

SENSORY ANALYSIS OF CONCORD WINES AFTER CHEMICAL REMOVAL OF  
METHYL ANTHRANILATE RESULTS IN HIGHER ACCEPTABILITY, AND LESS  
“FOXY” AROMA

A Thesis

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## ABSTRACT

A major feature of wine made from Concord grape is the very intense grape flavor referred to as “Foxy” which is not desirable in high quality wine, and limits the utility of this cold-resistant native grape. After using a chemical deodorization process to remove Methyl Anthranilate which causes this flavor, we report results of descriptive and affective sensory studies on wine made with concord juice with and without deodorization, as well as comparing it to an inexpensive wine made from non-concord grapes, and a blended sample. The goal of the study was to assess whether chemical removal of Foxy aroma would result in a perceptible change in sensory properties, and further in acceptability of the wine. The results from both descriptive and consumer sensory testing showed that Foxy flavor was significantly decreased in the deodorized wine, and that liking for deodorized samples was significantly higher than non-deodorized, despite most other sensory aspects of the wine remaining unchanged. We conclude that the deodorization process may allow wine producers to make more acceptable wine using blending of wine from such inexpensive native grapes.

**Keywords:** Wine; Methyl anthranilate; Foxy flavor; Sensory analysis

## BIOGRAPHICAL SKETCH

Wenyue Guan is a master of food science student at Cornell University with a nutritional science background, she is passionate about food and nutrition. Throughout her academic career, she engaged in a wide range of extracurricular activities related to her field of study, also gained valuable experience through industry and research especially in sensory evaluation. During the academic year, she has contributed to projects related to taste and aroma perception, product development, and sensory analysis etc. Her passion for food science and nutrition motivates her to pursue work opportunities in these fields. Looking to the future, Wenyue is excited to continue exploring food science and nutritional science. She is eager to contribute her knowledge, skills, and enthusiasm to the field, and is committed to making a positive impact through her work and advocacy.

## ACKNOWLEDGMENTS

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TABLE OF CONTENTS

BIOGRAPHICAL SKETCH..... iii  
ACKNOWLEDGMENTS.....iv  
LIST OF FIGURES.....vi  
  
INTRODUCTION.....1  
METHODS.....2  
Sample preparation.....2  
Methyl Anthranilate filtration.....3  
Sensory evaluation.....3  
Statistical analysis.....4  
RESULTS AND DISCUSSION.....5  
    Decrease in “foxy” aroma and increase in acceptability after deodorization.....9  
    No significant difference between blending and generic sample.....9  
CONCLUSION.....9  
REFERENCES.....10

## LIST OF FIGURES

Figure 1. Preference map.....	6
Figure 2. Descriptive Spider Chart.....	6
Figure 3. Descriptive analysis.....	7
Figure 4. Consumer test, scaling Foxy aroma.....	8
Figure 5. Consumer liking.....	8

## INTRODUCTION

Concord grapes, from the American grape species *Vitis labrusca L.*, are widely grown in New York state, and other colder, northern wine regions. Some of good characteristics of this grape species include cold and disease resistance, high productivity, a good nutrient profile, and a unique aroma (Yang, 2020). From previous study, researchers found that this grape variety has a very intense grape flavor referred to as “foxy”, caused by the chemical compound called Methyl Anthranilate (MA). This aroma is regarded as an undesirable attribute by some consumers, especially in the wine industry; wine companies err against using concord grapes for winemaking due to this aroma which is not often present in high-quality wine so that this aroma has been prohibited in the production of wine. Nelson found that methyl anthranilate appears to be important in concord wine (Nelson, 1977). One other perspective that we want to pay more attention on concord grape is that the price of this grape species is relatively low compared to the grapes that commonly used to make most wine, so some attention by the wine industry is being directed to removing this MA chemically using nanofiltration-resin (NFR) treatment (Demi Perry) in order to make a more acceptable wine.

Flavor and taste are some of the important factors in determining the quality of a wine product. The aroma and taste of wines mostly come from the grape varieties and the fermentation (Chen, 2009). The sensory characteristics are determined by human evaluation in most research studies. Sensory evaluation is an important component in food product development. There are many types of sensory evaluation with different usages such as descriptive panels, consumer tests, discrimination tests, etc. In this study, we use both descriptive and consumer tests in order to explore the change in sensory perceptions of “foxy” aroma from both trained and untrained sensory panelists, and to understand the consumer’s liking of concord wine after deodorization. Descriptive analysis uses trained panelists, all able to determine the intensity of different wine

attributes, especially the “foxy” aroma in this study. This technique allows us to obtain the intensity of different attributes to explore fine details of a food product (Yang, 2016). Consumer testing is used to explore the consumer’s acceptability of a new food product. Consumers evaluate a product by rating their overall liking of samples, as well as liking for different characteristics. The results from consumer tests will influence the success or failure of releasing a food product. So, sensory evaluation is currently considered to be a technique to improve quality and promote innovation in food products (Claudia, 2021). The objectives of this study were (1) to assess whether chemical removal of “foxy” aroma would result in a perceptible decrease of “foxy” flavor in finished wine using descriptive analysis, (2) whether its acceptability would be affected, using consumer sensory testing, and (3) to compare an inexpensive generic wine made from non-concord grapes versus the original odorous wine, the de-odorized wine, and one blending the inexpensive wine with 25% deodorized wine to approximate how winemakers may use a cheaper wine alongside wine from an expensive grape. The reason we use a blending sample is that the regulatory limit of blending into a varietal label wine is 75%. Since the concord grape variety is relatively less expensive than the grape variety that we used in the generic wine, if there is no significant difference in sensory between generic and blending samples, the wine industry could use such wines to lower the cost and still label the wine without a concord label.

## **METHODS**

### **Sample preparation**

There are four samples in this study: generic, odor, de-odor, and blending (75% generic with 25% de-odor). The generic sample was 2020 BEAUJOLAIS-VILLAGES LE PERREON 2020 which was directly purchased from the market. The grape variety of the generic wine was 100%

Gamay. The odor and de-odor samples were fermented at the end of 2022 using Welch's original 100% concord grape juice bought from a local market. All the samples were stored at room temperature after fermentation before the sensory tests. Due to COVID-19, the descriptive test was performed remotely at home. The wine samples were sealed in glass bottles with nitrogen in order to keep freshness and picked up by panelists. The consumer test was in-person one month after the descriptive test.

### **Methyl Anthranilate filtration**

Methyl anthranilate has been filtrated before the fermentation through a removal process called nanofiltration-resin (NFR) treatment. The concord juice was pumped through a nanofiltration membrane which can permeate small molecules such as methyl anthranilate. The compound permeates through the membrane is directed to a canister filled with a semi-selective resin which can selectively adsorbs methyl anthranilate molecules. Post-resin treated liquid is colorless, odorless, and tasteless. This system is recirculated for a few hours until methyl anthranilate is sufficiently lowered to sub-threshold concentrations (Demi Perry).

### **Sensory evaluation**

All procedures were approved by the Cornell University Institutional Review Board. For both of the descriptive and consumer sensory tests, all the panelists were unaware of the objectives of this study throughout the evaluation. Panelists provided informed consent, and were compensated for their time. All samples were counterbalanced, labeled with 3-digit random codes and served to panelists using transparent wine glasses at room temperature. The testing room was a professional clean and odorless sensory evaluation booth. Crackers and water were served between wine samples in order to avoid interference between the evaluation of each sample.

### *Descriptive test*

A duplicate descriptive test in 2 days was performed by 11 trained panelists (6 males, 5 female, ages 24-30), who had each undergone over 40 hours of descriptive sensory training. Panelists were trained on general wine attributes and the unique “foxy” aroma. Panelists were asked to smell the sample first without tasting them, then score the intensity of 7 attributes: Floral, Yeasty, Citrus, Foxy, Fruity, Green/Bell Pepper, and Oxidized/Vinegar. Followed by the smell, they were asked to taste the sample and score the intensity of 5 attributes: Sweetness, Bitterness, Tannic, Licorice, and Sour. The score on line scale is from 0 to 100 with 5 markers: 0 representing “None”, 10 representing “Barely detectable”, 40 representing “Slight”, 70 representing “Definite”, and 100 representing “Pronounced”.

### *Consumer test*

A consumer test was conducted one month after the descriptive test, performed by 95 panelists (30 male, 65 female, age 21-63). There was a 21 years old age restriction for the test due to alcohol. The test started from 11am to 5pm in several time slots, roughly 7-8 panelists per slot. Panelists were asked to complete several liking questions in a 9-point hedonic selection from “Dislike Extremely” to “Like Extremely” in 6 liking attributes: Overall, Appearance, Aroma, Flavor, Mouthfeel, and Aftertaste. They were also asked to rate the intensity of the “foxy” aroma in a scale from “No sensation” to “Strongest imaginable”.

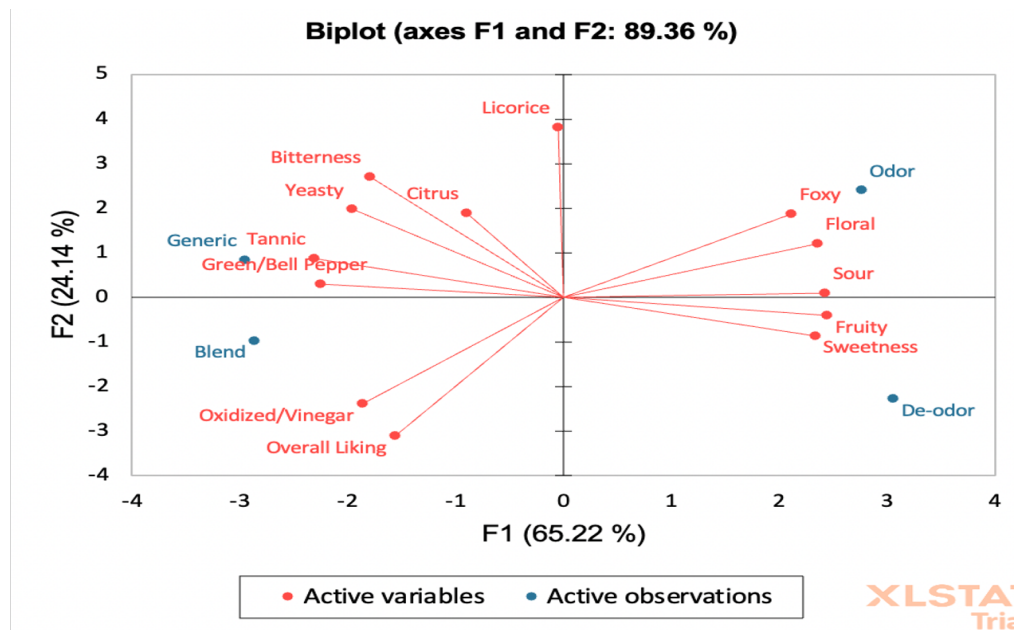
### **Statistical analysis**

The statistical analysis for this study consisted of a preference map and ANOVA analysis conducted using XLSTAT. Statistical significance was assumed at  $p < 0.05$ . The number of \* shows the degree of difference between samples (Boos, 2012). Preference map analysis provides clear information about each panelists’ response in an easy-understanding visual figure. The data used for the preference map analysis was the mean score of the 12 attributes from descriptive

panels plus the mean of overall liking score from the consumer test. ANOVA analysis is also a statistical tool that is widely used in sensory evaluation to determine if there are any significant differences between the sensory attributes of different samples (Guld, 2020). The data used for the spider chart was the mean score of the 12 attributes from descriptive panels.

## **RESULTS AND DISCUSSION**

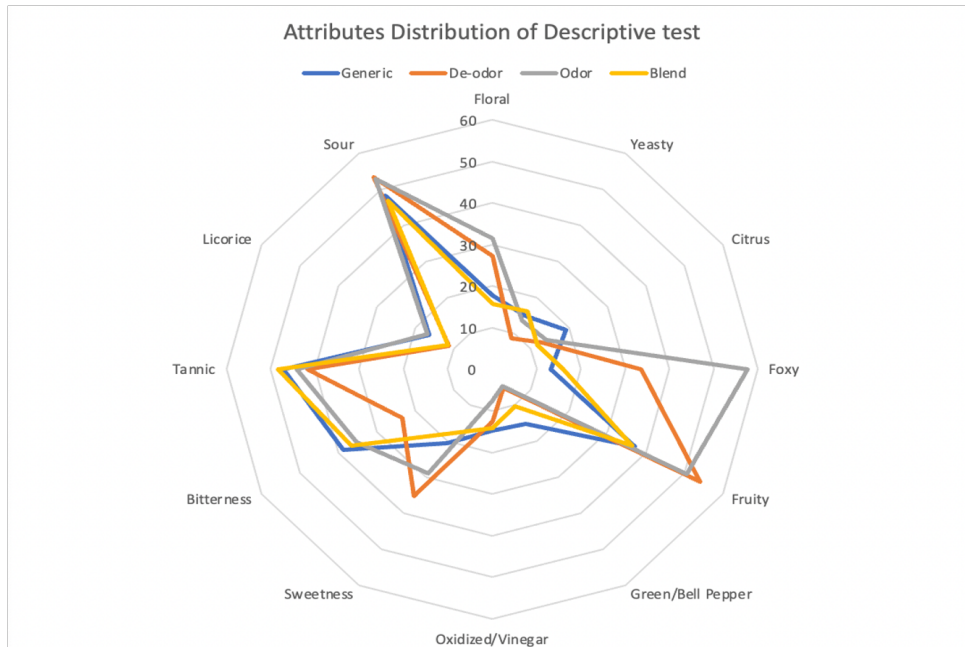
As shown in figure 1, the preference map clearly indicates the relationship between the attributes and each sample (Elmore, 1999). Text in blue represents the 4 samples, text in red represents the 12 attributes from descriptive analysis and the overall liking score from the consumer test, “foxy” aroma and overall liking seem to be almost exactly antiparallel. Specifically, “foxy” flavor was allocated towards the odor quadrants with other two attributes: floral and sour; the overall liking was allocated towards the blend quadrants with oxidized/vinegar. The results indicate that there is a significant decrease of the “foxy” aroma after deodorization so that the panelists can just slightly perceive the “foxy” flavor in the deodorized sample. For the other general attributes, Licorice, Bitterness, Yeasty, Citrus, Tannic, and Green/Bell Pepper were allocated in the generic quadrants; Fruity and Sweetness were allocated in the de-odor quadrants.



**Figure 1. Preference map.** “Foxy” aroma located in the odor area. Overall liking is located in the blending sample.

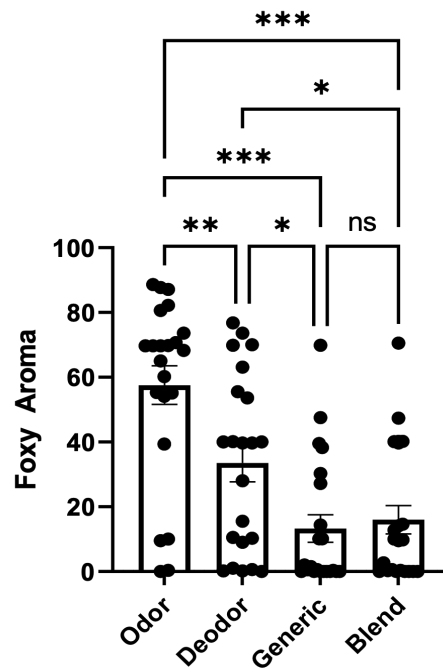
Figure 2 is the spider chart; the blue line represents generic sample, orange line represents the de-odor sample, gray line represents the odor sample, and yellow line represents blend sample.

As the result shown, the “foxy” aroma has highest score in the odor sample which roughly equals to 60. De-odorized samples scored significantly lower than the original samples in foxiness, and while they may not have been to the level of the generic wine, blending the deodorized sample with the generic left no significant difference between this sample and the generic, suggesting a clear utility for deodorized concord wine in blending.

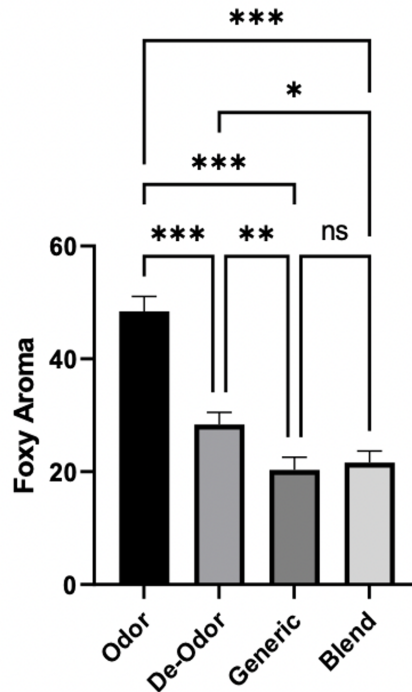


**Figure 2. Spider Chart.** Odor wine has highest score for “Foxy” aroma

Figure 3 displays the ANOVA result of “foxy” aroma from descriptive test. As the figure shown, there is a significant drop in foxiness between odor and de-odor sample, with no significant difference between generic and blending sample.

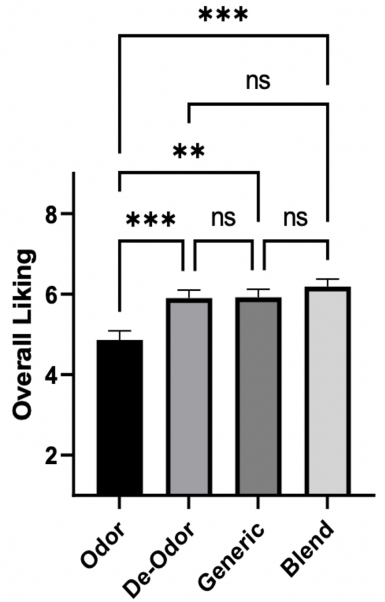


**Figure 3. Descriptive analysis.** Ouder wine has highest score for “Foxy” aroma. Bars show mean plus SEM, stars indicate statistical significance where ns is not significant; \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001



**Figure 4. Consumer test, scaling Foxy aroma.** Ouder wine has highest score for “Foxy” aroma. Bars show mean plus SEM, stars indicate statistical significance where ns is not significant; \*p < 0.05; \*\*p < 0.01; \*\*\*p < 0.001

In agreement with the trained sensory panelists, untrained wine consumers felt that foxiness dropped significantly with deodorization (Figure 4). Further, consumers also felt that introducing concord wine as a blending agent at 25% did not in turn introduce a significant foxy aroma to the resultant wine, again showing promise for concord blending. Figure 5 shows the result of consumer liking. As the result shows, there is significant increase in liking score of the concord wine with deodorization process. No significant difference was observed between the de-odor, generic, and blending sample.



**Figure 5.** Consumer liking. Bars show mean plus SEM, stars indicate statistical significance where ns is not significant; \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$

#### **Decrease in “foxy” aroma and increase in acceptability after deodorization**

The significantly different result between odor and de-odor sample from figure 3 and 4 indicates that both trained and untrained sensory analyses perceived a decrease in “foxy” aroma after deodorization. Figure 5 is the ANOVA result of overall liking score from the consumer test. As the figure shows, the liking of deodorized and blending concord wine was significantly higher than the odorous wine which suggests that the removal of Methyl Anthranilate resulted in a higher acceptability of concord wine.

#### **No significant difference between blending and generic sample**

As figure 3-5 show based on the descriptive and the liking scores, all of the 3 figures indicate that there is no significant difference for “foxy” aroma between generic and blending samples, as well as for liking. From the spider chart, the yellow line represents the blending sample and blue line represents the generic sample, with very minor differences in sensory profile introduced to the generic wine from blending with 25% concord wine. Going back to the second objective of

this study, we wanted to compare an inexpensive wine made from non-concord grapes which blended with 25% deodorized wine to the generic wine. The result supports that we can use the concord wine as a blending wine after deodorization. Since concord wine is less expensive than the generic, the wine industry may eventually be able to utilize concord wine to reduce costs in wine production.

## **CONCLUSION**

Using descriptive and consumer sensory evaluation, results from the study suggests that chemical removal of Methyl Anthranilate is readily perceived by wine consumers as a drop in Foxy aroma, with an increase in acceptability of wine produced in this manner is likely due to removal of Foxy aroma. The results from comparing blended samples also highlight the possibility of the deodorizing process to allow wine producers to make more acceptable wine using relatively inexpensive concord grapes.

Further research could address the potential cost of the removal of the Methyl Anthranilate, as this might result in a higher cost associated with the process. The removal process itself could be expensive and time consuming, requiring specialized equipment that may not be affordable for all wine producers. Moreover, if the deodorization and the fermentation process are located at a different plant, the transportation costs of the product may also need to be considered.

Overall, this study provides a significant result to support the decrease of “foxy” aroma after the removal of Methyl Anthranilate, and also increase the acceptability of concord wine. By promoting innovation and sustainability in wine production, we can help the development of the wine industry, while also better meeting preferences of consumers.

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