



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.

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.

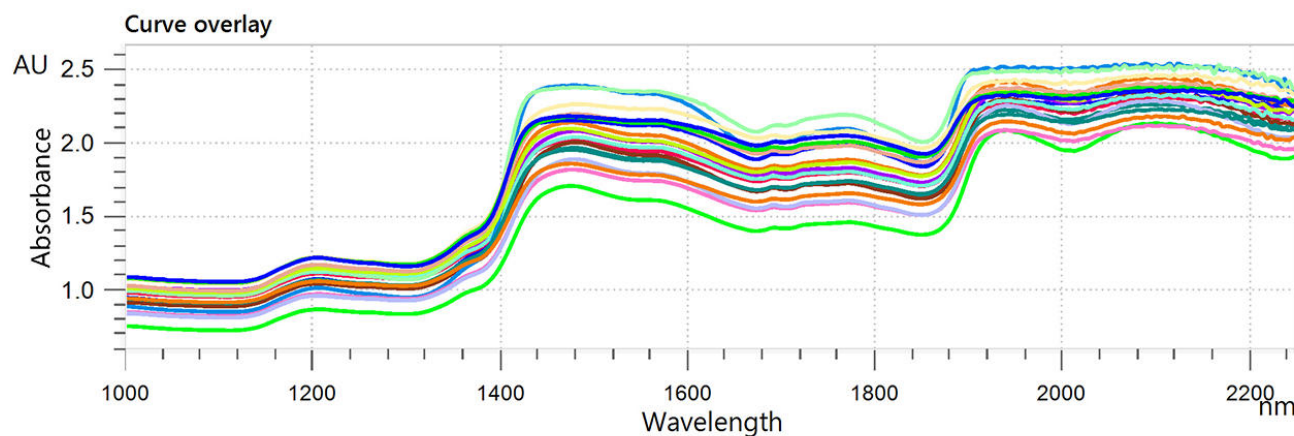


Figure 2. NIR spectra of honey analyzed on OMNIS NIR Analyzer Solid.

Result honey glucose content

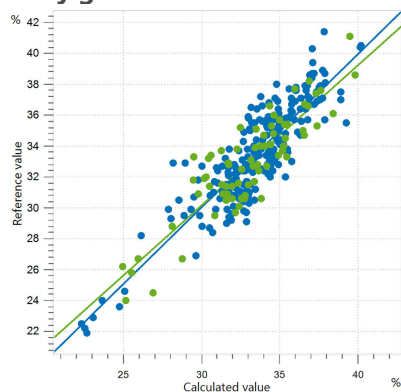


Figure 3. Correlation diagram and the respective figures of merit for the prediction of glucose content in honey. Reference values were obtained with HPLC.

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

RESULT

Result honey fructose content

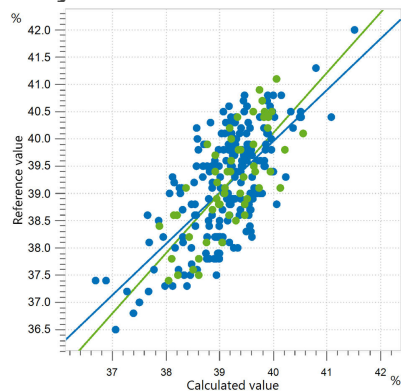


Figure 4. Correlation diagram and the respective figures of merit for the prediction of fructose content in honey. Reference values were obtained with HPLC.

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

Result honey sucrose content

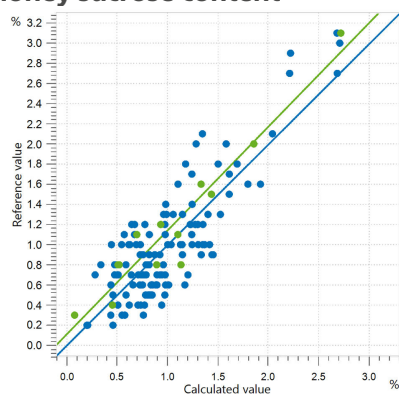


Figure 5. Correlation diagram and the respective figures of merit for the prediction of sucrose content in honey. Reference values were obtained with HPLC.

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

Result honey maltose content

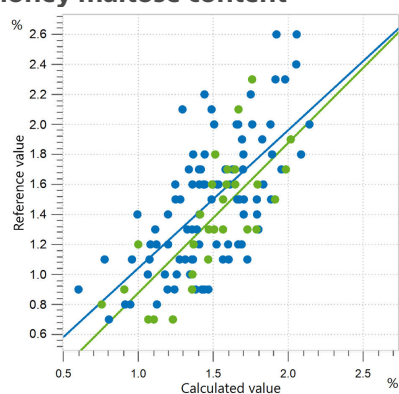


Figure 6. Correlation diagram and the respective figures of merit for the prediction of maltose content in honey. Reference values were obtained with HPLC.

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

Result honey turanose content

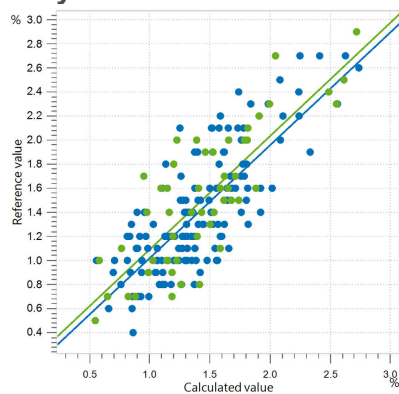


Figure 7. Correlation diagram and the respective figures of merit for the prediction of turanose content in honey. Reference values were obtained with HPLC.

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

Result color

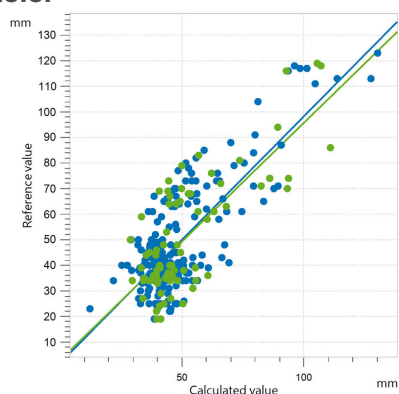


Figure 8. Correlation diagram and the respective figures of merit for the prediction of color in honey. Reference values were obtained with a Pfund colorimeter.

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

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

Spectromètre proche infrarouge pour échantillons solides et visqueux.

L'OMNIS NIR Analyzer est la solution de spectroscopie proche infrarouge (NIRS) développée et produite selon les normes de qualité suisses pour les analyses de routine tout au long de la chaîne de fabrication. L'utilisation des technologies les plus récentes et l'intégration dans le logiciel OMNIS moderne se reflètent dans la vitesse, la facilité d'utilisation et la flexibilité d'utilisation de ces spectromètres NIR.

Vue d'ensemble des avantages de l'OMNIS NIR Analyzer Solid :

- Mesures d'échantillons solides et visqueux en moins de 10 secondes
- Mesures multi-positions automatisées pour des résultats reproductibles même avec des échantillons non homogènes
- Intégration simple dans un système d'automatisation ou liaison avec d'autres technologies d'analyse (titrage)
- Prise en charge de nombreux récipients d'échantillon



Petit réflecteur OMNIS NIR, 2 mm

Réflecteur avec une dimension de fente de 2 mm (longueur de chemin optique de 4 mm) pour la mesure par transflexion des liquides.

Compatible avec les flacons à usage unique 28 mm réflexion (6.7402.140).



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Flacons à usage unique, 28 mm, réflexion

216 flacons en verre à usage unique, pouvant être refermés, d'un diamètre de 28 mm pour des analyses de matières solides par réflexion. Convient aux appareils d'analyse suivants :

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

Licence OMNIS autonome

Elle permet l'exploitation autonome du logiciel OMNIS sur un ordinateur Windows™.

Caractéristiques :

- La licence comprend déjà une licence pour appareils OMNIS.
- Elle doit être activée via le portail d'octroi de licences Metrohm.

Licence logicielle Quant Development

Licence logicielle pour la création et l'édition de modèles de quantification dans une installation du logiciel OMNIS Stand-Alone.