Assessing the potential for grapes to produce smoke-affected wine

When vineyards and grapes are exposed to smoke this can result in wines with undesirable ‘smoky’ sensory characters. The compounds in smoke primarily responsible for these characters are free volatile phenols. These can be absorbed directly by grapes and bind to grape sugars to give glycosides that have no smoky aroma. Aroma assessment of grapes or juice will therefore not give a good indication of the potential impact of smoke exposure on the resultant wine.

During fermentation or wine storage the glycosides can break apart, releasing volatile phenols into the must or wine, allowing the smoky flavour to be perceived. It is therefore recommended that winemakers conduct small-lot fermentations, followed by sensory assessment, to gauge the potential risk of smoke characters being perceived in wine made from grapes that have been exposed to smoke.

The AWRI recommends that grapes are also analysed for volatile phenols and glycosides at the same time the small-lot fermentation is started. This will allow the chemical results and the sensory assessment to be used to make harvest decisions.

This fact sheet sets out all the steps for conducting a small-lot fermentation. A flow chart is also provided on the final page (Figure 1).

When to sample

This procedure can be used as soon as grapes are ripe enough to be able to be fermented, but it is preferable to conduct the fermentations about two weeks before harvest. The later this procedure is used, the more reliable the indication of smoke exposure will be. It is best to plan in advance to ensure the small-lot fermentation is conducted in time to be used to support harvest decisions.
Grape sampling
It is important to ensure that a representative sample is collected from the entire vineyard. Refer to the AWRI grape sampling fact sheet for more details.

Weigh out approximately 5 kg of berries stripped off grape bunches and transfer them into a clean open container; for example, a 10 L stainless steel bucket, a large pot or a food grade plastic storage container. A loose-fitting lid or cover can be used to allow ferment gas to escape and prevent contaminants or vinegar flies from entering.

Fermentation on skins
The AWRI recommends that when conducting small-lot fermentations for the assessment of smoke risk the fermentation should be conducted on skins, regardless of whether the grapes are red or white. This provides an opportunity for maximum extraction of smoke taint compounds, if present, and therefore gives a ‘worst case scenario’ result for white wines. Winemakers may also choose to also conduct a fermentation off skins for white grapes, producing a wine for sensory assessment that reflects a more realistic outcome for a white wine fermentation.

Must preparation and additions
- Crush the grapes using a potato masher.
- Take a sample for Baume, pH and TA measurement.
- Add SO₂. Measure out approximately 1.5 mL of the 10% SO₂ solution into about 25 mL of water and then tip the whole lot evenly across the grapes. Mix in thoroughly with potato masher.
- Add pectinase. Measure out approximately 1.5 mL of the 10% pectinase solution and dilute further into 25 mL of water and then tip the whole lot evenly across the grapes. Mix in thoroughly with potato masher.
- Add DAP. Measure out approximately 6 mL of the 10% DAP solution and tip the whole lot evenly across the grapes. Mix in thoroughly with potato masher.

***Important – Do not mix SO₂ and pectinase solutions together prior to addition ***

- Adjust acidity to around pH 3.4 (if required). For every 0.1 pH decrease required, add 3 g of solid tartaric acid or 30 mL of a 10% tartaric acid solution. For every 0.1 pH increase required, add 1.5 g solid potassium bicarbonate or 15 mL 10% potassium bicarbonate solution. Mix in thoroughly with potato masher.

Note that due to the use of hand crushing, the addition amounts in this procedure are based on a low 600 L/T extraction rate, or around 3 L of juice expected from 5 kg of fruit.

See ‘Preparation of solutions’ for instructions on how to prepare the required solutions.

Yeast preparation and inoculation
- Add 50 mL of chlorine-free water (such as reverse osmosis treated, distilled or Milli-Q) to a clean drinking glass and heat in a microwave to a temperature of 38-40°C. Dissolve 2.5 g of sugar (raw or white) in the warm water. Weigh out 1 g yeast and sprinkle onto the water. Gentle mixing may be required to ensure all the yeast is properly wetted. Leave for 10 minutes to allow the yeast to rehydrate.
• Make sure the must is around 20°C (ideally 20-25°C). Add 50 mL of must to the 50 mL of hydrated yeast and leave for 10 minutes, before adding the entire contents of the yeast culture to the fermenter. This is a yeast addition of 300 mg/L. Yeast inoculation day is considered day 0. The time for the yeast rehydration procedure should not exceed 40 minutes.

• Place fermenter in an area that is between 20 and 25°C (e.g. winery laboratory).

Fermentation management
The ferment will take about five days.

Daily tasks:
• Mix the ferment three to four times per day by plunging with a potato masher or stirring with a long handled wooden spoon – try to break up and submerge the cap.

• Smell the ferment for any hydrogen sulfide (H₂S) or ‘eggy’ aroma. If observed, add 3 mL of 10% DAP solution (100 mg/L of DAP).

• On day 2, measure out approximately 6 mL of 10% DAP solution and tip the whole lot evenly across the grapes. Plunge to mix thoroughly.

• After five days of fermentation, take a sample and test for residual sugar using an AimTab or Clinitest.

• If the AimTab/Clinitest reads <2 g/L sugar, then proceed to drain and press, as described below. If the Clinitest reads >2 g/L sugar, then ferment for an extra day and recheck residual sugar. Repeat if necessary, then proceed to drain and press.

• Do not exceed seven days on skins post inoculation even if sugar >2 g/L.

Drain and press
• Weigh an empty sealable container (at least 3 L volume).

• Drain the ferment through a sieve into the container, press the solids against the sieve, then re-weigh the container to determine the wine volume (assuming 1 kg=1 L)

End of ferment additions
SO₂ addition:
• Using the determined wine volume, add 0.8 mL/L of 10% SO₂ solution to the wine and mix thoroughly.

Copper sulfate addition:
• Using the determined wine volume, add approximately 0.4 mL/L 0.2% CuSO₄ solution. It is ESSENTIAL to add this DROPWISE to the wine while mixing thoroughly.

Seal the container and place in refrigerator at 4°C for 48 hours to settle out solids.

Rack, decant, and bottle
• Rack or transfer the clear wine using a siphon hose into two 750 mL or four 375 mL clean wine bottles, filling them as much as possible to decrease headspace. Seal with a screwcap.

• Wine can now be subjected to sensory assessment for the presence of any smoke taint.
Preparation of solutions for additions

Use reverse osmosis (RO) treated water, distilled water or Milli-Q water to prepare the required solutions.

**10% SO₂ solution** (store at room temperature, expires after 2 weeks)
- Weigh 20 g of potassium metabisulfite (PMS) into a clean bottle (~100 mL).
- Add 80 mL of water and mix until all the crystals dissolve.
- Top up with water to a total volume of 100 mL.

**10% pectinase solution** (store in refrigerator, expires after 2 weeks)
- Measure 10 mL of liquid pectinase into a clean bottle (~100 mL).
- Top up with water to a total volume of 100 mL.
- If using powdered pectinase, follow manufacturer’s instructions then dilute as above.

**10% tartaric acid solution** (store at room temperature, expires after 3 months)
- Weigh 10 g of tartaric acid into a clean bottle (~100 mL).
- Add 80 mL of water and mix until all the crystals dissolve.
- Top up with water to a total volume of 100 mL.

**10% potassium bicarbonate solution** (store at room temperature, expires after 3 months)
- Weigh 10 g of potassium bicarbonate into a clean bottle (~100 mL).
- Add 80 mL of water and mix until all the crystals dissolve.
- Top up with water to a total volume of 100 mL.

**10% diammonium phosphate (DAP) solution** (store at room temperature, expires after 3 months)
- Weigh 10 g DAP into a clean bottle (~100 mL).
- Add 80 mL of warm water and mix until all the crystals dissolve.
- Top up with water to a total volume of 100 mL.

**2% copper sulfate – STOCK solution** (store in refrigerator, expires after 1 year)
- Weigh 2 g copper sulfate into a clean bottle (~100 mL).
- Add 80 mL of water and mix until all the crystals dissolve.
- Top up with water to a total volume of 100 mL.

***Do NOT add this stock solution to wine***

**0.2% copper sulfate – WORKING solution** - (store in refrigerator, expires after 3 months)
- Take 10 mL of the stock solution and add to 100 mL of water in a clean bottle (~100 mL).

**Contact**
For further information regarding this procedure or assistance with smoke taint please contact:

AWRI helpdesk
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**Update January 2021**

**WINEMAKING**

[Image of a diagram illustrating the steps in the small-lot fermentation method]

**DAY 0 Operations**

1. **Crush/squash grapes using hand or potato masher**
2. **Add SO₂ (50 mg/L) as 10% SO₂ solution = 1.5 mL/5 kg. Plunge.**
   - Add pectinase: as 10% solution 1.5 mL/5 kg (dilute further into 25 mL water). Plunge.
   - Add DAP (200 mg/L) as 10% solution = 6 mL/5 kg – Plunge.
3. **Adjust pH to 3.4 – as required using 10% tartaric acid to acidify or 10% potassium bicarbonate to deacidify, Plunge**
4. **Day 0: Inoculate Yeast @ 300 mg/L = 0.9 g yeast/5 kg**
   - Ferment on skins between 20 and 25°C
5. **Plunge/stir ferments 3-4 times per day**
   - Check Baume each day after first plunge
6. **Day 2: Add DAP: 200 mg/L as 10% solution = 6 mL/5 kg – Plunge**
7. **Press back into original fermenter or 4-5 L container with a sealable lid**

**Additions:**

- The crush SO₂ addition is based on a 500 L/t extraction rate (2.5 L/5 kg)
- ALL other must additions are based on a 600 L/t extraction rate (3 L/5 kg)

**DAY 1 Operations**

1. **Weigh 5 kg subsample into appropriate size vessel**
2. **Day 5: Press/sieve off skins**
   - Weigh press volume where 1 kg = 1 L
3. **When sugar dry (<2 g/L) – End of ferment additions**
   - Add SO₂: 80 mg/L as 10% SO₂ solution = 0.8 mL/1 L
   - Mix thoroughly, then:
     - Add CuSO₄: 0.2 mg/L Cu²⁺ as 0.2% CuSO₄ = 0.4 mL/1 L
     - Added *DROPWISE* to mixing vessel ***Critical step***
   - Seal lid and place in fridge/cool room to settle
4. **After two days of cold settling**
   - Clean rack to fill 750 mL bottles for sensory assessment

**Figure 1. Steps in the small-lot fermentation method**