Predicting grapevine starch levels using infrared spectroscopy

Prevoir les taux d'amidon dans la vigne a l'aide de la spectroscopie infrarouge

Joanna E. Jones[1*], Caroline Claye[1], Thomas Rodemann[2], Robert G. Dambergs[1, 3], Dugald C. Close[1]

[1]Perennial Horticulture Centre, Tasmanian Institute of Agriculture, University of Tasmania, Private Bag 98, Hobart TAS 7001

[2]Central Science Laboratory, University of Tasmania, Hobart TAS 7001

[3]Australian Wine Research Institute, PO Box 197, Glen Osmond SA 5064

** Corresponding author: Jones, +61 3 6226 2557, Joanna.Jones@utas.edu.au*

Background

- Carbohydrate reserves are needed to support new root and shoot growth following budburst, and can influence both reproductive development and shoot growth the following season.
- Traditional wet chemistry methods for carbohydrate analysis such as enzyme assays and HPLC, are expensive and time-consuming. Near infrared (NIR) and mid infrared (MIR) are possible alternatives to the traditional methods.
- The aim of the present work was to test the proof of concept for analysis of cane carbohydrates of ground wood samples by means of NIR and MIR spectroscopy.

Method

Cane wood was obtained from five commercial vineyards in Southern Tasmania, Australia in winter 2010 and 2011. Samples from vines of both Pinot Noir (clone D5V12) and Chardonnay (clone I10V1), pruned to two pruning systems (cane and spur pruning), were taken from each site. Samples were freeze dried then ground and the percent starch was determined enzymatically using a Megazyme total starch assay kit. MIR spectra were collected on a Bruker Vertex 70 spectrometer using a PIKE AutoDiff autosampler and a LN-MCT detector. The spectra were recorded from 500-4000 cm^{-1} using a resolution of 4 cm^{-1} and 64 scans. The NIR spectra were collected on a Bruker MPA spectrometer. The spectra were recorded from 4000-10000 cm^{-1} using a resolution of 8 cm^{-1} and 64 scans. Multidimensional statistical analysis was performed with The Unscrambler 10.1 software, using the partial least squares (PLS) regression algorithm.

Results

Both NIR and MIR gave good prediction performances for vine starch levels. The NIR model performed slightly better than the MIR model, as shown in *Table 1*.

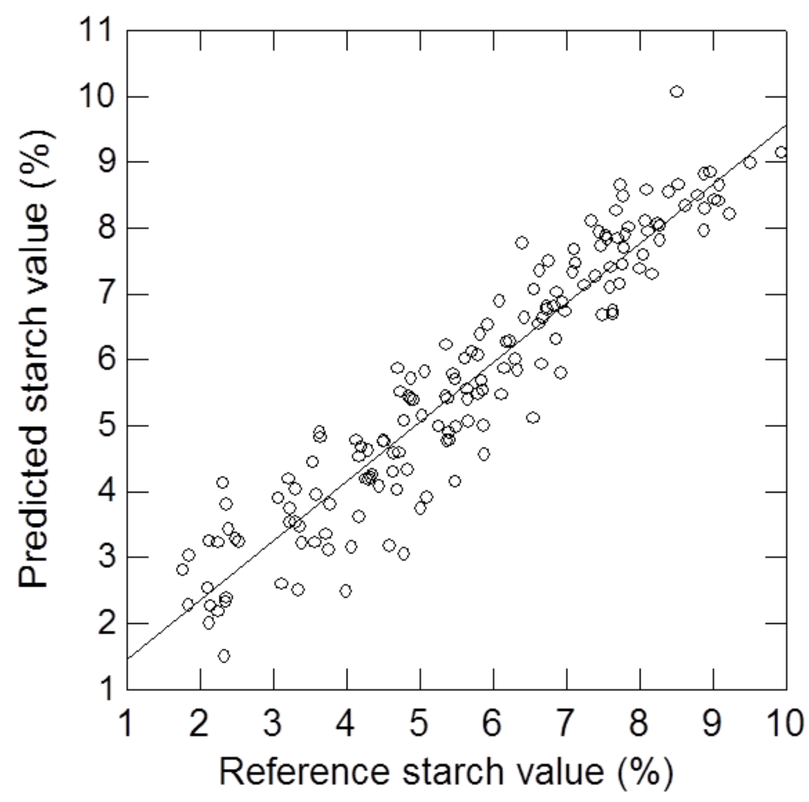
The values determined by wet chemistry and those predicted by PLS regressions of percent starch provided proof of concept that both NIR and MIR may be appropriate tools for rapid analysis of cane starch. The PLS regression using NIR is shown in *Figure 1*.

From this preliminary study, results suggest the NIR model is stronger than the MIR model. These chemometric models are dependent on a wide range of samples representing the full range of sample matrix variation, therefore with a greater number of samples it is possible that an improvement in the MIR model may be seen.

Table 1: Mean, standard deviation (SD) and range of the cane starch (%) and validation performance (R^2 and root mean square standard error of cross-validation: RMSECV) under NIR and MIR.

	Reference data Starch (%)				NIR		MIR	
No. Samples	Mean	Maximum	Minimum	SD	R^2	RMSECV	R^2	RMSECV
169	5.7	9.9	1.8	2.1	0.89	0.66	0.72	1.11

Figure 1 The PLS regression of reference and predicted percent starch using NIR, producing an R^2 of 0.89 and RMSECV of 0.66 % starch.



Conclusions

The possibility of using MIR and NIR as an easy, low-cost method for obtaining an accurate analysis of the total vine starch content has been demonstrated. The possibility exists for the method to be further developed from using ground wood samples to a non-destructive technique. This model has been developed for prediction of starch concentrations, however, it might also be possible to extend the research to measure seasonal soluble sugar availability.

Acknowledgements

The authors would like to thank Meadowbank, Tolpuddle, Bream Creek, and 572 Richmond Rd vineyards for samples.

This work was supported by an industry consortium through an AusIndustry, Industry Co-operative Innovation Program.

TIA is home to the AWRI's Tasmanian Node, which is jointly funded by TIA, UTAS, AWRI and the GWRDC

UTAS TIA is a joint venture of the University of Tasmania and the Tasmanian Government Tasmania Explore the possibilities