A preliminary study on the changes to dissolved CO_2 in bottled white wine following pouring and during consumption – implications for winemakers

Introduction

Dissolved carbon dioxide (DCO_2) affects the taste and mouth-feel of still wines (Gawel et al. 2020). Winemakers know there is a 'sweet spot' of DCO_2 in their bottled wine – if DCO_2 is too low the wine can taste flat and seem to lack freshness, but the same wine can taste fizzy or almost sparkling-wine-like if the DCO_2 concentration is excessive. Winemakers therefore attempt to achieve a DCO_2 concentration in bottled wine that is consistent with the style of wine being produced. However, DCO_2 is inevitably lost by diffusion to the atmosphere during pouring, when wine is standing in the glass prior to tasting, and during the agitation that occurs during repeated tasting. This raises questions as to how much of the winemaker's intended DCO_2 reaches the consumer during a typical tasting scenario, and if it varies for different wines, which wine compositional factors affect the rate of loss. A preliminary study was conducted to answer these questions using a typical consumption scenario involving white wine.

Methods

A commercially available Chardonnay wine (13.0% v/v ethanol) was used in the study. In addition to using the wine in its original state, samples were also adjusted to assess the effect of wine matrix components on DCO_2 loss from the bottle during wine serving and consumption. The treatments chosen were higher acidity (2 g/L tartaric acid added to the base wine), higher ethanol (2 % v/v added to the base wine) and higher residual sugar (5 g/L fructose added to the base wine).

Samples of 150 mL of wine at 7°C were poured into four stemless restaurant-style wine glasses (400 mL, 100 mm height, 80 mm bowl, 60 mm opening) and left to stand at room temperature (23°C). A DCO_2 measurement was taken from the first glass immediately after pouring, using a Hach Orbisphere 3658 with a sampling port modified for in-wine-glass measurement, while the remaining three glasses had 10 mL of wine tipped out to mimic consumption. The DCO_2 in the second glass was measured at 5 minutes, and the remaining two glasses had another 10 mL tipped out. The process was repeated until the DCO_2 concentration of the fourth glass was measured at 15 minutes. The process was repeated three times for each wine, for replication purposes.

Results and discussion

Pouring from bottle to the glass decreased bottled DCO_2 concentration by an average of 0.1 g/L (or 10%) (Figure 1). DCO_2 concentration further decreased linearly with losses of between 0.10 and 0.15 g/L over the 15 minutes where the wine was standing in the glass and was being subjected to simulated consumption. Of the compositional factors investigated, only the increased ethanol concentration significantly ($P<0.05$) hastened DCO_2 loss from the glass compared with the control wine (Figure 2).

While sensory analysis was not conducted on these wines, Le Calvé et al. (2010) reported a strong CO_2-related sensory response to changes in DCO_2 concentration within the range of concentrations used in this study. Gawel et al. (2020) also found perceptible differences in spritz intensity in white wines in a similar concentration range, suggesting that DCO_2 losses due to pouring and consumption under these conditions are likely to be perceptible.

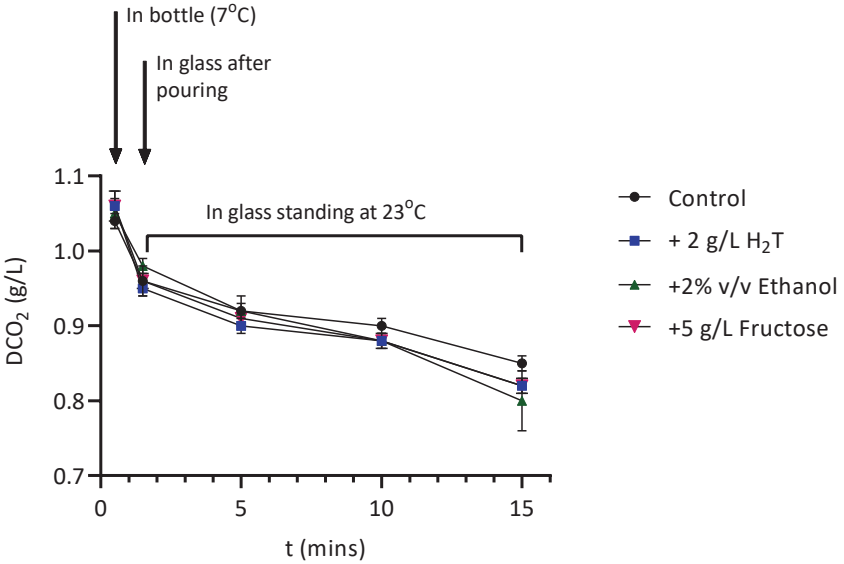

Figure 1. Dissolved CO_2 concentration of a Chardonnay control wine and three different treatments of that wine (added tartaric acid, added ethanol and added fructose), recorded in-bottle, after pouring and through simulated consumption. Error bars represent two standard errors.

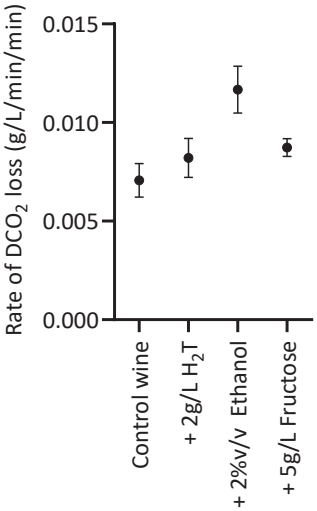

Figure 2. Rate of loss of DCO_2 from a Chardonnay control wine and three different treatments of that wine (added tartaric acid, added ethanol and added fructose), once poured into a glass and throughout standing and simulated consumption. Error bars represent two standard errors.

While further work is required to determine the spritz difference threshold of DCO_2 to clarify the sensory impact of the decrease of DCO_2 that occurs during pouring and consumption, this preliminary work suggests that winemakers should consider their protocols regarding pouring of samples and the time between pouring and assessment when making decisions at the tasting bench. The preliminary finding that DCO_2 is better retained in the wine glass in wines with lower alcohol may also influence decisions regarding DCO_2 specifications at bottling in lower-alcohol wine products.

Alex Schulkin, Scientist, *alex.schulkin@awri.com.au*
Richard Gawel, Research Scientist, *richard.gawel@awri.com.au*

References

Le Calvé, B., Goichon, H. Cayeux, I. 2010. CO_2 perception and its influence on flavour. Expr. Multidisciplin. Flav. Sci. 65: 55–58.

Gawel, R., Schulkin, A., Smith, P.A., Espinase, D. McRae, J.M. 2020. Effect of dissolved carbon dioxide on the sensory properties of still white and red wines. Aust. J. Grape Wine Res. 26: 172–179.