# Exploring potential for grape objective measures to predict wine grade and style

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***Grape composition is a primary determinant of the wine style achieved following winemaking yet, in Australia, grape assessment is largely subjective. A recent study at the AWRI investigated the use of objective chemical and spectral measures to predict existing subjective grape grading allocations. Both chemical and spectral analytical approaches were shown to be useful for grape grade prediction. This work was then extended to assess the possibility of predicting wine grade and/or style from grape analysis, with results showing that grape compositional measures have potential to be used to support decisions about streaming fruit to wine styles or grades. A new project, focussing on Shiraz, has recently been launched to investigate applying this knowledge through collaborations with a large wine producer in South Australia.***

## PREDICTING GRAPE GRADE USING CHEMICAL ANALYSIS OR SPECTRAL DATA

In Australia, the grade of grapes is currently assessed in a number of ways including vineyard assessments of vine condition, grape taste or disease presence; assessment of eventual wine quality; and/or through simple chemical measures such as colour, Brix, pH or TA. This project aimed to find out if existing subjective grading allocations could be predicted using objective chemical or spectral measures. A further aim was to assess the practical application of grape compositional grading measurements and to support wine producers who intend to apply these measures in their systems. Increased adoption of objective grading measures has potential to improve the transparency of relationships between growers and grape purchasers, to reduce labour costs and to increase value by ensuring fruit is used in the most appropriate production stream.

Cabernet Sauvignon, Shiraz and Chardonnay grapes from a range of quality grades were sourced from multiple regions across Australia. A wide range of chemical analyses were performed to determine the concentration of compounds known to affect wine style and key sensory properties. Juice and grape homogenate samples were also analysed spectrally in the UV-vis, NIR and MIR regions. The grading data for the grapes were supplied by the grower or the winery that made wine from those grapes.

## IDENTIFYING THE MOST IMPORTANT COMPOUNDS FOR PREDICTING GRAPE GRADE

Statistical models were developed to predict the grade of the fruit samples. A range of statistical techniques were trialled and overall the models were very successful, able to classify samples correctly to a high degree (85-100 percent). Further analysis was used to determine which aspects of grape composition were most important in differentiating between grades. For Cabernet Sauvignon, two seasons of data were available for analysis, with some seasonal differences observed. For Shiraz and Chardonnay, the grape grade prediction was performed only for one season, 2014.

For Cabernet Sauvignon, the key measures that were higher in higher grade fruit were phenolics (in particular colour and tannin), selected amino acids, Brix, chloride and glycosyl-glucose

### AT A GLANCE

- Chemical and spectral measures of compounds in grapes have been used to successfully predict grape allocation grades for Cabernet Sauvignon, Shiraz and Chardonnay.
- This work has been extended, to predict wine grade and/or style from grape measurements.
- Adoption of objective measures when assessing grapes could have benefits for both grapegrowers and winemakers.
- New work is under way to apply objective measures in assessing differences between two premium quality grades of Shiraz fruit.

(an indicator of overall flavour). Those measures that were lower in higher grade fruit included the 'green'/'grassy' C6 flavour compounds, and glutamic acid (an amino acid). The role of other nitrogen measures, titratable acidity (TA) and ß-damascenone was less clear, with different effects across two vintages studied.

For Shiraz, many of the key measures that were increased in higher grades were similar to those that were important for Cabernet Sauvignon, namely phenolics measures (in particular tannin), some amino acids, Brix and chloride. Others that were different from Cabernet, and were higher in better grades, included two of the C6 compounds and yeast assimilable nitrogen (YAN). Measures with lower values in higher grade fruit were aspartic acid, Z-3-hexenol and berry weight, with berry weight one of the measures that had the greatest influence on the predictive models for this variety.

For Chardonnay, key variables with higher values in higher grades included total acidity, malic acid, glycosyl glucose,

varietal thiol precursors, chloride, ammonia nitrogen and two C6 compounds. The measures of UV-Vis absorbance at 370nm (flavonols, a sun exposure marker) and proline concentration were higher in lower grades, and higher pH and E-2-hexenal were also associated with lower grades.

## SUCCESS WITH SPECTRAL MEASURES

Grape spectral data (a combination of UV-Vis spectra of grape extracts, MIR spectra of juice and grape homogenates and NIR spectra of homogenates) were statistically analysed separately from the targeted chemical analytical data, and were found to predict grade better than 90 percent for Cabernet Sauvignon, Shiraz and Chardonnay.

Spectra of grape homogenates in the mid-infrared region were found to be the most effective for grape grade prediction across the three varieties. The technology needed for this analysis is readily available to commercial laboratories, rapid, easy to use and can be calibrated across multiple seasons. This could have significant advantages over the slower and more complex methods needed for some of the chemical analyses discussed earlier.

## LOOKING AT WINE STYLE AND GRADE

In 2015 the project was extended to explore the relationship between grape composition and wine style. For this part of the study, only two varieties (Shiraz and Chardonnay) were considered, from a single region (Riverland). Grapes from a range of grades were sourced from the Riverland; however, the grading system used in that region was different from that used in the previous season and the samples represented a narrower range of grape grades.

Grapes were analysed for a similar range of compositional measures as those used in 2014. Small-lot wines (50kg) were made in duplicate using standardised winemaking conditions. Quantitative descriptive analysis was used to characterise the sensory properties of the wines and a panel of winemakers assessed style and grading categories from a commercial standpoint. Statistical analysis was used to relate grape compositional measures with wine style and grade allocations as well as the more detailed sensory profiles.

Overall, it was possible to develop models to predict wine style and grade based on grape measures, but the accuracy of the predictions was not as high as the models developed to predict grape grade. This may have been partly due to the limitations of the sample set (narrowness of quality grades compared with the previous study and limited numbers of samples in each category) but also due to the complexity of the processes converting grape compounds into wine flavours and aromas.

Nevertheless, many of the key grape measures found to be important in predicting grape grade in 2014 were also found to be important in predicting wine grade/style in 2015. These included Brix, glutamic acid, tannin, colour, chloride and E-2-hexenol. These findings provide leads to help focus future work in this area.

## NEW PROJECT ON SHIRAZ

A new project commencing in vintage 2017 will apply learnings from the work outlined above in collaboration with another large Australian wine producer. It will assess differences between two premium quality grades (Q2 and Q3) of Shiraz fruit and wine from 20 vineyards in South Australia. The aim is to identify chemical and spectral indicators that define Q2 and Q3 vineyards, both in terms of quality rating and wine style. Wines will be produced commercially from each vineyard/grade and analysed compositionally and sensorially to determine differences in styles achievable between grades. Additional goals will be to identify vineyard or winery management options to shift grades from Q3 to Q2, and explore options to reduce the costs of producing Q2 grapes.

## CONCLUSION

The work completed so far in identifying objective measures for grape grading and wine quality/style has confirmed the importance of some previously known quality markers but has also identified some new compounds not previously known to be important in defining quality or style. Both chemical and spectral measures have been successfully used in grape grade prediction, and the first efforts at extending this to prediction of wine grade and style are promising, but require further refinement. The application of such measures within the Australian wine sector has potential benefits for both grapegrowers and winemakers: improving transparency and communication across the value chain, reducing production costs and increasing value by ensuring that fruit is used most efficiently.

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