# THE EFFECTS OF WINE COMPONENTS ON THE SENSORY PERCEPTION OF WINE FAULTS

Daniel Kim[ab], Massimo Marcone[a], George Soleas[b], Chris Findlay[c], Paul McNicholas[d]

University of Guelph[a], Liquor Control Board of Ontario[b], Compusense[c], McMaster University[d]

## INTRODUCTION

Understanding how the wine matrix can affect the volatility of a wine fault is important in determining its potential impact on consumer perception and acceptability. If the sample matrix has the ability to decrease the partitioning of the wine fault into the headspace, the less chance that the wine would be rejected on the nose. To determine these effects, different concentrations of the wine matrix components (ethanol, tannic acid, and tartaric acid) on seven aromatic wine faults were studied using static headspace gas chromatography and sensory analysis.

## OBJECTIVES

The purpose of this research was to determine the influence of specific wine matrix compounds (ethanol, tannic acid, and tartaric acid) on the volatility and perception of aromatic wine faults.

## MATERIALS AND METHODS

### Chemical Reagents

Acetaldehyde (AC) [CAS 75-07-0, ≥ 99.5, Food Grade] , acetic acid (AA) [CAS 64-19-7, ≥ 99.5%, Food Grade] , ethyl acetate (EA) [CAS 141-787-6, ≥ 99%, Food Grade] , 2-isopropyl-3-methoxypyrazine (IPMP) [CAS 25773-40-4, 99%, Food Grade], 2,4,6-trichloroanisole (TCA) [CAS 87-40-1, 99%], 4-ethylphenol (EP) [CAS 123-07-9, 98%, Food Grade], and 4-ethylguaiacol (EG) [CAS 2785-89-9, 98%, Food Grade], tannic acid (CAS 1401-55-4, ACS) and L-tartaric acid (CAS 87-69-4, ≥ 99.5%) were purchased from Sigma-Aldrich (Ontario, Canada). 94% alc./vol. ethanol was purchased from Global Alcool (Quebec, Canada). Ultrapure water (18.2mΩcm) was obtained using Millipore's Milli-Q Integral 15 system (Ontario, Canada).

### Instrumental Analysis

The influence of ethanol, tannic acid, and tartaric acid on the volatility of the wine faults was studied using an Agilent G1888 static headspace sampler connected to a 7890 gas chromatograph with a 5975C mass selective detector. Each analysis was performed in triplicate with a vial equilibration temperature at 38˚C.

### Sensory Analysis

13-20 experienced wine assessors were presented with a forced choice unspecified tetrad test. Assessors were given a single fault: TCA (0.9 ng/L), EA (3 mg/L), AA (125 mg/L), EP (24 ug/L), EG (45 ug/L), IPMP (0.9 ng/L), and AC (27 mg/L). Faults were presented in an ethanol:water, tannic acid:5% alc./vol., or tartaric acid: 5% alc./vol. solution. Assessors were tasked with grouping the identical samples together after only nosing the samples.

## RESULTS

### Static Headspace Analysis

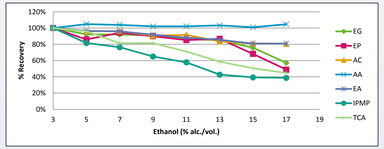


Figure 1. The effect of ethanol on the partitioning of aromatic wine faults in a binary (water:ethanol) solution as a percent recovery at 38°C. The values are an average of at least 3 replicates.

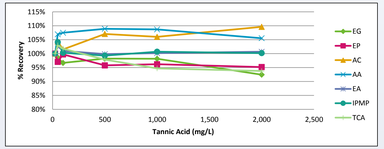


Figure 2. The effect of tannic acid on the partitioning of aromatic wine faults in a ternary (water:5% alc./vol. ethanol:tannic acid) solution as a percent recovery at 38°C. The values are an average of at least 3 replicates.

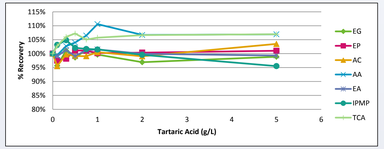


Figure 3. The effect of tartaric acid on the partitioning of aromatic wine faults in a ternary (water:5% alc./vol. ethanol:tartaric acid) solution as a percent change at 38°C. The values are an average of at least 3 replicates.

Table. 1 ANOVA results showing the effects of the wine matrix components (ethanol, tannic acid, and tartaric acid) on the partitioning of the aromatic wine faults (EG, EP, AC, AA, EA, IPMP, TCA) when analyzed on SH-GC-MS.

| | | Ethanol | | | Tannic Acid | | | Tartaric Acid | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Compound | Code | F | Pr > F | %(min/max) | F | Pr > F | %(min/max) | F | Pr > F | %(min/max) |
| 4-ethylguaiacol | EG | *5.72** | < 0.01 | 0.55 | 0.56 | 0.72 | 0.08 | 0.57 | 0.76 | 0.06 |
| 4-ethylphenol | EP | *8.80** | < 0.01 | 0.69 | 0.37 | 0.28 | 0.05 | 1.42 | 0.91 | 0.04 |
| Acetaldehyde | AC | *6.49** | < 0.01 | 0.22 | 0.90 | 0.57 | 0.09 | 0.80 | 0.53 | 0.08 |
| Acetic Acid | AA | 0.06 | 0.99 | 0.05 | 1.02 | 0.87 | 0.09 | 0.35 | 0.44 | 0.11 |
| Ethyl Acetate | EA | *5.37** | < 0.01 | 0.21 | 0.13 | 0.93 | 0.03 | 0.27 | 1.00 | 0.02 |
| 2-isopropyl-3-methoxypyrazine | IPMP | *81.24** | < 0.01 | 0.88 | 1.39 | 0.69 | 0.05 | 0.17 | 0.26 | 0.09 |
| 2,4,6-trichloroanisole | TCA | *78.87** | < 0.01 | 0.77 | 0.48 | 0.40 | 0.09 | 1.06 | 0.84 | 0.07 |

* indicate the results with a significance level lower than 0.05

### Sensory Analysis

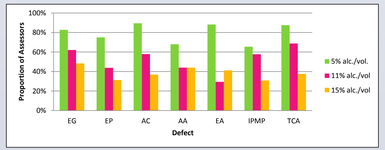


Figure 4. The proportion of assessors that could correctly group the identical pairs together when presented as a tetrad test in 5% alc./vol., 11% alc./vol., and 15% alc./vol. solution of ethanol.

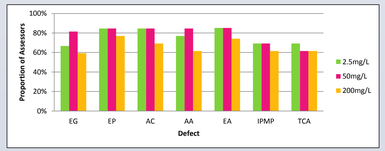


Figure 5. The proportion of assessors that could correctly group the identical pairs together when presented as a tetrad test in a tannic acid (2.5mg/L, 50mg/L, 200mg/L):5% alc./vol. ethanol solution.

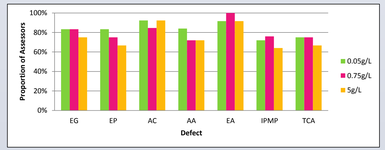


Figure 6. The proportion of assessors that could correctly group the identical pairs together when presented as a tetrad test in a tartaric acid (0.05 g/L, 0.75 mg/L, 5g/L):5% alc./vol. ethanol solution.

Table 2. D-prime results showing the effects of the wine matrix components (ethanol, tannic acid, and tartaric acid) on the perception of the aromatic wine faults (EG, EP, AC, AA, EA, IPMP, TCA).

| | Ethanol (% alc./vol.) | | | Tannic Acid (mg/L) | | | Tartaric Acid (g/L) | | |
|---|---|---|---|---|---|---|---|---|---|
| Compound | 5 | 11 | 17 | 2.5 | 50 | 200 | 0.05 | 0.75 | 5 |
| EG | *2.22** | *1.43** | 0.95 | 1.59* | 2.16* | 1.33* | 2.25* | 2.25* | 1.89* |
| EP | *1.89** | 0.78 | *0.00* | 2.31* | 2.31* | 1.97* | 2.25* | 1.89* | 1.59* |
| AC | *2.6** | 1.29 | 0.43 | 2.31* | 2.31* | 1.68* | 2.81* | 2.31* | 2.81* |
| AA | *1.63** | 0.79 | 0.79 | 1.97* | 2.31* | 1.41* | 2.28* | 1.78* | 1.78* |
| EA | *2.52** | 0.00 | 0.66 | 2.34* | 2.34* | 1.85* | 2.76* | 8.75* | 2.76* |
| IPMP | *1.54** | *1.28** | *0.00* | 1.68* | 1.68* | 1.41* | 1.78* | 1.93* | 1.5* |
| TCA | *2.47** | *1.66** | 0.47 | 1.68* | 1.41* | 1.41* | 1.89* | 1.89* | 1.59* |

* indicate the results with a significance level lower than 0.05

## CONCLUSIONS

Both the instrumental and sensory analysis demonstrated there was a significant negative correlation between the ethanol concentration and the amount of the wine fault detected in the headspace. Other wine matrix components had no statistically significant effect ($p<0.05$), except in the case of acetic acid, where only sensory analysis showed a statistically significant negative correlation, while instrumental analysis showed no statistically significant effect. This demonstrates that wine components can have a significant influence on how an aromatic fault is perceived. Understanding this phenomenon can assist wine-makers to ensure that their product offering and brand integrity is maintained, resulting in greater consumer acceptability and future sales.

## REFERENCES

1. Mitropoulou, A., Hatzidimitriou, E., & Paraskevopoulou, A. (2011). Aroma Release of a Model Wine Solution as Influenced by the Presence of Non-Volatile Components. Effects of Commercial Tannin Extracts, Polysaccharides and Artificial Saliva. *Food Research International*, *44*, 1561-1570.

2. Pozo-Bayon, M. A., & Reineccius, G. (2009). Interactions Between Wine Matrix Macro-Components and Aroma Compounds. In, vol. 8F (pp. 417-435).

3. Saenz-Navajas, M.-P., Campo, E., Cullere, L., Fernandez-Zurbano, P., Valentin, D., & Ferreira, V. (2010). Effects of the Nonvolatile Matrix on the Aroma Perception of Wine. *Journal of Agricultural and Food Chemistry, 58*, 5574-5585.

4. Villamor, R. R., & Ross, C. F. (2013). Wine matrix compounds affect perception of wine aromas. *Annu Rev Food Sci Technol*, *4*, 1-20.

## ACKNOWLEDGEMENTS

I would like to thank my colleagues at the LCBO, Compusense, and the University of Guelph for their continual support, guidance and motivation. I would like to also thank Dr. Tony Cullen and Dr. Stephen Cater for their help and guidance throughout this study.

RESEARCH POSTER PRESENTATION DESIGN © 2012
www.PosterPresentations.com