

## Applications of Infrared Spectroscopy from laboratory to industry

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The grape and wine industries have long sought rapid, reliable and cost-effective methods to screen and monitor all the stages of the winemaking process, which include grape ripening in the vineyard, harvest and grape reception at the weighbridge, the fermentation stage and the bottling of the final product. Primary requirements of effective quality control in this environment would include the handling of complex sample matrices, a high degree of automation, precision, accuracy and where relevant, good agreement with the reference methods conventionally used for grape and wine analysis. Although conventional chemical methods still remain the workhorse of the wine analytical laboratory, some disadvantages such as lengthy assay times, unsuitability for automation, labour-intensive activities and the generation of large amounts of chemical waste, place an obstacle in their use for rapid quality control purposes.

Infrared (IR) spectroscopy is not a new application in the field of analytical chemistry. Recent improvements in IR instrumentation and the development of innovative and powerful software applications have optimised this technology. Currently, multi-component analytical instruments with impressive performance data in terms of simple sample handling, accuracy, precision and speed of analysis, are commercially available. The technology is based on the measurement of vibrational frequencies of covalent bonds in functional groups such as C-C, C-H, O-H, C=O and N-H, upon absorption of radiation in the IR region of the electromagnetic spectrum. Since IR spectroscopy is an indirect method employing empirical correlations between compositional and/or functional quality attributes and the IR spectra of samples, multivariate data analytical techniques are used to establish these correlations.

This presentation highlights the use of near infrared (700-2500 nm) and mid infrared (2500 –  $5 \times 10^4$  nm) spectroscopy for quantitative and qualitative applications in the grape and wine industries. These include the measurement of colour, sugar and acidity in grapes, as well as the quantification of routine wine parameters such as pH, volatile acidity, titratable acidity, alcohol and sugar in wine. Industrial applications include the streaming of grape juice based on colour measurement. Future directions in IR spectroscopy regarding wine flavour analysis and product authentication are discussed.