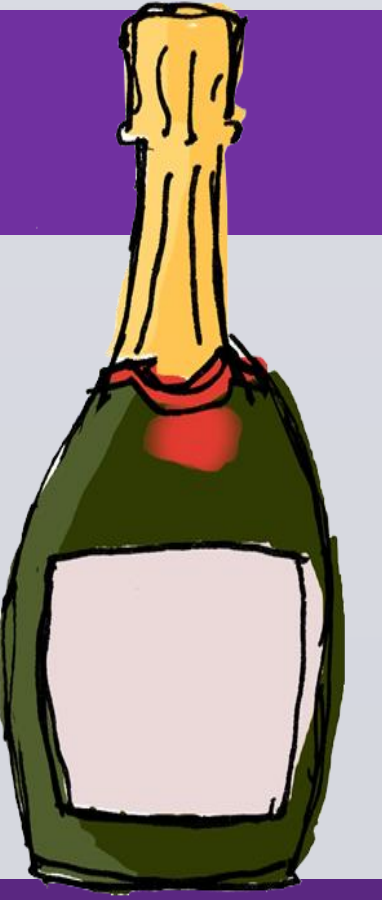


Introduction

During sparkling wine production, the addition of refined sugar products is used to carry out the secondary fermentation. Cane and beet sugar are both high purity sucrose products, although differences in their respective processing techniques have been attributed to sensory differences between these sugar types (1). Both cane and beet sugar are used in commercial winemaking, although their use is largely depending on availability, which is directly associated with geographic proximity to production and processing facilities. Canadian-grown and produced beet sugar may be a sustainable alternative to cane sugar in Ontario sparkling wine production.



Aims

The main objective of this study was to establish if beet sugar produces a different concentration of “fruity” volatile aroma compounds (VOCs), compared to cane sugar when used for second alcoholic fermentation of Auxerrois sparkling wines.

Materials & Methods

Auxerrois base wine from the 2020 vintage was separated into two lots; half was fermented with cane sugar and half with beet sugar (both sucrose products and tested for sugar purity). These sugars were used in yeast acclimation (IOC 2007), and base wines for the second fermentation (12 bottles each). Base wines were manually bottled at the Cool Climate Oenology and Viticulture Institute (CCOVI) research winery, Brock University, Ontario, Canada. The standard chemical analysis took place at intervals of 0, 4 weeks, and 8 weeks post-bottling.

Acidity and pH measurements were measured by auto-titrator. Residual Sugar (g/L) (glucose (g/L), fructose (g/L)), YAN (mg N/L), malic acid, and acetic acid (g/L) were analyzed by Megazyme assay kits. Sugar purity was evaluated by HPLC and carried out by Eurofins Experchem Laboratories (Toronto, Canada). Alcohol (% v/v) was assessed by GC-FID. VOC analysis of base wines, finished sparkling wines, as well as the two sugars in the dearomatized wine, was carried out by HS-SPME-GC-MS. VOCs included ethyl octanoate, ethyl hexanoate, ethyl butanoate, ethyl decanoate, ethyl-2-methylbutyrate, ethyl-3-methylbutyrate, ethyl 2-methyl propanoate, ethyl 2-hydroxy propanoate, 1-hexanol, 2-phenylethan-1-ol, ethyl acetate, hexyl acetate, isoamyl acetate and 2-phenylethyl acetate.

Results and discussion

Base wine

- Base wine chemical composition included TA 8.9 (g/L), pH 3.3, residual sugar 2g/L and 12 (mg N/L) YAN, so a YAN addition of 30ppm was made.
- There were no differences in the rate of yeast acclimation between cane and beet sugar wines, or between glucose and fructose concentrations during the second fermentation.

Sparkling Wine VOCs

- Volatile composition of Auxerrois sparkling wines produced with either cane or beet sugars for secondary fermentation were statistically evaluated by Student’s paired t-tests ($\alpha = 0.05$).
- Wines produced with beet sugar were shown to contain significantly higher VOCs compared to those produced with cane sugar, as shown in Figure 1.

Sugar Analysis

- Both cane and beet sugar were reported to be 99.9% sucrose by HPLC.
- When comparing cane and beet sugar-types prepared in dearomatized wine, four VOCs were determined to be significantly different by Student’s paired t-tests ($\alpha = 0.05$) as shown in Table 1. All compounds are at significantly higher levels in beet sugar solutions.

Table 1. Volatile composition of cane and beet sugar solutions prepared to 8 g/L in 10% ethanol (v/v) dearomatized wine. Mean concentrations (n=2) of volatile organic compounds with significant differences according to Student’s paired t-test ($p < 0.05$).

| Sugar Type | Concentration /ppb | | | |
|------------|--------------------|-----------------|-----------------|---------------|
| | Ethyl acetate | Isoamyl acetate | Ethyl hexanoate | Hexyl acetate |
| Cane Sugar | 1846.69 ± 35.37 | 74.22 ± 0.04 | 258.95 ± 0.00 | 36.93 ± 0.02 |
| Beet Sugar | 1984.27 ± 22.22 | 75.40 ± 0.07 | 259.29 ± 0.02 | 37.62 ± 0.01 |

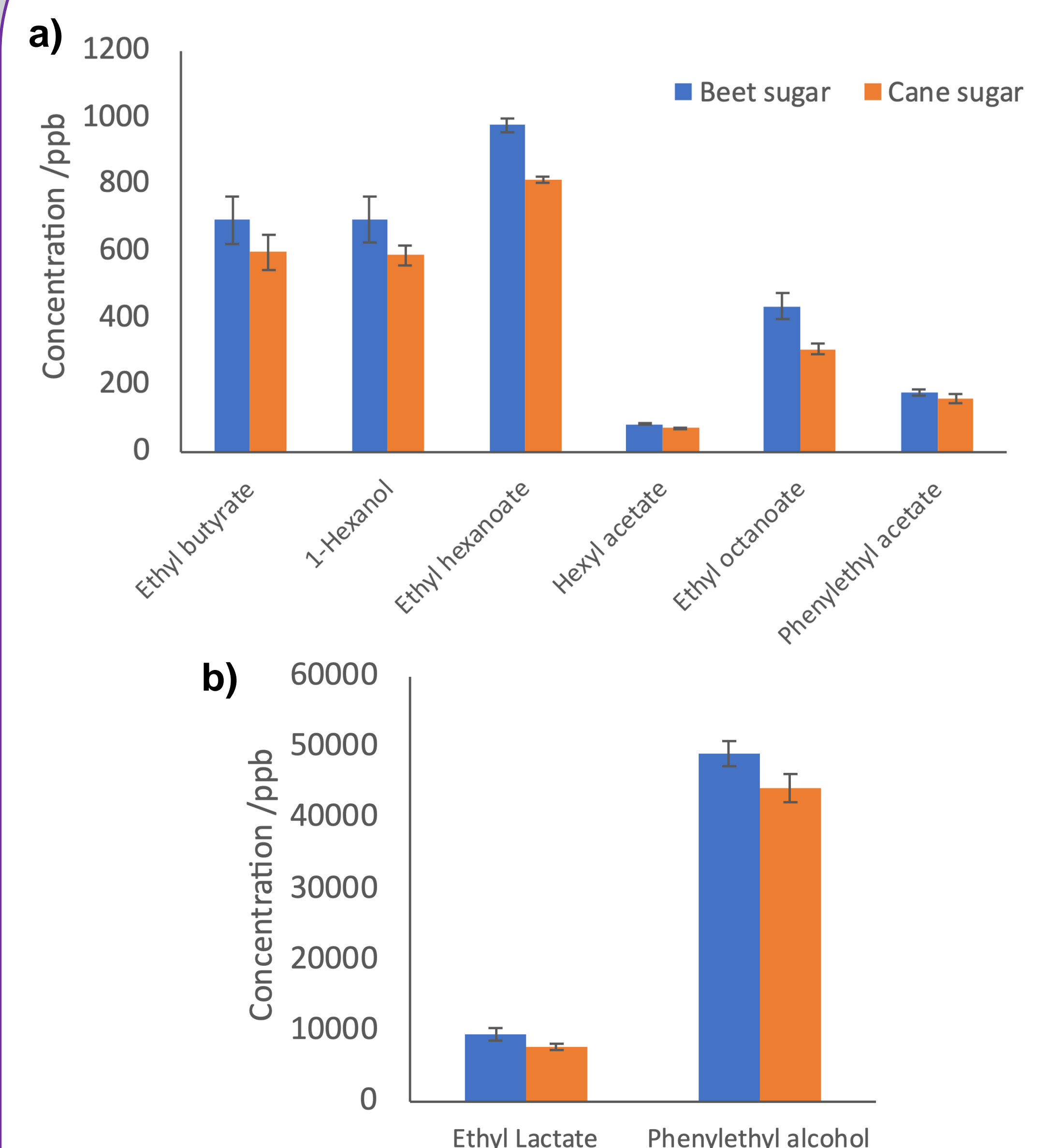


Figure 1. Mean concentration (n=4) of volatile organic compounds in Auxerrois sparkling wines produced using cane or beet sugar with significant differences according to Student’s paired t-test ($p < 0.05$).

Conclusion

- VOC differences are due to the raw material used (cane or Canadian-grown beet), and their respective processing methods.
- Winemakers can use this knowledge to adjust the flavor profile of sparkling wines
- Beet sugar is associated with an increase in VOC components.
- Further analysis during aging in contact with yeast lees is needed for the long-term effect of each sugar on the final wine.

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References

1. Urbanus, B. L. et al. Sensory Differences Between Beet and Cane Sugar Sources. *J. Food Sci.* 79, S1763–S1768 (2014).