The science of texture

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Astringency, viscosity, oiliness, hotness and bitterness: these 'textures' influence white wine consumers and contribute to wine style. But what makes a wine 'textural'? Phenolics, acidity and alcohol play important roles, but how? To find out, researchers at the AWRI measured their effect on white wine texture and analysed interactions between them. A major finding was that some phenolics reduce rather than increase astringency and hotness of white wine.

UNDERSTANDING PHENOLICS

The great white wines of the world are in some way 'textural'. Outstanding barrel fermented Chardonnay wines are defined by a creamy in-mouth texture; Pinot Gris and Viognier by their oily character. Others produce a refreshing drying sensation that works well with food.

In the early 2000s, scientists at the AWRI collaborated with The University of Adelaide to focus on texture. They recognised its importance and pioneered new sensory methods to evaluate textural characters in red and white wines.

For more than 40 years, researchers have known that phenolics play a role in producing these characters. Many winemakers have tried to reduce phenolic concentrations by using juice extraction or fining techniques, believing that phenolics undermine varietal characters, lead to premature oxidation, and create 'coarseness'.

Other winemakers are more open to phenolics, using them to create complex, textural wines that complement food. According to Mark Lloyd, a long-time exponent of Italian varieties in Australia, this has caused disagreement in the context of one variety, Fiano: "There is an inherent conflict between the phenolic or 'pithy' character of the wine which is, on the one hand, the basis of its individuality and, yet, can be seen as a fault in contemporary winemaking circles" (Lloyd 2010).

It is not unusual for producers of other Italian, Spanish and Greek white varietals to use higher phenolic levels to create texture and complexity at lower alcohol levels. Today, a number of these varieties are being planted in Australia.

Some argue that texture defines a 'typical' varietal as much as aroma and flavour. A 'typical' Viognier offers 'peach' and 'apricot', but other varieties can also display these flavours. A 'typical' Viognier is also characterised by a rich, oily mouthfeel.

Similarly, palate texture can define style variations, with Pinot Grigio/Gris as a good example. The Italian approach to the variety is to harvest earlier, producing subtle flavour, light body and crisp acidity. The Alsatian approach uses riper grapes; it also uses fermenting juices containing solids, often following skin contact. This results in more aromatic styles characterised by higher alcohol content, richer flavours and a full, oily texture. It is thought that higher phenolics – from later harvesting and greater maceration – contribute to the oily textures characteristic of 'Alsatian style'.

Different types of phenolics are found in different parts of the white grape. The most abundant is caftaric acid, one of the hydroxycinnamic acids and partly responsible for white wine colour. Juice expressed from pulp is rich in these acids.

Pulp juice also contains benzoic acids: gallic is the most important. Flavonol glycosides are found exclusively in the skins. Like red grapes, white skins and seeds are

AT A GLANCE

- managing and creating 'texture' can help to create outstanding white wines
- astringency, hotness, oiliness, viscosity and bitterness are key textural characters
- phenolic compounds influence texture - but how strongly depends on pH and alcohol concentration
- measuring total phenolics can be a 'blunt instrument', as their effects are not simply additive – some phenolic compounds reduce phenolic characters produced by others
- acidity, alcohol and other parts of the 'wine matrix' also directly impact on texture, particularly in the production of astringency, hotness and viscosity.

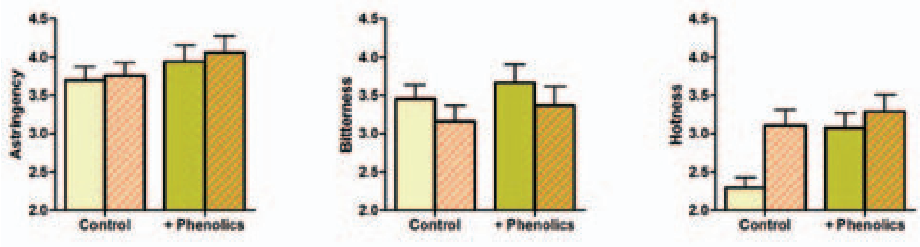

Figure 1. Tastes and textures of a Riesling wine, with and without added phenolics and 1.3% alcohol (striped bar).

a major source of flavanols such as catechin and epicatechin. Two other important phenolics are tyrosol – produced by yeast during fermentation – and grape reaction product (GRP) created from the oxidation of caftaric acids.

'COARSE' OR 'TEXTURED'?

The distinction between 'texture' and 'coarseness' is ill-defined. To better understand the science behind textural characters, researchers at the AWRI undertook a series of studies. Texture profiles were correlated with phenolic composition. The role of pH and alcohol on perception of 'phenolic' characters was also explored. The aim was to identify the compounds responsible for particular phenolic characters and determine the effect of juice extraction practices. The AWRI's priority was to help winemakers make informed decisions about their management of phenolics to achieve desired wine styles.

PHENOLICS AND TEXTURE

In white wine, the source of some textural characteristics remains a mystery. Hotness has been attributed to alcohol content; bitterness and astringency to phenolics. The sources of viscosity, oiliness and 'coarseness' remain unknown.

What is known is that these characters are likely to be of phenolic origin: the AWRI conducted two experiments to find out more. In the first, the AWRI collected phenolic compounds from a Clare Valley Riesling – chosen for its relatively low alcohol (11.4%v/v) and moderate phenolic content.

From other studies, it was established that wines made from hard pressings had around 30% more phenolics than wines made from free run juice. So, researchers added 30% more phenolics back to the same Riesling to make a higher phenolic wine in line with normal winemaking practices. Ethanol at 1.3%v/v was also added to some samples.

A trained tasting panel then rated the astringency, bitterness and hotness of the wines, with and without phenolics, and with and without added alcohol.

Adding 30% more phenolics produced slightly more astringent and bitter wines at low and high alcohol levels (Figure 1). Surprisingly, the phenolics also had a significant effect on hotness. At low alcohol levels, adding phenolics made the wine taste significantly hotter. At higher alcohol levels the wine also tasted hotter, but the effect was smaller. Here, it is important to note that phenolic hotness might be experienced differently to alcohol hotness. Phenolic hotness tastes more pungent and is felt at the back of the throat, whereas alcoholic hotness is experienced throughout the mouth. Regardless of such differences, higher phenolic wines were perceived to be hotter, particularly when alcohol levels were lower.

In a second study, researchers at the AWRI added phenolics from three different varieties to two different base wines at two alcohol levels. The phenolics were extracted from Australian Viognier, Fiano and an Alsatian Gewurztraminer. They were added to a Clare Valley Riesling (12.5%v/v) and a McLaren Vale unwooded Chardonnay (13.7%).

This time, researchers found that alcohol levels played a bigger role. Adding phenolics increased the hotness of the lower alcohol Riesling wine, but not the higher alcohol Chardonnay wine (Figure 2, see page 32).

Perceived viscosity was also analysed. It was found that all three phenolic extracts increased perceived viscosity of the Chardonnay and Riesling base wines (Figure 3, see page 32, shows the effect averaged across the three phenolic types).

In the higher alcohol Chardonnay (Chardonnay wine +1% added alcohol), adding phenolics did not affect viscosity, however. This showed that phenolics might have a limited impact on texture in higher alcohol wines. ►

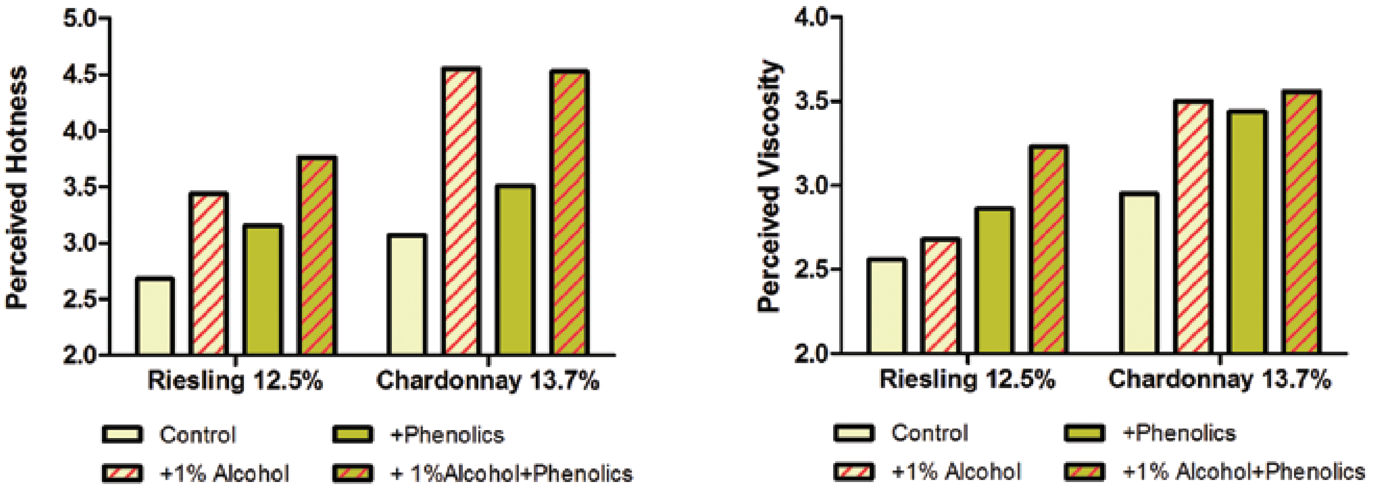

Figure 2. Perceived hotness and viscosity of Riesling and Chardonnay wines to which 1% alcohol was added (striped bar), and phenolics added (average of the ratings after adding phenolics from three different wine varieties).

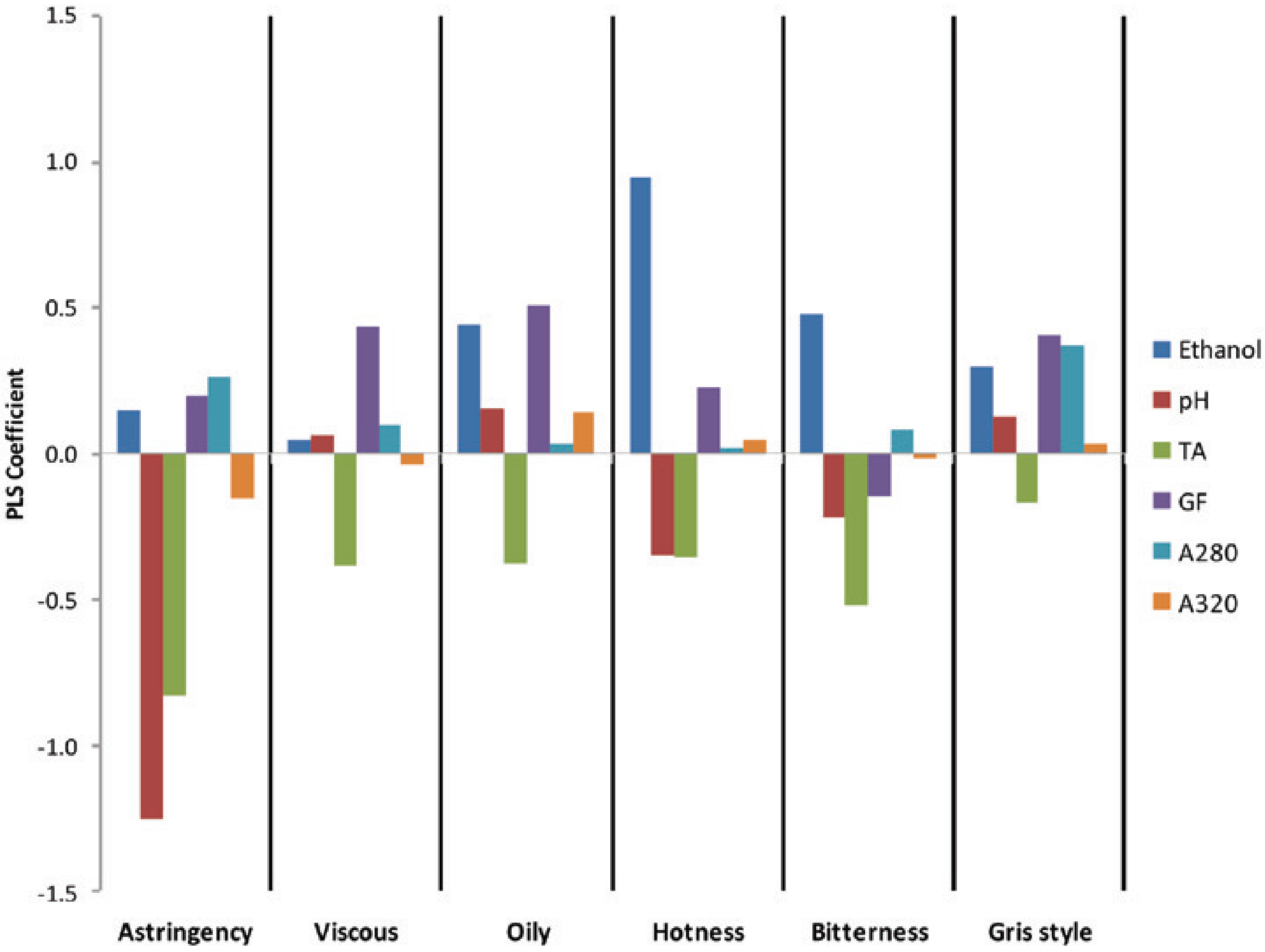

Figure 3. Sensory and style ratings modelled on wine composition including phenolics. Bars above 0 represent a positive relationship and those below a negative relationship. TA=titratable acidity, GF= glucose + fructose. A280 equates to total phenolics, and A320 equates to total hydroxycinnamates.

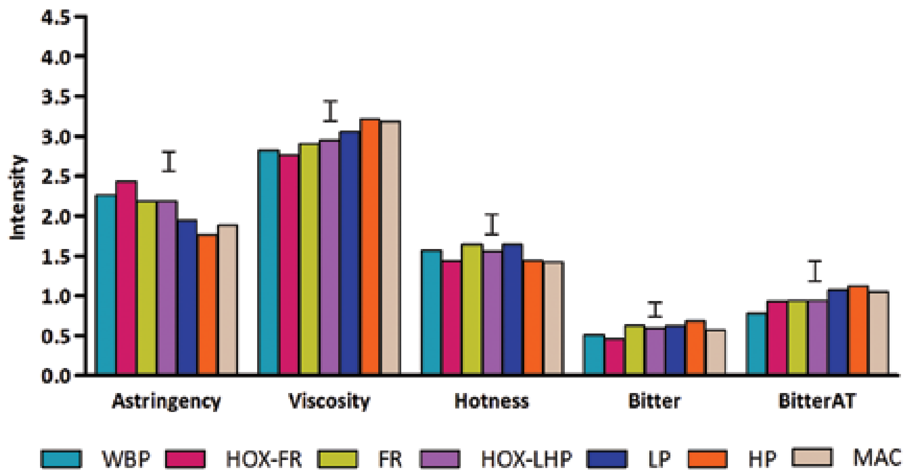

Figure 4. Texture ratings resulting from different juice extraction and handling processes averaged across three varieties. Treatments are ordered from lowest to highest total phenolics. AT=aftertaste.

PHENOLICS AND STYLE PERCEPTION

The AWRI's next study analysed phenolics and the wine 'matrix' (alcohol, pH, acidity and residual sugar) to correlate tastes and textures with the composition of finished wines.

For this study, a range of Pinot Gris/Grigio wines including higher alcohol, lower acidity wines ('Gris' like), and lower alcohol, higher acidity wines ('Grigio' like) were used. Tasters had five to 25 years' experience – many were winemakers.

It was found that pH and alcohol play a major role in the perception of tastes and textures normally associated with phenolics.

Higher pH wines were generally less astringent, and wines higher in titratable acidity were generally less viscous and oily. In these wines, bitterness was driven mainly by matrix elements, with alcohol adding to it and acidity masking it. Phenolic content was far less important in the perception of bitterness. Given that ethanol has a bitter component, and basic tastes such as acidity and bitterness mutually suppress each other, these results are not surprising.

Even though 'dry' wine styles were used, low levels of residual sugar were still associated with viscosity and oiliness. The patterns of viscosity and oiliness were almost identical, except that the more 'oily' wines generally contained higher alcohol. This suggested that alcohol contributed to palate oiliness but not, necessarily, to viscosity.

When considering each character individually, phenolics appeared to have less influence than alcohol, acidity or residual sugar. But when it came to differentiating 'Pinot G' wines, total phenolics were significant, contributing positively to overall perception of 'Pinot G' wine style.

THE EFFECTS OF JUICE EXTRACTION AND HANDLING ON TEXTURE

Winemakers can use juice extraction and handling methods to manage phenolics. Pressing whole bunches can produce low phenolic juices; adding pressings or contacting with skins before fermentation can produce higher phenolic juices with greater flavour intensity.

Winemakers can reduce phenolics by fining or by hyperoxidising the juice prior to fermentation. To assess the effect of winemaking on 'phenolic' character, the AWRI produced duplicate ferments of Eden Valley Riesling, Barossa Valley floor Chardonnay and Adelaide Hills Viognier wines.

Juices were used that were whole bunch pressed (WBP); hyperoxidised free run and pressings (HOX-FR, HOX-LHP); free run (FR); lightly pressed (LP); heavily pressed (HP) and extensively skin contacted (MAC). A trained tasting panel then profiled their textures (Figure 4).

The winemaking methods that produced higher phenolics resulted in greater bitterness. The idea that higher phenolics always result in greater bitterness requires re-assessment, however. It was found that bitterness and higher phenolic levels were not always connected: a more likely explanation for bitter characters was one group of phenolic compounds – the flavonones and flavonols.

Measuring total phenolics is not

always helpful, therefore. It can be a 'blunt instrument'.

Similarly, higher phenolic wines seemed less astringent and more viscous, but the analysis showed that pH is also a major factor. Winemaking techniques that result in greater skin maceration, such as hard pressings or skin contact, tend to be naturally higher in pH.

In the wines made for this study, 75% of the variation in astringency, and 66% of the variation in viscosity could be attributed to pH differences. Lower pH was associated with higher astringency and higher pH with greater viscosity.

DO ALL PHENOLIC COMPOUNDS CONTRIBUTE TO PHENOLIC CHARACTERS?

The answer is a resounding 'no'. Surprisingly, the final research study showed that some of the major phenolic compounds found in the pulp of white grapes might even reduce 'phenolic' textures.

Purified caftaric acid and GRP isolated from real white wines were added to a model wine (comprising water, alcohol and tartaric acid). Adding GRP reduced overall astringency; it also contributed to an increase in the pungent aftertaste – though adding caftaric acid negated the aftertaste effect.

Lastly, GRP contributed to oily texture. Interestingly, these two major phenolic compounds in white wine - caftaric acid from the pulp and GRP formed during oxidative handling of juice – did not significantly affect bitterness.

The AWRI's work on the wines from the Barossa, Eden Valley and Adelaide Hills demonstrates that phenolics contribute to bitterness, but this final study showed that some of the major white phenolic compounds are not responsible. Instead, they may reduce other textures arising from alcohol and acidity. Their contribution to textures such as astringency, pungency and oiliness is not as great as might be expected.

Further details of this work can be found at:

http://www.gwrdc.com.au/wp-content/uploads/2012/09/AWR-0901-FINAL-REPORT.pdf

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