active fermentation carry the gases formed through the tube, or 2) Sparging, or “gas flushing,” a sample with inert gas through a tube. Quantifying both H₂S production or H₂S in a sample is possible with minimal equipment and supplies.

This relatively easy method for measuring H₂S in any modestly equipped winery lab was then extended to elemental sulfur quantification. First, ground grapes are heated in a benign solvent. The sample is degassed (with an antacid tablet), and then reacted with a chemical that selectively turns all elemental sulfur in the sample into H₂S. The H₂S is then measured by sparging the sample with CO₂ (produced by another antacid tablet). An online video detailing this procedure is available: <http://youtu.be/yH83vDX8ORQ> “Assay for Measurement of Elemental Sulfur Residues on Grapes.”

Method for Measuring Sulfur Samples:



Figure 2. SO₂ tube apparatus. Reaction flask at bottom is connected to SO₂ detection tube via a condenser consisting of a volumetric pipette. (Image by Tammy Jones, Missouri Grape and Wine Institute)

Samples can be either fresh or frozen juice or grapes. It is important to minimize handling each sample to prevent sulfur from rubbing off the grapes onto your hands.

Equipment needed

Balance accurate to 1g
120ml Flask
Tubing
Glass Pipette
Detection tube

Reagents needed

PEG 400 (a makeup and food additive)
Dithiothreitol (reagent for sulfur conversion)
Effervescent Antacid (Alka-Seltzer™)

Steps

1. Grind grape Samples.
2. Heat Sample with PEG to suspend sulfur.
3. Convert sulfur to H₂S by DTT addition.
4. Push H₂S through tube using CO₂ generated by alka-seltzer.
5. Measure the length of the tube to dark end to find out how much Sulfur was in the original sample.

Implications:

- This novel method uses technology developed for the mining industry to measure elemental sulfur in wine and juice samples.
- Previous methods have required specialized laboratory equipment, reagents, and technical expertise.
- It will help wine growers quantify elemental sulfur in juice or wine to avoid levels that could compromise fermentations (Red wine limit 1 µg/g elemental sulfur and white wine limit 10 µg/g elemental sulfur).
- Equipment costs are under \$50, and consumable costs are approximately \$10/run. Recycling detection tubes can further decrease costs.
- Individual analysis are time-effective, less than 15 minutes per run, and require minimal laboratory facilities and equipment.
- Methods require no pre-concentration, extraction, or specialized equipment for wine makers.
- This work has future potential for adopting methodology to measure quantitative and qualitative properties of elemental sulfur in more complex samples.

Bottom Line: This novel and inexpensive method is available to winemakers in need of a practical way to measure sulfur levels of their grapes. **Related Links:**

- [Analyzing Elemental Sulfur Residues on Grapes](#) by Misha Kwasniewski and Gavin Sacks for eXtension
- [Measuring Field-Applied Sulfur Residues in Juice and Wine](#) by Chris Gerling for Cornell Cooperative Extension

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