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Producer friendly colour analysis of Pinot noir berries

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Background

Spectrophotometric measurements of red wine colour and phenolic content are proven tools for researchers and winemakers. In an effort to encourage New Zealand producers to undertake grape colour measurement to develop style, vineyard and vintage benchmarks, we have devised and tested refinements to the established Australian Wine Research Institute (AWRI) grape berry analysis protocols. In collaboration with Marama Labs Limited, we have also assessed the role that the CloudSpec™ instrument might play in facilitating colour measurement in grapes.

Materials and Methods

CloudSpec – Marama Labs

Figure 1: CloudSpec™.

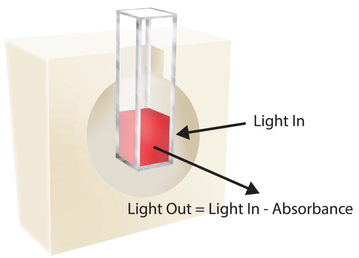


Figure 2: CloudSpec™ measuring chamber.

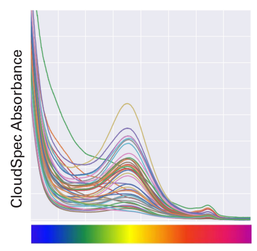
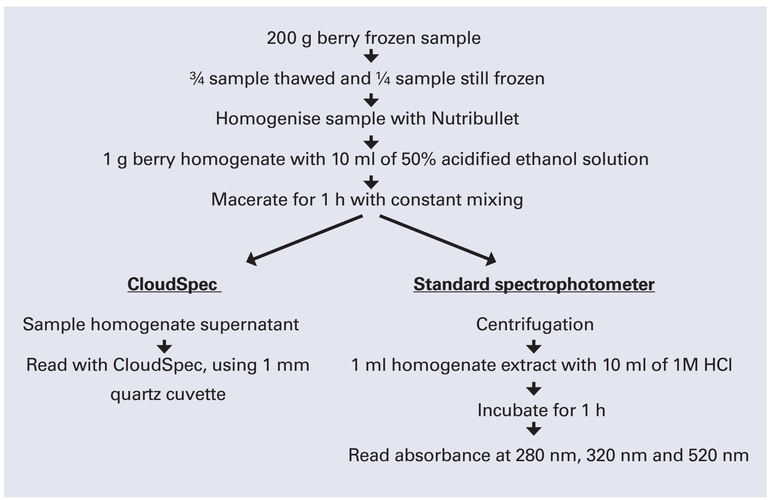


Figure 3: Absorbance spectra of juice samples, obtained with the CloudSpec™.

The CloudSpec **(Figure 1)** differs from the traditional spectrophotometer as it contains a unique chamber **(Figure 2)**, made of a highly reflective material, in which the light is recycled many times before exiting the sphere. Only the absorption of the sample is then measured, meaning the influence of turbidity is eliminated from the signal **(Figure 3)**.

Grape tannin, phenolic and colour protocol, based on the AWRI method



Optical density (OD) measurement

OD was measured in a UV transparent 96-well microplate using a Molecular Devices Spectramax 384 Plus plate reader **(Figure 4)**. The method was adapted from a published protocol (Somers & Evans 1977).

Subsamples were collected before centrifugation and OD was analysed on the CloudSpec **(Figure 5)**, 1 mm quartz cuvette.

Figure 4: Spectramax 384 Plus plate reader.

Figure 5: CloudSpec™.

Results and discussion

1. Relationship between berry colour measurement and finished wine colour

The absorbance measure at 520 nm gives an estimate of the concentration of all the red coloured pigments in the berry or wine sample, including anthocyanins and red polymeric compounds.

Method validation was undertaken using Pinot noir grapes and finished wine samples derived from 120 fruit lots from 12 vineyards in three New Zealand regions and spanning three vintages.

The relationship between the log transformed berry extract OD520 and the wine OD520 was strong ($r^2 = 0.74$; $P < 0.001$) when individual fruit lots were plotted.

The relationship further improved ($r^2 = 0.83$; $P < 0.001$) when data from fruit and wine lots were averaged by vineyard and by year (N = 31), reducing biological variation **(Figure 6)**.

Results indicate that the AWRI berry method was suitable for predicting Pinot noir wine colour from berry colour as long as representative berry sampling was achieved.

2. Relationship between the CloudSpec™ and standard spectrophotometer methods for berry colour measurement

Streamlining of the AWRI berry method to omit the centrifugation, acidification and sample dilution steps with direct feed of the homogenate supernatant into the CloudSpec instrument offered further improvements in efficiency and accuracy **(Figure 7)**.

There was a strong linear correlation between the OD520 absorbances of the AWRI and CloudSpec methods ($r^2 = 0.894$). Although the linear fit is not 1:1, CloudSpec is a suitable tool for relative comparison, even with a shorter methodology.

3. Relationship between berry and wine OD520 values for the CloudSpec™ and the standard spectrophotometer methods for 2021 samples.

The correlation between berry and wine OD520 is improved using the CloudSpec method ($r^2 = 0.64$) compared with the standard AWRI method ($r^2 = 0.49$) **(Figure 8)**.

These improvements appear to stem from the CloudSpec's ability to overcome interference from residual turbidity or scattering, especially in grape berry extracts. With only one vintage (2021) of unreplicated samples analysed, we found a good correlation from grape OD520 to wine OD520 although not as strong as **Figure 6**.

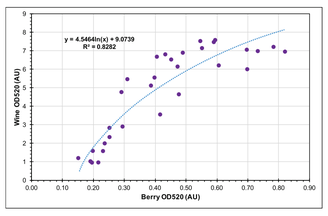


Figure 6: Relationship between berry extract OD520 and wine OD520.

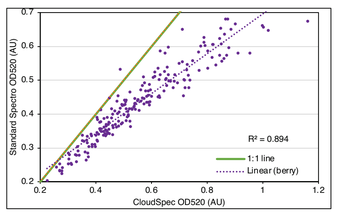


Figure 7: Relationship between the CloudSpec™ and the standard spectrophotometer for berry samples analyses using the Australian Wine Research Institute (AWRI) method.

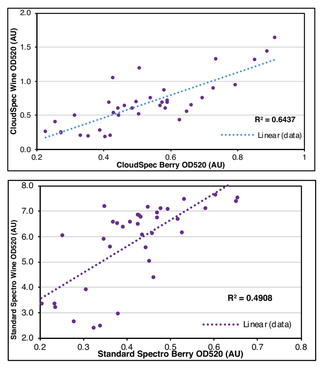


Figure 8: Relationship between berry and wine OD520 values for the CloudSpec™ (top) and the standard spectrophotometer methods (bottom) for 2021 samples.

Conclusions

The CloudSpec instrument has proven particularly useful when attempting to develop rapid colour measurements for grape berries. We have successfully developed a pilot grape berry phenolic analysis method that shortcuts the centrifugation, acidification and sample dilution steps of the reference AWRI method. This accelerates sample processing while achieving further improvements in accuracy. Method streamlining as well as introducing CloudSpec technology provide a significant advance in making grape quality assessment more accessible to Pinot noir winemakers. However, more work is required to validate these findings and optimise the methodology using a larger set of samples.

Reference: Somers TC, Evans ME 1977. Spectral evaluation of young red wines: Anthocyanin equilibria, total phenolics, free and molecular SO2,"chemical age". Journal of the Science of Food and Agriculture 28(3): 279-287.