PROTOCOL P

Smoke taint

Winemaking with fruit exposed to smoke

Forest fires and exposure of grapes to smoke have become a major winemaking issue. The key compounds responsible for the aromas are volatile phenols, guaiacol, 4-methyl-guaiacol, and many others, and are found on the outer (cuticle) layer of the grape. The smoke taint compounds exist in juice and grapes in the glycosylated form. Winemaking practices can release the odorous free volatile phenols, as can time and subsequent acid hydrolysis. Juice may taste acceptable, but during fermentation and over time may develop more serious smoke impact issues.

There are a number of winemaking techniques that can be used to reduce the effects of smoke in wines, and these are more valuable when used in combination. The following recommendations are based on current knowledge of how to reduce or mask smoke character, however, there are no known processes to completely remove all smoke compounds from a wine.

1 GENERAL RECOMMENDATIONS

- Take notes on the duration of the smoke exposure in the vineyard and the proximity of the fire. Fresh smoke can cause more damage compared to smoke that has traveled significant distance.
- Smoke analysis on berry samples can give an indication of the potential level of smoke taint, but small batch fermentations are a better way to estimate the level of damage in the vineyard. The UC Davis link below has a detailed protocol on small lot fermentations specifically for assessing smoke damage to grapes.
- Wash ash off fruit in the vineyard before harvest when possible.
- Hand harvest is preferred over machine harvest. If machine harvest is the only option, separate the first juice that comes out of the harvest bins or out of the press when making white or rose.
- Remove all MOG from fruit during processing. Leaves contain a significant amount of smoke compounds that can be released into the juice during maceration.
- Using oak during fermentation and aging can increase guaiacol levels in the wine. If smoke exposure analysis numbers will be used for insurance or contract issues, avoid using oak.

Analysis and testing for smoke impact during harvest can be difficult for a number of reasons : different analytical methods, different fires resulting in different types of impact, and different threshold levels of the compounds related to smoke on the various varietals used in winemaking. There is a great amount of complexity in this ongoing field of research.

Therefore, we present current content published by four of the major research institutions and analytical services in the wine industry from across the globe. Please see the following sensory threshold and impact guidelines from The Australian Wine Research Institute, ETS Laboratories, Washington State University and Washington Winegrowers, and UC Davis.

- **Australian Wine Research Institute (AWRI) -** Sensory Impact of Smoke Exposure
  This short fact sheet covers sensory thresholds of the common volatile phenolic smoke compounds and the sensory impact of glycosides with links to many more smoke taint resources.

- **ETS Laboratories -** Smoke Impact in Grapes and Wine
  ETS provides an explanation of the testing available and further links for interpreting results and current recommendations.

- **Washington Winegrowers-** Smoke Exposure Resource Site
  A great resource for up-to-date information on working with fruit exposed to wildfire smoke. There are links to webinars, smoke analysis laboratories, micro ferment instructions, and how to talk about smoke with winery customers.

- **UC Davis -** Wildfire and Smoke Exposure Resources
  Helpful website outlining grape sampling protocols, micro fermentations for assessing potential smoke damage in fruit, and a list of frequently asked questions and answers on smoke exposure.

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2 TIPS FOR MINIMIZING EXTRACTION IN WHITE WINE GRAPES

- ✓ Keep the fruit and juice as cold as possible.
- ✓ Whole cluster press and use a press cycle with minimal rotations.
- ✓ Keep press fractions separate, as the harder press fractions will have higher levels of smoke exposure compounds.
- ✓ Use a setting enzyme (pectinase) to clarify the juice:
  - → **LAFAZYM® 600 XL**^{ICE}: dosage 1 – 3 ml/hL.
  - → **LAFAZYM® CL**: dosage 10 – 20 ppm.
- ✓ To increase turbidity after clarification:
  - → **TURBICEL®** (cellulose): dosage 200 – 500 ppm.
  - → **OENOCELL®** (yeast hulls): dosage 200 – 400 ppm .
- ✓ Use a yeast strain that produces high amounts of fermentation esters:
  - → **ZYMAFLORE® X16** or **X5**
  - → **ACTIFLORE® ROSÉ**
- ✓ Add an oak alternative treatment during fermentation which can help add fruit character, texture, and mask/integrate the smoke character.
  - → NOBILE® FRESH Chips: dosage 0.5 – 2 g/L.
  - → NOBILE® SWEET VANILLA Chips: dosage 0.5 – 1 g/L.

  The use of oak during fermentation and aging can increase the guaiacol level in the wine and should be considered if analysis numbers will be used in legal context.
- ✓ Add an activated carbon to the fermentation to help bind and remove smoke compounds.
  - → **GEOSORB®**: dosage: low smoke exposure 250 ppm - high smoke exposure 450 ppm.
- ✓ After fermentation, rack clean wine off lees. Send a sample in for smoke compound analysis to get an idea of the level of smoke taint in the wine.
- ✓ Reverse Osmosis filtration may be used to lower smoke compounds, and if needed consider a treatment with **LAFAZYM® AROM** (ß-glucosidase) to increase the release of the bound smoke compounds. Add **LAFAZYM® AROM** at 500 ppm, allow enzyme to work for 8 days before filtration of the wine.
- ✓ The use of mannoproteins and oak to build up the wine can help integrate or mask the smoke character in the wine.
  - → NOBILE® Oak Alternative Range.
  - → **MANNOFEEL®** and **AUTOLEES®** – mannoprotein options (conduct bench trials).

NOBILE®
L'œnologie du bois

3 TIPS FOR MINIMIZING EXTRACTION IN ROSÉ WINE GRAPES

- ✓ Same protocols as white fruit.
- ✓ The challenge is the lack of skin contact time to get the desired color in the rose wine. If the smoke exposure was fresh or heavy, then it is best to avoid any skin contact time and whole cluster press. In this case, it is a safer option to adjust color with a red wine addition after fermentation.

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4 TIPS FOR MINIMIZING EXTRACTION IN RED WINE GRAPES

- ✓ Make a big volume red wine with complex flavors and aromatics. The bigger the wine, the easier the smoke will be integrated or masked:
  - → Use a fermentation tannin; **TANIN VR SUPRA®** & **TANIN VR COLOR®**: dosage 200 – 400 ppm.
  - → Use an enzyme for fast color and tannin extraction and ease of clarification after pressing; **LAFASE® FRUIT**: dosage 30 – 40 g/TON.
  - → Use a yeast strain that produces high amounts of fermentation esters; **ZYMAFLORE® RX60** or **FX10**.

- ✓ Add an activated carbon to the fermentation which can help bind and remove smoke compounds.
  - → **GEOSORB®**: dosage: low smoke exposure 500 ppm - high smoke exposure 1000 ppm.

- ✓ Add an oak alternative treatment during fermentation which can help add fruit character, texture, and mask/integrate the smoke character.
  - → NOBILE® FRESH Chips & Granulars: dosage 2 – 4 g/L.
  - → NOBILE® SWEET VANILLA Chips: dosage 2 – 4 g/L.

  The use of oak during fermentation and aging can increase the guaiacol level in the wine and should be considered if analysis numbers will be used in legal context.

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- ✓ Keep fermentation temperatures cool, 70 - 75°F.

- ✓ Add **POWERLEES® ROUGE** during fermentation or after pressing to improve mouthfeel and fruit character in the wine. Dosage: 200 – 400 ppm.

- ✓ After pressing and settling, rack clean wine off lees. Send a sample in for smoke compound analysis to get an idea of the level of smoke taint in the wine.

- ✓ After ML is complete, evaluate the wine and if necessary continue to build up the wine with tannins, oak alternatives, and mannoproteins (dosage determined with bench trials):
  - → **TANIN VR SKIN®** or **TAN'COR® GRAND CRU**
  - → NOBILE® range
  - → **MANNOFEEL®** or **AUTOLEES®**

- ✓ Reverse Osmosis filtration may be used to lower smoke compounds, and if needed consider a treatment with **LAFAZYM® AROM** (ß-glucosidase) to increase the release of the bound smoke compounds. Add **LAFAZYM® AROM** at 500 ppm, allow enzyme to work for 8 days before filtration of the wine.

- ✓ If smoke compounds persist, a second treatment with **GEOSORB®** is possible.
  - → Run trials with **GEOSORB®**: dosage 250 - 450 ppm.

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5 LAFFORT® USA SMOKE EXPOSURE INVESTIGATION TRIALS 2020 HARVEST

During harvest 2020 we tested the efficacy of multiple **LAFFORT®** products when added to the fermentation of smoke-exposed fruit, followed up by sensory and chemical analysis. The goal of the trial work was to find ingredients to implement in the winemaking process to help reduce the impact of smoke character in the potential wine. Wildfires can significantly delay analysis results, and there is often no time for trials. The trial did yield some helpful tools to add during fermentation to help improve wine quality without the risk of negative sensory attributes.

The trial incorporated 3 different viticulture regions in California and Washington and 4 different grape varietals, Pinot Noir, Merlot, Cabernet Franc, and Cabernet Sauvignon. In total, the trial had 125 micro-ferments resulting in 38 different wines made with **LAFFORT®** products added during fermentation to heavily smoke exposed fruit during the 2020 vintage. In February 2021, 288 wine industry professionals rated the intensity of 15 wine attributes in each wine, resulting in 29,895 wine sensory data points. Quantification of the smoke markers was performed with liquid-liquid extraction, acid-mediated hydrolysis, and gas chromatography/mass spectrometry with **EXCELL®** Laboratories in Bordeaux, France.

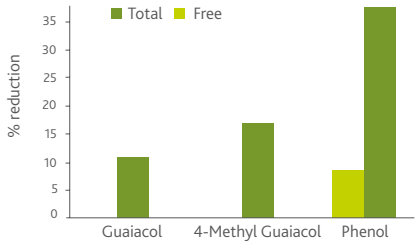

Figure 1: Average percent reduction of compounds. Related to smoke when **GEOSORB®** added between 60 - 100 g/hL.

6 GEOSORB® RESULTS

The **GEOSORB®** was added at the following rates during fermentation 40 g/hL, 50 g/hL, 60 g/hL, and 100 g/hL. The total or glycosidically bound phenolics are represented as range of reduction presented in **Figure 1**. The free phenolic compounds were minimally impacted or resulted in no impact. While the total glycosidically bound phenolics were reduced, the perceived impact of 'stripping' the wine of positive character was minimal. In all cases, as the smoke compounds were adsorbed and removed from the wine, the positive sensory character of the wines increased. **Figure 2** illustrates the positive impact of high and low dosages of **GEOSORB®** in these wines. While there is no magic formula for the removal of all smoke related sensory character, **GEOSORB®** represents an excellent first step in the removal of smoke related compounds and the ability to bring the wine to market.

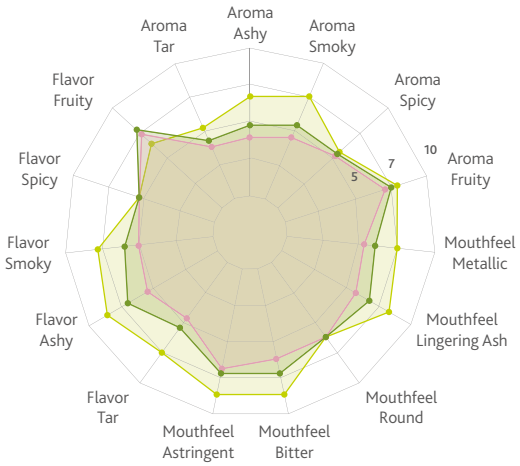

Figure 2: **GEOSORB®** in all four varietals.

7 YEAST DERIVATIVE RESULTS

Additions of yeast derivatives include the following rates during fermentation of Pinot Noir: 50 g/hL & 100 g/hL. We saw no reduction of total or bound smoke-related phenolic compounds as measured at **EXCELL®** Laboratories. However, according to our sensory panel, the wines treated with the Yeast Derivatives represented an improvement of the wine.

The more significant effect of the products on the wine is the decrease of the negative attributes associated with smoke exposure. Tasters thought the wines tasted 'less bad' with the product addition, and in some cases, tasted better. **Figure 3** illustrates the overall increase in panelists' positive scores and decreased negative scores related to the sensory character. While we recognize there is no magic bullet for removing all smoke-related sensory characters, yeast derivatives represent a way to help mask the negative characters of wines made from smoke-exposed grapes. These findings are consistent with previous studies on the Hsp12 peptide and the development of our **OENOLEES®**, **AUTOLEES®**, and **POWERLEES® LAFFORT®** product lines.

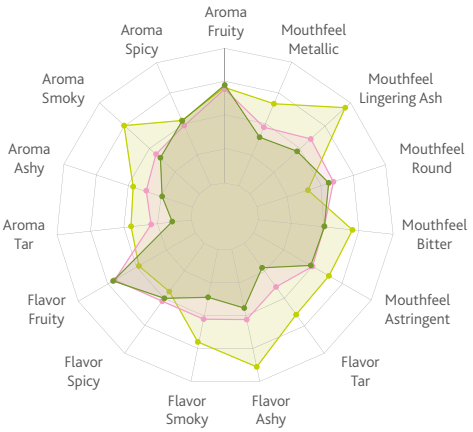

Figure 3: Sensory impact of Yeast Derivatives

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