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

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.

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.

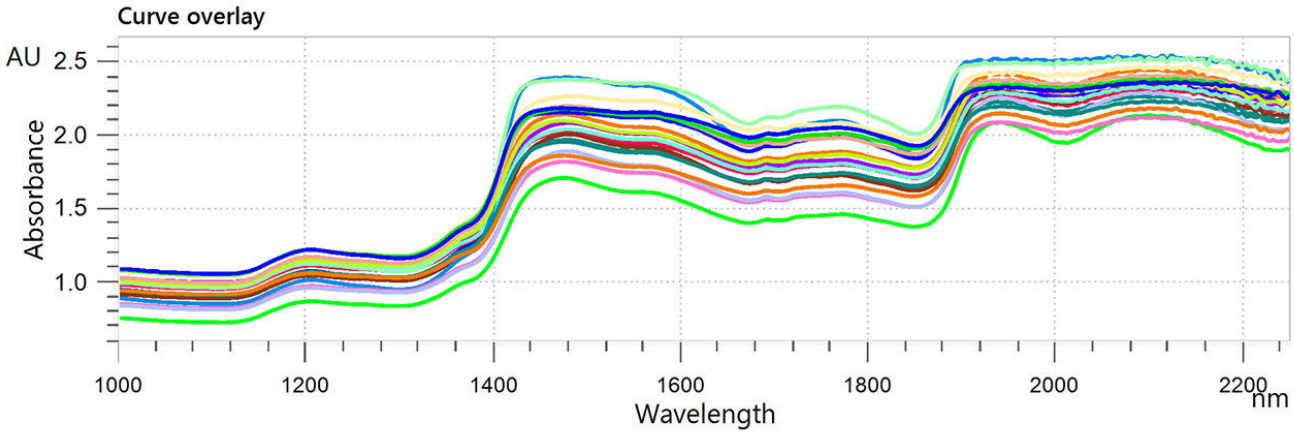

Figure 2. NIR spectra of honey analyzed on OMNIS NIR Analyzer Solid.

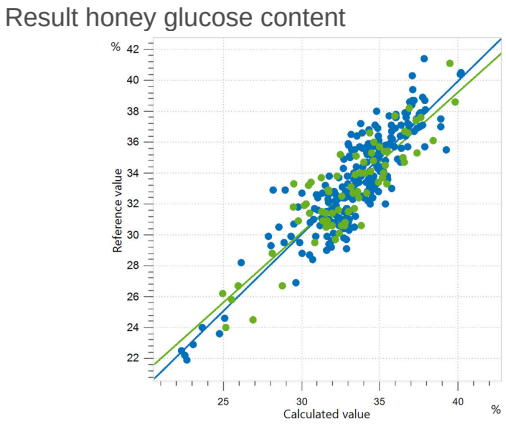

Figure 3. Correlation diagram and the respective figures of merit for the prediction of glucose content in honey. Reference values were obtained with HPLC.

R^2	SEC (%)	SECV (%)	SEP (%)
0.781	1.51	1.56	1.52

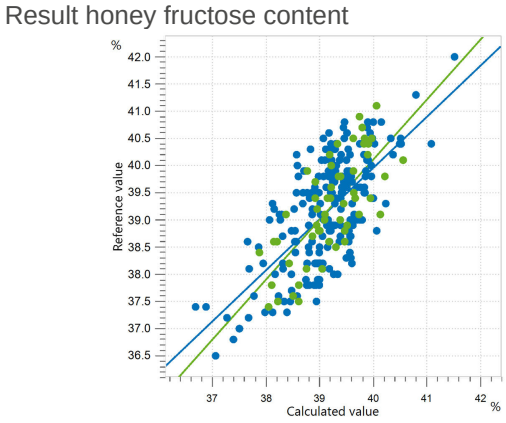

Figure 4. Correlation diagram and the respective figures of merit for the prediction of fructose content in honey. Reference values were obtained with HPLC.

R^2	SEC (%)	SECV (%)	SEP (%)
0.527	0.67	0.73	0.64

Result honey sucrose content

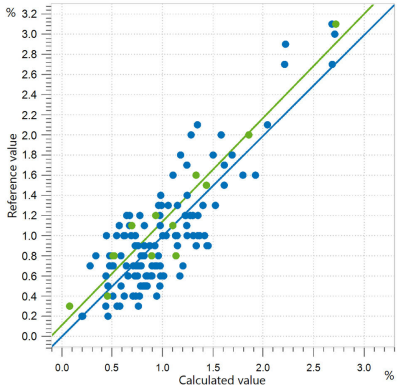

Figure 5. Correlation diagram and the respective figures of merit for the prediction of sucrose content in honey. Reference values were obtained with HPLC.

R^2	SEC (%)	SECV (%)	SEP (%)
0.917	0.29	0.32	0.25

RESULT

Result honey maltose content

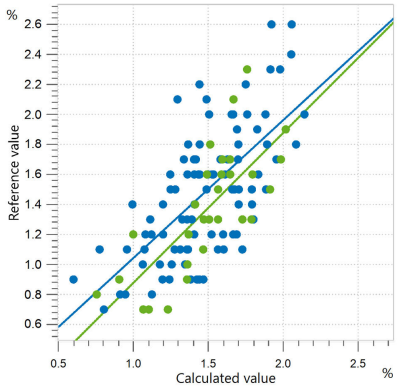

Figure 6. Correlation diagram and the respective figures of merit for the prediction of maltose content in honey. Reference values were obtained with HPLC.

R^2	SEC (%)	SECV (%)	SEP (%)
0.557	0.30	0.33	0.30

Result honey turanose content

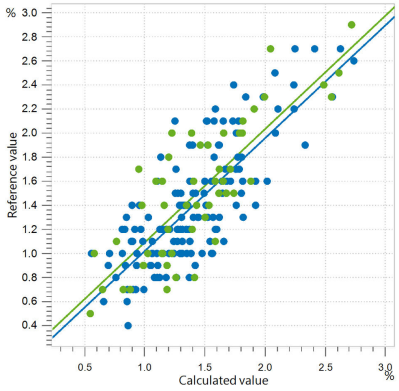

Figure 7. Correlation diagram and the respective figures of merit for the prediction of turanose content in honey. Reference values were obtained with HPLC.

R^2	SEC (%)	SECV (%)	SEP (%)
0.665	0.30	0.31	0.33

Result color

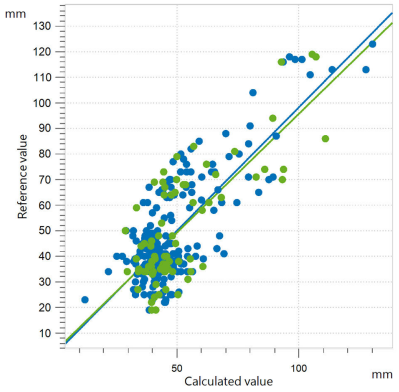

Figure 8. Correlation diagram and the respective figures of merit for the prediction of color in honey. Reference values were obtained with a Pfund colorimeter.

R^2	SEC (mm)	SECV (mm)	SEP (mm)
0.578	12.56	13.56	14.58

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

固体および粘性のサンプルのための近赤外スペクトロメーター。

OMNIS NIR Analyzer は、スイスの品質基準に従って開発・製造された、生産チェーン全体に沿ったルーチン分析のための近赤外分光法 (NIRS) ソリューションです。最新技術の適用と最新の OMNIS Software への統合は、この NIR スペクトロメーターの速度、ユーザビリティ、柔軟な使用に反映されています。

OMNIS NIR Analyzer Solid の利点の概要:

- 10秒未満で固体サンプルと粘性サンプルを測定
- 不均質なサンプルでも再現性のある結果を得るための自動マルチポジション測定
- オートメーションシステムへの統合、またはその他の分析技術 (滴定) との連結が容易
- 多数のサンプル容器に対応

OMNIS NIR2 mm

リフレクター、ギャップサイズ 2 mm (光路長 4 mm)、液体のトランスフレクション測定用。
28 mm 反射の使い捨てバイアル (6.7402.140) に適しています。

28 mm

28mm 216 :

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

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