Technical notes

Glycosides contribute to in-mouth flavour release

Introduction

Are naturally occurring aroma glycosides a previously overlooked source of flavour in wine? Could glycosides be the key to the pleasant and complex flavours that develop and then linger for minutes after tasting a great wine? Research is underway at the AWRI to find out.

Aroma glycosides consist of a volatile molecule joined to a sugar molecule, such as glucose or a disaccharide. The presence of the sugar stops the aroma molecule from being volatile, which means that the glycoside itself has no aroma. Many of the most important varietal compounds in grapes and wine are present as glycosides, which are often found in much higher concentrations than the free volatile form (Baumes 2009). The bond joining the aroma molecule to the sugar can be broken during winemaking through the action of yeast or bacterial enzymes, during ageing in bottle, and by the action of acid in the wine over time. Once the bond is broken the volatile aroma compound is released and can potentially be perceived. An interesting question is whether this release of the aroma compound could potentially occur in the mouth of a consumer during the consumption of wine. Some previously published work has suggested that this might be possible.

The perception of aromas in-mouth during eating or drinking (known as 'retronasal' aroma) is a very complex effect. The amount and type of volatiles that reach the olfactory bulb during eating or drinking depend on the volatile compounds present, aroma-receptor response and also the highly variable biological factors of saliva composition (including saliva pH, enzymes and bacteria), saliva flow-rate, temperature in-mouth, and factors like breathing, swallowing and mouth movements during consumption.

Examples of flavours being released in-mouth

One study showed that non-volatile sulfur compounds in onions can breakdown in-mouth, giving rise to perceptible flavour and contributing to lingering oniony flavour. Another study by the same research group demonstrated that the precursor cysteinyl 3-mercapotohexanol, tasted in water at a high concentration of 1 mg/L, was broken down during tasting to give rise to the distinctive passionfruit flavour of 3-mercaptohexanol, which is an important compound in Sauvignon Blanc (Starkenmann et al. 2008). However, the concentration used was ten times higher than the concentration usually found in wine.

The AWRI has previously investigated smoke taint phenol glycosides (Mayr et al. 2014, Parker et al. 2012). The surprising results from these studies showed that human saliva was able to release the volatile smoky- and medicinal-smelling volatile phenols from their glycosides. Furthermore, this release brought about a clear sensory effect when presented to sensory panellists in model wine, creating a strong flavour within 30 seconds and lingering for as long as 15 minutes in sensitive individuals.

As part of a new AGWA-funded project at the AWRI, naturally occurring aroma glycosides have been isolated from wine and grape juice, characterised and assessed in a formal sensory study.

Proof-of-concept sensory study

A set of purified glycoside extracts from a range of wines, including Chardonnay, Shiraz and Gewürztraminer were first included in a proof-of-concept tasting. Eight panellists were chosen from AWRI staff who were highly experienced in wine sensory assessment, including five that were known to be good at perceiving flavour from smoke taint glycosides. Samples were assessed in water at approximately the concentration they would be found in wine. The Chardonnay samples showed negligible flavour, with the Shiraz also being very weak in flavour but strongly bitter. The Gewürztraminer extracts were found to have the most noticeable flavour, with six out of eight panellists detecting various levels of flavour. These panellists described a strong floral-like character which developed after expectorating.

Time-intensity sensory analysis

So glycosides can give rise to flavour in the mouth when tasted in water, but is this a significant effect when tasted in a realistic wine-like system? This question was tested in a time intensity sensory study using purified Gewürztraminer wine and juice glycosides. The time intensity sensory methodology requires panellists to continuously rate the intensity of an attribute over a defined period of time, giving a picture of how long a flavour lasts as well as its maximum intensity.

Gewürztraminer was found to be the most promising variety from the proof-of-concept study due to its high levels of monoterpene glycosides and its lack of a significant bitter component that might overwhelm any fruity or floral retronasal character. Glycosides were extracted from Gewürztraminer juice and wine and spiked into a model wine at a concentration five times greater than occurs naturally. In addition, the pure glycoside, geranyl β-D-glucoside, synthesised at the AWRI was also included in the study. The model wine used was 11% v/v alcohol at pH 3.50.

A sensory panel continuously rated the intensity of 'overall fruit' flavour (defined as floral, stone fruit, confectionary and citrus) from the time the sample was placed in the mouth until two minutes had elapsed. As shown in Figure 1, there was clearly perceptible fruit flavour for each of the glycosides studied. The juice glycosides gave the highest maximum intensity, following a delay in initial onset of flavour, and had the longest aftertaste. This was not surprising given that aroma glycosides are known to be present in juice in significantly higher concentrations than are found in a finished wine. The pure geranyl glucoside sample had a more rapid increase in flavour. The overall magnitude of the effect was similar for the wine glycosides, the juice glycosides and the geranyl glucoside.

Overall, the results of this time intensity study give strong evidence that clear perceptible flavour is generated in-mouth from glycosides. The results indicate that the pool of glycosides in a wine can enhance both the intensity of flavour and the length of flavour. This outcome is of great interest, showing that even during the short period a wine is present in the mouth cavity there is sufficient time for breakdown of glycosides to occur.

Further research will determine whether in the presence of free volatile aroma compounds there is in fact an enhancement of flavour due to the release of aroma compounds from the glycosides, or whether the amount of flavour released from glycosides is relatively minor compared to that contributed by the free volatiles.

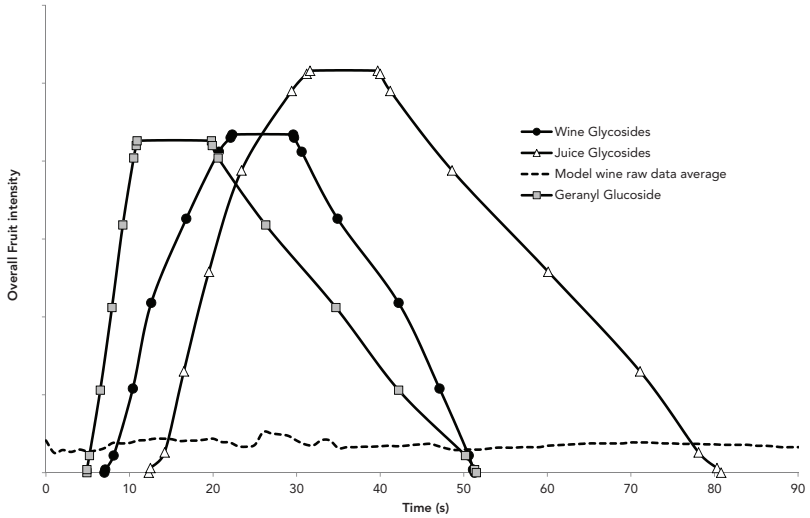

Figure 1. Mean time intensity curves for 'overall fruit' flavour intensity, generated by extracting parameters from individual raw data curves from 11 judges x 3 replicates for the three samples with added glycosides assessed in model wine.

Glycoside levels in commercial wines

To provide a context for the sensory results, a small survey of glycosides in Australasian Riesling and Gewürztraminer wines was conducted. Sixteen young (2013 and 2014) Riesling wines and fifteen Gewürztraminer wines (2010–2014) from Australia and New Zealand were selected, with a range of price points and regions. The wines were analysed for both total glycosides and glucosides (the subset of glycosides where the sugar component is glucose) of monoterpenes and 2-phenylethanol (compounds responsible for floral and fruity aromas). The box-plots in Figure 2 show the median (the middle line) and the range where 50% of the data occurs (the box), with the whiskers corresponding to the lowest and highest values within a range limit.

For the Rieslings (Figure 2a), the concentration of the monoterpene glycosides was relatively low, and possibly below the concentration needed to have a sensory effect. The Gewürztraminers (Figure 2b) were up to ten times richer in monoterpene glycosides, while the concentration of the 2-phenylethanol glycosides was similar for the two varieties. With the lower concentration of monoterpene glycosides observed in the Riesling wines, it is not clear whether there might be a sensory effect for this variety, or if the breakdown of glycosides in-mouth is only relevant for highly floral varieties such as Gewürztraminer. Further sensory studies are planned to answer this question.

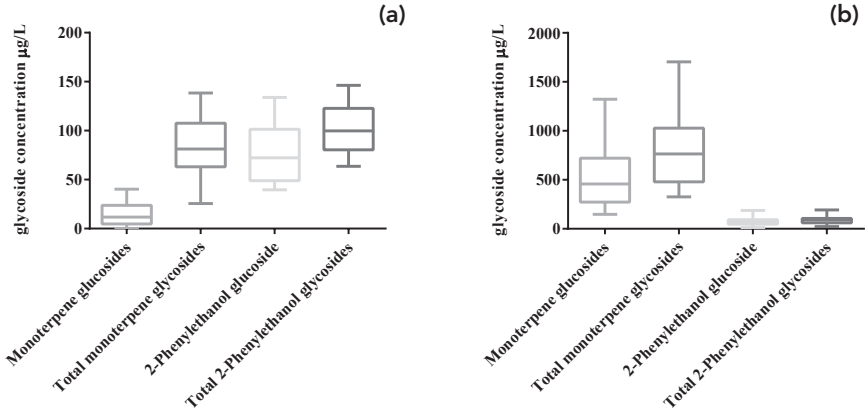

Figure 2. Box-plot showing the distribution of total glycosides and glucosides quantified in (a) sixteen Riesling wines, and (b) fifteen Gewürztraminer wines.

Summary

This work has shown for the first time that glycosides of monoterpene flavour compounds can contribute substantial flavour in-mouth during wine tasting, and that the flavour effect can be very persistent. The concentration of these compounds is relatively high in many of the young Gewürztraminer wines surveyed, and planned research studies will make clearer whether this source of flavour is important for other varieties. It is possible that increasing the levels of glycosides in wines through viticulture or winemaking practices could be an important means of intensifying wine flavour and persistence. This AWRI project will continue to shed new light on this fascinating area of wine flavour.

Acknowledgement

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Mango Parker, Scientist, *mango.parker@awri.com.au*
Cory Black, Research Scientist
Wes Pearson, Sensory Scientist
Alice Barker, Technical Officer – Sensory Analyst
Leigh Francis, Research Manager – Sensory and Flavour
Markus Herderich, Group Manager – Research