Application Note AN-NIR-153

Monitoring quality of intact olives with near-infrared spectroscopy

Determination of oil and moisture content in intact olives

Near-infrared spectroscopy (NIRS) can be used for intact olives' quality control. NIRS allows producers to evaluate olive quality faster and estimate potential economic returns. Furthermore, because olive oil quality is highly dependent on selecting the optimal harvest date – when the olives should be delivered to the mill – methods capable of monitoring oil content in olives at various ripeness stages are crucial for the olive oil industry. This helps ensure the best possible oil yield.

NIR spectroscopy provides fast and chemical-free analysis of oil content, moisture, and maturity index without any sample preparation. The NIRS solution is easy to use and can be applied in oil mills before oil production, or in quality control laboratories.

EXPERIMENTAL EQUIPMENT

This application studied 800 samples of olives composed of two varieties (Picual and Arbequina). Intact olives with different oil content, moisture content, and maturity index were measured in an OMNIS NIR Analyzer Solid (Figure 1) in diffuse reflection mode (1000–2250 nm) using a large cup OMNIS NIR, 100 mm and large holder OMNIS NIR (Table 1). To compensate for the inhomogeneity of the samples, rotating and multipoint measurement were used.

Figure 1. OMNIS NIR Analyzer Solid.

Table 1. Hardware and software equipment overview.

Equipment	Article Number
OMNIS NIR Analyzer Solid	2.1071.0010
Large holder OMNIS NIR, 100 mm	6.07402.100
Large cup OMNIS NIR, 100 mm	6.07402.110
OMNIS Stand-Alone	6.06003.010
Software license Quant Development	6.06008.002

RESULT

The obtained NIR spectra of olive samples (Figure 2) were used to create prediction models for the different parameters. The quality of the prediction models was evaluated using correlation diagrams which display a high correlation coefficient between the NIR prediction and the standard reference method for all parameters (Figures 3–5).

Out of the total, 25% of the samples were selected as a validation set and the other 75% as a calibration set. A leave one out validation procedure was used. The respective figures of merit (FOM) display the expected precision and confirm the feasibility during routine analysis.

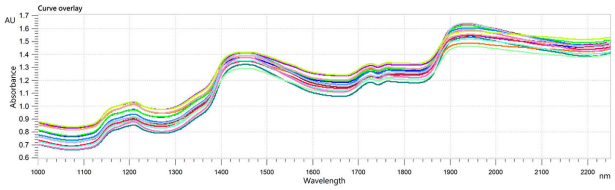

Figure 2. NIR spectra of different olive varieties measured on an OMNIS NIR Analyzer Solid.

RESULT OIL CONTENT IN INTACT OLIVES

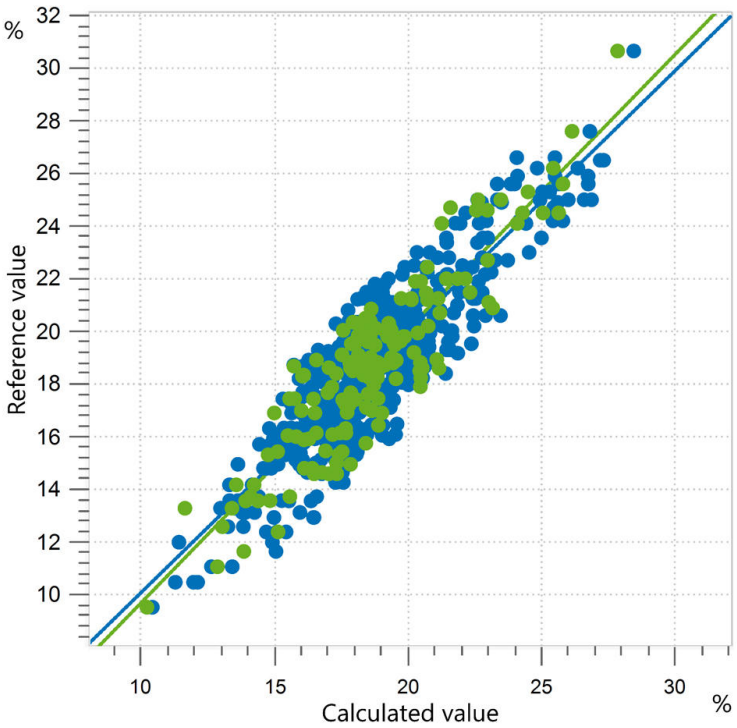

Figure 3. Correlation diagram and the respective FOMs for the prediction of oil content in intact olives using an OMNIS NIR Analyzer Solid. Oil content lab values were obtained using Soxhlet extraction.

R^2	SEC (%)	SECV (%)	SEP (%)
0.811	1.39	1.43	1.44

RESULT MOISTURE CONTENT IN INTACT OLIVES

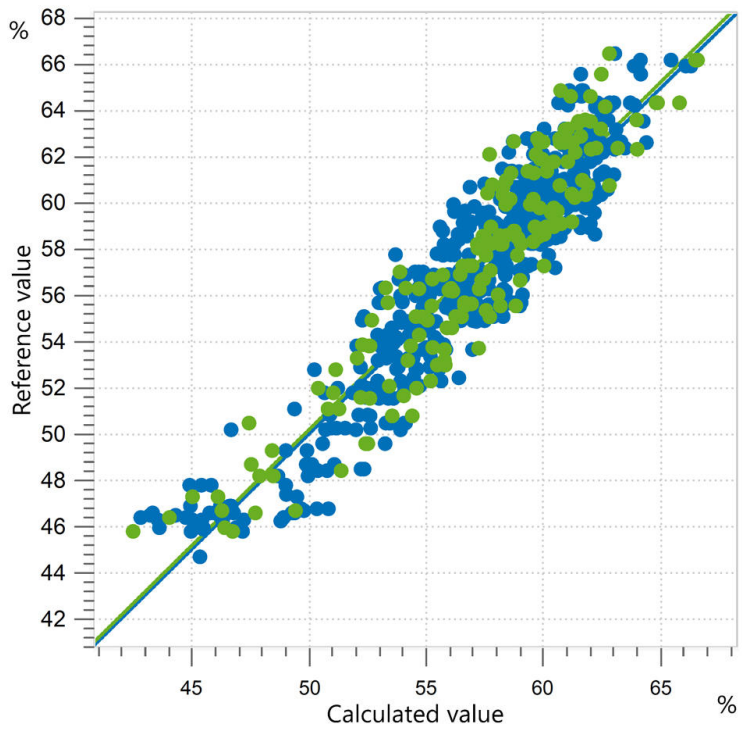

Figure 4. Correlation diagram and the respective FOMs for the prediction of moisture content in intact olives using an OMNIS NIR Analyzer Solid. Moisture lab values were obtained using the loss on drying method.

R^2	SEC (%)	SECV (%)	SEP (%)
0.868	1.70	1.75	1.81

RESULT MATURITY INDEX IN INTACT OLIVES

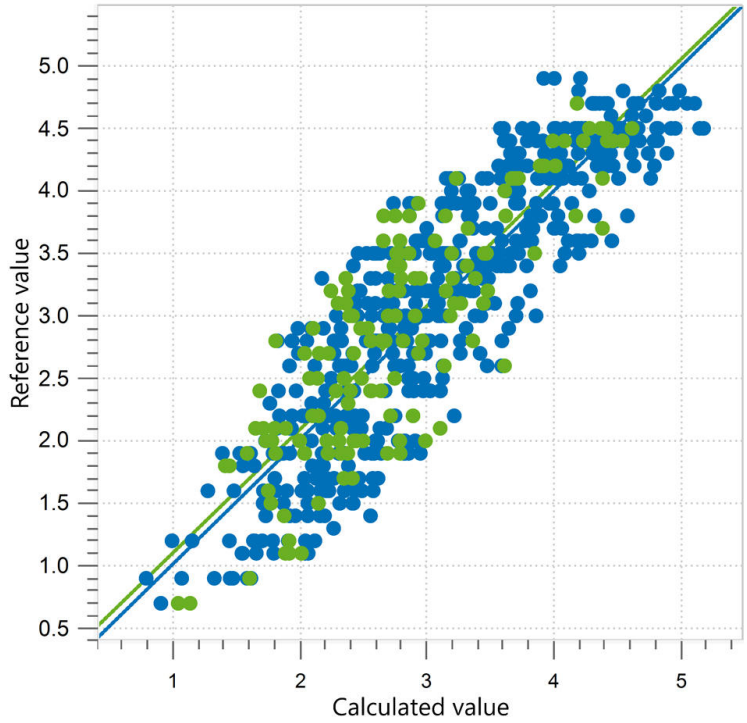

Figure 5. Correlation diagram and the respective FOMs for the prediction of olive maturity index in intact olives using an OMNIS NIR Analyzer Solid. Lab values were obtained according to guidelines from the International Olive Council (IOC Standards, Methods and Guides).

R^2	SEC	SECV	SEP
0.706	0.48	0.49	0.51

CONCLUSION

Oil content and moisture determinations by NIRS in olive paste were habitually applied for routine analysis. Now analysis of intact olives by NIR spectroscopy is possible and grinding them to a paste is unnecessary.

NIRS shows comparable efficacy against well-established methodologies such as NMR (nuclear magnetic resonance) and Soxhlet extraction. These established traditional methods are time consuming and require solvents and specialized personnel. Alternatively, NIR spectroscopy is fast, reagent free, and easy to use.

This Application Note shows the feasibility of using near-infrared spectroscopy to analyze intact olives, making the use of NIR spectroscopy even easier since no sample preparation is required.

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CONFIGURATION

OMNIS NIR Analyzer Solid

Near-infrared spectrometer for solid and viscous 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 Solid:

- Measurements of solids and viscous samples in less than 10 seconds
- Automated multi-position measurements for reproducible results, even with nonhomogeneous samples
- Simple integration in an automation system or link with additional analysis technologies (titration)
- Supports numerous sample vessels

Large holder OMNIS NIR, 100 mm

Large holder for large sample vessel OMNIS NIR, 100 mm (6.07402.110).

Permits unambiguous positioning of the sample vessel and the rotation of the sample vessel.

Large cup OMNIS NIR, 100 mm

Large sample vessel for the spectra acquisition of powders and granulates in reflection at various sample positions.
The glass bottom is made of resistant Gorilla® Glass.
Compatible with:

- Large holder OMNIS NIR, 100 mm (6.07402.100)

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.

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

Software license Quant Development

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