

# Environmental Drivers of Tannin Extractability in Pennsylvania Wine Grapes

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## Introduction

### Hybrid wine grapes:

- Desirable growing properties – cold hardiness and resilience to common plant pests and pathogens<sup>1,2</sup>
- Crucial for the wine industries of PA, the Midwest, and Canada.
- May allow for more sustainable grape cultivation.

### Wine tannins:

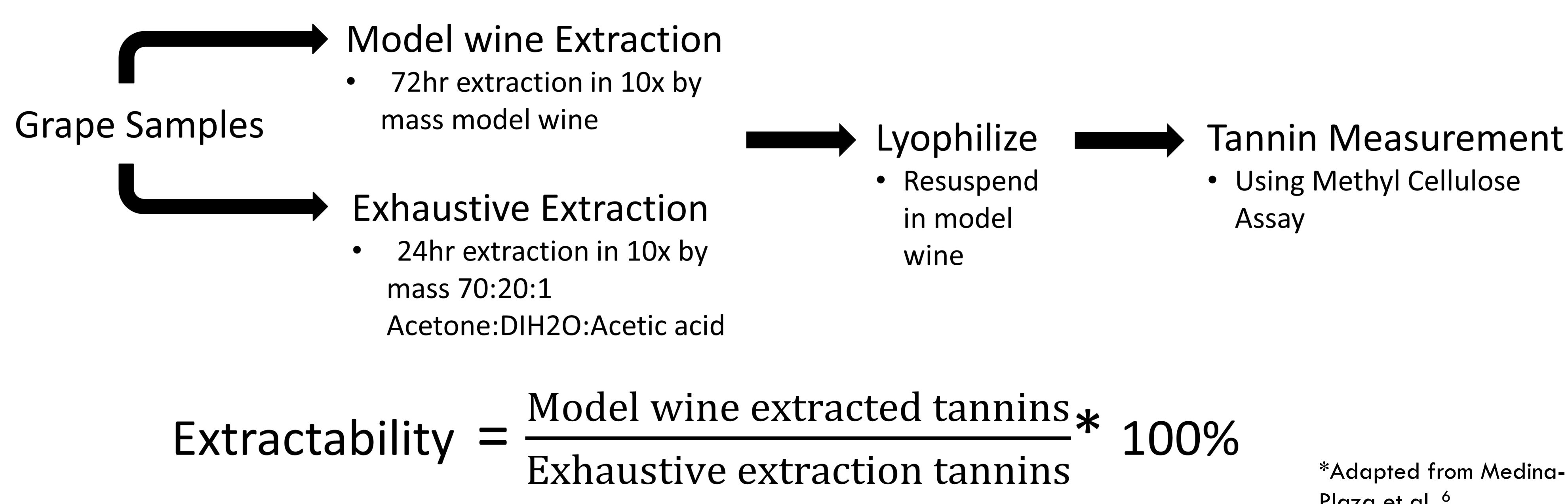
- Provide important sensory<sup>3</sup> and health-promoting<sup>4</sup> properties to red wines
- Low in Hybrid cultivars when compared to *V. vinifera*<sup>5</sup>. Extraction is limited by interactions with proteins or other cell-wall-material components
- Low wine tannins may limit the quality and profitability of hybrid-centric wine industries

### Research Questions:

- Is low tannin extractability conserved or highly variable in different cultivars, locations, vintages?
- How does grapevine environment modulate tannin extractability?
- How can we use this information to improve hybrid wine products?

## Methods – Extract Preparation

Figure 1: Preparation of Grape Extracts and Calculation of Tannin Extractability



## Grape Sampling

Figure 2: Grape Sampling

**Locations.**  
Location codes for each grape sample are overlaid on a map of Pennsylvania's plant hardiness zones<sup>7</sup>. Chambourcin (Hybrid) and Cabernet Franc (*V. vinifera*) were collected for each location except for Location "HV"

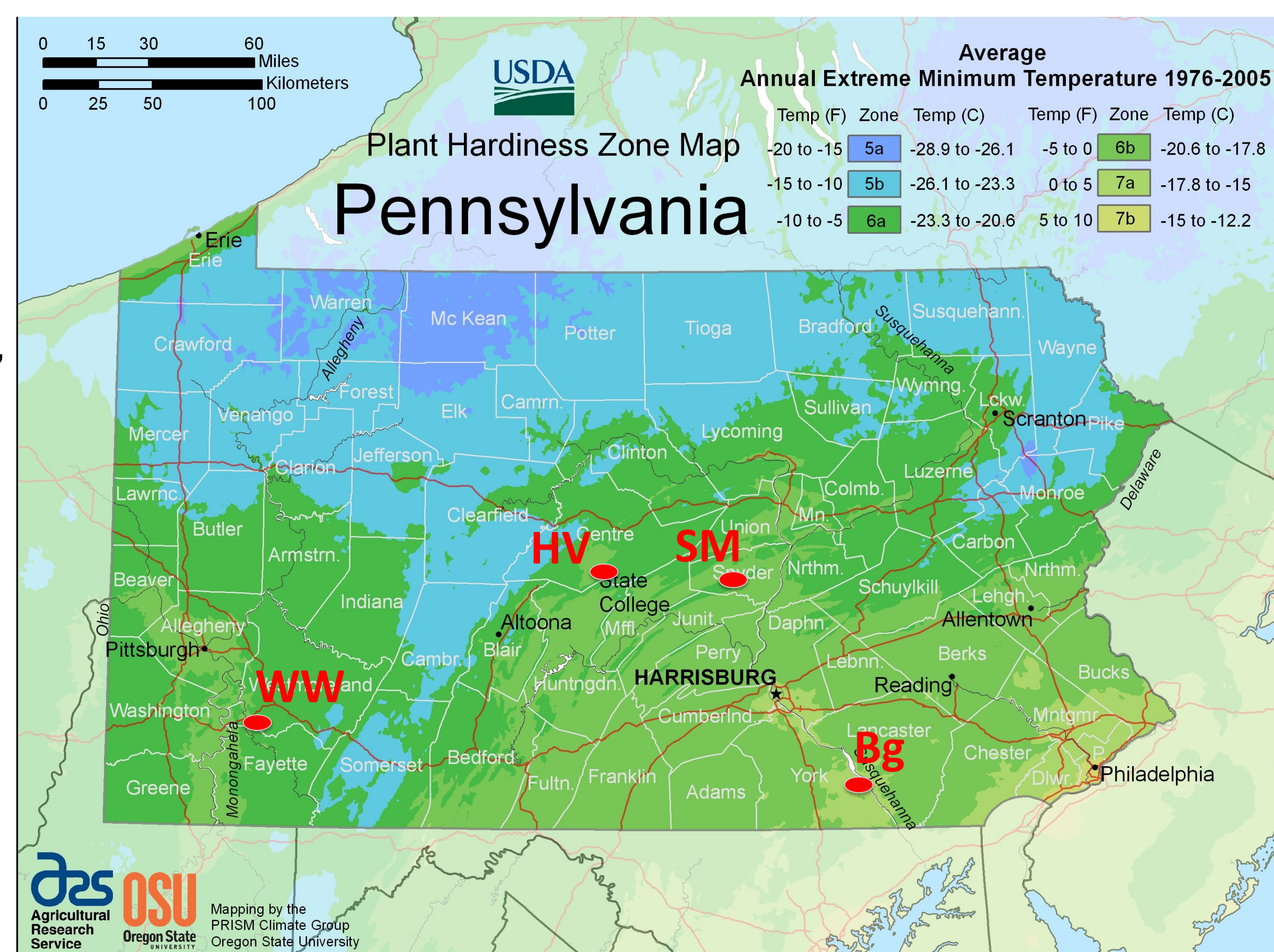


Table 1: Grape Sample Characteristics.

Basic environmental and chemical characteristics of each grape sample are displayed. Cumulative Degree Days (CDD) were calculated using a base temperature of 50°F. Temperature and Precipitation data were sourced from in-vineyard weather stations or through NOAA Online Weather Data<sup>8</sup>.

Location	Variety	Vintage	CDD (°F)	Cumulative Precipitation (in.)	°Brix	pH	Size (g/grape)
BG	Chambourcin	2022	3753	36.8	23.6	3.22	2.73
BG	Cabernet Franc	2022	3753	36.8	23.1	3.74	1.46
HV	Chambourcin	2021	3077	34.1	19.5	3.27	2.89
SM	Chambourcin	2022	3177	25.3	24	3.17	1.43
SM	Cabernet Franc	2022	3177	25.3	23.9	3.51	1.29
WW	Chambourcin	2022	3151	25.2	24.6	3.21	1.92
WW	Cabernet Franc	2022	3151	25.2	22.8	3.63	1.34

## Results

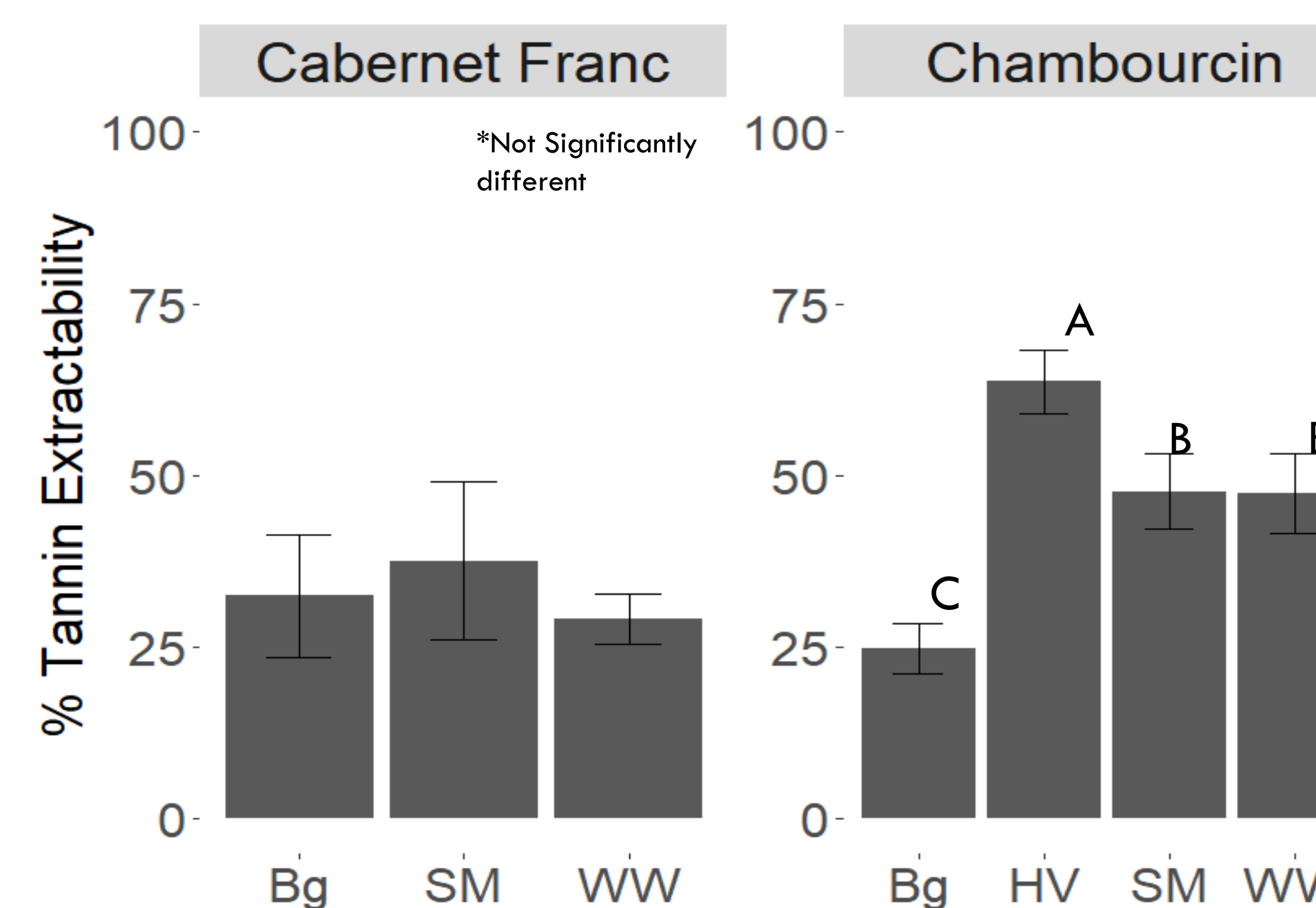
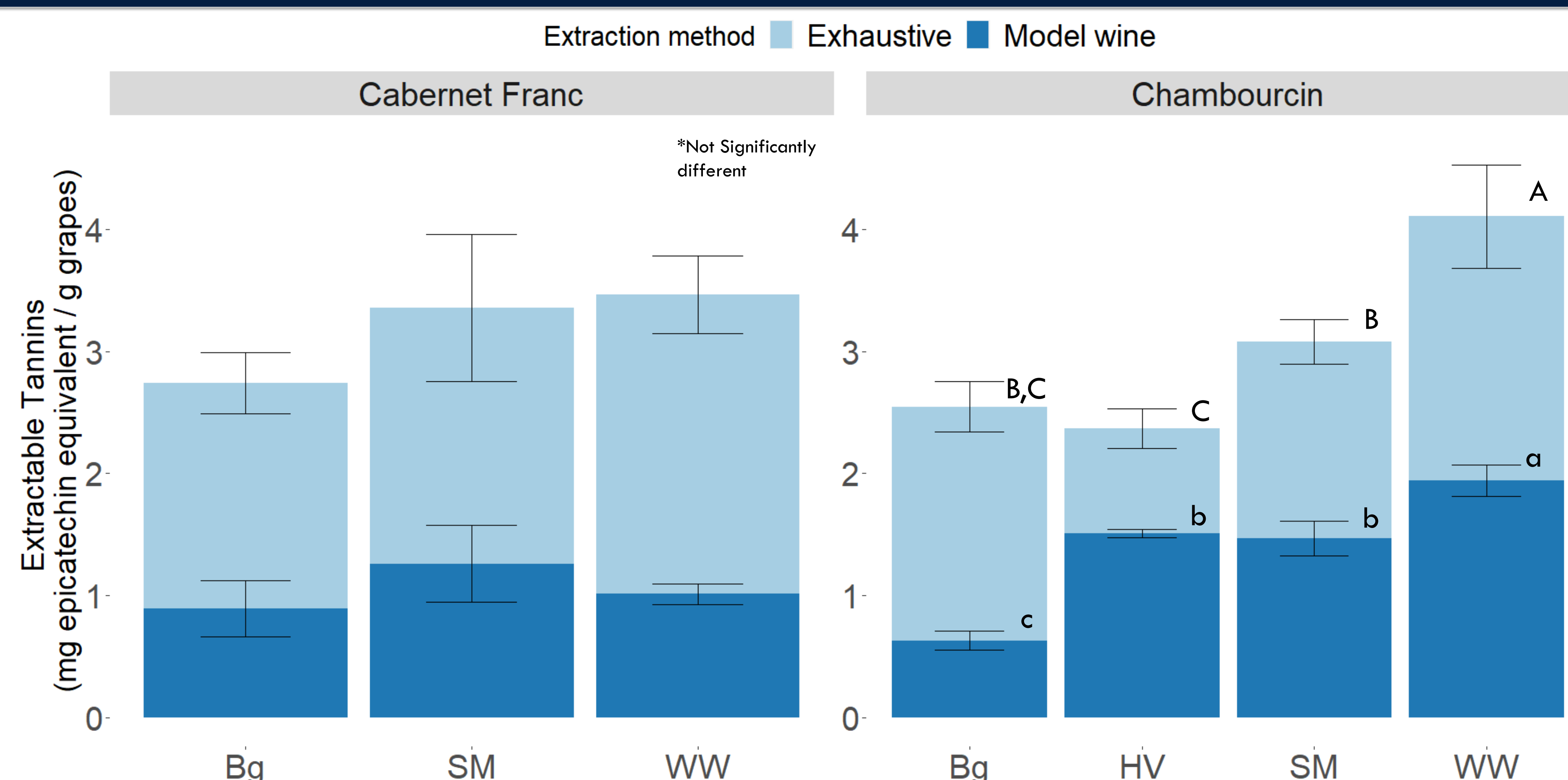


Figure 3: Tannin Content of Model Wine and Exhaustive Grape Extracts.

Tannin concentration of each extract was determined by the methyl-cellulose assay, procedure adapted from Mercurio et al.<sup>9</sup>. Tannin values were normalized to the starting grape mass. Extractions were conducted in triplicate and the error bars represent the standard deviation in these quantities. ANOVA and tukey's HSD was used to compare values within each extraction and variety, with different letters signifying significant differences ( $p = 0.05$ ) between extractable tannins

Figure 4: Percent Extractability Across Grape Samples

Percent extractability was calculated for each grape sample as a ratio of the model wine and exhaustive extracted tannins multiplied by 100%.

## Conclusions

- For **Chambourcin**, tannin content and extractability were **highly variable** across location.
- For **Cabernet Franc**, tannin content and extractability were **not significantly different** across location
- Tannin content and extractability was not always lower in the hybrid cultivar, contrary to expectations
- Future studies should examine more locations, vintages, and environmental data
- Future Studies should measure the tannin binding affinity of cell-wall-material from different grapes

## Acknowledgements

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