Effect of carbonation level on the perception of sparkling wine

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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).

![Graph showing the effects of carbonation on sensory perception](image1)

The sours response temporal curve was right-shifted and damped.

![Graph showing TCATA curves](image2)

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 CO2 concentrations.

![Graph showing TCATA citation proportion](image3)

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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).

![Graph showing correlation analysis](image4)

Note there is significant interaction between Time and CO2 concentration (which is visualized here as differences in slopes). Leading up to 30 s, assessors describe low-CO2 wines as Sour more often than high-CO2 wines; thereafter the low-CO2 wines are described as Sour less often than high-CO2 wines. The Citation Proportion for Sour depends on the interaction effect between Time and CO2 concentration.

![Graph showing interaction plot](image5)

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 CO2 concentrations.

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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