ETS LABORATORIES

TECHNICAL BULLETIN

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ETS Volatile Sulfide Analysis

Sulfides in Wine

Sulfide formation in wine has been a persistent problem. The chemistry of sulfide formation is complex. There are many potential interactions with vineyard and winemaking practices. Corrective options are limited and current winemaking techniques often include risks for sulfide formation.

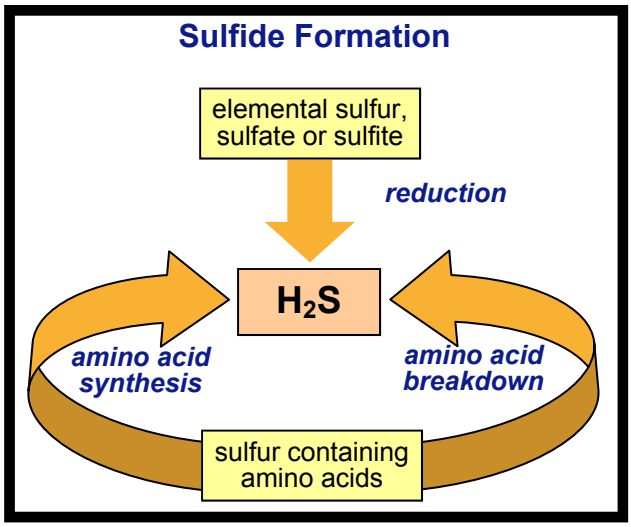
Volatile sulfur compounds can contribute to *reduced*, *rotten egg* aromas in otherwise acceptable wines. These unpleasant aromas are almost always caused by sulfides or mercaptans.

ETS Laboratories offers a detailed analysis of sulfides and mercaptans. This information can help winemakers understand the origins of a sulfide problem and is indispensable in designing an effective treatment and prevention program.

Sensory Thresholds in Wine

Nearly 100 volatile sulfur containing compounds have been found in wine. Fewer than ten of these are usually associated with sulfur aroma defects. Sensory thresholds for the most common problematic volatile sulfur compounds in wine are listed in Table 1.

Sensory thresholds for volatile sulfur compounds vary depending on the type of wine and interactions with other wine aromas. The values shown in Table1 are compiled from published literature and in-house sulfide studies at ETS Laboratories.



Hydrogen Sulfide (H_2S)

H_2S production is a natural by-product of yeast metabolism. Yeasts form H_2S by reduction of sulfates, sulfites, and elemental sulfur during amino acid synthesis. Problems arise when inconsistent H_2S production exceeds its utilization and excess H_2S "leaks" into the wine. Additional amounts of H_2S can be formed in wine by the natural breakdown of sulfur-containing amino acids.

H_2S is the volatile sulfur compound found most frequently in fermenting wine. Large amounts of H_2S are often produced during fermentation. Under normal conditions, most of this H_2S is volatilized from the wine along with CO_2. However, the residual H_2S may pose a serious problem due to its low sensory threshold and its potential reactivity. Several other volatile sulfur compounds may develop from chemical modification of H_2S.

Table 1: Reported Sensory Thresholds for Sulfur Compounds

compound	structure	sensory description	range (ppb)
hydrogen sulfide	H_2S	rotten egg, sewage-like	0.9 - 1.5
ethyl mercaptan	CH_3CH_2SH	burnt match, sulfidy, earthy	1.1 - 1.8
methyl mercaptan	CH_3SH	rotten cabbage, burnt rubber	1.5
diethyl sulfide	$CH_3CH_2SCH_2CH_3$	rubbery	0.9 - 1.3
dimethyl sulfide	CH_3SCH_3	canned corn, cooked cabbage, asparagus, vegetal	17 - 25
diethyl disulfide	$CH_3CH_2SSCH_2CH_3$	garlic, burnt rubber	3.6 - 4.3
dimethyl disulfide	CH_3SSCH_3	vegetal, cabbage, onion-like at high levels	9.8 - 10.2

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Mercaptans (R-SH)

Mercaptans (thiols) are commonly found in wines. Their *"burnt match"* and "*rotten cabbage"* aromas may be even more pungent and offensive than H_2S. Although the mechanisms of mercaptan formation are not clear, mercaptans are probably formed during fermentation by reactions involving H_2S or breakdown of sulfur containing amino acids. Fermenting samples that contain H_2S usually also contain mercaptans.

Methyl mercaptan is the most common problem sulfide compound found in post-fermentation wines. Ethyl mercaptan is less commonly found above its sensory threshold. Under certain conditions, mercaptans may be oxidized to form mono and disulfides. While this may remove the objectionable sensory effects of mercaptans, the effect may be temporary (see below).

Disulfides (RS-SR)

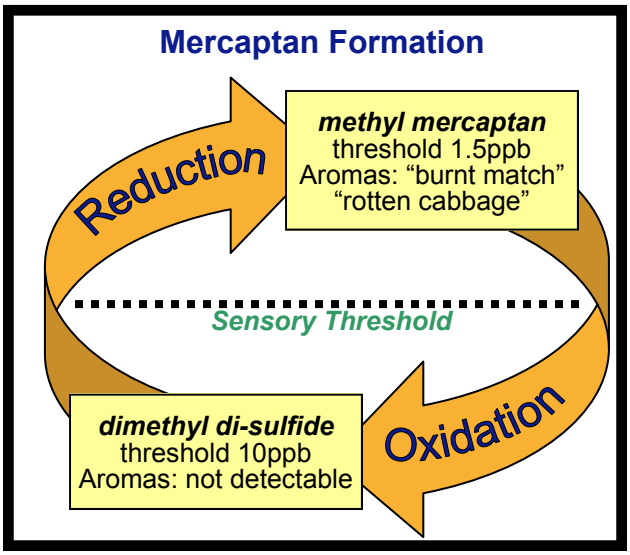
Disulfides are common in wine, but are usually found below sensory thresholds. They are typically formed after fermentation from oxidation of sulfide or mercaptan precursors. They are a serious concern due to their propensity to revert back to mercaptans. This conversion is often accompanied by an increase in objectionable odors due to the lower mercaptans threshold limits. Disulfides are not responsive to copper without pretreatment to break the disulfide bond.

Diethyl and Dimethyl Sulfide (H_3C-S-CH_3)

Diethyl sulfide is usually present in wine at levels below its sensory threshold.

Dimethyl sulfide (DMS) is present in almost all wines and is probably a breakdown product of amino acids. The formation of DMS does not appear to be related to H_2S production. At low levels (15 to 20 ppb in whites and 20 to 30 ppb in reds) DMS can contribute "*roundness"*, "*fruitiness"*, or "*complexity"*.

Analytical Details:	Juice	Wine
Sample Size Required:	375mL	375mL
Target Response Time:	2 days	2 days
Sample Container:	glass	glass



DMS concentrations increase with wine age and the "*canned corn"* or "*truffle"* sensory characteristics of DMS may develop during bottle aging. At higher levels (> 30 ppb for whites and > 50 ppb for reds) DMS may contribute vegetative, "*cooked cabbage"*, or "*sulfide"* smells to wines. DMS does not respond to copper applications.

Prevention and Treatment

The initial prevention of H_2S formation during fermentation is the most important part of a control strategy for volatile sulfur compounds in wine. Preventive measures that reduce formation of H_2S before and during fermentation are far more likely to be successful than treatment programs for stinky wines. Early treatment of wines containing H_2S is desirable to minimize and avoid the formation of mercaptans and other complex sulfides more resistant to treatment.

Possible Causes of Sulfide Problems in Wine

- residues from vineyard spray programs
- high turbidity
- yeast strains
- must nitrogen deficiencies
- other nutritional deficiencies
- high fermentation temperatures
- fermentor size and shape
- inadequate aeration during fermentation
- gross lees contact and extended lees contact

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