How polyphenols can influence the aroma of Sauvignon blanc wines

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Wines contain thousands of molecules, some **volatile** (aromatic) and some **non-volatile** (non-aromatic). Research often focuses on the interactive effects of aromatic molecules and their impact on the overall sensorial perception of the wine. However, wines also contain an array of non-volatile compounds such as **polyphenolic compounds whose effect on aromatic sensory perception has not been well studied.**

Polyphenols are large molecules (molecular weights over 300-400 Da) that do not have the capacity to reach the olfactory receptors in the human nose[1] and are therefore **not perceived by the olfactory system**. Due to this property, there has been very little sensory research examining the role of white

wine polyphenolic compounds on the perception of wine aroma. Most of the sensory research of wine polyphenolic compounds has focussed on the perception of mouthfeel and taste.

In a study[2] published in 2009, the effect of polyphenols on the sensory perception of key aroma compounds from Sauvignon blanc wines was investigated. The **main findings from this study will be reported in this blog post** and could assist winemakers in managing polyphenol levels to achieve desirable aroma profiles.

Materials and Methods

A dry white wine was diluted by 50% to create a dilute base wine. Selected aroma compounds and polyphenols were added to this diluted base wine to reach the reported concentrations before being presented to a trained sensory panel for evaluation.

The aroma compounds (varying concentrations) included in this study were:

- Methoxypyrazine: **Isobutyl methoxypyrazine (IBMP)** – described as 'green capsicum'
- Volatile thiol: **3-mercaptohexanol (3MH)** – described as 'passion fruit skin/stalk'
- Volatile thiol: **3-mercaptohexyl acetate (3MHA)** – described as 'sweet sweaty passion fruit'

The above aroma compounds were combined with three polyphenols at realistic wine concentrations:

- **Catechin** (12 mg/L)
- **Caffeic acid** (102 mg/L)
- **Quercitin** (10 mg/L)

Fifteen sensory-trained panellists experienced in tasting Sauvignon blanc evaluated the wines. Samples were prepared 1 hour prior to the tasting and served at room temperature (20°C). Panellists evaluated the wines orthonasally in a specified randomised order. The panellists were not given any information regarding the contents of the sample. The study was performed using the R-index difference test methodology[3].

The panel had to **indicate in a pair wise comparison whether two samples differed**. The control sample was a sample containing only the polyphenol in question while no volatile compounds were present. This sample was then compared to a sample containing both the polyphenol as well as the aromatic compound at a specific concentration. The panellists were asked whether the pairs were the "same" or "different".

Results - Polyphenols effects on IBMP

- In the absence of a polyphenol, **17 ng/L of IBMP** had to be added to the base wine for the judges to note a difference compared to a sample **devoid of both polyphenols and IBMP**.

- As soon as **catechin** or **caffeic acid** was added, the **IBMP concentration had to be increased to a whopping 175 ng/L** for the judges to report a difference in aroma perception when compared to the sample containing only the phenolic compounds.

- The addition of **quercetin** had no or little effect.

The aromatic perception of IBMP was suppressed by the presence of either catechin or caffeic acid and to a lesser extent by quercitin. The exact mechanism by which non-volatile polyphenols suppress the perception of IBMP is unknown. One suggestion is that the large number of -OH groups on these polyphenols may form reasonably strong, although temporary, non-covalent bonds with the methoxypyrazines, thus decreasing its volatility.

These findings raise questions regarding the **perceived green aromas** in wine. Methoxypyrazines are usually present in South African Sauvignon Blanc wines in the range of 0-40 ng/L and all wines contain polyphenols (varying concentrations). **If, as the findings of this study would suggest, the polyphenols have a powerful suppressive effect on IBMP, how come we are still able to perceive the green aromatics in most wines?** The high IBMP concentration needed for the judges to perceive differences when the polyphenols are present raises the question of whether **the methoxypyrazines alone are responsible for perceived green aromas**. Studies have reported the contribution of other compounds to green aromas and the topic warrants further investigation[4].

Results - Polyphenols effects on 3MH

The perception of 3MH-related aroma was affected to different degrees by the addition of polyphenols.

- Compared to a sample that did not have any phenolic compounds or 3MH added, the **concentration of 3MH had to be increased to 1750 ng/L** for the panel to report a difference between the two samples.

- By adding 10 mg/L **catechin**, the **3MH concentration had to be increased to 3000 ng/L** before a difference was observed when compared to a sample containing catechin only.

- When 10 mg/L of **quercitin** was added, an **even stronger suppression effect was observed**, where the **3MH required an increase to 5000 ng/L** before any difference was perceived compared to a sample containing quercitin only.

The increases in 3MH concentration needed for the panellists to report a difference in samples containing catechin and quercitin would suggest that the **polyphenols are interacting with the aroma compound influencing the way in which the aroma was perceived.**

- Adding **caffeic acid showed the opposite effect** as to what was observed with catechin and quercetin. In the presence of caffeic acid, the **3MH had to be increased to 1500 ng/L** before the panellists reported a difference compared to a sample containing caffeic acid only. Note that this value is **lower than when no polyphenols were present**. This result suggests that caffeic acid may suppress other aroma compounds in the diluted base wine that initially masked the aroma associated with 3MH.

Polyphenol effects on 3MHA

The aroma perception of 3MHA was the **least affected by added polyphenols** in comparison with other aroma compounds tested in this study.

- In the absence of polyphenols, the **3MHA concentration had to be increased to 200 ng/L** for the panellists to report a sensory difference compared to a sample devoid of polyphenols as well as 3MHA.

- In the presence of **caffeic acid**, the **3MHA concentration had to be increased to 200 ng/L** for the panellists to report a sensory difference when compared to a sample containing caffeic acid only.

- In the presence of **quercitin**, the **3MHA concentration had to be increased to 200 ng/L** for the panellists to report a sensory difference when compared to a sample containing quercitin only.

- In the presence of **catechin**, the **3MHA concentration had to be increased to 150 ng/L** for the panellists to report a sensory difference when compared to a sample containing catechin only. Note that this value is lower than when no polyphenols were present.

3MHA was only slightly affected by the addition of polyphenols. The reason for this observation could be that the structure of 3MHA differs from 3MH in that the -OH has been esterified with acetic acid making the ester less likely to interact with the polyphenol.

Conclusion

The study was designed to investigate the **effects of polyphenols on aroma perception** of three important Sauvignon blanc aroma compounds. Results showed **each polyphenol had a unique effect** when blended with a specific aroma compound, either suppressing, accentuating or showing little effect.

The perception of **IBMP and 3MH was largely suppressed by the added polyphenols**. IBMP had the most severe suppression effects with catechin and caffeic acid additions, and, to a lesser extent, quercitin additions. There was some suppression of 3MH by the addition of catechin and quercitin and some accentuating effects on the perception of 3MH with caffeic acid additions. Conversely, the perception of **3MHA-related aromas was minimally suppressed** when polyphenols were added and the aroma was even accentuated with the addition of catechin.

This study highlights the **importance of wine composition on the perception of aroma compounds**. **A high concentration of a specific aroma compound does not necessarily relate to increased aromatic intensity. Other factors, such as the presence of non-volatile compounds, might play a more important role than what is popularly believed.** Therefore, two different wines might have the same 3MH concentration but have completely different 3MH-aroma intensities due to the interacting effects of other volatile **and non-volatile** compounds present. To complicate matters even further, each of the **polyphenols interacted uniquely** with each specific aroma compound. Of the three polyphenols, catechin showed the greatest suppression effect on the aroma compounds but had a slight accentuating effect on 3MHA perception.

3MHA is a key flavour contributor to Sauvignon blanc wines and was only slightly affected by the addition of the three polyphenols tested in this study. **The lack of suppression by the polyphenols and the higher concentration of 3MHA in some Sauvignon blanc wines demonstrates the crucial role 3MHA plays in the flavour of Sauvignon blanc.**

The suppression effects of polyphenols are important for the perceived aromas of Sauvignon Blanc wines, especially from countries where the natural thiol levels are not exceptionally high. For wines containing higher than average thiol levels, these suppression effects might be slight or insignificant, while the effects can be important at lower average thiol concentrations.

References

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