APPLICATION OF SMOKE CONTAINING ^{13}C ISOTOPES TO WINE GRAPES FOR CHEMICAL CHARACTERIZATION OF SMOKE INFLUENCES IN WINE

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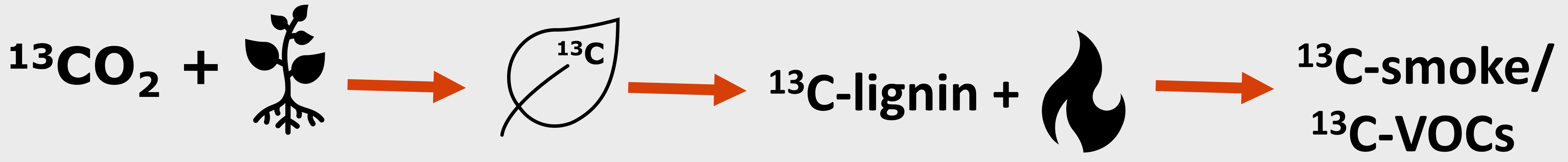
ABSTRACT

Smoke exposure to wine grapes has been a growing concern for vintners, winemakers, and consumers as many vineyards the United States and Australia reside in areas where wildfire intensity has been increasing since at least the 1950s. Wine has shown to be particularly sensitive to smoke exposure, often acquiring an "ashy", "burnt rubber", or medicinal flavors or aromas after smoke exposure. To better serve the industry, we have designed a method to perform a more thorough inventory of chemical compounds associated with smoke. A fuel source for smoke, barley, was chemically labeled using the stable isotope of $^{13}CO_2$. Upon assimilation after 10 days of $^{13}CO_2$ exposure, the ^{13}C is expected to be incorporated into the smoke precursor compounds, such as lignin. After drying, the barley was burned and the smoke piped "cold" to chardonnay and pinot noir grapes, grown in Willamette Valley, Oregon, post-harvest in a sealed container designed for this study. Chemical analysis using RP-HPLC, mass spectrometry, and ^{13}C-NMR will be used to elucidate the chemicals potentially responsible for smoke flavors and aromas in affected wines. Herein, we show the methodology for producing and applying smoke containing isotopically labeled compounds.

OBJECTIVE

Create a method to incorporate ^{13}C into barley to be used as a chemical biomarker for future studies on the chemical effects of burning near wine grapes.



METHODS & RESULTS

Figure 1 – Barley was grown from seed in DeepPots (Stuewe and Sons, Inc) at ~29 °C (daytime), watered ~25 mL daily until growth stage (GS) 3 of the Zadok's scale was reached by a majority of each cohort

Figure 2 – Upon achieving GS 3, barley was sealed in plastic containers, purged with low CO_2 air (<5 ppm), and provided with 99.9% $^{13}CO_2$ to desired meter reading

Figure 3 – Barley was dried *in situ* for 2 weeks at ambient greenhouse temperatures, 32-40 °C on average during day light hours

Figure 4 – 5 g barley burned and piped "cold" for smoke transfer to pinot noir (left) and chardonnay (right) wine grapes, 1 µm smoke particle density maintained >70 mg/m^3

FUTURE DIRECTIONS

- Determine quantity of ^{13}C assimilation using $^{13}C/^{12}C$ combustion infrared mass spectrometry
- Continue burn studies of barley in the presence of wines grapes followed by analytical chemical analysis of grapes and wine
- Compare chemical analysis with sensory studies on smoke-affected wine

FURTHER READING

1. An, T, *et al*. Carbon fluxes from plants to soil and dynamics of microbial immobilization under plastic film mulching and fertilizer application using ^{13}C pulse-labeling. *Soil Biology & Biochemistry*. **2015.** 80:53-61

2. Bromand, S., *et al*. A pulse-labelling method to generate ^{13}C-generated plant materials. *Plant and Soil.* **2001.** 235: 253:257.

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