

Volatile Acidity

by

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SGGA Meeting - 11/20/2008

- Sources
- Recognition
- Prevention
- Cure (... not !)

Why a talk on VA ?

After oxidation, VA is the main wine fault in home made wines and in wines made by small wineries, due mostly to lack of SO₂ and inadequate sanitation procedures.

VA Correction

- Sterile **filtration** (to remove acetobacter) and **blending** out with low VA wine(s) to bring blended VA level down to acceptable level.
- **Reverse Osmosis:** Expensive for small volumes (<100 Gallons)

VA Analysis

- **Traditional method:** Cash Still using steam distillation followed by NaOH titration (not used by wine labs any more). Quite involved and can be error prone if not done rigorously.
- **More recent methods:** Segmented Flows (spectrophotometric - \$17), Enzymatic (\$35) and Gas Chromatography (\$80)

Volatile vs Non-Volatile Acidity in Wine

- **Volatile Acidity** (contribute to taste and aroma): Mainly acetic acid, but also some carbonic acid (from CO₂), sulfurous acid (from SO₂), sorbic acid (fermentation inhibitor in sweet wines), and often accompanied, at higher levels, with ethyl acetate (nail polish smell).
Note: Ethyl acetate (nail polish smell) results from acetic acid, but is not strictly part of it (it is not an acid).
- **Non-Volatile Acidity** (contribute to taste only, not aroma), also called fixed acids: Malic, Tartaric, Lactic, etc.
Note: When measuring Titratable Acidity (T.A., as opposed to total or tartaric acid), volatile acids also contribute to the results. This means that wines with high levels of acetic acid (and carbonic acid), will lead to higher T.A. readings than coming from fixed acids alone. Unexplained increased in T.A. During aging could come from an increase in V.A.

Acetic Acid in Wine

- **Acetic acid sources:**

- “Normal” Sources:

- Alcoholic fermentation yeasts: 0.2-0.6 g/L, with higher sugar/alcohol & red wines at the higher end.
- ML bacteria (0.1-0.2 g/L), as by-product of malic to lactic fermentation.
- Barrel aging (0.1-0.2 g/L, after 1 year), from the wood itself, even new wood.

Note: *Acetic acid levels of up to 0.8 g/l are normal in wine. Up to those levels, it contributes to complexity and to magnify fixed acids and tannins in a positive manner. It is masked by higher alcohol, so in such wines, the sensory threshold is even higher. At higher acetic acid levels, vinegary notes start to be detected.*

- “Nasty” Sources:

- Acetobacter (the main culprit in producing excessive acetic acid production). Present everywhere, but even more on spoiled/rotten grapes and, of course, in dirty equipment. Less present in white wines (less skin contact). Needs O₂ to oxidize alcohol, as follows: **Alcohol (ethanol) + O₂ => Acetic Acid + Water**
- Other yeasts (Brett, Dekkera) & bacteria (Lactobacillus)

Note: *Excessive acetic acid production can not only lead to stuck fermentation but is a sign of the presence of one (or more) of these “nasty” sources.*

- Effect of temperature: Slow at < 61oF, then rate doubles from 65oF to 73oF, and then doubles again from 73oF to 82oF.
- Effect of pH: Slow at pH=3.0, possible at pH=3.2, easy at pH>=3.4

- **Legal Limits:** 1.2 g/l (reds), 1.1 g/L (whites)

Ethyl Acetate in Wine

- **Source:** Acetic Acid + Alcohol (ethanol) => Ethyl Acetate + Water
- **Sensory effects:**
 - At low level (< .12 g/L): Contributes to fruity character of wine.
 - At intermediate level (0.12-0.18g/L): Starts to add harshness to finish, but still no aroma yet.
 - Higher levels (>0.18g/L): Aroma notes of nail polish (and not nail polish remover, which is acetone) start to appear.
- **Ethyl acetate production depends on:** Yeast strain, fermentation temperature (largest factor) and SO₂ level (inhibition).
- Since the **sensory threshold** of ethyl acetate is ~ 0.2 g/L and the sensory threshold of acetic acid is ~0.8 g/L, ethyl acetate can have a negative sensory impact on the wine at a lower level and even if the acetic acid does not.

VA Prevention – Grapes

- Sort out spoiled/rotten grapes (VA already started in those grapes).
- Be aware that bird/bee damaged grapes most likely already contain VA, so try to control it as early as possible (drop in the vineyard or sort it out before crushing).
- Add sufficient SO₂ at crush:
 - Good condition grapes => 50 ppm
 - Some spoiled/rotten grapes present => 75ppm
 - Grapes are in poor condition => 100ppm
 - Most of the sulfite will be consumed during crush and very little if any will be left afterwards.

VA Prevention – Fruit Fly Control

- Fruit flies are also known as vinegar flies and there is a reason for this !
- Try to keep fruit fly population in the winery to a minimum early before the population explodes. If controlled early, will not become a big problem until the end of the season, if at all.
- Keep the winery doors closed as much as possible. Fermenting inside promotes inside fruit fly population explosion (closed system, still air, warmer). Reduced fruit fly problems are often experienced when fermenting outside (open system, cooler, air currents).
- Use fruit fly traps (wine can be used to lure flies instead of bait liquid provided with trap, but wine needs to be changed every day, otherwise it becomes a source of VA for escaping flies – some do).
- Other tools: Vacuum cleaner is a useful (*and very satisfying !*) weapon. Fans can also be used. Fly zappers are not very efficient with fruit flies.
- Protect fermentation tanks from fruit flies (use covers or screens), especially at beginning and end of fermentation when CO2 blanket is low.
- Dispose of stems and pressed skins as far away from winery as possible (will produce acetobacter carried back into the winery by fruit flies).

VA Prevention – After Fermentation

- Be aware that extended post-fermentation skin-contact/maceration increases risk of VA, so monitor closely and protect must from oxygen (plastic sheets on must or N₂-filled head-space) & fruit flies.
- Rack-off gross lees soon after fermentation, especially if spoiled/rotten grapes (and/or H₂S) were involved.
- Fill containers to top and protect wine from oxygen (& fruit flies).
- Small VA increase can be observed after ML and is normal. Recent studies have shown that co-inoculation of ML bacteria at same time as yeast inoculation does not produce more VA and allows bringing sulfite level to adequate levels much sooner (within 2-3 weeks of inoculation), so you might want to consider doing this. *Note: This is also a good idea up here because the higher alcoholic fermentation temperature will help ML fermentation get started and prevent it from stalling as it often happens up here when the wine cools off after fermentation is over, especially near the end of the season.*
- Bring SO₂ levels to adequate level (pH related) as soon as ML is finished (about 25-30ppm, less for low-pH wines & more for high pH wines)
- Continue maintaining adequate SO₂ levels in wine.

VA Prevention – After Fermentation (cont'd)

- Analyze wines for VA periodically (at least after ML is finished, a couple of times during aging and before bottling), especially if slightest VA whiff is detected. This will help in spotting increasing trends and allow correcting & isolating the offending container (to avoid cross-contamination through tools and blending).
- Only open containers when absolutely needed and minimize amount of time container stays open, to reduce air exposure (& risk of contaminated fruit flies getting in). Top up before closing to displace out as much air as possible.
- Beware of used barrel (built-in VA source often included - *for free* !). Only buy barrels that have been power-washed, ozoned and recently sulfited. If possible (difficult if they have been sulfited), smell them before you buy (they should smell like oak, not veneer or nail polish => ethyl acetate).
- As barrels loose wine, they can also loose SO₂ (as much as 10ppm per month !), so check/maintain SO₂ levels.
- In principle, barrels should be topped up regularly. ***However***, if a vacuum seems to consistently develop in a barrel (a whoosh sucking sound when bung out is pulled out - indicating a tight bung seal), some winemakers recommend to leave such barrels alone because opening them to top up actually introduces the air you will be getting rid off by topping off. The developing vacuum will actually protect the wine from O₂ and less SO₂ will actually be required.

Equipment Specific Precautions

- **Overall:** Clean up your equipment right before/after every use (avoid letting stand dirty overnite).
- **Pumps:** After thorough cleaning, open up pumping chamber plate for detailing & full drying.
- **Hoses:** Notorious VA sources when not cleaned adequately (need more than just water rinsing – use cleaning/sanitizing solutions).
- **Corker:** The delrin inverted cone chuck against which the top of the bottles sit gets splashed with wine a lot and can be a sneaky last minute VA source just before the corks goes in, if not cleaned thoroughly after & sanitized before every bottling session. This also applies to hand corkers.
- **Barrel Bungs with “breathing” flaps on top:** Trapped wine between the flap and the bung will produce VA, so they need to be cleaned regularly or use the type with a plug instead of a flap like the one made by Alasco.
- **Cartridge filters:** Clean thoroughly by flushing profusely and then soaking in cleaning/sanitizing solutions (lots of microscopic places for VA bacteria to hide and grow).
- **Winery:** Clean up any wine spills in the winery as soon as possible (will generate acetobacter and attract fruit flies & will be a source of future contamination) => Otherwise can lead to systemic VA problems.
- **In general:** Anywhere where skins, juice, wine can be trapped and spoil is a potential VA risk. Even if acetobacter can also operate in an airborne manner, direct contact is the main cause.

Cleaning Protocol at Solune

- **Solutions:**
 - ProxyClean (see barrelbuilders.com):
 - Oxygen base cleaner (no chlorine – a no-no in wineries => TCA).
 - Sodium Percarbonate: Mixture of hydrogen peroxide & sodium carbonate (soda ash).
 - 6-12 tbsp powder per gallon of water.
 - Sulfite/Citric Solution:
 - Sulfite: 0.5 g/L (500ppm).
 - Citric: 10 g/L (for pH~3, to activate sulfite => generation of free SO₂).
- **Solution Application:**
 - Spraying (spray bottle, hand-pump sprayer).
 - Circulating (for pump & long hoses).
 - Dipping (for smaller part).
 - Prepare full pails of Proxyclean, Sulfite/Citric & fresh water for sprayer filling, dipping & circulation.
- **Cleaning, immediately after use:**
 - Rinsing (power washing, if possible), ProxyClean, brushing/scrubbing (if possible), more rinsing.
 - This gets rid of wine residues (eliminates possibility of VA developing from spoiled leftover wine).
- **Sanitizing, immediately before use:**
 - Rinsing (removes dust, bugs, etc. – no power washing needed here), sulfite/citric solution application, more rinsing.
 - Citric removes any soapy residue from previous ProxyClean application (citric acid).
 - Sulfite (activated with citric) sanitizes (needs a couple minute contact).
- **Miscellaneous:**
 - Have a few clean/sanitized pails of various sizes on hand.
 - Spills, including on floor, need to be cleaned as soon as feasible (rinse/powerwash, then spray with sulfite).

Overall goal: Leave as little wine residues as possible, to minimize exposure to spoilage agents. Complete elimination would require sterilization, not required in wine production because of higher alcohol (but required in beer & dairy industries).

IN A NUTSHELL

- VA prevention involves minimizing/eliminating the source of acetobacter (the bacteria from which VA is produced) via:
 - Adequate winery/equipment cleanliness,
 - Protecting from the oxygen required for the development of VA (includes adequate SO₂) levels)
 - Avoiding the high temperatures & high pH promoting VA production.
- Monitoring is also important to ensure prevention is working.
- Cure is possible but partial, expensive and, except for large volumes, impractical.

Last words: The more you know, the luckier you will get !