



Sulfite Management

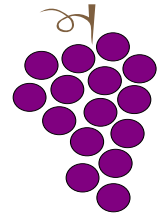
Too little sulfite:

- Oxidation (antioxidant)
- Wild organisms take over (anti-microbial)

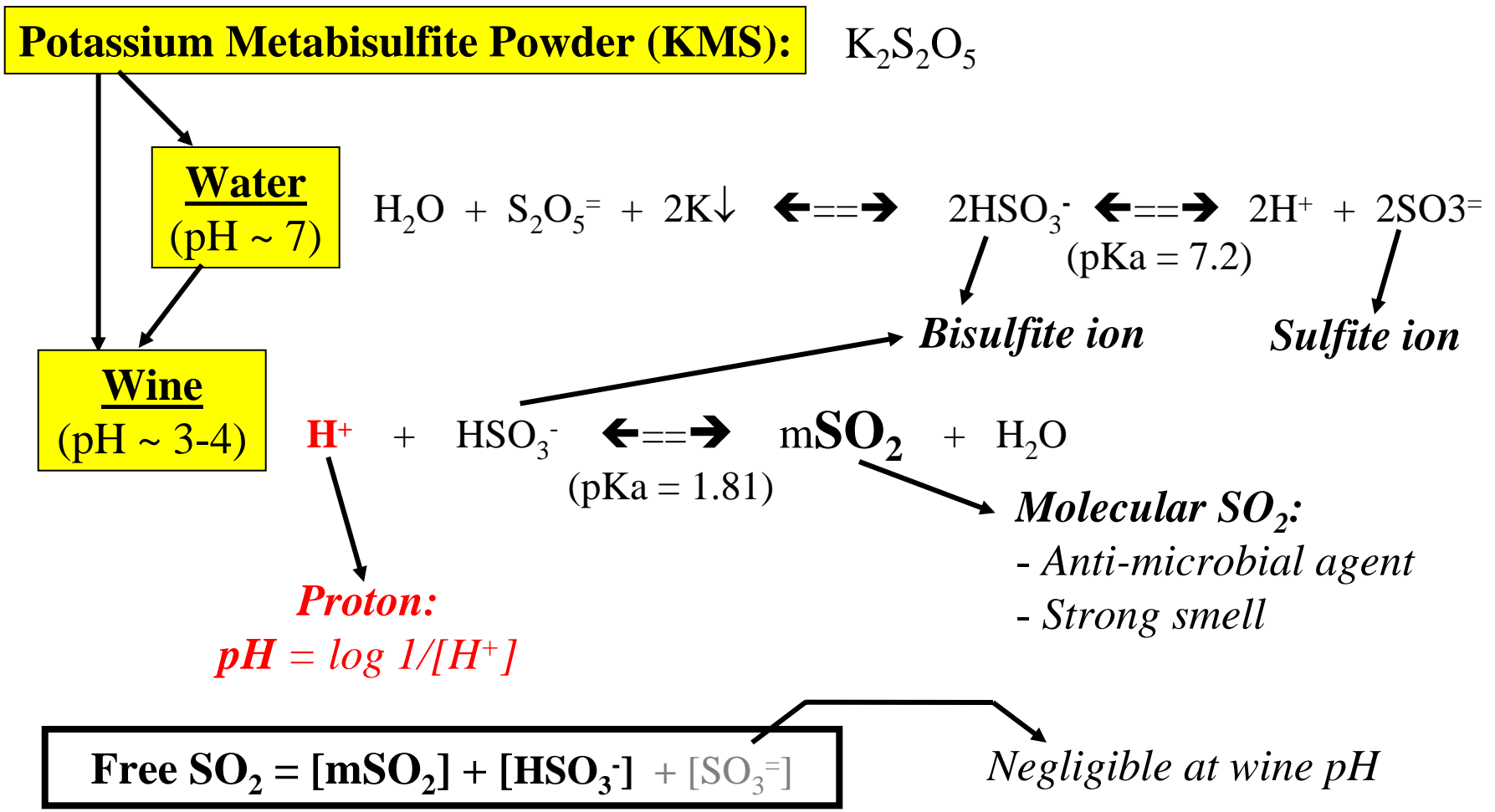
Too much sulfite:

- Strong/irritating smell

A large proportion of wine faults can be traced back to incorrect sulfite utilization

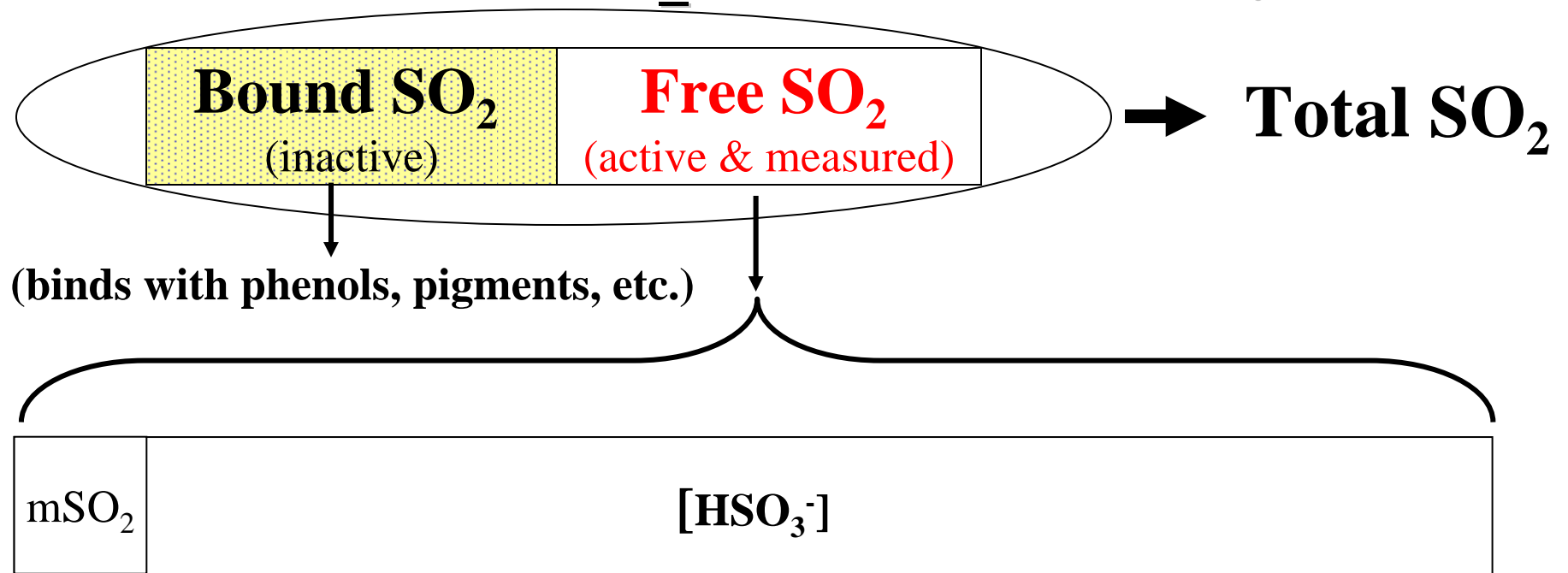


SO₂ Chemistry

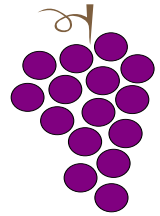




Interaction of SO₂ with Wine Components



$$\frac{[\text{mSO}_2]}{[\text{Free SO}_2]} = \frac{1}{\{1 + 10^{\text{pH} - 1.81}\}} \longrightarrow [\text{Free SO}_2] = [\text{mSO}_2] * \{1 + 10^{\text{pH} - 1.81}\}$$



Anti-Microbial Protection from mSO₂

Minimum molecular SO₂ concentration required :

- 0.8 ppm for White Wines
- 0.5 ppm for Red Wines (tannin also acting as preservative)

Free SO₂ vs pH Tables:

For Red Wines => $[\text{Free SO}_2]_{\min} = 0.5 \text{ ppm} * \{1 + 10^{[\text{pH} - 1.81]}\}$

For White Wines => $[\text{Free SO}_2]_{\min} = 0.8 \text{ ppm} * \{1 + 10^{[\text{pH} - 1.81]}\}$

[Free SO₂]min is pH dependant

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Anti-Microbial Protection from mSO₂

[FSO₂]min

pH	White Wine [mSO ₂]min = 0.8 ppm	Red Wine [mSO ₂]min = 0.5 ppm
3.2	~20	~13
3.6	~32	=20
3.8	~83	~52
4.0	~125	~78

Typical sensory detection threshold for FSO₂ starts at ~ 50ppm

So high pH wines cannot be protected adequately without sensory detection

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SO₂ Addition to Wine

Units

1 ppm = 1 mg /L = 1 g/1000L

1 ounce (weight) = 28.35 g

1 U.S. gallon = 3.78 liters

1 U.S. fl.ounce = 29.6 ml

1 U.S. teaspoon ~ 5ml

Potassium Metabisulfite Powder (K₂S₂O₅ or KMS)

- 57.5 % is sulfite (rest is potassium): 1.74ppm of KMS => 1ppm FSO₂

- 17.4g of KMS per 100 L of wine => 100 ppm Free SO₂

- 4g of KMS in 225 L barrel => 10 ppm FSO₂

} *Dissolve in distilled
water first
(~ 10ml per 10g)*

Campden Tablets

- 1 standard tablet (0.44g – check package) = 0.25g SO₂

- 1 tablet per gallon = 67ppm SO₂ 1 tablet per 10 liter = 25ppm SO₂

- Need to be crushed (mortar/pestle) & dissolved in water (~0.5ml per tablet)
before adding to wine

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SO₂ Addition to Wine

Self-mixing effervescent SO₂ (contains potassium bicarbonate)

- Efferbaktol granules (Vinquiry): in 2, 5, 10, 50, 100 & 125 gram SO₂ packages
Add to receiving container before it gets full (can fizz out if added to nearly full barrel)
- Oenosteryl tablets (Scott Lab): Do not use (they do not dissolve completely)

SO₂ Stock Solution

- Mix 87g KMS per L of distilled water (prepare enough for ~ 1 week's worth)
 - This is equivalent to about 15 level half-teaspoons per liters (see bottom note).
 - 1ml of stock solution per L of wine => 50ppm of SO₂
 - 45 ml solution into 225 L barrel => 10ppm of SO₂
- } *Solution can be added to top of filled containers. No need for vigorous mixing*

Note: The KMS density is ~2.34g/mL and 1 teaspoon ~5ml, so 87g is ~37ml or ~15 half-teaspoons. However, up to 20% error can happen when using teaspoons type measurements, so using a scale is better.



Natural SO₂ Production in Wine

Up to 15ppm SO₂ can be naturally produced during fermentation

SO₂ allergies

- There is more sulfite in white wines than in red wines, yet headache reactions are usually observed with reds.
- Allergic reaction to sulfite is not headaches, but respiratory, with asthmatic population most sensitive.
- Red wine headaches caused by natural histamines produced by red wines vinification. Taking anti-histamine medication prior to drinking wine can help.

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SO₂ Losses in Wine

- Most sulfite added to must before fermentation becomes bound to wine components, is lost through pressing/racking or is lost via oxidation, and has **disappeared** after fermentation.
- For Total SO₂ < 60ppm, about 50% of SO₂ added is bound (and not active), therefore, in that range you need to add twice the amount of desired free SO₂.
Note: The sulfite calculator in the Winemaker magazine already takes this into account, so don't add more than it recommends.
- For Total SO₂ > 60ppm, most of SO₂ added survives as free SO₂.
- Some bound SO₂ is lost at every racking, with sediments (therefore reducing Total SO₂).
- Free SO₂ is gradually lost through reaction with oxygen every time the wine is exposed to air.

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Free SO₂ Measurements:

- For White and Rosé Wines:

- Ripper Method (iodine titration with starch indicator)
- Botrytis (aldehydes) reacts with iodine yielding false high results (~ +20ppm)

- For Red Wines:

- Tannin and pigments reacts with iodine yielding false high results (~ +20ppm)
- Need to use Aeration/Oxidation method, where Free SO₂ is removed from sample by an air stream and oxidized by H₂O₂ into sulfuric acid (H₂SO₄) and then titrated with NaOH. => Too costly/complicated for most winemakers. Commercial labs can be used (Vinquiry, The Wine Lab; ~\$13 per test)

- Note on Chemetrics Titrets: Use Ripper chemistry and therefore produce false high SO₂ readings (up to 20ppm too high) for red wines and botrytized white wines. However, can be used as a qualitative check to assess if sulfite is too low.

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Total SO₂:

- Measurements:

- Sample is treated (heat & H₂SO₄) to liberate bound SO₂ and same analysis as for FSO₂ is then performed.
- Is not the same (less) as the sum of all SO₂ added since beginning (excludes all bound SO₂ lost during settling, clarifying & racking).

- Levels:

- Need to keep below 50ppm Total SO₂ for ML to take place.
- Only need to measure to make sure below allowed levels (350ppm, but should keep below 150ppm).

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pH Measurement (required for correct SO₂ dosage):

- Hanna Model HI 98113 (Piccolo Plus):

- See <http://hannainst.com/usa/prods2.cfm?id=002003&ProdCode=HI%2098113>
- Hand model (portable)
- +/- 0.01 accuracy
- About \$180

- Hanna Model HI 222 (professional pH meter for wine analysis)

- See <http://hannainst.com/usa/prods2.cfm?id=002001&ProdCode=HI%20222>
- Bench top model (not portable)
- Automated calibration, +/- 0.01 accuracy
- Automated detection of dirty electrode
- About \$500

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SO₂ Addition Strategy:

- At crush:

- 20 – 70ppm (100ppm for grapes in bad condition or high pH must) to reduce effect of wild organisms => Most of it will be **gone** after fermentation/1st racking

- After fermentation:

- 20-40ppm if ML is done, irrespective of pH.
- 50ppm if ML is not done, irrespective of pH.

- At each racking:

- First few rackings: Adjust according to pH table.
- Subsequent rackings: Add 10ppm per racking.

- Before bottling:

- Make sure FSO₂ is at level required for pH, plus 10ppm if wine is exposed to air during bottling.
- Make sure FSO₂ is stable (i.e., add final sulfite ~ 1 month before, then measure after a week and add more until same reading is obtained consecutively)

Note: For very high pH wines (above 3.8), do not bring free SO₂ levels above 50ppm (can start to taste/smell it), even if table calls for more. That is one of the major problems with high pH wines, not only are they more prone to microbial spoilage, but there is a limit as to how much sulfite can be added to protect against them. Such wines are not expected to age as long without developing some sort of spoilage problem.

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Too Much SO₂ ?

- Aeration racking

- Sulfite will react with oxygen

- Nitrogen bubbling (from bottom)

Not sufficient for high pH wines

- Hydrogen Peroxyde (H₂O₂)

- 10ppm reduction: 50ml 1% H₂O₂ solution to 100 L wine
- Can also oxidize other components of wine => Do small scale test
- Perform reduction in steps, only 10ppm at a time.
- Only do at end near bottling when all racking and processing has been done (excess sulfite might be reduced sufficiently by that time).



SO₂ Sanitizing Solution for Equipment:

- **Dissolve 3g KMS (~1/4 heaping tsp) and 38g citric acid (~ 8 level tsp) into 1 gallon of water:**
 - ~500 ppm SO₂ solution
 - 10 g/L or pH ~3 (releases lots of active mSO₂)
- **Use hand sprayer or pesticide pump sprayer and spray all surfaces**
- **Leave sulfite/citric solution in contact with surface for a couple of minutes (a quick spray and immediate rinse is not enough), then rinse thoroughly.**
- **Prolonged exposure of stainless steel surfaces to concentrated SO₂ solution can result in pitting and rusting.**