Application Note AN-NIR-135

Quality control of honey with NIR spectroscopy

Simultaneous determination of color and glucose, fructose, sucrose, maltose, and turanose content with results in seconds

SUMMARY

Honey is mainly comprised of the sugars glucose and fructose, which make up to 85% of its total weight. It additionally contains sucrose, a disaccharide composed of fructose and glucose, and other disaccharides such as maltose and turanose—present in concentrations from 0.5 to 3.5% [1]. The sugar content of honey is usually measured with high performance liquid chromatography (HPLC). Honey's color is a quality attribute evaluated by consumers and is an important sensory property in the beekeeping market. Internationally, different types of honey are classified using the Pfund color scale. All of these honey quality parameters can be measured simultaneously in just a few seconds without any sample preparation using near-infrared spectroscopy (NIRS).

EXPERIMENTAL EQUIPMENT

Pure honey samples were measured with an OMNIS NIR Analyzer Solid (Figure 1). All measurements were performed in transflection mode (1000–2250 nm) using a 2 mm gap size reflector and 28 mm disposable vials. OMNIS Software was used for all data acquisition and prediction model development. HPLC was the reference method used to measure the concentration of glucose, fructose, sucrose, maltose, and turanose in honey. Color was measured using a Pfund colorimeter and the Pfund scale, which ranges from 0 to 140 mm (from very light-colored honey up to the darkest honey).

Figure 1. The OMNIS NIR Analyzer Solid from Metrohm.

RESULT

The obtained NIR spectra of honey samples (Figure 2) were used to create prediction models for quantification of glucose, fructose, sucrose, maltose, and turanose content, as well as color. The quality of the prediction models was evaluated using correlation diagrams (Figures 3–8) which display a very high correlation between the NIR prediction and the reference values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis.

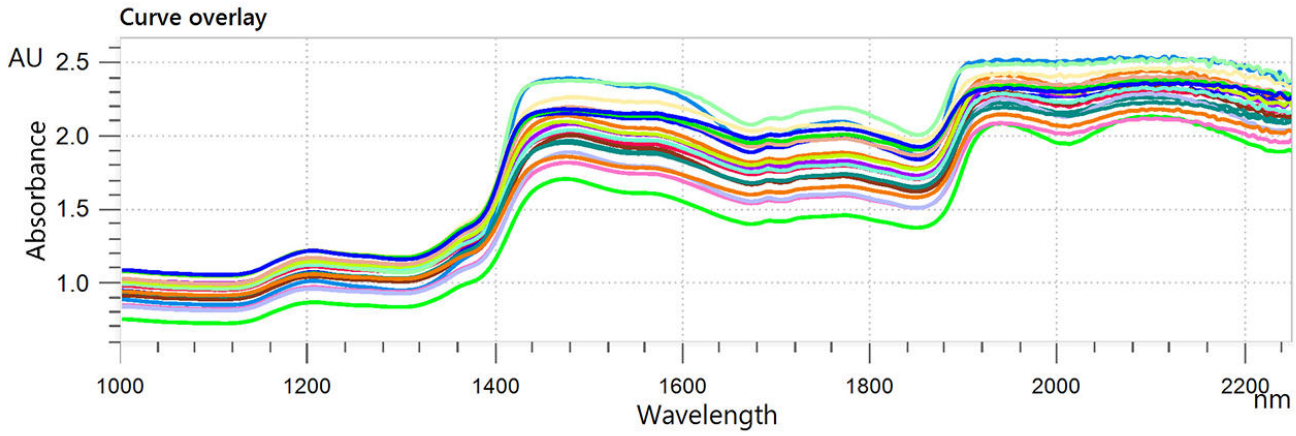

Figure 2. NIR spectra of honey analyzed on OMNIS NIR Analyzer Solid.

Result honey glucose content

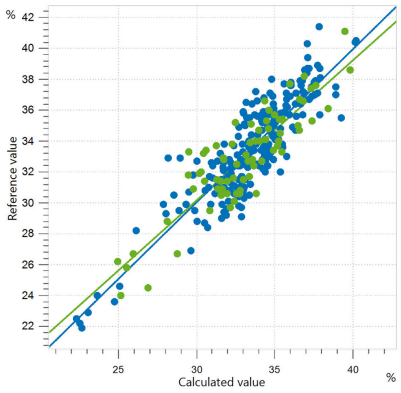

Figure 3. Correlation diagram and the respective figures of merit for the prediction of glucose content in honey. Reference values were obtained with HPLC.

R2	SEC (%)	SECV (%)	SEP (%)
0.781	1.51	1.56	1.52

Result honey fructose content

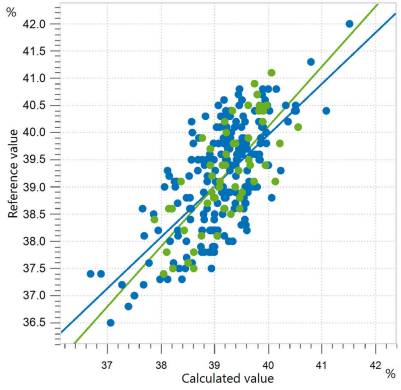

Figure 4. Correlation diagram and the respective figures of merit for the prediction of fructose content in honey. Reference values were obtained with HPLC.

R2	SEC (%)	SECV (%)	SEP (%)
0.527	0.67	0.73	0.64

Result honey sucrose content

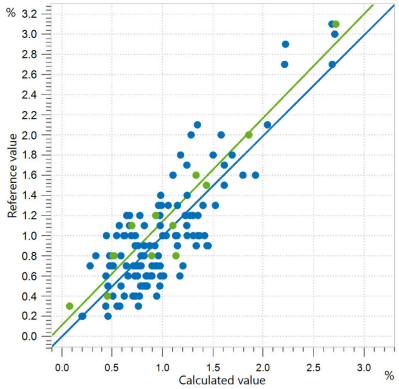

Figure 5. Correlation diagram and the respective figures of merit for the prediction of sucrose content in honey. Reference values were obtained with HPLC.

R2	SEC (%)	SECV (%)	SEP (%)
0.917	0.29	0.32	0.25

Result honey maltose content

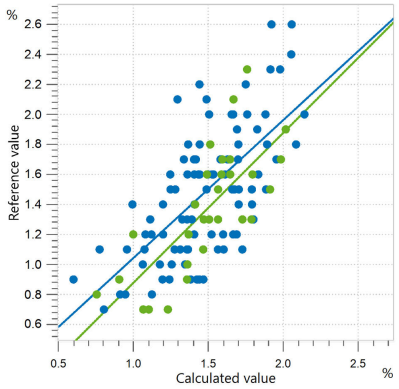

Figure 6. Correlation diagram and the respective figures of merit for the prediction of maltose content in honey. Reference values were obtained with HPLC.

R2	SEC (%)	SECV (%)	SEP (%)
0.557	0.30	0.33	0.30

Result honey turanose content

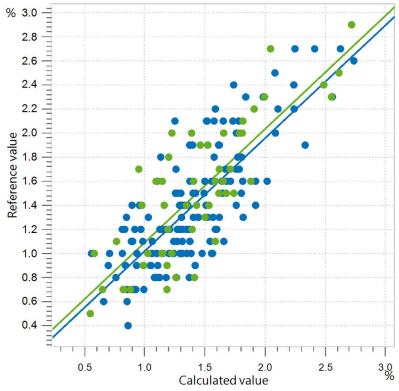

Figure 7. Correlation diagram and the respective figures of merit for the prediction of turanose content in honey. Reference values were obtained with HPLC.

R2	SEC (%)	SECV (%)	SEP (%)
0.665	0.30	0.31	0.33

RESULT

Result color

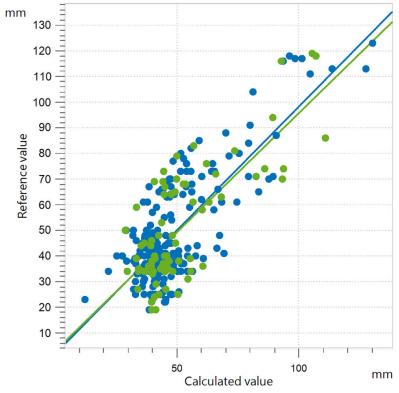

Figure 8. Correlation diagram and the respective figures of merit for the prediction of color in honey. Reference values were obtained with a Pfund colorimeter.

R2	SEC (mm)	SECV (mm)	SEP (mm)
0.578	12.56	13.56	14.58

CONCLUSION

This Application Note displays the benefits of using near-infrared spectroscopy for quality control of honey. Color, along with glucose, fructose, sucrose, maltose, and turanose content can be measured simultaneously in only a few seconds.
Measurements performed with NIR spectroscopy do not need any sample preparation nor solvents, saving users time and money. By using NIRS, only one analytical technology is required for sample measurement, compared to other conventional methods (Table 1). Finally, NIRS does not require skilled technical operators to perform the measurements, unlike HPLC.

Table 1. Overview of analytical methods used for the determination of reference values in honey.

Parameter	Method	Time to result
Glucose, fructose, sucrose, maltose, turanose	HPLC	~5 min (preparation) + ~40 min (HPLC)
Color	Pfund Method	~5 min

REFERENCE

1. Kolayli, S.; Boukraâ, L.; Sahin, H.; et al. Sugars in Honey. In *Dietary Sugars: Chemistry, Analysis, Function and Effects*; 2012; pp 3–15.

CONTACT

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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

Small reflector OMNIS NIR, 2 mm

Reflector with a gap size of 2 mm (optical path length of 4 mm) for the transflection measurement of liquids.

Suitable for disposable 28 mm reflection vials (6.7402.140).

Disposable vials, 28 mm, reflection

216 lockable disposable glass vials with a diameter of 28 mm for analyses of solids in reflection. Suitable for the following analyzers:

- NIRS DS2500 Analyzer
- NIRS XDS RapidContent (Solid) Analyzer
- NIRS XDS MultiVial Analyzer
- NIRS XDS MasterLab Analyzer

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
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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.