# CARBON DIOXIDE AND ITS SENSORY INFLUENCE

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Basic Wine

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The concentration of **dissolved carbon dioxide** ($CO_2$) can have a **major influence on the sensory perception of wine**. Attributes commonly associated with $CO_2$ in beverages include “tingling”, “prickling”, “burning”, “fizzy” and “spritzy” and it is well known that too low $CO_2$ concentrations will result in a wine tasting “flat” and lacking freshness. Typically, dissolved $CO_2$ concentrations in Sauvignon Blanc wines will range anything from 0.8 g/L to 1.8 g/L, however, the exact $CO_2$ sweet spot will depend on the **wine style**.

The concentration of dissolved $CO_2$ can be **adjusted by the winemaker** to obtain the desired sensory effect. It can be **lowered by sparging** the wine with nitrogen gas while **carbonation will increase** the dissolved $CO_2$ concentration. There are various recommendations[1,2] when sparging which will be addressed in future blog posts.

Many opinions on the effect of dissolved $CO_2$ on the perception of wines exist and researchers from The Australian Wine Research Institute conducted a formal study to elucidate the exact effects of which the results were published in a paper titled, "Effect of dissolved carbon dioxide on the sensory properties of still white and red wines"[3].

## MATERIALS AND METHODS

Two white and two red wines were used in the study[3]: Chardonnay (W1), Viognier (W2), Shiraz (R1) and Cabernet Sauvignon (R2).

In order to determine the effect of different $CO_2$ concentrations on the sensory experience of the wines, the $CO_2$ contents of the wines were **adjusted** to different levels (Table 1). Different $CO_2$ levels were obtained by either **blending** the control wine with the same **wine saturated with $CO_2$** (increase) or with the same wine which had been **entirely decarbonated** by sparging with nitrogen (decrease). The white wines' **pH values were standardised** after carbonation. No pH adjustments were needed for the red wines. After resealing the bottles, the wines were stored at 4°C for up to 48 hours prior to sensory assessment. The temperature of the white wines at the time of the sensory assessment was approximately 10°C, while the red wines were evaluated at approximately 23°C.

Table 1. The average concentration of dissolved $CO_2$ in the white and red wine treatments after $CO_2$ adjustments[3]

Average dissolved $CO_2$ concentration (g/L) of the white wine treatments

| | |
|---|---|
| High | 2.7 |
| Medium-high | 1.8 |
| Untreated (Control) | 1.0 |
| Low | 0.4 |

Average dissolved $CO_2$ concentration (g/L) of the red wine treatments

| | |
|---|---|
| High | 0.84 |
| Untreated (Control) | 0.53 |
| Low | 0.12 |

# RESULTS

## *LOSS OF $CO_2$ FROM BOTTLE TO GLASS*

A preliminary test was conducted to investigate the **change in dissolved $CO_2$** concentration when the wine is poured **from the bottle to the glass**.

Results showed that there is a **significant loss in $CO_2$** during this process. The pouring of the wine from the bottle into the glass led to dissolved $CO_2$ **decreases of up to approximately 0.5 g/L**. For the 20-minute duration after pouring, the dissolved $CO_2$ concentration in the wine **continued to decrease slowly** and resulted in the decrease of an additional (approximately and up to) 0.5 g/L dissolved $CO_2$. There were also differences in dissolved $CO_2$ concentration of poured wine (in different glasses) **from the same bottle**. This in-glass variation is likely caused by differences in the amount of agitation while pouring. These losses and differences can be significant and should be considered when conducting sensory evaluations. The sensory assessment of the current study was conducted **within two minutes** after pouring the wine to minimise the loss of dissolved $CO_2$.

## *THE EFFECT OF DISSOLVED $CO_2$ ON VARIOUS SENSORY ATTRIBUTES*

- As expected, the intensities of the attribute "**spritz**" were **significantly higher** in the treatments that contained **higher concentrations of dissolved $CO_2$** for both the white and red wines. The spritz sensation can thus be adjusted within the legally defined and commercially accepted concentration ranges for still wines.

- A significant **increase** in the intensity of "**sweetness**" was observed for the W1 treatments containing ***medium-high* to *high*** concentrations of dissolved $CO_2$ when compared to the untreated control sample and the sparged wine *(low)*. For W2, a similar increase in perceived sweetness was observed, however, the differences were marginal.
  The dissolved $CO_2$ **similarly affected the red wines** and the samples containing the **highest concentration of $CO_2$ *(high)* was perceived as being significantly sweeter** compared to samples containing the lowest concentration of dissolved $CO_2$ *(low)*.

- For the two white wines tested, the **intensity of "bitterness" decreased as dissolved $CO_2$ increased**. The perceived bitterness for both red wines also tended to be less intense when the dissolved $CO_2$ concentration was higher, although this trend was not significant.

- The intensity of "**astringency" decreased as the dissolved $CO_2$ increased**. This was mostly seen for W1, however, there seems to be a similar trend for the two red wines.

- For all four wines tested, the intensity of "**overall fruit flavour**" **was lower** (to varying degrees and significance) **in the samples that were sparged with nitrogen *(low)*** when compared to the other dissolved $CO_2$ levels. No change in attribute intensity was observed by increasing the dissolved $CO_2$ compared to the control sample. The lower intensity of "overall fruit flavour" in the *low* samples could indicate that the delivery of odorants to the olfactory epithelium was handicapped due to the lack of dissolved $CO_2$[4,5].

- Interestingly, the perception of **"acidity" was not significantly affected by the dissolved $CO_2$** concentration of the samples. Keep in mind the pH values of the white wines were standardised after carbonation. An increase in perceived acidity is often observed in carbonated water and is likely due to the formation of carbonic acid species under normal atmospheric conditions producing a slightly acidic solution (pH 5.7)[6]. In a more wine-like system, such as an aqueous solution containing organic acids, dissolved $CO_2$ either had no effect[7] or it suppressed perceived acidity[8,9]. This effect may be explained by the predominance (>98%) of $CO_2$ over carbonic acid at wine pH[6].

- **Dissolved $CO_2$ did not affect perceived viscosity** of any of the wines.

## CONCLUSION

The results reported in this study[3] shows that the concentration of **dissolved $CO_2$ can significantly and directly affect the sensory perception** of both white and red wines. The **increase in perceived sweetness and the decrease in perceived bitterness due to higher dissolved $CO_2$ concentrations** in wine could change the way we look at carbonation/sparging especially for still wines which contain sub-saturated levels of dissolved $CO_2$.

Some of these results differ when compared to similar studies conducted in $CO_2$ saturated samples. Keep in mind that this study was performed to investigate the effect of dissolved $CO_2$ on **still wines** (lower dissolved $CO_2$ range), and **not sparkling wines** (saturated dissolved $CO_2$).

The sensory interactive effects and the way the tasters perceive the wine as a whole should also be considered. For example, if a beverage tastes sweeter, it tends to also taste less bitter. However, the **physiological mechanisms underlying dissolved $CO_2$ induced reduction in bitterness and increase in sweetness still needs further investigation**[3].

DISCLAIMER

Some contradicting results were reported in the study[3]. I decided to rely on the interpretation of the results by the authors (as specified in the text) and assumed an error in one of the figures.

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