Application Note AN-NIR-147

Ethanol content in wine by near-infrared spectroscopy

Rapid determination of alcohol levels in wine with NIRS

Ethanol content is an important parameter to determine in wine—during the fermentation process, for quality control, and for other legal requirements of alcoholic beverages. Traditional time-consuming methods like gas chromatography (GC) can be used for the determination of ethanol content in wine. However, measuring the alcohol content in wine can be done easily without sample preparation by using near-infrared spectroscopy (NIRS).

NIRS is a fast, easy to use, and chemical-free analysis method. The NIRS solution can be used either atline during the wine fermentation process or in a quality control laboratory.

EXPERIMENTAL EQUIPMENT

Samples of red wine and white wine with varying alcohol content were measured on an OMNIS NIR Analyzer Liquid (1000–2250 nm). Measurements were performed in transmission mode with a 2 mm flow-through cell and corresponding holder for flow-through cells. The built-in peristaltic pump on the OMNIS Sample Robot S was used for liquid transfer (Figure 1). OMNIS Software was used for all data acquisition and prediction model development.

Figure 1. OMNIS NIR Analyzer Liquid and OMNIS Sample Robot S – WSM (1T/2P).

Table 1. Hardware and software equipment overview.

Equipment	Article number
OMNIS NIR Analyzer Liquid	2.1070.0010
NIRS 12.5 mm quartz cuvette flow 2 mm	6.7401.320
Holder OMNIS NIR, flow-through cells	6.07401.100
OMNIS Stand-Alone license	6.06003.010
OMNIS Stand-Alone: 1 instrument license	6.06002.010
Software license Quant Development	6.06008.002
OMNIS Sample Robot S – WSM (1T/2P)	2.1010.1120
OMNIS Sample rack, 25 x 75 mL (PP)	6.02041.040
Gripper fingers 28-48 mm	6.02601.040

RESULT

The obtained NIR spectra of wine (Figure 2) were used to create a prediction model for ethanol content. A leave one out validation procedure was applied. A correlation diagram showing the relation between the NIR prediction and the reference values is shown in Figure 3 together with the respective figures of merit (FOM).

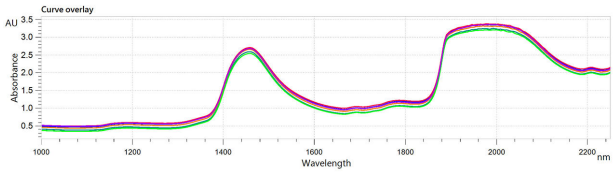

Figure 2. NIR spectra of different wine samples measured on an OMNIS NIR Analyzer Liquid with a 2 mm flow-through cell.

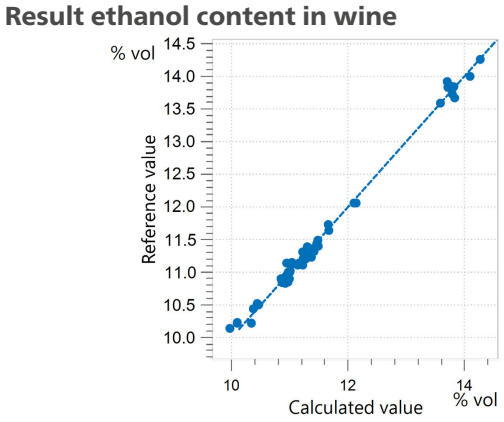

Figure 3. Correlation diagram and the respective figures of merit for the prediction of ethanol in wine. The determination of ethanol content in wine using gas chromatography was performed for reference values.

R^2	SEC (% vol)	SECV (% vol)
0.995	0.080	0.082

CONCLUSION

This Application Note shows the feasibility of using NIR spectroscopy for testing ethanol content in wine. The analysis can be conducted within seconds. No chemicals are used, saving costs. Automation possibilities with the OMNIS platform allow the unattended measurement of up to 175 samples.

CONTACT

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CONFIGURATION

OMNIS NIR Analyzer Liquid

Near-infrared spectrometer for liquid samples.

Developed and produced in accordance with Swiss quality standards, the OMNIS NIR Analyzer is the near-infrared spectroscopy (NIRS) solution for routine analysis along the entire production chain. Its application of the latest technologies and its integration in the modern OMNIS Software are reflected in its speed, operability, and flexible utilization of this NIR spectrometer.

Overview of the advantages of the OMNIS NIR Analyzer Liquid:

- Measurements of liquid samples in less than 10 seconds
- Temperature control on the sample from 25–80 °C
- Automatic detection of the insertion and removal of the sample vessel
- Simple integration in an automation system or link with additional analysis technologies (titration)
- Supports numerous sample vessels with different path lengths

NIRS 12.5 mm quartz cuvette flow 2 mm

The flow quartz cuvettes enable continuous monitoring, for example of tablet disintegration processes and reaction kinetics. The high pressure resistance and a special bubble capturing system make all measurements particularly easy.

Windows made of quartz glass of maximum purity and homogeneity ensure a transmission of more than 80% in the wavelength range of 200 nm - 2,500 nm.

A variety of pathlengths are available:

0.5 mm pathlength and a volume = 175 µL (order number: 67401300)

1 mm pathlength and a volume = 350 µL (order number: 67401310)

2 mm pathlength and a volume = 700 µL (order number: 67401320)

5 mm pathlength and a volume = 1,750 µL (order number: 67401330)

10 mm pathlength and a volume = 3,500 µL (order number: 67401340)

Dimensions h x l x w = 35 mm x 12.5 mm x 12.5 mm

Window height = 8.5 - 15 mm

Compatible with the NIRS spacer for the XDS RapidLiquid Analyzer and the DS2500 holder for the DS2500 Liquid Analyzer.

Holder OMNIS NIR, flow-through cells

Cuvette holder for the OMNIS NIR Analyzer for flow-through cells

(6.7401.300; 6.7401.310; 6.7401.320; 6.7401.330; 6.7401.340).

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone license

Enables stand-alone operation of the OMNIS software on a WindowsTM computer.

Features:

- The license already includes one OMNIS instrument license.
- Must be activated via the Metrohm licensing portal.
- Not transferable to another computer.

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone: 1 instrument license

1 instrument license for operating one additional OMNIS instrument in OMNIS Stand-Alone.
The following instruments are supported:

- OMNIS instruments
- Metrohm USB devices
- RS-232 instruments (e.g., balance)

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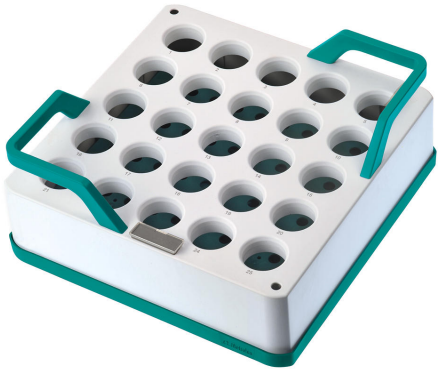
Software license Quant Development

Software license for the creation and editing of quantification models in a stand-alone OMNIS Software installation.

OMNIS Sample Robot S – WSM (1T/2P)

OMNIS Sample Robot S – WSM, equipped with an OMNIS Workstation Module with 2 pumps for cleaning and extraction of the sensors and sample vessels, a workstation, rod stirrers, and extensive accessories for getting started directly with fully automated titration. The system provides space in two sample racks for 32 sample beakers of 120 mL each. This modular system is supplied completely installed and can thus be put into operation in a very short time. The system can also be extended upon request to include 2 additional peristaltic pumps and another workstation, thus doubling the throughput. If additional workstations are required, then the Sample Robot S can be extended to become an L-sized OMNIS Sample Robot, thus enabling samples from 7 racks to be processed in parallel on up to 4 workstations to quadruple the sample throughput.



OMNIS sample rack, 25 x 75 mL, (PP)

OMNIS sample rack for OMNIS Sample Robot Pick&Place, suitable for 25 sample beakers. The following sample beakers can be used: 6.01402.000, 6.01402.003, 6.1459.400.
Plastic: Polypropylene (PP)

Gripper fingers 28-48 mm

Gripper fingers for OMNIS Sample Robot Pick&Place for gripping sample beakers with an outer diameter of 28 - 48 mm.