

Research BULLETIN

WEST COAST SMOKE EXPOSURE TASK FORCE

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ABOUT

In November 2024, USDA's Agricultural Research Service (ARS) and the National Grape Research Alliance hosted a workshop at Oregon State University with wine industry stakeholders and the scientific community. Dr. Arran Rumbaugh, of USDA-ARS, developed a research roadmap – **Following the Smoke Signals: Elucidating the Future of U.S. Smoke Exposure Research** – that summarized workshop outcomes and highlighted critical research priorities. The West Coast Smoke Exposure Task Force is publishing a seven-part Research Bulletin series to provide summaries of the roadmap. The full document is available at wcsetf.org.

BULLETIN NO. 3

Current and Future Research Directions

ESTABLISHING THRESHOLD LEVELS

Current research focuses on understanding the impact of chemical composition in grapes, particularly regarding sensory effects such as smoke taint in wine, and the role of marker compounds in predicting these impacts. Future directions include the creation of smoke marker databases and the standardization of grape and wine samples to build comprehensive datasets. There is also an emphasis on developing predictive models that incorporate timing and duration of smoke exposure and grape varietal. Efforts are underway to establish a correlation between sensory thresholds in wines made from smoke-exposed grapes and smoke-marker compounds in grapes.

KNOWLEDGE GAPS IDENTIFIED

Several knowledge gaps remain, particularly regarding the precise baseline and threshold levels for smoke taint in wine, as well as the varying sensory thresholds across different consumers and grape varieties. While sensory thresholds for smoke-impacted wines are relatively well understood, much less is known about the threshold levels in the grapes themselves and how these levels affect sensory perceptions in wine. The complexity of compounds involved, such as guaiacol, cresols and thiophenols, and their varying natural presence in different grape varieties, complicates the establishment of reliable “baseline” values. To define meaningful thresholds, more data and a standardized

approach to sampling, testing methods, and data analysis are needed.

Additionally, the impact of smoke exposure during various phenological stages of grape development remains underexplored. Further research is necessary to bridge the gap between baseline measurements and the consumer's ability to detect taints. Furthermore, the role of predictive models based on chemical composition and sensory impact requires deeper investigation, along with the development of effective strategies for industry-wide data sharing and collaboration.

RESEARCH AIM 1: CREATE DATABASE OF BASELINE LEVELS

The first step in understanding the impact of smoke exposure on grapes and wine is to establish a comprehensive database of baseline levels for smoke marker compounds. This requires tracking compounds over multiple years to understand their natural variability in different grape cultivars and regions. The database will serve as a foundation for determining when smoke exposure exceeds normal levels and affects the sensory characteristics of wine.

Objectives

- Collect and analyze baseline data for smoke marker compounds in grapes including volatile phenols, thiophenols, and glycoconjugates.
- Standardize sampling methods to ensure consistency in data.



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- Track data across multiple vintages and regions to capture variations and establish reliable baseline values.
- Monitor and record the response of different grape varieties to smoke exposure throughout grape development, particularly the presence of glycosylated compounds as markers of exposure.
- Develop a centralized, accessible database of smoke marker compound levels to facilitate further research and decision-making.

RESEARCH AIM 2: ESTABLISHING GRAPE THRESHOLD LEVELS

While there is progress in understanding the sensory thresholds of smoke exposure in wine, the threshold levels of smoke marker compounds in grapes remain less clear. Establishment these thresholds is essential for determining when smoke exposure in grapes starts to affect wine quality. This research will focus on identifying the levels of smoke marker compounds in grapes that lead to altered sensory characteristics, particularly undesirable “ashy” tastes.

Objectives

- Define the threshold levels of smoke marker compounds in grapes that correlate with changes in wine sensory characteristics, such as “ashy” flavors.
- Investigate the impact of thiophenols and other key smoke-related compounds on wine quality and consumer perception.

- Identify the differences in grape cultivar responses to smoke exposure and how these affect the establishment of thresholds for different varieties.
- Develop methods to monitor and measure smoke marker compounds in grapes that contribute to smoke taint in wines for a more comprehensive understanding of exposure.
- Explore the relationship between different stages of grapevine growth (e.g., veraison) and the absorption of smoke marker compounds to determine optimal sampling times.

RESEARCH AIM 3: DEVELOP DECISION MATRIX

To help winemakers and grape growers make informed decisions about grape acceptance and wine quality, a decision matrix is needed that incorporates smoke exposure levels, sensory perceptions and potential risks to wine quality. This matrix will take into account varying thresholds for different consumer segments, including casual drinkers, sommeliers, wine critics and high-end consumers. The goal is to provide a practical tool that helps the industry assess the viability of affected grapes and wines.

Objectives

- Develop a decision matrix to guide grape growers and winemakers in assessing smoke exposure risk and wine quality based on threshold levels of smoke marker compounds.

- Include variables such as the level of smoke exposure, grape cultivar, phenological stage of growth, and consumer segment preferences in the matrix.
- Create a tiered approach to categorize smoke exposure into low, moderate, and high-risk categories for both grapes and wines.
- Incorporate sensory evaluations from different wine consumption groups (e.g., consumers, sommeliers, wine critics) to define acceptable thresholds for each group.
- Explore the feasibility of a smoke exposure index, similar to the air quality index, to track and communicate smoke-related risks across the industry.
- Integrate findings into educational materials and training programs for the industry to better understand smoke exposure and its impact on wine quality.

The full roadmap, which includes explanatory graphics, is available at wcsetf.org.



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The **West Coast Smoke Exposure Task Force** is a coalition of industry leaders committed to providing timely communications, resources and best practices to help winegrape growers and vintners navigate the challenges of wildfire smoke. The task force serves as a central hub for updates, education and collaboration to support industry resilience and informed decision-making.