Effect of carbonation level on the perception of sparkling wine

J. C. Castura[1], K. M. McMahon[2], C. F. Ross[2]
[1]*Compusense Inc., Guelph, ON, Canada*
[2]*Washington State University, Pullman, WA, USA*

Study

From a sensory perspective, sparkling wines are highly complex products. Carbonation increases surface area and kinetic energy, and imparts characteristic mouthfeel effects that include tingling and other sensations, and may trigger gustatory, olfactory, trigeminal, and auditory perceptions as well. To investigate the effects of carbonation level on perception, McMahon, Culver, and Ross (2017a) made eleven wines starting from the same base cuvee, resulting in 1 (still) base wine and 10 sparkling wines, each at a different carbonation level. Wine chemistry analysis confirmed differences amongst samples with respect to carbonation, and similarity in terms of sensory thresholds levels in recorded concentrations of sugars, titratable acid, pH, and ethanol. As reported McMahon, Castura, Culver, and Ross (2017b), wines were evaluated according to a replicated experimental design by trained assessors via (i) sensory descriptive analysis (which provides static data on attribute intensities), and (ii) temporal check-all-that-apply (which provides dynamic data related to attribute applicability over time).

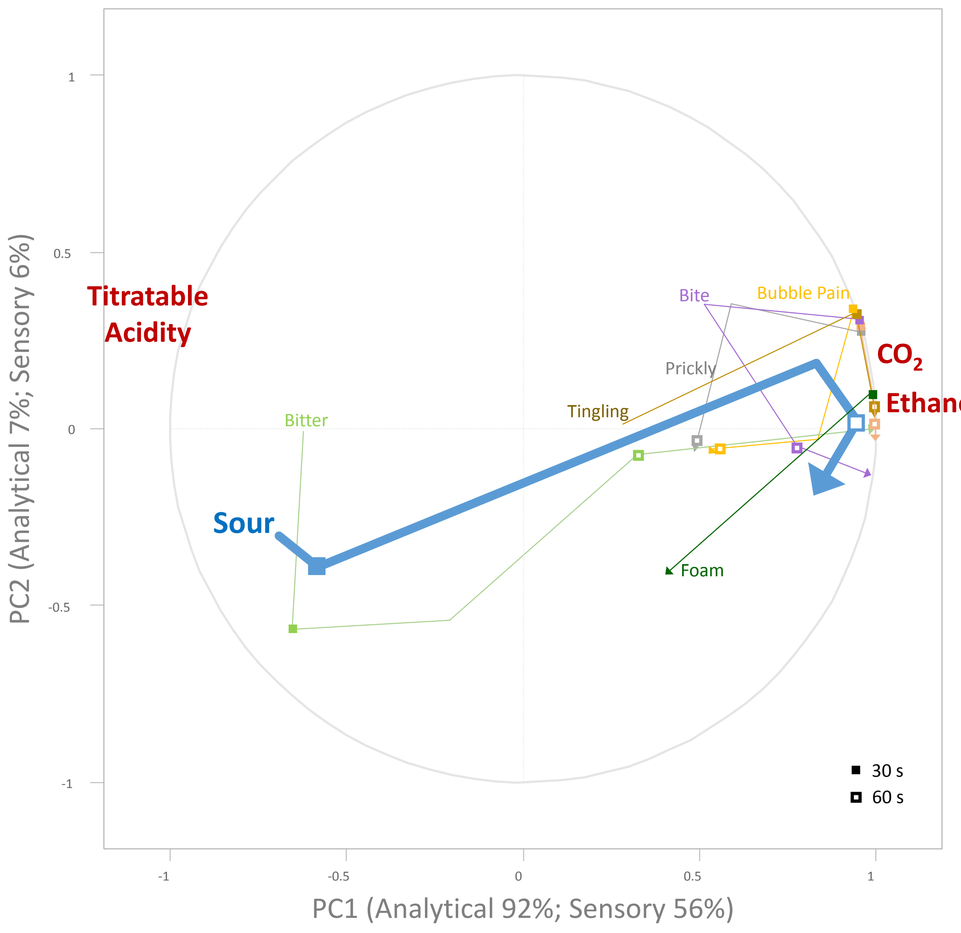


Fig. 1. Partial least square regression analysis of analytical measurements (**Titratable Acidity**, **CO_2**, and **Ethanol**) *vs.* TCATA **Citation Proportion** for 15-s intervals leading up to 15, 30, 45, 60, and 75 s.

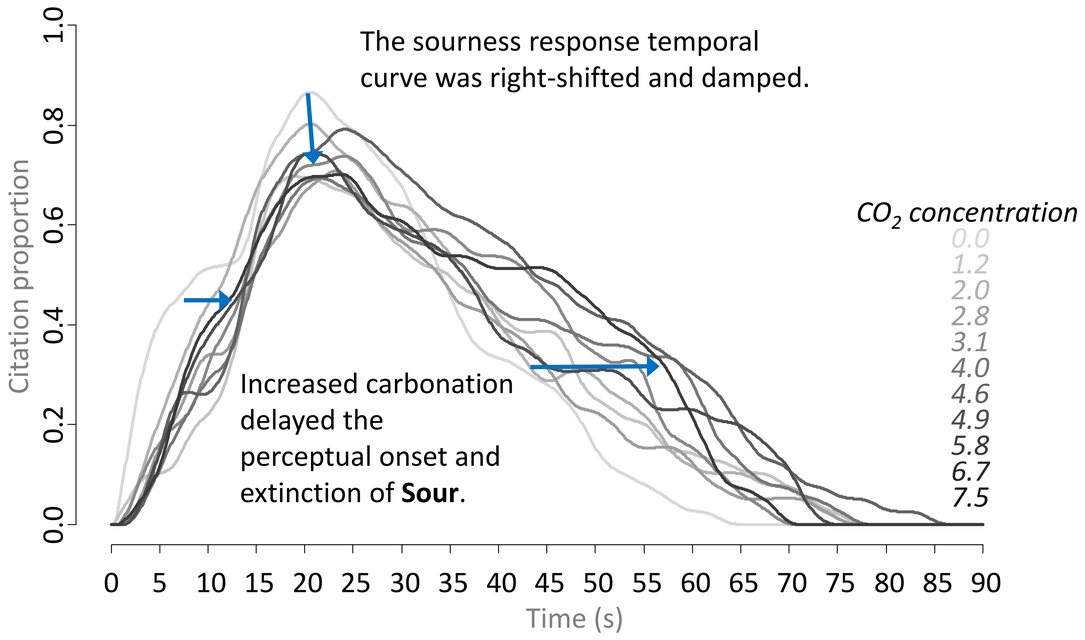
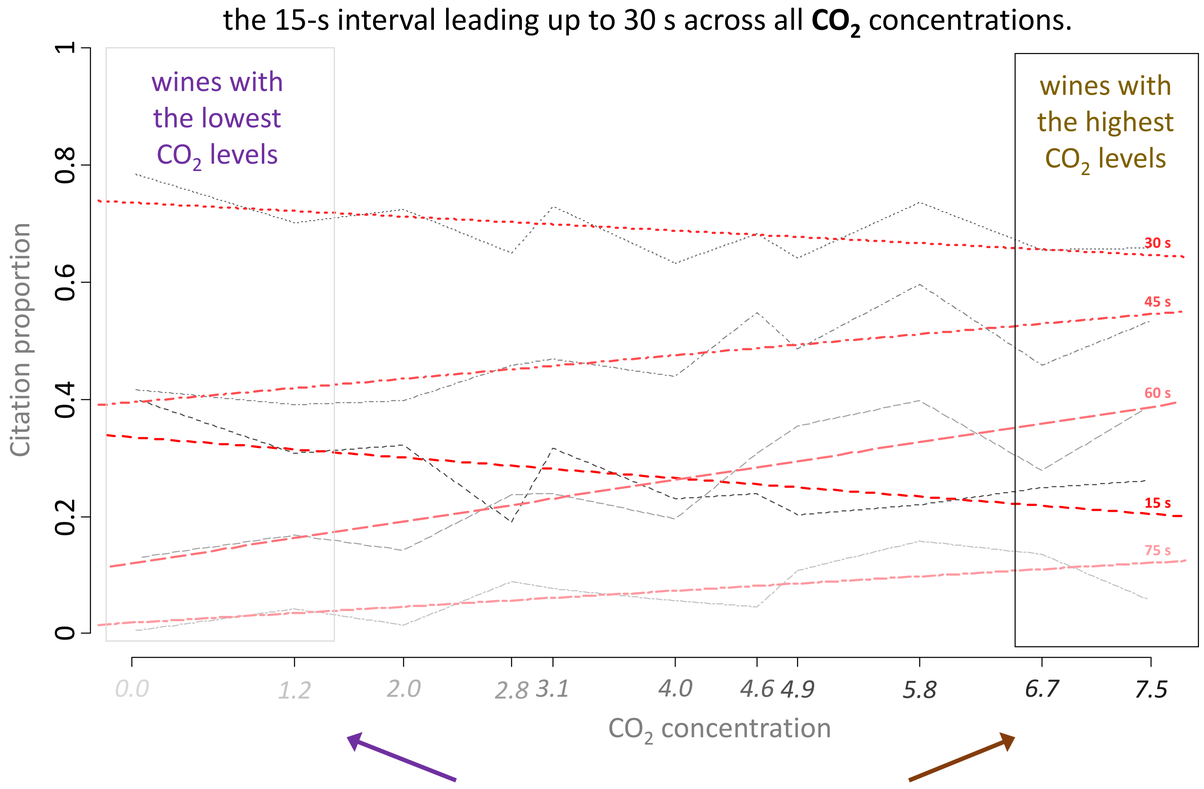


Fig. 2. TCATA curves for the attribute **Sour** for the eleven samples which varied in **CO_2** concentration.

There is a strong relationship between **Citation Proportion** and **Time**. The proportion of assessors describing the wine as **Sour** is highest in the 15-s interval leading up to 30 s across all **CO_2** concentrations.



Note there is significant interaction between **Time** and **CO_2** concentration (which is visualized here as differences in slopes). Leading up to 30 s, assessors describe low-CO_2 wines as **Sour** more often than high-CO_2 wines; thereafter the low-CO_2 wines are described as **Sour** less often than high-CO_2 wines. The **Citation Proportion** for **Sour** depends on the interaction effect between **Time** and **CO_2** concentration.

Fig. 3. Interaction plot showing cumulative TCATA **Citation Proportion** for the 15-s intervals leading up to 15, 30, 45, 60, and 75 s *vs.* **CO_2** concentration.

Results

Correlation analysis as well as various multivariate statistical techniques were applied to investigate analytical-sensory correlations. Results from partial least squares regression (PLSR2) are shown in Fig 1. The relationship between carbonation level and mouthfeel sensations related to effervescence is big and obvious, but more subtle for taste and flavour attributes (McMahon et al., 2017b). Intensities of vanilla flavour, caramel flavour, and sweet taste were correlated (McMahon et al., 2017b). In contrast to other research, sourness did not increase with carbonation concentration (McMahon et al., 2017b). Although sourness intensities of the wines were not significantly different, increased carbonation concentration affected the dynamics of sourness perception (Figs. 2, 3).

Summary

Potential explanations include **a masking or distraction effect** (e.g. dynamic effects of carbonation draw attention away from sensations that arise in other sensory modalities) or **an anaesthetizing effect** (e.g. carbonation partially reduces the ability to perceive sourness). The right-shifted curves in Fig. 2 may indicate adaptation, with perceived sourness attenuating after initial perception. Findings are relevant to product developers working on carbonated products, and suggest potential for further research for systematically investigating how carbonation level interacts with other wine components at different concentrations to affect how products are perceived in mouth.

References

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For more information, please contact jcastura@compusense.com +1 519 836 9993